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ESE 2025 : Prelims Exam
CLASSROOM TEST SERIES

CIVIL ENGINEERING

Test 10

Section A : Structural Analysis [All Topics]

Section B : CPM PERT-I + Hydrology and Water Resource Engineering-I [Part Syllabus]

Section C : Design of Steel Structure-II + Surveying and Geology-II [Part Syllabus]

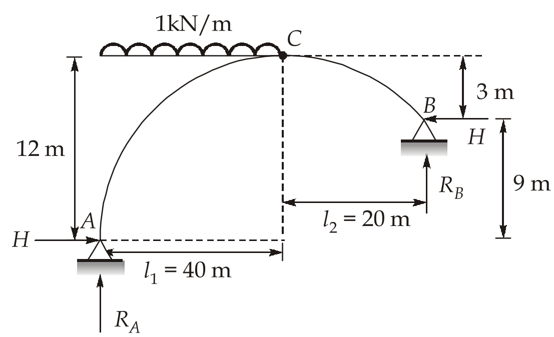
1.	(a)	16.	(b)	31.	(d)	46.	(d)	61.	(d)
2.	(b)	17.	(a)	32.	(c)	47.	(d)	62.	(c)
3.	(d)	18.	(b)	33.	(b)	48.	(c)	63.	(c)
4.	(c)	19.	(a)	34.	(a)	49.	(a)	64.	(b)
5.	(c)	20.	(a)	35.	(a)	50.	(b)	65.	(d)
6.	(d)	21.	(d)	36.	(c)	51.	(b)	66.	(a)
7.	(d)	22.	(d)	37.	(d)	52.	(c)	67.	(c)
8.	(d)	23.	(b)	38.	(d)	53.	(c)	68.	(c)
9.	(c)	24.	(d)	39.	(c)	54.	(c)	69.	(c)
10.	(c)	25.	(b)	40.	(b)	55.	(d)	70.	(a)
11.	(c)	26.	(b)	41.	(d)	56.	(d)	71.	(c)
12.	(d)	27.	(c)	42.	(c)	57.	(a)	72.	(a)
13.	(a)	28.	(b)	43.	(b)	58.	(b)	73.	(b)
14.	(c)	29.	(a)	44.	(c)	59.	(c)	74.	(d)
15.	(c)	30.	(b)	45.	(d)	60.	(b)	75.	(a)

DETAILED EXPLANATIONS

Section A : Structural Analysis

1. (a)

2. (b)



$$l_1 = 60\left(\frac{\sqrt{12}}{\sqrt{12}+\sqrt{3}}\right) = 40\,\text{m}$$

$$l_2 = 60 - 40 = 20 \text{ m}$$

$$\Sigma f_y = 0$$

$$\Rightarrow \quad R_A + R_B = 40 \text{ kN} \quad \text{...(i)}$$

Taking moment about C (left side)

$$R_A \times 40 - H \times 12 - 1 \times 40 \times 20 = 0$$

$$R_A = \frac{12H + 800}{40}$$

Taking moment C (Right side)

$$R_B \times 20 - H \times 3 = 0$$

$$R_B = \frac{3H}{20}$$

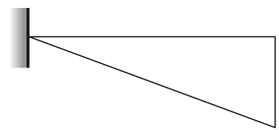
On putting the value of R_A and R_B in equation (i)

$$\frac{12H+800}{40} + \frac{3H}{20} = 40$$

$$H = \frac{400}{9}\text{kN} = \frac{400000}{9}\text{N}$$

3. (d)

- Influence line for horizontal thrust in a three hinged arch is triangular with maximum ordinate at the central hinge.
- Influence line for BM at fixed end in a cantilever beam is a triangle with zero at fixed end and maximum ordinate at free end.



