CLASS TEST

S.No.: 08_CE_JP_18032025

RPSC
Rajasthan Public Service Commission
ASSISTANT ENGINEER EXAMINATION

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CIVIL ENGINEERING

STRUCTURE ANALYSIS

Duration : 1:00 hr. **Maximum Marks : 100**

Read the following instructions carefully

1. This question paper contains **50** objective questions. **Q.1-50** carry two marks each.
2. Answer all the questions.
3. Questions must be answered on Objective Response Sheet (**ORS**) by darkening the appropriate bubble (marked A, B, C, D) using HB pencil against the question number. Each question has only one correct answer. In case you wish to change an answer, erase the old answer completely using a good soft eraser.
4. There will be **NEGATIVE** marking. For each wrong answer **1/3rd** of the full marks of the question will be deducted. More than one answer marked against a question will be deemed as an incorrect response and will be negatively marked.
5. Write your name & Roll No. at the specified locations on the right half of the **ORS**.
6. Using HB pencil, darken the appropriate bubble under each digit of your registration number.
7. No charts or tables will be provided in the examination hall.
8. Use the blank pages given for rough work.
9. Choose the **Closest** numerical answer among the choices given.

DO NOT OPEN THIS TEST BOOKLET UNTIL YOU ARE ASKED TO DO SO

Q.1 The number of independent equations to be satisfied for static equilibrium of a space structure is:
(a) 1 (b) 2
(c) 3 (d) 6

Q.2 Consider the following statements:
1. When the number of members (n) and joints (j) are such that the equation $n = (2j - 3)$ is satisfied, the framed structure is said to be a perfect structure.
2. In a redundant frame, the number of members is less than that required for a perfect frame.
3. If, in a framed structure, the number of members provided is more than that required for a perfect frame, it is called as a deficient frame.

Which of the above statements is/are correct?
(a) 1, 2 and 3 (b) 1 only
(c) 2 only (d) 3 only

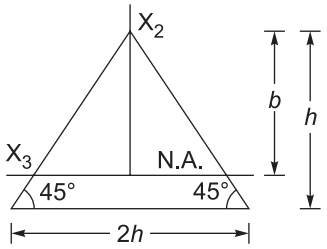
Q.3 The number of unknown reactions to be found at a fixed support of a beam, during analysis is/are:
(a) 1 (b) 2
(c) 3 (d) 4

Q.4 In a statically determinate plane frame the relationship between number of bars and joints can be expressed as
(a) $j = 2n - 3$ (b) $n = 2j - 3$
(c) $j = 3j - 2$ (d) $n = 3j - 2$
Where n = number of bars, and j = number of joints

Q.5 A two-dimensional structure in general is classified as a statically indeterminate structure if it cannot be analyzed by which of the following equations of equilibrium
(a) Sum of vertical forces is zero
(b) Sum of horizontal forces is zero
(c) Sum of moments of all the forces about any point in the plane is zero
(d) All of the above

Q.6 When a body is in equilibrium undergoes an infinitely small displacement, work imagined to be done, is known as:
(a) Imaginary work (b) Negative work
(c) Virtual work (d) None of the above

Q.7 The beam of triangular cross-section as shown in the figure below, is subjected to pure bending. If a plastic hinge develops at a section, determine the location of neutral axis (distance b from top) at that section. The beam material is elastic-perfectly plastic (i.e., yield stress is constant)



(a) $\frac{h}{\sqrt{3}}$ (b) $\frac{h}{2}$
(c) $\frac{h}{\sqrt{2}}$ (d) $\frac{h}{3}$

Q.8 The moment need to produce a unit rotation at one end of a member if the other end of the member is fixed is known as
(a) Rotational Stiffness
(b) Deflection
(c) Flexural Stiffness
(d) Deformation

Q.9 Which of the following statement(s) is/are true?
(i) Magnification factor is minimum at resonance.
(ii) The maximum value of amplification factor increases as damping factor decreases.
(iii) The maximum value of amplification factor increases as damping factor increases.
(iv) Magnification factor is maximum at resonance
(a) (i) and (ii) (b) (i) and (iii)
(c) (ii) and (iv) (d) Only (ii)

