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PREFACE

B. Singh (Ex. IES)

For each and every aspirant in the preparation for any competitive exam, consolidating what is learnt and to get the flavour & feel of actual exam are among the top in list of desiderata. With the students' expression of interest for a book to prepare effectively for State Level exams, this objective book is debut of MADE EASY in exclusive State Level Services study material which will definitely fulfil all the requirements of aspirants.

This book covers around 2500+ questions from various papers of 11 different PSCs across the country (namely APPSC, BPSC, RPSC, OPSC, MPSC, MPPSC, KPSC, HPPSC, TNPSC, UKPSC and Kerala PSC); book will certainly be a path for students to achieve their goal.

Reasonable efforts are been taken to make sure that answers are framed and transcribed accurately. With key formulae, relevant theory and graphical/pictorial representations this book will not only give questions of various PSCs over the years but also will equip students with concepts, knowledge and understanding of the subject. This book is not only for State Services exams but also it is equally beneficial for the preparation of various other competitive exams like ESE, GATE, PSUs exam etc.

It is impossible to acknowledge all the individuals who helped us, but would like to sincerely thank all authors, editors and reviewers for putting their painstaking efforts to publish this book.

B. Singh (Ex. IES)
Chairman and Managing Director
MADE EASY Group

Contents

■■■■

APPSC 2016

Andhra Pradesh Public Service Commission

Exam held in 2016 **Mains**

Q.1 As per Indian standard code 1077, the burnt clay building bricks having compressive strength less than _____ N/mm^2 are known as common burnt clay bricks
(a) 3.5 (b) 12.5
(c) 30 (d) 40

Q.2 After 24 hours immersion in cold water, water absorption by weight shall not exceed _____ percent of the dry weight of the brick.
(a) 40 (b) 20
(c) 25 (d) 30

Q.3 Maximum slenderness ratio allowed as per Indian standard for an unreinforced load bearing wall (using Portland Cement or Portland Pozzolana Cement in mortar) is
(a) 13 (b) 20
(c) 27 (d) 35

Q.4 The test conducted for the calculation of basic compressive stress of masonry is:
(a) Vibration test (b) Prism test
(c) CBR test (d) Slump cone test

Q.5 Efflorescence test is conducted for burnt clay bricks to find out the
(a) presence of alkaline substance
(b) hardness
(c) soundness
(d) presence of cracks or holes

Q.6 The apparatus used for determining the Soundness of cement is
(a) Slump cone
(b) Le Chatelier apparatus
(c) Vicat's needle
(d) UTM

Q.7 Cement used for railway sleepers is designated as
(a) 40-S (b) 53-S
(c) 46-S (d) 48-S

Q.8 The main constituent of cement which is responsible for initial setting of cement is
(a) Dicalcium silicate
(b) Tricalcium silicate
(c) Tricalcium aluminate
(d) None of the given answers

Q.9 For testing compressive strength of hydraulic cement other than masonry cement as per IS 4031 - Part 6, the size of cube used is
(a) 150 mm (b) 100 mm
(c) 70.6 mm (d) 50 mm

Q.10 Plywood has the advantage of
(a) Greater tensile strength in longer direction
(b) Greats- tensile strength in shorter direction
(c) Same tensile strength in both directions
(d) None of the given answers

Q.11 A queen closer is
(a) Full brick
(b) Longitudinally $\frac{1}{2}$ brick
(c) $\frac{3}{4}$ brick
(d) $\frac{1}{2}$ brick

Q.12 The artificial seasoning method that causes timber to become brittle and easy to break is
(a) Boiling
(b) Chemical seasoning
(c) Electrical seasoning
(d) Kiln seasoning

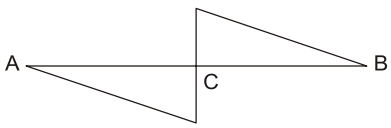
Q.13 The age of tree can be known by examining
(a) Cambium layer (b) Annular rings
(c) Medullary rays (d) Heart wood

Q.14 Inadequate compaction during concrete casting results in
(a) Honey combing
(b) Bleeding
(c) Segregation
(d) Bleeding and Segregation

Q.15 If characteristic compressive strength at 28 days is 40 N/mm^2 and the standard deviation is 5 N/mm^2, the target strength at 28 days for concrete mix proportioning
(a) 40 N/mm^2 (b) 45 N/mm^2
(c) 43.25 N/mm^2 (d) 48.25 N/mm^2