ILD for BM at fixed end of cantilever beam

4. (c)

Total length of cable is given by,

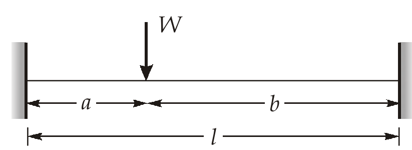
$$L_t = l + \frac{2}{3}\left(\frac{h_1^2}{l_1}\right) + \frac{2}{3}\left(\frac{h_2^2}{l_2}\right)$$

Here, $h_1 = 5$ m, $h_2 = 2$ m, $l_1 = 25$ m, $l_2 = 12$ m

$$\therefore \quad L_t = (25 + 12) + \frac{2}{3}\times\left(\frac{5^2}{25}\right) + \frac{2}{3}\left(\frac{2^2}{12}\right)$$

$$\simeq 37.89 \text{ m}$$

5. (c)



Deflection under the load is $\dfrac{Wa^3b^3}{3EIl^3}$

Maximum deflection occurs at a distance of $\dfrac{2al}{3a+b}$ from left end.

Maximum deflection is given by $\dfrac{2}{3}\dfrac{Wa^3b^2}{(3a+b)^2\,EI}$

6. (d)

Given, bending moment at P and Q = $\dfrac{6EI\Delta}{l^2}$ = – 80 kN-m

$\therefore$ Bending moment for member RS

$$M_{RS} = \frac{3(2EI)\Delta}{(2l)^2}$$

$$= \frac{1}{4}\left(\frac{6EI\Delta}{l^2}\right) = \frac{-80}{4} = -20 \text{ kN-m}$$

7. (d)

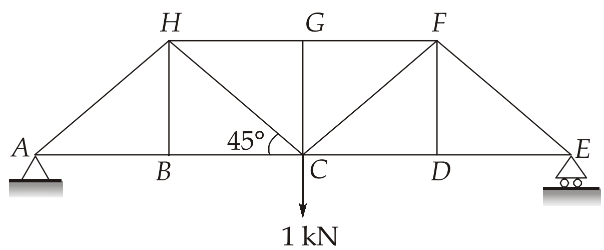
This method can be conveniently applied in the analysis of statically indeterminate structure in which degree of redundancy does not exceed 3.

Analysis of frames with sway can be made by column analogy method without involving long and laborious procedure.

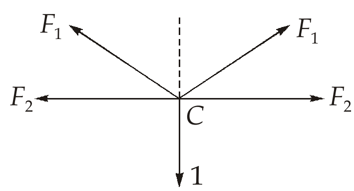
The column analogy method is based on the analogy or similarity between the moments in a statically indeterminate structure and the stresses produced in an eccentrically loaded short column.

8. (d)

Apply unit load at joint *C* in the vertical direction.



At joint C:



$$\Sigma F_y = 0$$

$$\Rightarrow \quad 2\,F_1 \sin 45° = 1$$

$$\Rightarrow \quad F_1 = \frac{1}{2\times\frac{1}{\sqrt{2}}} = \frac{1}{\sqrt{2}}\text{ kN} = K_{CH} = K_{CF}$$

From virtual work theorem, $\Sigma F_y = 0$

Internal work done = External work done

$$\Rightarrow \quad K_i\left(L_i\alpha_i\Delta T_i\right) = 1\,\Delta_C$$

$$\Rightarrow \quad \frac{1}{\sqrt{2}}\left(\sqrt{2}\times\frac{1}{150000}\times 5\right) = 1\,\Delta_C$$

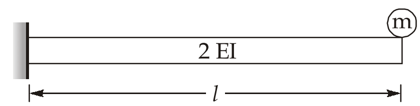
$$\Rightarrow \quad \Delta_C = \frac{1}{30000}$$

$$= 0.33\times 10^{-4}\text{ m}$$

$$= 0.33\times 10^{-1}\text{ mm}$$

$$= 0.033\text{ mm}$$

9. (c)



Stiffness of cantilever beam,

$$K_{\text{Beam}} = \frac{3(2EI)}{l^3} = \frac{6EI}{l^3}$$

Natural frequency of the system is given by

$$\omega_n = \sqrt{\frac{K_{\text{Beam}}}{m}} = \sqrt{\frac{6EI}{ml^3}}$$

10. (c)