Q.10 A two-hinged parabolic arch is subjected to u.d.*l.* w over entire span. Then the horizontal thrust is
(a) $\frac{wl^2}{3h}$ (b) $\frac{wl^2}{4h}$
(c) $\frac{wl^2}{6h}$ (d) $\frac{wl^2}{8h}$

Q.11 A two-hinged parabolic arch of span *L* and rise *h* carrying a concentrated load *P* at the crown, will have horizontal thrust equal to

(a) $\frac{128}{25}\frac{P.h}{L}$ (b) $\frac{25}{128}\frac{P.h}{L}$

(c) $\frac{128}{25}\frac{PL}{h}$ (d) $\frac{25}{128}\frac{PL}{h}$

Q.12 For a single-point load *W* moving on symmetrical 3-hinged parabolic arch of span *L*, the maximum sagging moment occurs at a distance x from ends. The value of x is

(a) 0.211 L (b) 0.25 L
(c) 0.34 L (d) 0.5 L

Q.13 Which of the following statements are correct in respect of temperature effect on a load-carrying three-hinged arch?

1. No stresses are produced in a three-hinged arch due to temperature change alone.
2. There is a decrease in horizontal thrust due to rise in temperature
3. There is an increase in horizontal thrust due to rise in temperature.

(a) 1 and 2 only (b) 1 and 3 only
(c) 2 only (d) 3 only

Q.14 If cable in transmission line tower, move or deflect downward direction due to it's own self weight, the profile (shape) achieved in elevation is _____.

(a) straight line profile
(b) cubic parabola profile
(c) catenary profile
(d) parabolic profile

Q.15 The cable and arch are subjected to axial forces respectively as, _____.

(a) Tensile and Compressive
(b) Compressive and Tensile
(c) Tensile and Tensile
(d) Compressive and Compressive

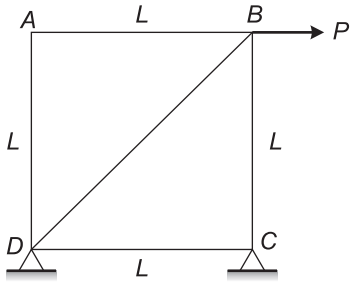
Q.16 The span of the bridge is said to be economical when

(a) the cost of supporting system of one span is equal to cost of one pier
(b) the cost of supporting system of one span is OR equal to cost of one abutment
(c) the cost of pier is equal to half the cost of abutment
(d) the cost of supporting system of one span is equal to half the cost of pier

Q.17 Which one is not a redundant structure?

(a) Completely closed ring
(b) Fixed Portal frame
(c) Three-hinged arch
(d) Propped cantilever

Q.18 What is the force in member *AB* of the pin-jointed frame as shown below?



(a) P (tension)
(b) P (compression)
(c) $\frac{P}{\sqrt{2}}$ (compression)
(d) zero

Q.19 Lack of fit between members of a truss causes

(a) no deflections
(b) vertical deflection only
(c) horizontal deflection only
(d) horizontal & vertical deflections both

Q.20 Castigliano's first theorem is applicable

(a) For statically determinate structures only
(b) When the system behaves elastically
(c) Only when principle of superposition is valid
(d) For statically indeterminate structures only

Q.21 Independent displacement at each joint of a rigid-jointed plane frame are:

(a) Three linear movements
(b) Two linear movements and one rotation
(c) One linear movement and two rotations
(d) Three rotations

Q.22 Depending on the transmission of loads to joints, bridge are classified as:

(a) Deck type (b) Pratt type
(c) Warren type (d) Howe type

Q.23 The strain energy stored due to bending for a cantilever beam of span l, Modulus of elasticity E, moment of inertia I and a point load P at free end is