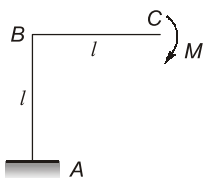
Q.16 A statistically indeterminate structure is the one which
(a) cannot be analysed using equations of statics alone
(b) cannot be analysed at all
(c) is not stable for general loading
(d) can be analysed with the equations of statics along

Q.17 If the BMD for a simply supported beam is as shown below, the load on the beam will be



(a) a concentrated load at C
(b) equal and opposite couples at the ends A and B
(c) a uniformly distributed load acting on the entire span
(d) concentrated couple at C

Q.18 The ratio of maximum deflection to maximum flexural stress in a simply supported beam of span l and depth d subjected to a concentrated load at mid-span is



(a) $\frac{l^2}{(6Ed)}$ (b) $\frac{l^2}{(8Ed)}$
(c) $\frac{l^2}{(16Ed)}$ (d) $\frac{l^2}{(60Ed)}$

Q.19 The horizontal deflection at C for the frame loaded and supported as shown below is (EI is constant)

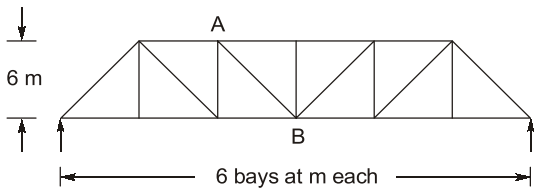
(a) $\frac{Ml^2}{(4EI)}$ (b) $\frac{Ml^2}{(2EI)}$
(c) $\frac{Ml^2}{(3EI)}$ (d) $\frac{2Ml^2}{(EI)}$

Q.20 The influence line for deflection at the free end of a cantilever is
(a) a triangle with zero ordinate at fixed end and maximum ordinate at free end
(b) a constant line
(c) a cubic parabola with zero ordinate at fixed end and maximum ordinate at free end
(d) a parabola with zero ordinate at fixed end and maximum ordinate at free end

Q.21 A prismatic beam simply supported carries a concentrated load W at mid-span. If the same beam is fixed at its ends, what load at mid-span can produce the same deflection at mid-span?
(a) 4 W (b) 2 W
(c) 3 W (d) 5 W

Q.22 Two concentrated loads of 50 kN each spaced at 4 m cross a simply supported girder of span 8 m. The absolute maximum bending moment in the girder is
(a) 1125 kN-m at 3 m from support
(b) 113.5 kN-m at 3 m from support
(c) 11.25 kN-m at 3 m from support
(d) 93.75 kN-m at 3 m from support

Q.23 Influence line for member force in AB of the truss shown is obtained by



(a) $\sqrt{2}$ times the ordinates of influence line for bending moment at A

(b) $\sqrt{2}$ times the ordinates of influence line for shear in 3rd panel from left

(c) $\sqrt{2}$ times the ordinates of influence line for bending moment at B

(d) $s\sqrt{2}$ times the ordinates of influence line for shear in 3rd panel from right

Q.24 A parabolic arched rib, of span 30 m, is hinged at the springing and crown and is having a central rise of 5 m. If the coefficient of thermal expansion for the arch material is 12×10^{-6} per 0C, the effect of a temperature rise of 300C is

(a) to cause thermal stresses

(b) to cause thermal stresses as well as a central rise of 18 mm

(c) to cause a central rise of 18 mm

(d) to cause no effect on the structure

Q.25 A temperature rise in a two hinged symmetric and parabolic arched rib causes

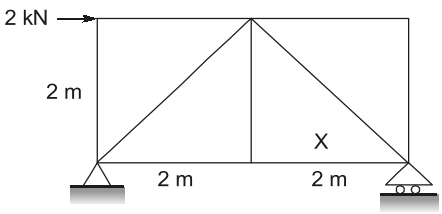
(a) a uniform bending moment in the rib

(b) no bending moment in the rib

(c) a maximum bending moment at the crown of the arch

(d) a minimum bending moment at the crown of the arch

Q.26 The force in the member 'X' of the truss supported and loaded as shown is



(a) $\sqrt{2}$ kN, Tension

(b) $\sqrt{2}$ kN, Compression

(c) 1 kN, Tension

(d) 1 kN, Compression

Q.27 A three-span continuous beam is fixed at the ends and supported by unyielding roller supports in between. What is the size of the stiffness matrix?

(a) 2×2 (b) 3×3

(c) 1×1 (d) 4×4

Q.28 Which of the following is displacement method?