Joint	Member	Stiffness	T.S.	D.F.
O	OA	0	$\frac{5EI}{2}$	0
	OB	$\frac{(4EI)}{4} = EI$		$\frac{2}{5}$
	OC	$\frac{3EI}{3} = EI$		$\frac{2}{5}$
	OD	$\frac{4EI}{8} = EI/2$		$\frac{1}{5}$

Moment distribution in member '*OD*' at *O*,

$$M_{OD} = (DF)_{OD} \times 100 = \frac{1}{5} \times 100 = 20 \text{ kN-m (clockwise)}$$

Moment at *D*, $$M_D = (COF)\, M_{OD} = \frac{1}{2} \times 20 = 10 \text{ kN-m (clockwise)}$$

11. (c)

Total thrust is the sum of the horizontal thrust due to each of the loads.

$$H = \Sigma \frac{W}{\pi} \sin^2 \alpha \quad \text{due to load } W$$

$$\Rightarrow \quad H = \frac{160}{\pi} \sin^2 30° + \frac{120}{\pi} \sin^2 90° + \frac{100}{\pi} \sin^2 60°$$

$$\Rightarrow \quad H = \frac{1}{\pi}\left(160 \times \frac{1}{4} + 120 + 100 \times \frac{3}{4}\right)$$

$$\Rightarrow \quad H = \frac{235}{\pi} kN$$

12. (d)

For frame

$$D_s = 3\text{ m} - 3i - R - R'$$

Frame *A* : $D_s = 3 \times 5 - 3 \times 6 + 7 - 0 = 4$

B : For beam, $D_s = 3\text{ m} + r_e - 3j - r_r$

$= 3 \times 4 + 9 - 3 \times 5 - 1$

$= 21 - 16 = 5$

Frame *C* : $D_s = 3 \times 15 + 12 - 3 \times 13 - 1 = 17$

Frame *D* : $D_s = 3 \times 4 + 9 - 3 \times 5 - 1 = 5$

13. (a)

A structure is said stable internally when no part of the structure can more relative to another part so as to change the geometry appreciably.

14. (c)

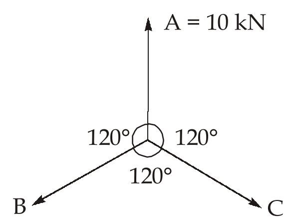
Using slope deflection equation, $M_{AB} = \bar{M}_{AB} + \dfrac{2EI_{AB}}{L_{AB}}\left(2\theta_A + \theta_B - \dfrac{3\Delta}{L_{AB}}\right)$

$$\therefore \quad M_{BC} = \frac{2(3EI)}{6}(2\theta_B + \theta_C) = \frac{6EI}{6}(2\theta_B + \theta_C)$$

15. (c)

In pin jointed frames, force method is used because unknowns are forces and not displacements.

16. (b)



For all three forces

$$\Sigma F_x = 0$$
$$\Sigma F_y = 0$$

which is possible only when,

$$B = 10 \text{ kN}$$
$$C = 10 \text{ kN}$$

17. (a)

By symmetry, force in each member is the same, Let S be the force in each member,

Now, $\quad \Sigma F_y = 0$

$\Rightarrow \quad 3S\cos\theta = P$

$\Rightarrow \quad S = \dfrac{P}{3\cos\theta}$

Now, strain energy stored by tripod, $U = \sum \dfrac{S^2 l}{2AE} = \dfrac{3 \times P^2}{9\cos^2\theta} \times \dfrac{l}{2AE}$

$$U = \frac{P^2 l}{6\cos^2\theta AE}$$

$$\delta = \frac{\partial U}{\partial P} = \frac{2Pl}{6\cos^2\theta\, AE} = \frac{Pl}{3\cos^2\theta\, AE}$$

18. (b)

Horizontal thrust due to UDL coming on left half, $H_1 = \frac{wl^2}{16h} = \frac{60 \times 25^2}{16 \times 5} = 468.75$ kN

Horizontal thrust due to point load at centre, $H_2 = \frac{25}{128}\frac{Wl}{h} = \frac{25}{128} \times \frac{200 \times 25}{5} = 195.31$ kN