(a) $P^2l^3 / (6\,EI)$ (b) $P^2l^5 / (40\,EI)$
(c) $P^2l^3 / (96\,EI)$ (d) $P^2l^5 / (240\,EI)$

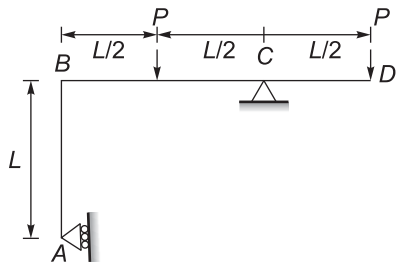
Q.24 The number of plastic hinges which will cause the overall total collapse of a structure is :

(a) one more than the order of static indeterminacy
(b) equal to order of static indeterminacy
(c) one less than the order of static indeterminacy
(d) not determinable

Q.25 The analysis of statically indeterminate structures by the unit load method is based on

(a) consistent deformation
(b) consistent force
(c) stiffness
(d) none of the above

Q.26 A frame *ABCD* is supported by a roller and a hinge as shown in figure. The reaction at the roller end A is given by



(a) P (b) $2P$
(c) $P/2$ (d) Zero

Q.27 A rigid frame detailed to provide good ductility and support for both lateral and gravity loads by flexural action is called

(a) Ordinary moment resisting frame
(b) Intermediate moment resisting frame
(c) Special moment resisting frame
(d) All of the above

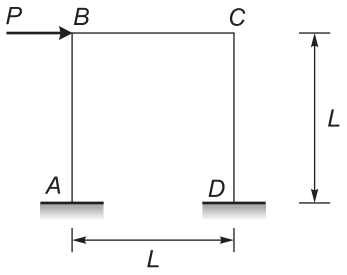
Q.28 Which one of the following methods is more accurate for the analysis of rigid frames?

(a) Substitute frame method
(b) Protal method
(c) Factor method
(d) Slope deflection method

Q.29 For approximate analysis of building frames under vertical loads, the point of inflection is assumed at

(a) Centre of each beam
(b) One-tenth of the span length from each end of the beam
(c) Centre of each column
(d) Both (a) and (c)

Q.30 What is the shear equation in slope deflection method for the portal frame shown below?



(a) $\frac{M_{AB}+M_{BA}}{L}+\frac{M_{CD}+M_{DC}}{L}+P=0$

(b) $\frac{M_{AB}+M_{BA}}{L}+\frac{M_{BC}+M_{CB}}{L}+P=0$

(c) $\frac{M_{BC}+M_{CB}}{L}+\frac{M_{CD}+M_{DC}}{L}+P=0$

(d) $\frac{M_{BC}+M_{CB}}{L}+P=0$

Q.31 **Assertion (A):** The principle of superposition for deflection of beams subjected to a number of loads can be applied in the case of large deformations.
Reason (R): In the principle of superposition, the resultant deflection due to all the loads will be the algebraic sum of the deflections due to each load acting separately.

(a) Both A and R are true and R is the correct explanation of A
(b) Both A and R are true but R is not the correct explanation of A
(c) A is true but R is false
(d) A is false but R is true

Q.32 A single-bay portal frame of height h fixed at the base is subjected to a horizontal displacement Δ at the top. With constant EI, the base moment developed is proportional to

(a) $\frac{1}{h}$ (b) $\frac{1}{h^2}$

(c) $\frac{1}{h^3}$ (d) $\frac{1}{h^4}$

Q.33 In a single bay, single storey frame with fixed ends and columns have the same values of moment of inertia, the displacement factor for the column is

(a) – 0.75 (b) – 0.50
(c) – 1.0 (d) + 1.0

Q.34 The Muller-Breslau principle can be used to

1. determine the shape of the influence line
2. indicate the parts of the structure to be loaded to obtain the maximum effect
3. calculate the ordinates of influence lines

The correct answer is

(a) 1 only (b) Both 1 and 2
(c) 2 and 3 (d) 1, 2 and 3

Q.35 The maximum ordinate of the influence line diagram for bending moment at the fixed support in cantilever beam will occur at:

(a) fixed support
(b) mid span
(c) quarter span from fixed end
(d) free end

Q.36 In a frame the point of inflection occurs in

(a) beam only
(b) column only
(c) beam column joint
(d) anywhere in the frame

Q.37 Influence line for a forcing function gives its variation at

(a) mid span
(b) support
(c) given section
(d) every where in the beam

Q.38 Which of the following method is a displacement method?

