CLASS TEST

S.No.: 04_CE_JP_08112024

RPSC

Rajasthan Public Service Commission

ASSISTANT ENGINEER EXAMINATION

MADE EASY

India's Best Institute for IES, GATE & PSUs

Delhi | Bhopal | Hyderabad | Jaipur | Pune | Kolkata

Web: www.madeeasy.in | **E-mail:** info@madeeasy.in | **Ph:** 011-45124612

STEEL STRUCTURE

CIVIL ENGINEERING

Date of Test : 08/11/2024

ANSWER KEY

1. (c)	11. (b)	21. (d)	31. (b)	41. (a)
2. (b)	12. (b)	22. (a)	32. (a)	42. (d)
3. (a)	13. (d)	23. (b)	33. (d)	43. (d)
4. (d)	14. (d)	24. (d)	34. (d)	44. (c)
5. (d)	15. (c)	25. (d)	35. (a)	45. (c)
6. (c)	16. (b)	26. (d)	36. (b)	46. (c)
7. (c)	17. (d)	27. (d)	37. (b)	47. (d)
8. (b)	18. (c)	28. (b)	38. (c)	48. (c)
9. (b)	19. (a)	29. (d)	39. (a)	49. (c)
10. (a)	20. (b)	30. (d)	40. (a)	50. (d)

Detailed Explanations

2. (b)
Width of lacing bar.
(min. width) $\nless 3\times$ nominal dia of bolt

4. (d)
$A_{net} = (B - nd)t = Bt - ndt$
where, Bt = Gross Area (Ag)
ndt = Area of the rivet holes.
n = Number of rivets.
d = Diameter of rivet holes.
t = Thickness

6. (c)
Design strength of bolt (V_{db})

$$= \text{min.}\begin{cases}\text{design shear strength of bolt } (V_{dsb})\\ \text{design bearing strength of bolt } (V_{dpb})\end{cases}$$

7. (c)
Nominal diameter of bolt = 20 mm
Then diameter of hole = 20 + 2 = 22 mm
Minimum pitch = 2.5 × 20 = 50 mm
Minimum end/edge distance = 1.5 × 22 = 33 mm
Let n be the number of bolts, then
$2 \times 33 + (n - 1) \times 50 = 140$
$\Rightarrow \quad n = 2.48$
Therefore, maximum 2 number of bolts can be provided.

8. (b)
In T-section and flat section only, force pass through CG of section so (a) and (c) ruled out. Since flat section flutter during wind or any dynamic loading that is why we prefer T-section as best for tension member.

9. (b)
Effective net width of plate

$$= 300 - \left[3d - \frac{s_1^2}{4g_1} - \frac{s_2^2}{4g_2}\right]$$

$s_2 = s_1 = 50$ mm
$g_1 = g_2 = 100$ mm
$d = 25$ mm

$$\therefore \text{ Net width } = 300 - \left[3\times 25 - \frac{2\times 50^2}{4\times 100}\right]$$

$$= 237.5 \text{ mm}$$

11. (b)
Fillet welds when subjected to a combination of normal stress (due to axial tension/compression or bending tension/ compression) and shear stresses, the equivalent stress,

$$f_e = \sqrt{f_a^2 + 3q^2} \le \frac{f_u}{\sqrt{3}\gamma_{mw}}$$

12. (b)
Shear determines the design of beams.
1. When the depth of beam section is small and is loaded uniformly.
2. When large concentrated loads are placed near beam supports.
3. In plate girder where the web thickness is small.

According to **I.S. 800-1984** the maximum permissible shear stress should not exceed the value of τ_{vm} given by $\tau_{vm} = 0.45\ f_y$.

The permissible average sher stress τ_{va} on a web whose depth does not exceed 85 times its thickness, is equal to 0.40 f_y.

Allowable shear stress in the web of a beam decreases with increase in h/t ratio and increase in distance between stiffeners.

13. (d)
Depth of web fulfils deflection criteria and thickness of web fulfil corrosion so combinely we can say that stiffness is for serviceability.

14. (d)
Number of plastic hinges
= Degree of indeterminacy + 1
= 2 + 1 = 3

15. (c)
$a = 4$ m, $b = 2$ m, $L = a + b = 6$ m

$$\text{Collapse load} = \left(\frac{L+b}{ab}\right) \times M_P$$

$$= \left(\frac{6+2}{4\times 2}\right) \times M_P = M_P$$

24. (d)
The design strength of members under axial tension (T_d) is the lowest of the design strength due to yielding of gross-section (T_{dg}), rupture of critical section (T_{dn}) and block shear (T_{db}).

27. (d)
IS 800 : 2007 proposes, perry robertson approach to determine design compressive stress, for an axially loaded compression member

$$f_{cd} = \frac{f_y / \gamma_{mo}}{\phi + \left[\phi^2 - \lambda^2\right]^{1/2}}$$

34. (d)

The factor of safety is given as

$$F_1 = \frac{\text{Yield stress}}{\text{Allowable stress}} = 1.5$$

When the allowable stress is increased by 20%, then factor of safety will be

$$F_2 = \frac{\text{Yield stress}}{1.2 \times \text{Allowable stress}}$$

$$\Rightarrow \quad F_2 = \frac{1}{1.2} \times \frac{\text{Yield stress}}{\text{Allowable stress}}$$

$$\Rightarrow \quad F_2 = \frac{1}{1.2} \times 1.5 = 1.25$$

$\therefore$ Load factor = Shape factor × Factor of safety

$= 1.12 \times F_2 = 1.12 \times 1.25$

$= 1.40$

35. (a)