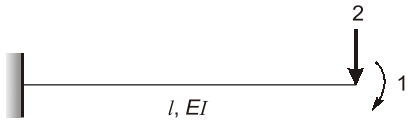
(a) Flexibility method

(b) Moment distribution method

(c) Kani's method

(d) None of the given answers

Q.29 For the structure shown, the elements of the flexibility matrix are



(a) $f_{11} = \frac{l}{(EI)}$; $f_{21} = \frac{l^2}{(2EI)}$; $f_{12} = \frac{l^2}{(2EI)}$;

$f_{22} = \frac{l^3}{(3EI)}$

(b) $f_{11} = \frac{l^3}{(3EI)}$; $f_{21} = \frac{l^2}{(2EI)}$; $f_{12} = \frac{l^2}{(2EI)}$;

$f_{22} = \frac{l}{(EI)}$

(c) $f_{11} = \frac{l}{(EI)}$; $f_{21} = \frac{l^2}{(EI)}$; $f_{12} = \frac{l^2}{(EI)}$;

$f_{22} = \frac{l^3}{(3EI)}$

(d) $f_{11} = \frac{l}{(EI)}$; $f_{21} = \frac{l^2}{(2EI)}$; $f_{12} = \frac{l^2}{(2EI)}$;

$f_{22} = \frac{l^3}{(4EI)}$

Q.30 An agricultural land of 437 ha is to irrigate for a particular crop. The base period of the crop is 90 days and the total depth of water required by crop is 105 cm, if a rainfall of 15 cm occurs during the base period, the duty of irrigation water is

(a) 437 ha/cumec (b) 487 ha/cumec

(c) 741 ha/cumec (d) 864 ha/cumec

Q.31 The absolute stiffness of a prismatic member with one end hinged is

(a) $\frac{2EI}{l}$ (b) $\frac{4EI}{l}$

(c) $\frac{3EI}{l}$ (d) $\frac{EI}{l}$

Q.32 The angle of dispersion of a concentrated load on the flange to the web plate of a steel beam is
(a) 70 Degrees with horizontal
(b) 60 Degrees with vertical
(c) 45 Degrees with vertical
(d) 30 Degrees with vertical

Q.33 Sway calculations and non-sway calculations are carried out in a single operation in
(a) Kani's method
(b) Moment distribution method
(c) Unit load method
(d) None of the given answers

Q.34 The Eddy's theorem is valid for
(a) Vertical loads only
(b) Horizontal loads only
(c) Dynamic loads only
(d) All loads

Q.35 As per IS-875, where access is not provided except for maintenance, live load on roofs, while designing a truss, in respect of its plan area is adopted as
(a) 100 N/sq.m (b) 400 N/sq.m
(c) 750 N/sq.m (d) 1500 N/sq.m

Q.36 A steel column in a multi-storeyed structure carries a load of 125 kN. It is builtup of 2 ISMC 350 channels connected by lacing. The lacing carries a load of
(a) 125 kN (b) 12.5 kN
(c) 3.125 kN (d) Zero

Q.37 An electric pole 5 m high is fixed into the foundation. It carries a wire at the top and is free to move sideways. The effective length of the pole is
(a) 3.25 m (b) 4 m
(c) 5 m (d) 10 m

Q.38 The maximum slenderness ratio of compression members carrying loads resulting from dead loads and superimposed loads is
(a) 100 (b) 180
(c) 150 (d) 200

Q.39 The minimum thickness of web plate from corrosion point of view should be
(a) 12 mm (b) 6 mm
(c) 3 mm (d) 20 mm

Q.40 For compression member having the same effective length about any cross-sectional aids, the most preferred section from the point of view of strength is
(a) a box (b) an I-section
(c) a circular tube (d) a single angle

Q.41 In Pigeaud's coefficient method for the analysis of an interior panel of a T-beam bridge
(a) Notation for coefficient as $\alpha x4$ and $\alpha y4$ includes suffix 4 since panel is continues on all the 4 edges
(b) Poisson's ratio of concrete has no contribution
(c) Applicability is restricted, to the case when wheel load is centrally placed
(d) Dispersion of load is considered through wearing coat only

Q.42 The members of a roof truss which carry axial compression are called
(a) Column (b) Beam
(c) Stanchion (d) Strut

Q.43 Shape factor for circular section is
(a) $\frac{4}{\pi}$ (b) $\frac{16\pi}{3}$
(c) $\frac{20}{(3\pi)}$ (d) $\frac{16}{(3\pi)}$

Q.44 As per IS-800, the minimum pitch of bolts in a row of bolts is recommended as the diameter of the bolt times
(a) 2 (b) 2.5
(c) 3 (d) 4

Q.45 Loss of stress with time at constant strain in steel is called
(a) relaxation (b) creep
(c) shrinkage (d) Ductility