(a) Column analogy method
(b) Three moment equation
(c) Euler's method
(d) Moment distribution method

Q.39 The displacement method is also referred to as

(a) Minimum strain energy method
(b) Maxwell Mohr method
(c) Consistent deformation method
(d) Slope-deflection method

Q.40 Slope deflection method is suitable for analysis of

(a) Continuous beam
(b) Simply supported beam
(c) Fixed beam
(d) Cantilever beam

Q.41 Which one of the following statements is true with regard to the flexibility method of analysis?

(a) The method is used to analyze determinate structures.
(b) The method is used only for manual analysis of indeterminate of flexible structure.
(c) The method is used only for analysis of flexible structure.
(d) The method is used for analysis of indeterminate structures with lesser degree of static indeterminacy.

Q.42 The size of the basic stiffness matrix for a plane truss member, in member coordinate system is

(a) 2×2
(b) 3×3
(c) 4×4
(d) 6×6

Q.43 Which one of the following is a force method of structural analysis?

(a) Slope deflection method
(b) Kani's method
(c) Moment distribution method
(d) Strain energy method

Q.44 The Castigliano's theorem is essentially a

(a) Force method
(b) Displacement method
(c) Strain method
(d) Equilibrium method

Q.45 Which one of the following method does not fall under the category of force method?
(a) Method of consistent deformation
(b) Column analogy method
(c) Equilibrium method
(d) Three moment equation

Q.46 The three-moment equation is applicable only, when
(a) the beam is prismatic
(b) there is no settlement of supports
(c) there is no discontinuity such as hinges within the span
(d) the span are equal

Q.47 The effect of sinking of supports by 'δ' is to create a bending moment equal to
(a) $\frac{2EI\delta}{l^2}$ (b) $\frac{6EI\delta}{l^2}$
(c) $\frac{3EI\delta}{l^2}$ (d) $\frac{EI\delta}{l^2}$

Q.48 The analysis of a structure is
(a) Deciding the material of the member
(b) Deciding the dimension of the member
(c) Calculating the magnitude and nature of various straining actions at salient points of the structure
(d) Planning of the structure

Q.49 The number of simultaneous equation to be solved in the slope deflection method is equal to
(a) the degree of statically indeterminacy
(b) the degree of kinematics
(c) the number of joints in the structure
(d) the number of spans in the structure

Q.50 The moment distribution method in structural analysis can be treated as:
(a) Force method
(b) Displacement method
(c) Flexibility method
(d) None of the above

■■■■

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STRUCTURE ANALYSIS

CIVIL ENGINEERING

Date of Test : 18/03/2025

ANSWER KEY ➤

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

Detailed Explanations

1. (d)

For space frames number of equation of equilibrium is 6.

Equations of equilibrium for space frames

$\Sigma f_x = 0$, $\Sigma M_x = 0$

$\Sigma f_y = 0$, $\Sigma M_y = 0$

$\Sigma f_z = 0$, $\Sigma M_z = 0$

2. (b)

- $n = (2j - 3) \rightarrow$ Perfect frame.
  $n > (2j - 3) \rightarrow$ Redundant frame
  $n < (2j - 3) \rightarrow$ Deficient frame (Unstable)
- Perfect frame are the frames which can be analysed to get the internal member forces and external support reaction by using the three conditions of static equilibrium.
- Deficient frame is also called as unstable frame i.e. the frame will deform if the external load is applied.

