

2020

RANK *Improvement* **WORKBOOK**



**Answer key and Hint of
Objective & Conventional Questions**

Civil Engineering
Strength of Materials



MADE EASY
Publications

1

Properties of Metals, Stress & Strain, Elastic Constants

LEVEL 1 Objective Questions

1. (d)
2. (c)
3. (a)
4. (b)
5. (b)
6. (c)
7. (a)
8. (80)

LEVEL 2 Objective Questions

9. (c)
10. (a)
11. (c)
12. (a)
13. (c)
14. (c)
15. (a)
16. (10)
17. (d)
18. (c)

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19. (6.5)

20. (12.65)

21. (c)

22. (a)

LEVEL 3 Conventional Questions

Solution : 1

Deflection = 0.132 mm

Solution : 2

(184.26 MPa, 46.065 MPa, 184.26 MPa, 93.93 MPa, 23.48 MPa, 93.93 MPa)

Solution : 3

Max. safe load = 172.26 kN

Solution : 4

$\sigma_A = 105.44 \text{ MPa}$, $\sigma_S = 219.7 \text{ MPa}$

Solution : 5

$\delta L_x = 0.04125 \text{ mm}$

$\delta L_y = 0.00833 \text{ mm}$

$\Delta L_z = 0.00292$

$P = 110 \text{ kN}$

Solution : 6

$P_{AB} = P_{BC} = 25 \text{ kN}$

$\sigma_{AB} = 100 \text{ MPa (Comp.)}$

$\sigma_B = 200 \text{ MPa (Tensile)}$

$\Delta_A = 0$, $\Delta_B = -0.625 \text{ mm}$

$\Delta_{CE} = 1.175 \text{ mm}$

Solution : 8

$S_D = 0.1125 \text{ mm}$

Change in volume = 7.5 mm^3 (Increase)

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2

SFD and BMD

LEVEL 1 Objective Questions

1. (0.25)
2. (a)
3. (c)
4. (a)
5. (c)
6. (b)
7. (c)
8. (16)
9. (d)
10. (50)

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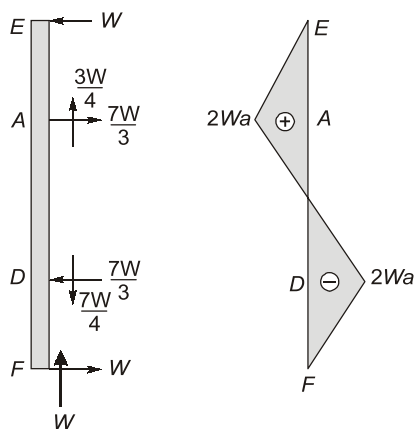
LEVEL 2 Objective Questions

11. (c)
12. (c)
13. (d)
14. (c)
15. (a)
16. (c)
17. (b)
18. (d)
19. (d)
20. (150)
21. (d)
22. (b)
23. (c)
24. (a)
25. (d)

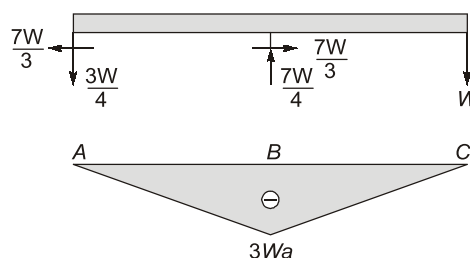
LEVEL 3 Conventional Questions**Solution : 1**

Maximum bending moment = 258 kNm at distance 7.25 m from A.

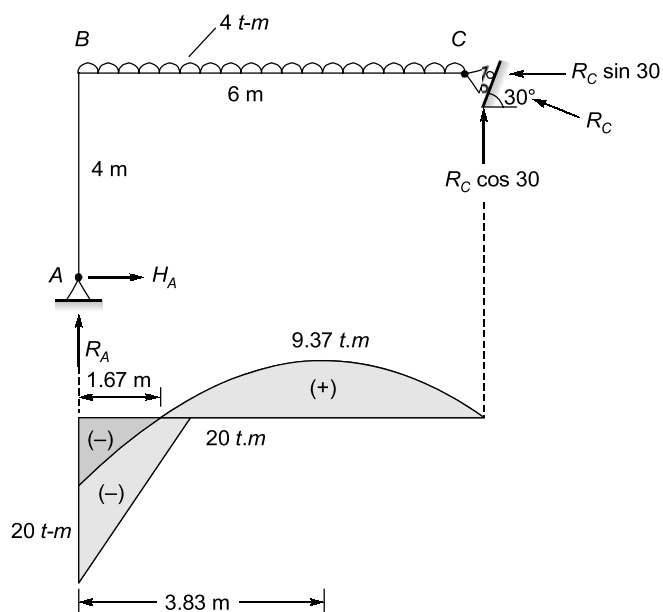
Point of contraflexure = 3.16 m from B.