As per Table 2 of **IS : 875 part-II 1987**

$$\text{Live load} = 0.75 - 0.02\,(\theta - 10), \not< 0.40 \text{ kN/m}^2$$

$$\text{Live load} = 0.75 - 0.02\,(15 - 10)$$

$$= 0.65 \text{ kN/m}^2, \not< 0.40 \text{ kN/m}^2$$

36. (b)

Maximum deflection for EOT operated gantry girder $= \frac{L}{750} = \frac{7500}{750} = 10$ mm (Upto 500 kN)

39. (a)

$$M = \frac{f_y b_f t_f}{\gamma_{m_0}} d$$

assuming M is carried out by flanges only

$$b_f\, t_f = \frac{M\gamma_{m_0}}{f_y d}$$

$$\gamma_{m_0} = 1.1$$

$$A = 2b_f t_f + d\,t_w = \frac{2M\gamma_0}{f_y d} + dt_w$$

Take, $\frac{d}{t_w} = k$

$$A = \frac{2M\gamma_{m_0}}{f_y d} + \frac{1}{k} d^2$$

For minimum value of A, $\frac{dA}{dd} = 0$

$$0 = -\frac{2M\gamma_{m0}}{f_y d^2} + \frac{2}{k}d$$

$$d^3 = \frac{Mk\gamma_{m0}}{f_y}$$

$$d = \sqrt[3]{\frac{Mk\gamma_{m0}}{f_y}} = kt_w$$

$$t_w = \left(\frac{M}{f_y k^2}\right)^{0.33}$$

40. (a)

- Effective length of groove welds in case of butt joint is equal to length of continuous full size weld.
- Effective length of welds in case of fillet joint is equal to overall length of weld minus two times the size of weld.

41. (a)

Nominal diameter = 16 mm

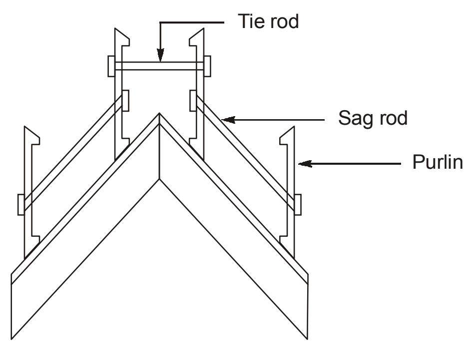
Gross diameter = 16 + 2 = 18 mm

$$\text{Design strength} = \frac{0.9f_u}{\gamma_{m1}} \times A_{net} = \frac{0.9 \times 410}{1.25} \times (B - 2d_0) \times t$$

$$= \frac{0.9 \times 410}{1.25} \times (150 - 2 \times 18) \times 10$$

$$= 336 \text{ kN}$$

42. (d)



At the crown, sag rod provided is termed as tie rod, this resists the tangential components from the two sides of the roof truss.

43. (d)

Wind load = $0.6 \times V_z^2$

V_z = Design wind speed = $K_1 K_2 K_3 V_b$

V_b = Basic wind speed

K_1 = Risk coefficient, depends on location

K_2 = Factor dependent on height of structure and shape

K_3 = Terrain factor

44. (c)

The buckling class associated with built up compression members is buckling class 'c'.

Table 10 - IS : 800-2007 (Page 44)

45. (c)

As per IS 800-2007, partial safety factors for materials are given as

- When resistance is governed by ultimate stress, γ_{m1} = 1.25.
- When resistance is governed by yielding, γ_{m0} = 1.1.

46. (c)

Near the support web of the beam may cripple due to lack of bearing capacity as shown in figure below. The crippling occurs at the rest of the radius. IS 800 : 2007 has accepted the following formula to find crippling of web.

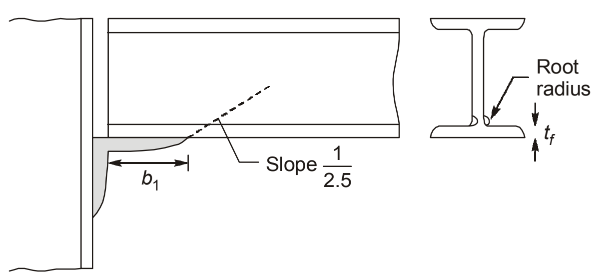
$$F_W = (b_1 + n_c)\, t_w \times \frac{f_{yw}}{\gamma_{m_0}}$$

where b_1 = stiff bearing length

n_c = length obtained by dispersion through the flange to the web junction at a slope of 1 : 2.5 to the plane of flange.

$$n_c = 2.5\, t_f$$

f_{yw} = yield stress of the web



47. (d)

IS : 800-1984 recommends the provision of web stiffeners as follows.

(i) $\frac{d}{t_w} \leq 85$, no stiffner is required.

(ii) $85 < \frac{d}{t_w} \leq 200$, vertical stiffener is provided.

(iii) $200 < \frac{d}{t_w} \leq 250,$ vertical stiffner and one horizontal stiffener at a distance from the comnpression flange equal to two fifths of distance from the compression flange to the neutral axis are provided.

(iv) $250 < \frac{d}{t_w} \leq 400,$ one more horizontal stiffener provided of neutral axis in addition of condition (iii).

(v) $\frac{d}{t_w} > 400,$ Redesign of increase the thickness of web.

49. **(c)**

As per IS : 1367 (Part I)

$$A_{\text{net}} = 0.78 \times A_{\text{shank}}$$

Hence, $$\frac{A_{\text{net}}}{A_{\text{shank}}} = 0.78 \text{ i.e option (c) is correct}$$

■■■■