3. (c)

Type of support	No. of unknown reaction
fixed	3
hinged	2
roller	1

4. (b)

2D - frame/ Truss, statically determinate

$$n + 3 - 2j = 0$$

$$n = 2j - 3$$

5. (d)

If structure is determinate it is analyzed by equilibrium equations only - $\Sigma f_x = 0$, $\Sigma f_y = 0$, $\Sigma M = 0$.

If structure is not analyzed by using above equation S. For a static only, then structure is called statically indeterminate structure.

6. (c)

Virtual work: Virtual work is the total work done by the applied forces and the internal forces of a mechanical system as its waves through a set of virtual displacement.

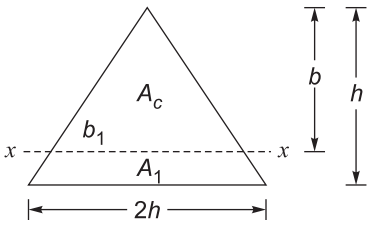
Negative work: Negative work is done when an object moves in opposite direction of the direction of application of forces.

7. (c)

$$A_c = A_t$$

$$\frac{1}{2} \times b \times b_1 = \frac{1}{2}\left[\frac{1}{2} \times 2h \times h\right]$$

$$b_1 = \frac{h^2}{b}$$



From similar triangles

$$b \to b_1$$
$$h \to 2h$$
$$b \times 2h = b_1 h$$
$$b = \frac{b_1}{2}$$
$$b = \frac{h^2}{b \times 2}$$
$$b^2 = \frac{h^2}{2}$$
$$b = \frac{h}{\sqrt{2}}$$

8. (a)

Rotational stiffness is the ratio of the applied moment to the angular rotation. For unit rotation, the moment is equal tot he rotational stiffness if the other end of member is fixed.

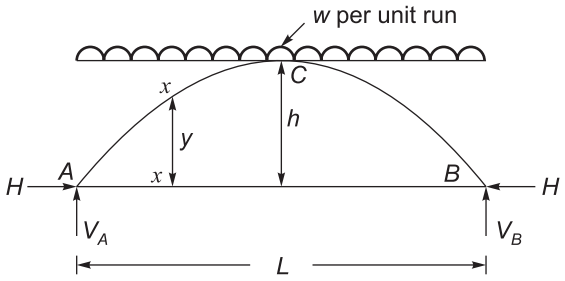
$$K = \frac{M}{\theta}$$

9. (c)

Magnification factor is maximum at resonance.

The maximum value of amplification factors increase as damping factor increases.

10. (d)



Taking moment at point *A*

$$-V_B \times L + wL \times \frac{L}{2} = 0$$
$$V_B = \frac{wL}{2}$$
$$V_A = \frac{wL}{2}$$
$$M_x = \frac{wl}{2} \times x - \frac{wx^2}{2}$$
$$y_x = \frac{4h}{l^2} \times (l - x)$$

Horizontal thrust, $$H = \frac{\int_0^l \mu y \, dx}{\int_0^l y^2 \, dx} \qquad \{\mu = M_x\}$$

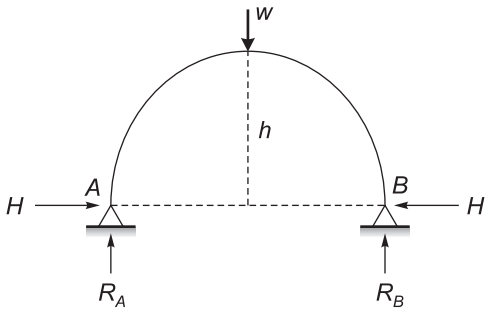
$$= \frac{\int_0^l \left(\frac{wlx}{2} - \frac{wx^2}{2}\right)\frac{4h}{l^2}dx}{\int_0^l \left[\frac{4h}{l^2}x(l-x)\right]^2 dx}$$

$$= \frac{\frac{4h}{l^2}\times\frac{w}{2}\int_0^l (lx - x^2)x(l-x)dx}{\left(\frac{4h}{l^2}\right)^2 \int_0^l [x(l-x)]^2 dx}$$

$$= \frac{\frac{w}{2}\left(\frac{4h}{l^2}\right)\int_0^l (lx - x^2)dx}{\left(\frac{4h}{l^2}\right)^2 \int_0^l (lx - x)^2}$$

$$H = \frac{wl^2}{8h}$$

11. (d)