Q.46 In a footing, it is usual to assume that the maximum value of transverse bending will occur at a distance, equal to (measured from the face of the column)
(a) Half the effective depth
(b) Effective depth
(c) Twice the effective depth
(d) None of the given answers

Q.47 The minimum and maximum % of reinforcement in RCC short column are
(a) 0.8 and 6 (b) 6 and 0.8
(c) 0.8 and 4 (d) 4 and 6

Q.48 A simply supported RC beam carries UDL and is referred as beam A. A similar beam is prestressed and carries the same UDL as the beam A This beam is referred as beam B. The mid-span deflection of beam A will be
(a) more than that of beam B
(b) less than that of beam B
(c) the same as that of beam B
(d) generally less but sometimes more depending upon the magnitude of UDL

Q.49 As the span of a bridge increases, the impact factor
(a) decreases
(b) increases
(c) decreases up to a critical value of span and then increases
(d) increase up to a critical value of span and then decreases

Q.50 The neutral axis of the reinforced beam passes through
(a) centre of gravity of the concrete section
(b) meta-centre of the concrete section
(c) centroid of the transformed section
(d) centroid of the concrete section

Q.51 The minimum size of the reinforcement bar in RCC column is
(a) 3 mm (b) 6 mm
(c) 12 mm (d) 10 mm

Q.52 Lateral ties in RC columns are provided to resist
(a) bending moment
(b) shear
(c) budding of longitudinal steel bars
(d) both bending moment and shear

Q.53 The section in which concrete is not fully stressed to its maximum permissible value while stress in steel reaches its maximum value, is called
(a) Under reinforced section
(b) Critical section
(c) Over reinforced section
(d) Balanced section

Q.54 In a slab, the transverse reinforcement is provided at _____ to the span of the slab.
(a) 45 degrees
(b) 60 degrees
(c) 75 degrees
(d) Right angle

Q.55 When the ratio of effective length of the column to its least lateral dimension does not exceed 15, it is termed as a
(a) Long column
(b) Short column
(c) Plain column
(d) None of the given answers

Q.56 What type of stresses are artificially induced by Prestressed concrete in a structure before it is loaded?
(a) Tensile (b) Torsional
(c) Shear (d) Compressive

Q.57 In a prestressed concrete member
(a) High strength concrete should be used
(b) Normal strength concrete should be used
(c) High strength concrete and low tensile steel should be used
(d) High strength concrete and high tensile steel should be used

Q.58 Drops are provided in flat slab to resist primarily
(a) bending moment (b) thrust
(c) shear (d) torsion

Q.59 Total amount of shrinkage strain for a pretensioned member is
(a) 3×10^{-4} (b) 3×10^{-5}
(c) 3×10^{-6} (d) 3×10^{-7}

Q.60 The important events located on the activities in a bar chart are known as
(a) Key events (b) Key stones
(c) Milestones (d) Key points

Q.61 PERT stands for
(a) Programme evaluation and research technique
(b) Programme examination and review technique
(c) Programme examination and research technique
(d) Programme evaluation and review technique

