POSTAL Book Package 2023

CIVIL ENGINEERING

Design of Steel Structures

Objective Practice Sets

Contents

MADE EASY Publications

1 CHAPTER

Introduction

Q.1 **Statement (I):** Steel is particularly useful for carrying heavy loads with relatively small sections as compared to other structural materials.
Statement (II) : As compared to other structural materials, steel has high strength to weight ratio.
(a) Both Statement (I) and Statement (II) are individually true; and Statement (II) is the correct explanation of Statement (I)
(b) Both Statement (I) and Statement (II) are individually true; but Statement (II) is NOT the correct explanation of Statement (I)
(c) Statement (I) is true; but Statement (II) is false
(d) Statement (I) is false; but Statement (II) is true

Q.2 Which of the following statement is false?
(a) Steel can be reused.
(b) Being heavy, it is quite difficult to transport.
(c) Steel has a very long life when maintained properly.
(d) Steel is a ductile material.

Q.3 For steel in contact with water and soil and those subjected to alternate wetting and drying, how much additional thickness should be provided in steel sections?
(a) 1 mm (b) 1.5 mm
(c) 2 mm (d) 2.5 mm

Q.4 Which of the following statement is true for compact sections?
(a) The stress distribution for such sections is triangular.
(b) These can develop plastic hinges and have rotation capacity required for failure of structure by formation of plastic hinges.
(c) These can develop plastic moment of resistance, but have inadequate plastic hinge rotation capacity for formation of a plastic mechanism before buckling.
(d) None of the above

Q.5 Which code is used to calculate earthquake load on structure?
(a) IS 875 Part IV (b) IS 875 Part III
(c) IS 1839 (d) IS 1893

Q.6 Which of the following methods of design would be suitable for metal structures subjected to stress reversals and impact?
1. Simple working stress design
2. Rigid-plastic design
3. Semirigid design
4. Elastic rigid design

Select the correct answer using the codes given below:
(a) 1, 2 and 4 (b) 1, 3 and 4
(c) 1, 2 and 3 (d) 2, 3 and 4

Q.7 Consider the following statements regarding tensile test diagrams for carbon steel with varying carbon contents:
As the carbon content increases
1. the ultimate strength of steel decreases
2. the elongation before fracture increases
3. the ductility of the metal decreases
4. the ultimate strength increases

Which of these statements are correct?
(a) 3 and 4 (b) 1 and 3
(c) 1, 2 and 3 (d) 1 and 2

Q.8 Consider the following statements:
Aluminum is being increasingly used for structural purposes because
1. its modulus of elasticity is double that of steel
2. its coefficient of thermal expansion is half that of steel
3. it requires less maintenance
4. the strength to unit weight ratio of aluminum is high

Which of these statements are correct?
(a) 1 and 4 (b) 2 and 4
(c) 1, 2 and 3 (d) 3 and 4

Q.9 In the context of the ultimate load theory for steel, the stress-strain curve for steel is idealized as
(a) a single straight line
(b) bilinear
(c) a quadratic parabola
(d) a circular arc

Q.10 Unit mass of steel and modulus of elasticity (as per IS 800 : 2007)
(a) 7850 kg/m^3, 2×10^5 N/mm^2
(b) 7850 kg/m^3, 2.1×10^6 N/mm^2
(c) 7500 kg/m^3, 2×10^5 N/mm^2
(d) 7850 kg/m^3, 2.1×10^5 N/mm^2

Q.11 As per IS : 875, for the purpose of specifying basic wind velocity, the country has been divided into
(a) 4 zones (b) 5 zones
(c) 6 zones (d) 7 zones

Q.12 IS 800 : 2007 is based on
(a) elastic design method
(b) ultimate load method
(c) working stress method
(d) limit state method

Answers Introduction

1. (a) 2. (b) 3. (b) 4. (c) 5. (d) 6. (b) 7. (a) 8. (d) 9. (b) 10. (a)
11. (c) 12. (d)

Explanations Introduction

1. (a)
As compared to other structural materials, steel has high strength to weight ratio. It implies, steel possess very high strength and results in smaller sections as compared to other structural materials. Thus steel is particularly useful for carrying heavy loads with relatively small sections.