We know the horizontal thrust in two hinged parabolic arch subjected to concentrated load W at crown in which moment of Inertia $(I) = I_0 \sec\theta$ is given by

$$H = \frac{25}{128}\frac{wl}{h}$$

Here, $w = p$

$$H = \frac{25}{128}\times\frac{PL}{h}$$

12. (a)

Considering a three hinged parabolic arch of span l and subjected to a moving point load W, the position of the point load for

- Maximum negative bending moment is 0.25 l from end supports.
- Maximum positive bending moment is 0.211 l from end supports.

13. (a)

- A three hinged arch has two hinges at abutments and one hinge at the crown. It is a statically determinate structure.

- Increase in temperature causes increase in the length of the arch since the hinge at crown is not connected to any permanent object. Increase in the rise of the arch equals.

$$\left[\int \frac{\left(l^2 + 4h^2\right)}{4h} \alpha T\right]$$

- Stresses are not produced in the arch due to the temperature change alone.
- The decrease in the horizontal thrust due to the rise in temperature is given by:

$$dH = -\frac{dh}{h}(H)$$

Where, dh = Increase in rise of arch due to rise in temperature
h = Rise of arch before the temperature increase
H = Horizontal thrust due to loading before rise in temperature.

14. (c)

Catenary profile achieved in elevation when the cable is left freely in a transmission line and move downward due to its own weight.
Catenary curve has a U-like shape, superficially similar in appearance to a parabolic arch. It has minimal surface.

15. (a)

The cable and arch are subjected to axial forces respectively as, tensile and compressive.

16. (a)

The span of the bridge is said to be economical when the cost of supporting system of one span is equal to cost of one pier.

17. (c)

The excess members or reaction of an indeterminate structure are called redundants.
Three hinged arch is not a redundant structures.

18. (d)

When in perpendicular members no force is acting on the same then in that member the force is zero.
Hence AB and AD are perpendicular members and no force is acting on joint hence force in AB is zero.

19. (d)

Lack of fit between members of a truss causes horizontal & vertical deflection both.
Internal forces can develop in a redundant frame (with external loads) due to lack of fit.
$M = 2J - 3$ Stable perfect truss
$M < 2J - 3$ Insufficient or unstable truss
$M > 2J - 3$ Internally Redundant truss

20. (b)

Castigliano's first theorem is applied to both elastic and inelastic material behaviour.
Castigliano's first theorem is useful in analyzing statically indeterminate structure. Castigliano's second theorem:

- Useful for finding the deflections of statically determinate structures.
- Applicable only when principle of super position is valid.

21. (b)

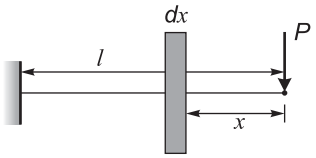
Independent displacement components or degree of freedom for different types of joints:

	Type of Joint	Degree of freedom
(i)	Pin joint of plane frame	2 (Translations)
(ii)	Pin joint of space frame	3 (Translations)
(iii)	Rigid joint of a plane frame	3 (One rotation and two translations)
(iv)	Rigid joint of a space frame	6 (3 rotations and 3 translations)

22. (a)

The trusses and girders in bridge of deck type transmit all loads received by the joints to the abutments or supporting piers.

23. (a)



Moment, $M_x = px$

Strain energy, $\int Ux = \int_{\partial}^{l} \frac{(px)^2}{2EI} dx$

$$U = \frac{p^2 l^3}{6EI}$$

24. (a)

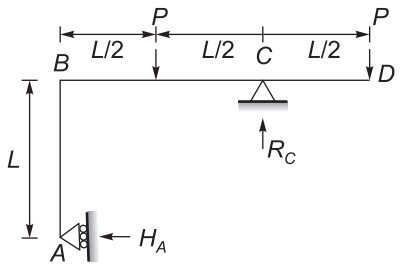
The number of plastic hinges which will cause the overall total collapse of a structure is one more than the order of static indeterminacy.