Answers Andhra Pradesh Engineering Services Exam 2016

1.	(d)	**2.**	(b)	**3.**	(c)	**4.**	(b)	**5.**	(a)	**6.**	(b)	**7.**	(b)	**8.**	(c)	**9.**	(c)	**10.**	(c)
11.	(b)	**12.**	(a)	**13.**	(b)	**14.**	(a)	**15.**	(d)	**16.**	(a)	**17.**	(d)	**18.**	(a)	**19.**	(b)	**20.**	(c)
21.	(a)	**22.**	(b)	**23.**	(b)	**24.**	(c)	**25.**	(c)	**26.**	(c)	**27.**	(a)	**28.**	(b)	**29.**	(a)	**30.**	(d)
31.	(b)	**32.**	(b)	**33.**	(a)	**34.**	(a)	**35.**	(c)	**36.**	(c)	**37.**	(d)	**39.**	(b)	**39.**	(b)	**40.**	(a)
41.	(c)	**42.**	(d)	**43.**	(d)	**44.**	(b)	**45.**	(a)	**46.**	(d)	**47.**	(a)	**48.**	(a)	**49.**	(a)	**50.**	(c)
51.	(c)	**52.**	(c)	**53.**	(a)	**54.**	(d)	**55.**	(b)	**56.**	(d)	**57.**	(d)	**58.**	(c)	**59.**	(a)	**60.**	(c)
61.	(d)	**62.**	(c)	**63.**	(b)	**64.**	(a)	**65.**	(b)	**66.**	(d)	**67.**	(a)	**68.**	(a)	**69.**	(d)	**70.**	(b)
71.	(a)	**72.**	(a)	**73.**	(a)	**74.**	(d)	**75.**	(c)	**76.**	(c)	**77.**	(b)	**78.**	(b)	**79.**	(b)	**80.**	(c)
81.	(d)	**82.**	(a)	**83.**	(a)	**84.**	(b)	**85.**	(b)	**86.**	(a)	**87.**	(d)	**88.**	(b)	**89.**	(a)	**90.**	(c)
91.	(b)	**92.**	(a)	**93.**	(d)	**94.**	(c)	**95.**	(b)	**96.**	(d)	**97.**	(c)	**98.**	(b)	**99.**	(c)	**100.**	(a)
101.	(d)	**102.**	(c)	**103.**	(a)	**104.**	(c)	**105.**	(b)	**106.**	(b)	**107.**	(d)	**108.**	(d)	**109.**	(b)	**110.**	(a)
111.	(b)	**112.**	(c)	**113.**	(d)	**114.**	(b)	**115.**	(a)	**116.**	(c)	**117.**	(c)	**118.**	(a)	**119.**	(a)	**120.**	(b)
121.	(d)	**122.**	(a)	**123.**	(b)	**124.**	(a)	**125.**	(d)	**126.**	(b)	**127.**	(a)	**128.**	(a)	**129.**	(c)	**130.**	(c)
131.	(d)	**132.**	(b)	**133.**	(b)	**134.**	(a)	**135.**	(b)	**136.**	(a)	**137.**	(c)	**138.**	(c)	**139.**	(a)	**140.**	(d)
141.	(d)	**142.**	(c)	**143.**	(a)	**144.**	(b)	**145.**	(b)	**146.**	(a)	**147.**	(d)	**148.**	(d)	**149.**	(b)	**150.**	(c)

Explanations

1. (d)

As per IS code 1077, burnt clay bricks having compressive strength more than 40 N/mm^2 are known as heavy duty bricks and are used for heavy duty structures such as bridges, piers etc. Common burnt clay bricks have minimum strength of 3.5 N/mm^2 and upto 40 N/mm^2.

2. (b)

For a good brick water absorption after 24 hrs immersion in water should not be more than 20% of its dry weight.

3. (c)

Maximum slenderness ratio for a load bearing wall.

No of storeys	Maximum slenderness ratio	
	Using Portland cement or Portland Pozzolana Cement in mortar	Using lime mortar
Not exceeding 2	27	20
Exceeding 2	27	13

4. (b)

Prism test is a laboratory test to calculate the compressive strength of a masonry prism.
A masonry prism is an assemblage of masonry units and mortar that is constructed to serve as a test specimen for determining properties.

5. (a)

Efflorescence test is conducted for burnt clay bricks to find out the presence of alkaline substance.

For this the bricks are soaked in water at room temperature. After the water is evaporated check for pressure of white spots (salts) on the brick.

It should be <50% of brick area for upto class 12.5 of bricks and <10% for higher classes.

6. (b)

Soundness test: The purpose of this test is to detect the presence of uncombined lime in cement 'or' to detect the change in volume of cement after setting. It is performed with the help of:

Le-Chatelier's method	Autoclave test
• Unsoundness due to free lime only.	• Sensitive to both lime and magnesia
• 100 gm of cement + 0.7 P	• Internal mould dimension 25 × 25 × 250 mm.
• Result is given in mm.	• Result is given in %.

7. (b)

Cement used for railways sleeper is designated as 53-S. It is because the cement used is OPC grade 53 i.e. ordinary portland cement with strength 53 MPa.

8. (c)

Tricalcium aluminate - Initial settling, may even cause false settling if in excess. Does not provide strength.

Tricalcium silicate - Responsible for one weak strengths.

Dicalcium silicate - Responsible for 1 year strength.

9. (c)

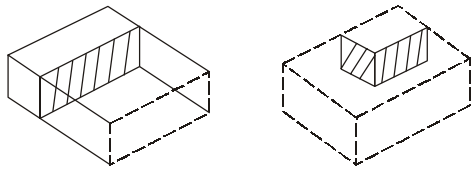
For testing compressive strength of cement, the standard size of cube according to IS 4031 - Part 6 is 70.6 mm.

10. (c)

In plywood, veneers are placed one above the other with the direction of grains of successive layers at right angles. This cross graining of veneers makes the strength of the panel consistent across both directions.