2. (b)
Being light, steel can be handled conveniently and thus it offers ease in transportation.

3. (b)
An additional thickness of 1.5 mm should be provided in steel which is in content with soil and water and is subjected to alternate welting and drying.

4. (c)
Stress distribution of compact sections is rectangular.

5. (d)
IS 1893 is used for earthquake load stadia an a structure.
IS 875 part *I* to *V* are used to calculate dead load, live load, wind load, snow load, and various possible load combinations respectively and IS 1893 is used for for earthquake load.

6. (c)
Working stress design, rigid plastic design, semirigid design are suitable design methods for metal structures subjected to stress reversals and impact.

7. (a)
Carbon has the maximum influence on the mechanical properties of steel. Iron carbon alloys containing upto 2% carbon are called carbon steel while those having more than 2% are called cast steel. With increase in carbon content, the tensile strength of steel increases but the ductility decreases.

8. (d)
Aluminium in increasingly used because it require less maintenance and its strength to unit weight ratio of alluminum is high.

11. (c)
6 basic winds speeds considered for zoning are:
55 m/sec (198 km/h) Very high damage risk zone-A
50 m/sec (180 km/h) Very high damage risk zone-B
47 m/sec (169.2 km/h) High damage risk zone-C
44 m/sec (158.4 km/h) Moderate damage risk zone-A
39 m/sec (140.4 km/h) Moderate damage risk zone-B
33 m/sec (118.8 km/h) Low damage risk zone

■■■■

2 CHAPTER
Riveted, Bolted and Pinned Connections

Q.1 The yield stress of mild steel of normally rolled structural steel is about (in N/mm^2):
(a) 240 to 260 (b) 330 to 360
(c) 420 (d) 550

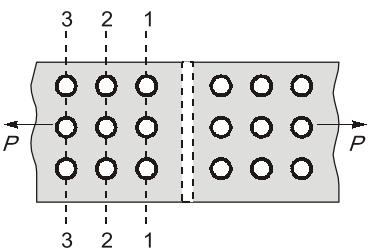
Q.2 Minimum pitch for riveted connections should **not** be less than
(a) 1.5 times the hole diameter
(b) 2.5 times the hole diameter
(c) 1.5 times the nominal diameter of rivet
(d) 2.5 times the nominal diameter of rivet

Q.3 If same number of bolts has been used in the joints, then which of the following patterns will yield highest efficiency?
(a) Chain (b) Staggered
(c) Diamond (d) Staggered diamond

Q.4 For reversal of stress, the most suited bolt is
(a) black (b) turned
(c) friction grip (d) ordinary

Q.5 High strength bolts are designed on the basis of
(a) friction (b) tension
(c) compression (d) shear

Q.6 Two steel plates each of 10 mm thickness are connected by double cover butt joint by bolts as shown in figure. If the bolt diameter is 20 mm and steel is of grade Fe 410, then which one of the following section is the most critical section for the main plate?



(a) Section 1-1
(b) Section 2-2
(c) Section 3-3
(d) Both section 1-1 and section 3-3

Q.7 When the axis of load lies in the plane of rivet group, then the rivets are subjected to
(a) only shear stresses
(b) only tensile stresses
(c) only compressive stresses
(d) torsional moment

Q.8 Which of the following types of riveted joint is free from bending stresses?
(a) Lap joint
(b) Butt joint with single cover plate
(c) Butt joint with double cover plates
(d) None of the above

Q.9 As compared to field rivets, the shop rivets are,
(a) stronger (b) weaker
(c) equally strong (d) any of the above

Q.10 By providing sufficient edge distance, which of the following failures of riveted joint can be avoided?
(a) Tension failure of plate.
(b) Shear failure of rivet.
(c) Shear failure of the plate.
(d) Crushing failure of rivet.