25. (a)

The analysis of statically indeterminate structure by the unit load method is based on consistent deformation method.

The method consistent deformations development in the proceeding sections for analyzing structures with a single degree of indeterminacy can easily be extend 10 the analysis of structures with multiple degree of indeterminacy.

26. (d)



$\Sigma V = 0$

$R_C = P + P = 2P$

$R_C = 2P$ ...(i)

Taking moment at C point

$$H_A \times L + P \times L/2 = P \times L/2$$
$$H_A \times L = 0$$
$$H_A = 0$$

Hence, Point *A* the reaction will be zero.

27. (d)

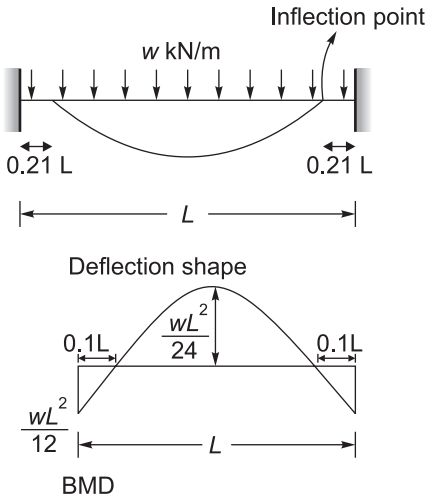
A rigid frame detailed to provide good ductility and support for both lateral and gravity loads by flexure action is known as moment resisting frame. It can be classified further as

- Ordinary moment resisting frame.
- Intermediate moment resisting frame.
- Special moment resisting frame.

28. (d)

Slope deflection methods is more accurate for the analysis of rigid frames.

29. (b)



- For fixed beam, subjected to vertical loads the point of inflection or point of zero moment occurs at 0.21 L from the both ends of the support.
- For a building frame, the support provided by the columns is neither fixed nor simply supported. For the purpose of approximate analysis the inflection point is assumed to occur at $\left(\frac{0+0.21\,L}{2}\right) \simeq 0.1L$ from the support.

30. (a)

Shear equation is given by

i.e. $$H_A + H_D + P = 0$$

$$H_A = \frac{M_{AB} + M_{BA}}{L}$$

and $$H_D = \frac{M_{DC} + M_{CD}}{L}$$

Hence shear equation is

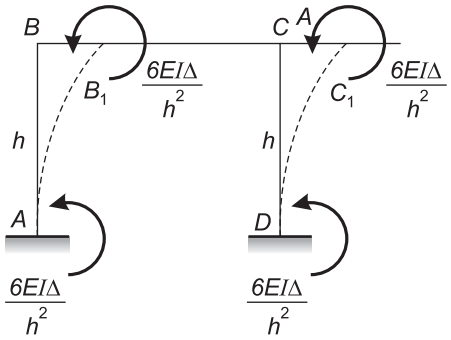
$$\frac{M_{AB} + M_{BA}}{L} + \frac{M_{CD} + M_{DC}}{L} + P = 0$$

31. (d)

Superposition method follows only for small deflection.

The principle of superposition states that resultant deflection due to all the loads will be the Algebraic sum of individual deflection.

32. (b)



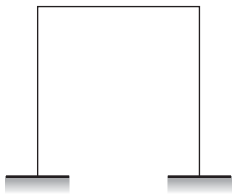
Base moment, $$M = \frac{6EI\Delta}{h^2}$$

$$M \propto \frac{1}{h^2}$$

So, the base moment developed is inversely proportional to h^2.