11. (b)

Queen closer:



(Half) Longitudinally half brick

(Quarter) Both longitudinally and laterally half brick

12. (a)

Artificial seasoning: Adopted for faster drying. It is possible to provide different drying condition based on the species of timber.

(a) **Boiling:** Timber is immersed in water and it is boiled. This is a very quick method. It affects the strength and elasticity of wood.

(b) **Chemical (salt seasoning):** Timber is immersed in solution of suitable salt. It is taken out and seasoned in the ordinary way.

(c) **Electrical seasoning:** High frequency alternating current is used. It's most rapid method but uneconomical.

(d) **Kiln seasoning:** Drying is carried out in air tight chamber or oven.

(e) **Water seasoning:** Log's of wood immersed in running water with their larger ends pointing upstream.

13. (b)

Annular rings are the rings on the c/s of a tree trunk. These are added every year, hence by counting them, we can estimate the age of the tree.

14. (a)

When concrete is not vibrated properly it may leave voids called honey combing. The exposed aggregate leaves a honey comb look and hence the name.

15. (d)

The target mean strength is given as

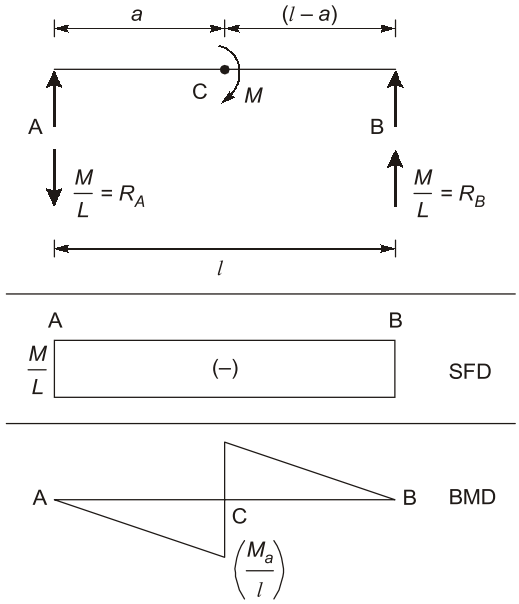
$$f_m = f_{ck} + 1.65\,\sigma$$
$$= 40 + 1.65 \times 5$$
$$= 48.25\ \text{N/mm}^2$$

16. (a)

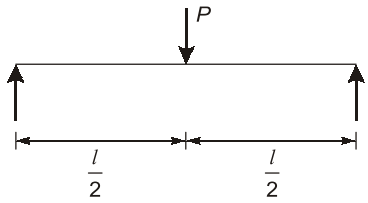
A statistically indeterminate structure cannot be analyzed by using equations of statics alone we use compatibility equations also to find all the unknowns.

17. (d)

BMD - sudden jump indicates concentrated load and st. line means - constant shear force - no load.



18. (a)



$$\delta_{max} = \frac{Pl^3}{48EI}$$

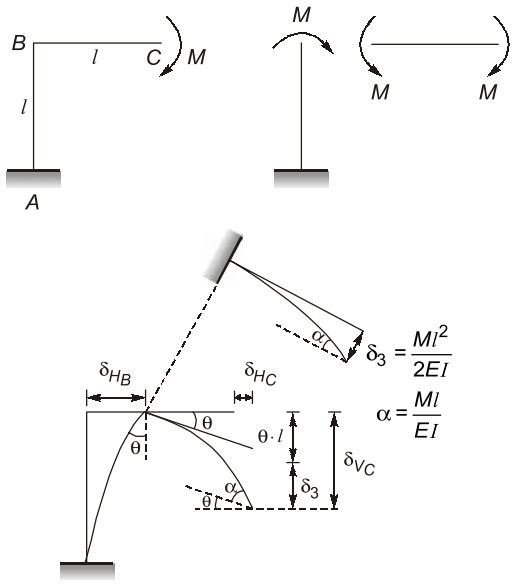
$$\sigma_{max} = \frac{m_{max} y_{max}}{I}$$

$$= \frac{Pl}{4} \times \frac{d}{2} \times \frac{l}{I}$$

$$\frac{\delta_{max}}{\sigma_{max}} = \frac{Pl^3}{48EI} \times \frac{8I}{Pld}$$

$$= \left(\frac{l^2}{6Ed} \right)$$

19. (b)