$\therefore \quad H_{Total} = H_1 + H_2 = 664.06 \text{ kN} \simeq 664 \text{ kN}$

19. (a)

20. (a)

Length of member AB, $\quad AB = \sqrt{6^2 + 2.5^2} = 6.5$ m

Joint	Member	Relative stiffness	Total relative stiffness
B	BA	$\frac{I}{6.5} = \frac{10I}{65}$	$\frac{23I}{65}$
	BC	$\frac{I}{5} = \frac{13I}{65}$	

$\therefore \quad DF \text{ of member } BC = \frac{13I/65}{23I/65} = \frac{13}{23}$

21. (d)

Fixed end moments,

$$\bar{M}_{AB} = \frac{-60 \times 5^2}{12} = -125 \text{ kNm}, \quad \bar{M}_{BA} = 125 \text{ kNm}$$

$$\bar{M}_{BC} = \frac{-90 \times 1 \times 2^2}{3^2} = -40 \text{ kNm}, \quad \bar{M}_{CB} = \frac{90 \times 1^2 \times 2}{3^2} = +20 \text{ kNm}$$

Using slope deflection method,

For Span *AB*

$$M_{AB} = -125 + \frac{2EI}{5}(0 + \theta_B) = -125 + \frac{2}{5}EI\theta_B$$

$$M_{BA} = 125 + \frac{4}{5}EI\theta_B$$

For Span *BC*

$$M_{BC} = -40 + \frac{2EI}{3}(2\theta_B + 0) = -40 + \frac{4}{3}EI\theta_B$$

Considering joint equilibrium equation at *B*,

$$M_{BA} + M_{BC} = 0 \Rightarrow 125 + \frac{4}{5}EI\theta_B - 40 + \frac{4}{3}EI\theta_B = 0$$

$\Rightarrow \quad EI\theta_B = -39.84$

$\therefore \quad M_{AB} = -125 + \frac{2}{5}(-39.84) = -140.94$ kNm

$\Rightarrow \quad M_{AB} \simeq 141$ kNm

22. (d)

The flexibility and stiffness matrices are inverse of each other and both are symmetrical.

The value of determinant of flexibility matrix is $\frac{1}{EI} \times 59 = \frac{59}{EI}$

$\therefore$ The stiffness matrix will be $[S] = \frac{1}{|F|}\text{adj}(F) = \frac{EI}{59}\begin{bmatrix} 4 & -5 \\ -5 & 21 \end{bmatrix}$

23. (b)

Tension in a cable under UDL varies along it's length and has maximum value at the support.

24. (d)

$$\bar{M}_{AB} = \bar{M}_{BA} = 0$$

$$\bar{M}_{BC} = \frac{M_0 a(3b - l)}{l^2} = \frac{5 \times 2 \times 4}{25} = 1.6 \text{ kNm}$$

$$M_{BC} = \bar{M}_{BC} + \frac{2EI}{S}(2\theta_B + \theta_C) = \bar{M}_{BC} + \frac{4EI\theta_B}{L}$$

$$= 1.6 + \frac{4EI\theta_B}{5} = 1.6 + 0.8EI\theta_B$$

$$M_{BA} = \bar{M}_{BA} + \frac{4EI\theta_B}{L} = 0 + \frac{4E(2I)\theta_B}{4} = 2EI\theta_B$$

At joint B,

$$M_{BA} + M_{BC} = 0$$

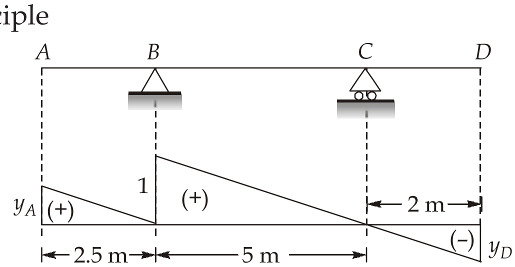
$\Rightarrow$ $$1.6 + 0.8EI\theta_B + 2EI\theta_B = 0$$