33. (a)

$$\text{Distribution factor} = \frac{\frac{4EI}{L}}{\frac{4EI}{L}+\frac{4EI}{L}}$$



$$\text{Distribution factor} = \frac{4}{8} = 0.5$$

Displacement factor, $$\Delta = -1.5 \times \text{D.F.}$$

$$\Delta = -1.5 \times 0.5$$

$$\Delta = -0.75$$

34. (d)

The Muller-Breslau principle can be used to:

(a) Determine slope of the influence line.

(b) The structure to be loaded to obtain the maximum effect.

(c) Calculate the ordinates of influence lines.

35. (d)

The maximum ordinate of the influence line diagram for bending moment at the fixed support in cantilever beam will occur at free end.

36. (d)

Point of inflection, where bending moment changes sign, it depends on loading so it may occur anywhere in the frame.

37. (c)

Influence line represents variation of a stress function such as shear force, bending moment, reaction, slope or deflection at a section when unit concentrated load moves from one end to the other end.

38. (d)

In displacement method forces are known and displacement is calculated.

There are three types of displacement methods:

1. Slope deflection method
2. Moment distribution method
3. Stiffness matrix method.

39. (d)

In the slope deflection method displacement (slope and deflection) are treated as unknown. Thus the slope deflection method is a displacement method. In this it is assumed that deformation are caused due to bending moment only.

40. (a)

Slope deflection method is the classical beam shown For determinate structure, slope deflection method is method of analysis of indeterminate beams and frames suitable for continuous beam.

41. (d)

Flexibility method is used for analysis of redundant structure with lesser degree of static indeterminancy.

Note-Stiffness methods is used where kinetic indeterminacy is less than static indeterminacy.

42. (a)

The size of the basic stiffness matrix for a plane truss member in member co-ordinate system is 2×2.

43. (d)

Force method of analysis are:

- Method of consistent deformation.
- Strain Energy method
- Three moment theorem: clapeyron.
- Column Analogy Method: Hardy cross.
- Elastic Centre Method.
- Maxwell - Mohr equations.
- Castigliano's theorem of minimum strain energy.
- Flexibility Matrix method.
- Slope deflection method, Kani's method, Moment distribution method are all displacement method.

44. (a)

The Castigliano's Method, named after Carlo Alberto Castigliano, is a method for determining the displacement of a linear-elastic system based on the partial derivatives of the energy.

45. (c)

Method used as force Method

1. Method of consistent deformation
2. Column Analogy Method
3. Three Moment Method
4. Virtual work/unit load Method
5. Elastic centre method
6. Castigliano's theorem of minimum
7. Maxwell-Mohr equation

Method of displacement

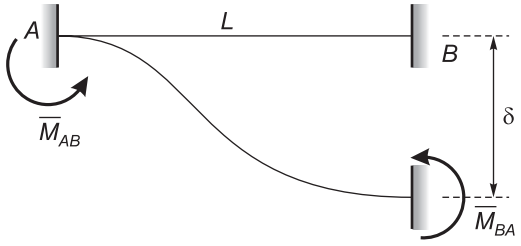
1. Stiffness Method
2. Equilibrium Method
3. Slope deflection method
4. Moment distribution method
5. Minimum potential energy method

46. (c)

The three - moment equation is applicable only when no discontinuity equation such as hinges within the span.

47. (b)

If both the supports are fixed and support B settles down (sinks) by δ then



$$\overline{M}_{BA} = \frac{+6EI\delta}{L^2}$$

$$\overline{M}_{BA} = \frac{-6EI\delta}{L^2}$$

If settlement of supports causes rotation of member in clockwise direction the fixed and moment developed will be in anticlockwise direction vice-versa.

48. (c)

The analysis of a structure is calculating the magnitude and nature of various straining actions at salient points of the structure.

49. (c)

The number of simultaneous equation to be solved in the slope deflection method is equal to the number of joints in the structure.

50. (b)

The moment distribution method in structural analysis can be treated as displacement method.

Example of displacement method are

- moment distribution method
- slope deflection method
- Kani's method
- Stiffness matrix method

■■■■