$$\delta_{H_B} = \frac{Ml^2}{2EI}; \theta = \frac{Ml}{EI}$$

$$\delta_{H_C} = \delta_{H_B} = \frac{Ml^2}{2EI}$$

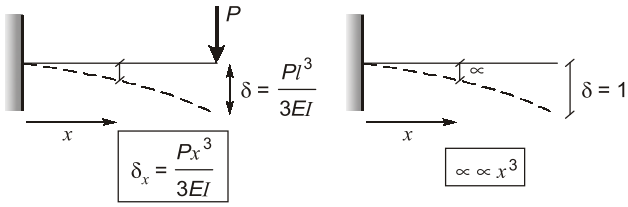
$$\delta_{V_C} = \theta \times l + \delta_3$$

$$= \frac{Ml}{EI} \times l + \frac{Ml^2}{2EI} = \frac{3}{2} \cdot \frac{Ml^2}{EI}$$

$$\theta_C = \theta + \alpha$$

$$= \frac{Ml}{EI} + \frac{Ml}{EI} = \frac{2Ml}{EI}$$

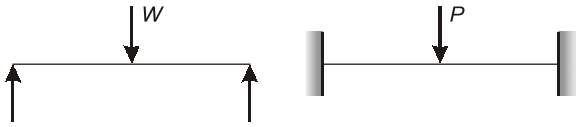
20. (c)



In a cantilever, the ILD for deflection at the free end is same as elastic curve of the beam due to unit load placed at the free end.

Deflection due to point load placed on cantilever is given as $\frac{Px^3}{3LI}$ is cubic parabola and hence ILD for deflection for a cantilever will also be cubic parabola.

21. (a)



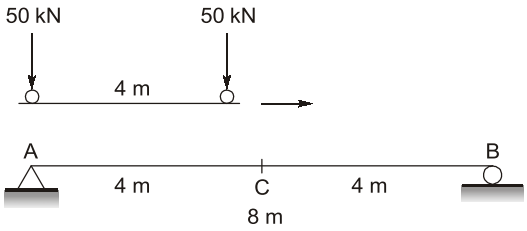
$$\delta_1 = \frac{Wl^3}{48EI}, \quad \delta_2 = \frac{Pl^3}{192EI}$$

For $\delta_1 = \delta_2$

$$\Rightarrow \quad \frac{Wl^3}{48EI} = \frac{Pl^3}{192EI}$$

$$P = 4\,W$$

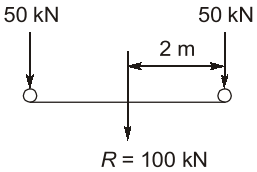
22. (b)



To find absolute maximum bending moment:

- Generally absolute maximum bending moment will occur below heavier load particularly if it is closer to mid span.

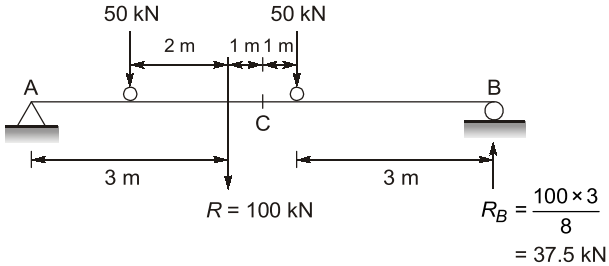
Case 1: Maximum bending moment under leading 50 kN load:



$$R = 100\text{ kN}$$

$$\bar{x} = \frac{50\times 0 + 50\times 4}{100} = 2\text{ m}$$

We know that, for maximum bending moment below a point load, the point load should be so placed that the point load and resultant load are equidistant from mid span.

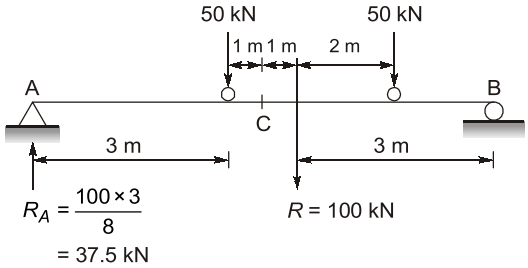


$\therefore$ Bending moment under leading 50 kN load

$= R_B \times 3$

$= 37.5 \times 3 = 112.5$ kNm

Case 2: Maximum bending moment under trailing 50 kN load:



$\therefore$ Bending moment under trailing 50 kN load

$= R_A \times 3$

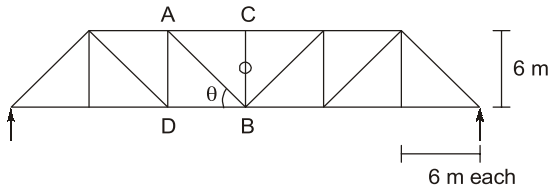
$= 37.5 \times 3 = 112.5$ kNm

$\therefore$ Absolute maximum bending moment

= Maximum of the above 2-criteria

= 112.5 kNm at 3 m from either support

23. (b)