$\Rightarrow$ $$2.8EI\theta_B = -1.6$$

$\Rightarrow$ $$\theta_B = \frac{4}{7EI} \circlearrowleft$$

25. (b)

As per Muller-Breslau principle



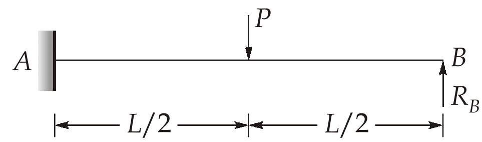
From similar triangle property

$$\frac{y_A}{2.5} = \frac{1}{5} = \frac{y_D}{2}$$

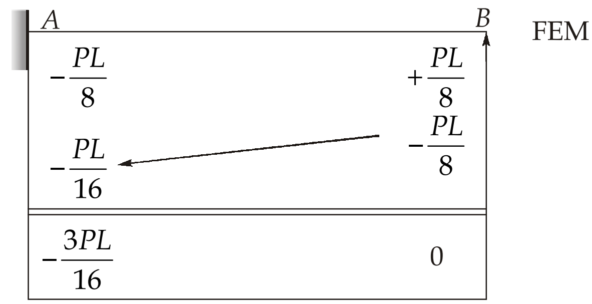
$\Rightarrow$ $$\frac{y_A}{2.5} = \frac{1}{5}$$

$\Rightarrow$ $$y_A = \frac{2.5}{5} = 0.5 \text{ m}$$

26. (b)



EI = Constant



$$\Sigma M_A = 0$$

$$\Rightarrow \quad -R_B \times L + \frac{PL}{2} - \frac{3PL}{16} = 0$$

$$\Rightarrow \quad R_B = \frac{5P}{16}$$

Stiffness of BA, $$k_{BA} = \frac{4EI}{L}$$

Slope, $$\theta_B = \frac{M}{k} = \frac{PL/8}{4EI/L} = \frac{PL^2}{32EI}$$

27. (c)

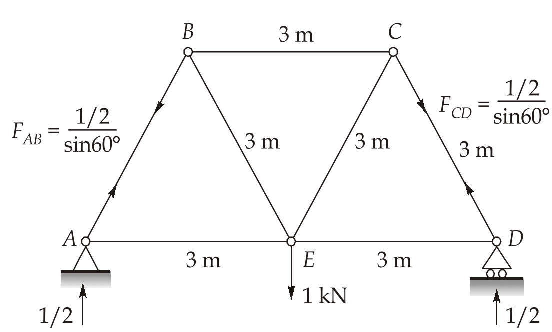
Rigid joint does not mean that there will be, no deformation in structure. Rigid joint can translate and rotate but it ensures compatibility of displacement of ends of connecting elements at joints.

28. (b)

ILD for determinate structures → Bilinear

ILD for indeterminate structures → Curvilinear

29. (a)



$$F_{AB} = \frac{-1}{\sqrt{3}}$$

$$F_{AB} = F_{CD} = \frac{-1}{\sqrt{3}}$$

$$\delta_E = \Sigma(kL\alpha\Delta T)$$

Where k is the force in truss members when a unit load is applied at E.

$\therefore$ $$-1.25 \times 10^{-3} = 2\times\frac{-1}{\sqrt{3}}\times 3\times 12\times 10^{-6}\times\Delta T$$

$\Rightarrow$ $$\Delta T = 30°\text{C}$$

30. (b)

When a fixed beam is subjected to line loads (such as wheel loads passing over bridges), frequent variations of bending moment and corresponding vibrations would soon affect the degree of fixity at the ends.

The above objections against fixed beams can be avoided by adopting the double cantilever construction. In this method, at the points of contra flexure for the fixed beam, hinged joints are introduced. Now the beam will therefore consist of a central simply supported girder, supported on the ends of cantilevers.