Solution : 2

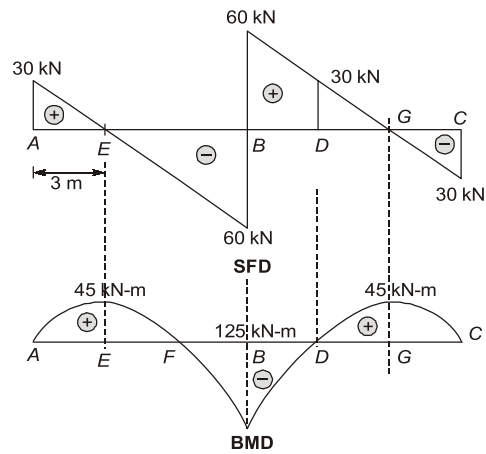
Bending moment diagram of vertical post



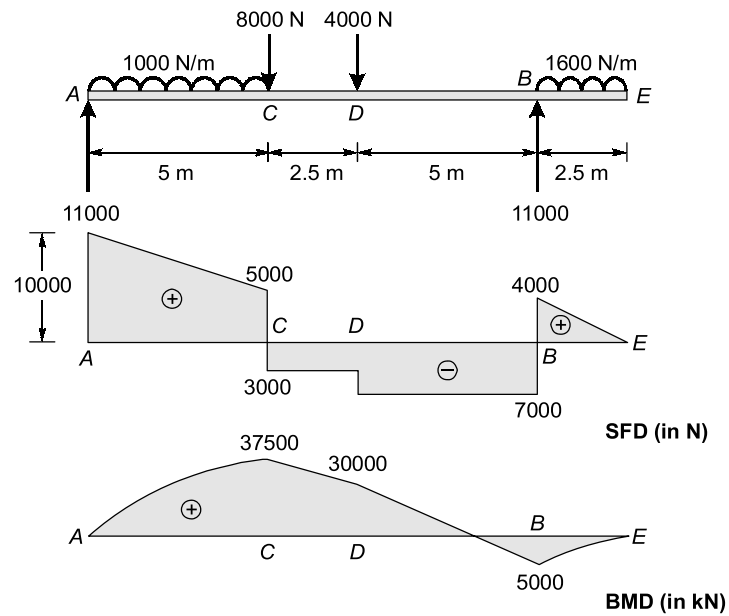
Bending moment diagram of horizontal arm

Vertical post and horizontal arm of crane**Solution : 3**

Solution : 4



Solution : 5



Solution : 6

$$R_A = 1867 \text{ N}, \quad R_B = 3250 \text{ N}$$

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3

Bending and Shear Stresses

LEVEL 1 Objective Questions

1. (120)
2. (c)
3. (c)
4. (b)
5. (d)
6. (1)
7. (b)
8. (c)
9. (b)
10. (d)
11. (b)
12. (166.67)
13. (b)
14. (d)

LEVEL 2 Objective Questions

15. (c)
16. (0.33, -0.32)
17. (b)
18. (b)

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19. (1.36)

20. (89.05)

21. (3.43)

22. (26.67)

23. (56.25)

24. (d)

25. (266.67)

26. (d)

27. (b)

28. (b)

LEVEL 3 Conventional Questions

Solution : 1

$$W = 5.6 \text{ kN}$$

Solution : 2

$$t \leq 20.62 \text{ mm.}$$

Solution : 3

$$W = 3.179 \text{ kN/m}$$

Solution : 4

$$\text{Ratio} = 1.73$$

Solution : 5

$$w = 66.05 \text{ kN/m}$$

Solution : 7

$$(0, 2.65 \text{ MPa}, 13.6 \text{ MPa})$$

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4

Principal Stress & Principal Strain

LEVEL 1 Objective Questions

1. (a)
2. (b)
3. (b)
4. (70)
5. (d)
6. (d)
7. (160)
8. (75)

LEVEL 2 Objective Questions

9. (3.67)
10. (c)
11. (c)
12. (b)
13. (c)
14. (a)
15. (c)
16. (a)
17. (c)

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18. (112.51)

19. (a)

20. (91.60)

21. (d)

22. (b)

LEVEL 3 Conventional Questions

Solution : 2

$$\sigma_1 = 72.54 \text{ MPa}$$

$$\sigma_2 = -3.84 \text{ MPa}$$

$$\tau_A = 38.2 \text{ MPa}$$

Solution : 3

$$\sigma_1 = 435.1 \text{ MPa}$$

$$\sigma_2 = 114.9 \text{ MPa}$$

$$\theta = 19.33^\circ \text{ or } 109.33^\circ$$

$$\tau_{\max} = 160.1 \text{ MPa}$$

$$\theta = 25.67^\circ \text{ or } 115.67^\circ$$

Solution : 4

$$500.7275 \text{ mm}, \quad 500.0525 \text{ mm}$$

Solution : 5

$$\sigma_A = 72.38 \text{ MPa}, \quad \sigma_B = 34.38 \text{ MPa}$$

Solution : 6

$$d = 69.1 \text{ mm}$$

Solution : 7

$$\sigma_1 = 41.1 \text{ MPa}, \quad \sigma_2 = -66.1 \text{ MPa}, \quad \theta = 33.4^\circ$$