Q.11 Which of the following statement is correct?
(a) Material cost of a rivet is higher than that of a bolt.
(b) Tensile strength of a bolt is lesser than that of a rivet.
(c) Bolts are used as temporary fastenings whereas rivets are used as permanent fastenings.
(d) Riveting is less noisy than bolting

Q.12 Minimum pitch of the rivets shall not be less than
(a) 1.5d (b) 2.0d
(c) 2.5d (d) 3.0d

Answers Riveted, Bolted and Pinned Connections

1. (a)	2. (b)	3. (c)	4. (c)	5. (a)	6. (c)	7. (a)	8. (c)	9. (a)	10. (c)
11. (c)	12. (c)	13. (b)	14. (d)	15. (c)	16. (c)	17. (b)	18. (a)	19. (b)	20. (a)
21. (d)	22. (c)	23. (c)	24. (b)	25. (b)	26. (b)	27. (c)	28. (c)	29. (c)	30. (c)
31. (c)	32. (a)	33. (c)	34. (b)	35. (c)	36. (c)	37. (a)	38. (a)	39. (a)	40. (a)
41. (b)	42. (a)	43. (d)	44. 363.64		45. 94.03		46. 2800		47. 19
48. (d)	49. (c)	50. (c)	51. (d)	52. (d)	53. (d)	54. (b)	55. 109.56		56. (c, d)
57. (c, d)		58. (b, d)		59. (a, b, c, d)		60. (a, d)		61. (a, d)	
62. (a, d)		63. (a, d)		64. (b, c)		65. (c, d)			

Explanations Riveted, Bolted and Pinned Connections

1. (a)

Yield stress ≈ 250 MPa

Ultimate stress ≈ 410 MPa

2. (b)

According to clause 10.2.2 of IS 800-2007, the minimum pitch for riveted connections should not be less than 2.5 times the hole diameter.

3. (c)

For the same number of bolt used in joint hen diamond pattern will yield highest efficiency.

6. (c)

For the given diagram/joint connections section 3-3 is the most critical section for the main plate and section 1-1 in the most critical section for the cover plates.

9. (a)

Shop rivets are stronger than the field rivets.

10. (c)

By provide proper edge distance, we can prevent shear failure, splitting failure and bearing failure of plates.

11. (c)

Bolts are temporary fasteners as they can be tighted as can be loose with the help of nut bolt combination but there is not such scope is case of rivets.

Material cost of bolted connection is higher than riveted connection.

12. (c)

Minimum pitch of rivets shall not be less than 2.5 times the nominal diameter of rivet.

14. (d)

Grater gauge of long rivet $\not> 8d$

where d = diameter of rivet

17. (b)

Rivet value in single shear

$$= \text{Min. of} \begin{cases} \frac{\pi}{4} d^2 \times \tau_{vf} \\ \sigma_b \times d \times t \end{cases}$$

$$= \text{Min of} \begin{cases} \frac{\pi}{4} \times \frac{21.5^2 \times 80}{1000} = 29.04 \text{ kN} \\ \frac{250 \times 21.5 \times 10}{1000} = 53.75 \text{ kN} \end{cases}$$

= 29.04 kN

Rivet value in double shear

$$= \text{Min. of} \begin{cases} 2 \times \frac{\pi}{4} d^2 \times \tau_{vf} \\ \sigma_b \times d \times t \end{cases}$$

$$= \text{Min. of} \begin{cases} 58.08 \text{ kN} \\ 53.75 \text{ kN} \end{cases}$$

= 53.75 kN

Difference = 53.75 – 29.04 = 24.7 kN

19. (b)

$$\frac{\text{yield stress of power driven shop rivets}}{\text{permissible bearing stress of mild steel}} = 0.8$$