Section B : CPM PERT-I + Hydrology and Water Resource Engineering-I

31. (d)

ABC Analysis:

- **Group A items :** These are high usage value items, which account for 70% of the inventory cost. Number of such items is about 5%-15% of all items.
- **Group B items :** These are medium usage value items, which account for nearly 20% of the inventory cost. Their number is also in the range of 15%-25%.
- **Group C items :** These are remaining about 65%-75% of the items, which account for hardly 10% of inventory cost.

32. (c)

Management constraint may occur when the sequence of otherwise independent activities is controlled by a management decision or when normally concurrent activities are ordered to be done in certain sequence, simply because management arbitrarily wants them to do it that way.

33. (b)

Operator cost is not considered for selection of construction equipment.

34. (a)

Gross weight of tractor = 20,000 kg = 20 t

$\therefore$ Rolling resistance offered by haul road (@ 55 kg/t) = 20 × 55 = 1100 kg.

$$\text{Load on driving tyres} = \frac{60}{100}\times 20{,}000 = 12{,}000 \text{ kg}$$

Maximum possible rimpull prior to slippage of tyres = Coefficient of traction × Load on driving tyres

$$= 0.65 \times 12{,}000 = 7800 \text{ kg}$$

$\therefore$ $$\text{Maximum effective rimpull} = 7800 - 1100 = 6700 \text{ kg}$$

35. **(a)**

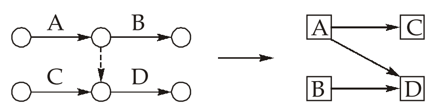
Time along 1-2-3-6-7-8 = 23 days
Time along 1-2-4-5-7-8 = 27 days
Time along 1-2-3-5-7-8 = 23 days

∴ Critical path is along 1-2-4-5-7-8

36. **(c)**

37. **(d)**

38. **(d)**



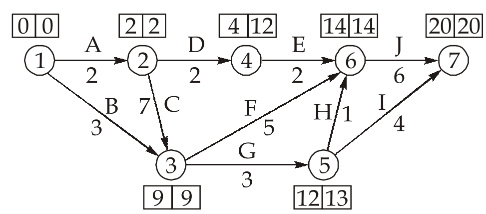
A – O – N system eliminates the use of dummy activity.

39. **(c)**

A wheel tractor possesses speed 3 to 4 times higher than a crawler tractor.

40. **(b)**

Network diagram with time estimates can be drawn as,



Independent float of activity I = (20 – 12) – (Slack of event 7) – (Slack of event 5) – $(t_{ij})_I$
= 8 – 0 – 1 – 4
= 3 days

41. **(d)**

Other coefficients C_0 and C_2 are,

$$C_0 = \frac{-Kx + 0.5\Delta t}{K - Kx + 0.5\Delta t}, C_2 = \frac{K - Kx - 0.5\Delta t}{K - Kx + 0.5\Delta t}$$

42. **(c)**

43. **(b)**

Given;

A = 500 hectares = 5 km^2 t_r = 30 min = 0.5 hr, t_c = 40 min = $\frac{2}{3}$ hr

Now, $$T_P = \frac{t_r}{2} + 0.6t_c = \frac{0.5}{2} + 0.6 \times \frac{2}{3}$$
$$= 0.25 + 0.4 = 0.65 \text{ hr}$$

Now, peak discharge, $$Q_P = \frac{2.08A}{T_P} = \frac{2.08 \times 5}{0.65} = 16 \text{ m}^3/\text{s}$$

44. **(c)**

Cumulative infiltration, $F_p = \int_0^t f_p dt = \int_0^2 \left(\frac{1}{2} st^{-\frac{1}{2}} + k\right) dt$

$$= \left[st^{\frac{1}{2}} + kt\right]_0^2 = 5 \times \sqrt{2} + 0.4 \times 2 = 7.87 \text{ cm}$$

45. (d)

46. (d)

Duration of rainfall, $D = 6$ hr

Intensity of rainfall, $i = 0.8$ cm/hr

Area, $A = 16 \text{ km}^2$

Runoff volume, $V = 256000 \text{ m}^3$

Rainfall lost other than runoff per hour,

$$R = i - \frac{V}{A \times D}$$

$$= 0.8 - \frac{256000 \times 10^2}{16 \times 10^6 \times 6}$$

$$= 0.8 - 0.267$$

$$= 0.533 \text{ cm/hr}$$

47. (d)

Slope-area method is an indirect stream flow determination technique.