Solution : 8

$$\sigma_1 = 0.062 \text{ MPa}$$

$$\sigma_2 = -0.645 \text{ MPa}$$

$$\theta = 17.22^\circ \text{ or } 107.22^\circ$$

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5

Deflection of Beams

LEVEL 1 Objective Questions

1. (a)
2. (0.67)
3. (33.85)
4. (b)
5. (a)
6. (d)
7. (a)
8. (a)
9. (d)
10. (b)
11. (b)

LEVEL 2 Objective Questions

12. (c)
13. (c)
14. (c)

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15. (c)
16. (b)
17. (0.78)
18. (a)
19. (187.5)
20. (a)
21. (2.2)
22. (c)
23. $\left(\frac{3Pa^3}{EI} \right)$
24. $\left(\frac{Pa^3}{EI} + \frac{Pa^3}{GJ} \right)$
25. (b)
26. (0.21)
27. (a)
28. (c)
29. (54.1)

LEVEL 3 Conventional Questions**Solution : 1**

$$y = 22.61 \text{ mm}$$

Solution : 2

$$\Delta_C = 2.4 \text{ mm}, \quad \Delta_D = 5.8 \text{ mm}$$

Solution : 3

$$w = 4 \text{ kN/m}$$

Solution : 4

$$\theta_B = \frac{wL^3}{6EI}, \quad \theta_A = \frac{wL^3}{2EI}, \quad \theta_C = \frac{-wL^3}{12EI}$$

Solution : 5

$$\theta_B = \frac{7qL^3}{48EI}, \quad \delta_B = \frac{41qL^4}{384EI}$$

Solution : 7

$$q_A = -0.3^\circ, \quad y_A = 5.2 \text{ mm}, \quad y_C = -8.656 \text{ mm}$$

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6

Torsion of Shafts and Springs

LEVEL 1 Objective Questions

1. (b)
2. (c)
3. (d)
4. (b)
5. (b)
6. (b)
7. (c)
8. (b)
9. (20)
10. (a)
11. (b)
12. (4.5)
13. (d)

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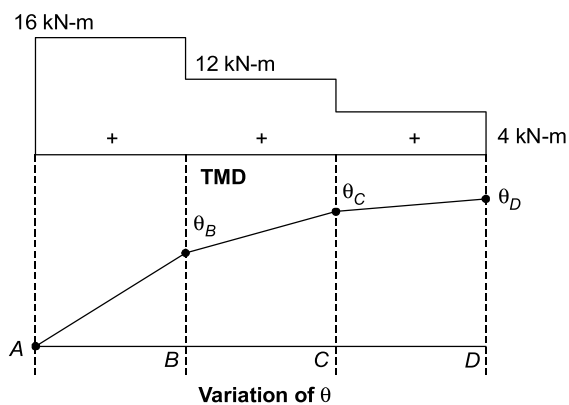
14. (13.7)
15. (b)
16. (c)
17. (c)
18. (d)
19. (64)
20. (400)
21. (b)
22. (b)
23. (0.12)
24. (c)
25. (a)
26. (b)

LEVEL 3 Conventional Questions

Solution : 1

48.55 mm, 50 mm, 49.34 mm

Solution : 2



Solution : 3

$T_a = 21862.4 \text{ Nm}$, $T_s = 18218.6 \text{ Nm}$, $T = 24607.6 \text{ Nm}$, $T = 21.868.4 \text{ Nm}$, $T_{\min} = 21868.4 \text{ Nm}$

Solution : 4

23.7 MPa, 35.5 MPa, 0.565°

Solution : 5

53.72 kW, 472 mm, 528 mm

Solution : 6

$d = 106.733 \text{ mm}$, 29.77%

Solution : 7

4.22 Nm, 106.11 Nmm, $21.1.11 \text{ N/mm}^2$

Solution : 8

1.0915 mm, 1.254 m, 0.6544 m, 5.426 kNm

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7

Theory of Columns and Shear Centre

LEVEL 1 Objective Questions

1. (d)
2. (c)
3. (c)
4. (b)
5. (d)
6. (b)
7. (b)
8. (c)
9. (1.33)
10. (c)

LEVEL 2 Objective Questions

11. (b)
12. (b)

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13. (a)
14. (c)
15. (4.97)
16. (94.12)
17. (59.04)
18. (173.20)
19. (2937.38)
20. (14.28)
21. (b)

LEVEL 3 Conventional Questions

Solution : 1

(2.134 N/mm², 0.518 N/mm²)

Solution : 2

Max^m axial load that can be transferred is

$$= \frac{17.85}{2} = 8.925 \text{ kN}$$

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