48. (c)

The main advantage of IUH is that it is independent of the duration of ERH and thus has one parameter less than a D-h unit hydrograph.

49. (a)

50. (b)

PET critically depends upon climatological factors, rather than on characteristics of plants and soils.

AET is largely affected by characteristics of soil and vegetation.

51. (b)

For computation of peak discharge in western Ghats of Maharashtra we use Inglis formula.

Peak discharge, $Q_p = \frac{124A}{\sqrt{A + 10.4}}$; A is in km^2

Q_p is in m^3/s

$$\therefore \quad Q_p = \frac{124 \times 14.6}{\sqrt{14.6 + 10.4}} = 362.08 \simeq 362 \text{ m}^3/\text{s}$$

52. **(c)**

The fraction of water held back in the aquifer is known as specific retention.

The actual volume of water that can be extracted by the force of gravity from a unit volume of aquifer material is known as specific yield.

Section C : Design of Steel Structure-II + Surveying and Geology-II

53. **(c)**

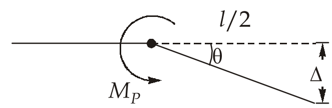
A cross section in which the extreme fibre in compression can reach yield stress but cannot develop the plastic moment of resistance due to local buckling is called semi-compact or non-compact section.

54. **(c)**

Statement 1 is false. No such assumption is made regarding plastic analysis.

55. **(d)**

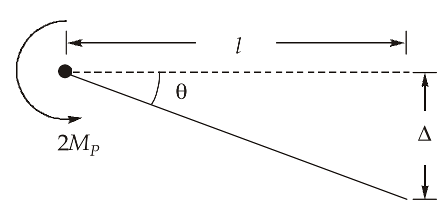
Case I: Plastic hinge at the point where cross section changes.



$$\text{External work} = \text{Load} \times \text{Deflection}$$
$$= 1.5\, W_u \times \Delta$$
$$= 1.5\, W_u \times \frac{l}{2}\theta = \frac{3}{4} W_u l\theta$$
$$\text{Internal work} = \text{Moment} \times \text{Rotation} = M_p\theta$$
$$\frac{3}{4} W_u l\theta = M_p\theta$$
$$W_u = \frac{4M_p}{3l}$$
$$\therefore \quad W_u = \frac{4}{3}\frac{M_p}{l} \quad \text{...(i)}$$

Case II: Plastic hinge at the support.

$$\text{External work} = \text{Load} \times \text{Deflection}$$
$$= 1.5\, W_u \times \Delta = \frac{3}{2} W_u l\theta$$



$$\text{Internal work} = 2M_p\theta$$
$$\therefore \quad 2M_p\theta = \frac{3}{2} W_u l\theta$$
$$\Rightarrow \quad W_u = \frac{4M_p}{3l} \quad \text{...(ii)}$$

From (i) and (ii), collapse load, $W_u = \dfrac{4M_p}{3l}$

56. (d)

57. (a)

The design of column base plates requires consideration of bearing pressure on the supporting material and bending of plate.

58. (b)

Disadvantages of truss girder are higher cost of fabrication and erection, problem of vibration and impact, requirement of higher vertical clearance and costly maintenance.

59. (c)

$$\text{Permissible bearing stress} = 0.75 \times f_y$$
$$= 0.75 \times 250 = 187.5 \text{ N/mm}^2$$

60. (b)

Surge loads are the lateral loads produced because of sudden stopping or starting of the movement of trolley across the building.

Drag loads also called longitudinal loads are caused by sudden starting or stopping of the crane when it moves in the longitudinal direction.

61. (d)

Gantry girder is generally laterally unsupported except at columns.

- A vertical load acting over the gantry girder is the reaction from the crane girder and consists of the self-weight of the crab and the crane capacity.

62. (c)

Pratt trusses are favoured because due to gravity loads the longer members will be in tension while for Howe truss, the longer members will be in compression. However, if reversal of forces occur due to uplift, the benefit will be lost.

63. (c)

Scanning system measures radiation from the scene point by point over a finite time.

64. (b)

The energy of quanta is given by

$$Q = \frac{hc}{\lambda} = hf$$

where λ = wavelength

f = frequency

h = Planck's constant ($6.626 \times 10^{-39} Js$)

65. (d)

The TRANSIT system is composed of six satellites orbiting at an altitude of about 1100 km with nearly circular polar orbits. TRANSIT system was developed primarily to determine the coordinates of vessels and aircrafts.

66. (a)

The error sources in GPS can be classified into three groups, namely satellite-related errors, propagation-medium related errors and receiver-related errors. These are known as systematic errors. However sometimes errors are introduced intentionally known as selective availability.

67. (c)

$$\text{Tangent length} = R\tan\frac{\Delta}{2}$$

$$\Rightarrow \quad 100 = R\tan\left(\frac{60°}{2}\right)$$

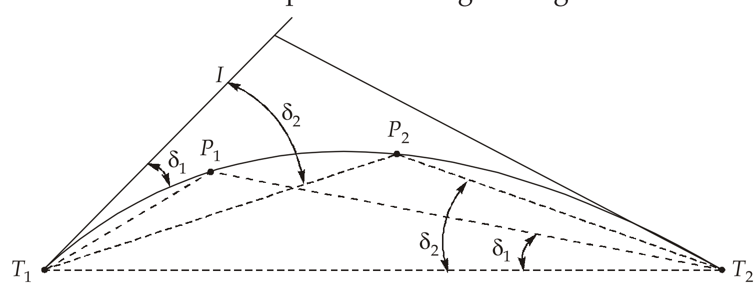
$$\Rightarrow \quad R = \frac{100}{\tan 30°} = 173.2 \text{ m}$$

By the method of offset from chord produced, third offset is

$$= \frac{O_3^2}{R} = \frac{30^2}{173.2} = 5.196 \text{ m} \simeq 5.2 \text{ m}$$

68. (c)

The principle of the method can be explained from given figure.



T_1 and T_2 are two tangent points. P_1 is a point on curve, T_1P_1 is chord and subtends an angle 2δ at centre.

From the property of circle, if the angle between the tangent and the chord is δ, then 2δ will be the angle subtended at the centre. A chord will also subtend half the angle subtended at the centre at another point on curve. Thus, angle $T_1T_2P_1$ is also δ. Thus, if we get angle δ from T_1I and the same angle δ from T_2T_1, we get point P_1 as their intersection.

This is the principle on which the two theodolite method is based.

69. (c)

When the measurement of time is based upon the diurnal motion of a star or the 'first point of Aries' it is known as Sidereal time.

70. (a)

One lunar day equals $24^h\ 51^m$.

Since the moon shifts eastward against the celestial background, much more rapidly than the sun, a lunar day is longer than a solar day.

71. (c)

Given, $h_1 = 250$ m, $r_1 = 10$ cm, $S_d = \frac{1}{5000}$

Datum scale $S_d = \frac{1}{5000} = \frac{f}{H} = \frac{200/1000}{H}$

$\Rightarrow$ $H = \frac{200}{1000} \times 5000$

$\Rightarrow$ $H = 1000$ m about MSL

Now, Relief displacement $= \frac{r_1 h_1}{H - h_1} = \frac{10 \times 250}{1000 - 250}$

$= 3.33$ cm

72. (a)

Controlled mosaics are obtained by rectified aerial photograph and uncontrolled mosaic is a representation of the ground achieved by assembling unrectified photographs without any reference to the ground control points.

73. (b)

74. (d)

Parabolas in vertical curves can be approximated as circular curves.

75. (a)

Tubular section in trusses may be jointed either by means of a gusset plate or member-to-member by welding.

Gussets provide additional length of fillet welding to the tube. Since tubes have thin sections, it is easier to use fillet welds.

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