Member BC is a zero force member since it is the non collinear member is 3 members joining @ C

Now use $\Sigma F_x = 0$ @ joint B

$$\tan\theta = \frac{6}{6}$$

$$\Rightarrow \quad \theta = 45^\circ$$

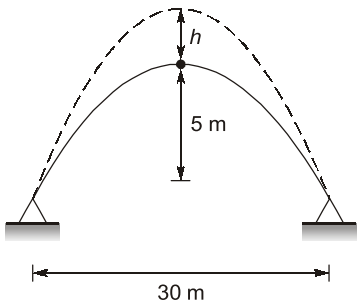
$$F_{AB}\cos\theta + F_{BD} = 0$$

[due to symmetry analyze only left portion]

$$F_{AB} = (-\sqrt{2}F_{BD})$$

i.e. $\sqrt{2}$ times force in 3rd panel.

24. (c)



$\propto$ = 12×10^{-6}/°C

h = central rise = 5 m

ΔT = 300°C

dh = Rise due to temperature change

$$= \left(\frac{l^2 + 4h^2}{4h}\right) \propto T$$

$$= \left[\frac{900 + 4 \times (25)}{4 \times 5}\right] \times 12 \times 10^{-6} \times 300$$

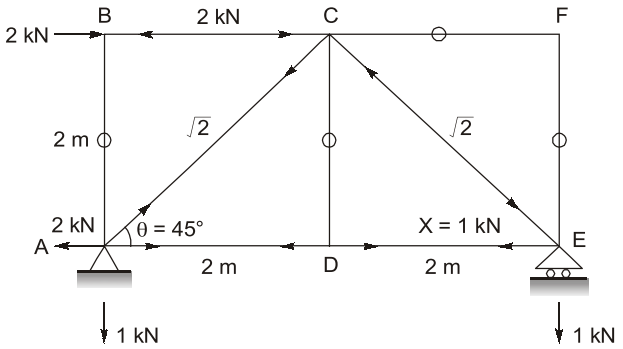
= 0.18 m = 180 mm

25. (c)

Due to temperature change horizontal reaction develops at the support which will induce moment in the arch.

Maximum moment will develop at the crown since it is farthest from the reaction.

26. (c)



Members AB, CD, CF and EF are zero member forces

H_A = 2 kN

We have to balance a moment of

2×2 kNm = 4 kNm

$V_A = -V_E \rightarrow$ No vertical force

$-V_A \times 4 = 4$ $\quad -V_A = 1$

$-V_E = (-1)$ $\quad V_A = (-1)$

$V_E = 1$

$$F_{AC} = \frac{1}{\cos\theta} = \sqrt{2}\ (T)$$

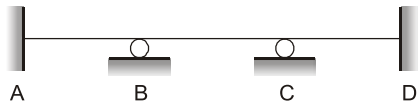
$$F_{AD} = \begin{bmatrix} F_{AC}\cos\theta \\ -2K \end{bmatrix} = -1\ \text{kN (C)}$$

= 1 kN (T)

At joint D

$F_{AD} = F_{DE}$ = 1 kN (T)

27. (a)



No of unknowns = 2 (θ_B and θ_C)

D_K = Size of stiffness matrix

28. (b)

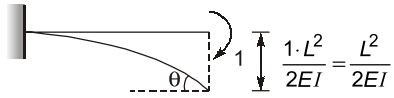
In displacement method, displacements are taken as unknowns. Among the options only moment distribution method is a displacement method.

29. (a)

Development of flexibility matrix:

f_{ij} = deflection in coordinate direction (i) due to unit load applied at (j)

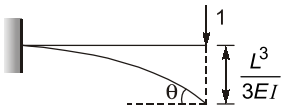
Ist column:



$$\theta = \frac{ML}{EI} = \frac{L}{EI}$$

$$f_{11} = \frac{L}{EI},\ f_{21} = \frac{L^2}{2EI}$$

IInd column:



$$\theta = \frac{L^2}{2EI}$$

$$f_{12} = \frac{L^2}{2EI},\ f_{22} = \frac{L^3}{3EI}$$

$\therefore$ Flexibility matrix = $\begin{bmatrix} \frac{L}{EI} & \frac{L^2}{2EI} \\ \frac{L^2}{2EI} & \frac{L^3}{3EI} \end{bmatrix}$

30. (d)

Duty is given as

$$D = \frac{8.64B}{\Delta}$$

$$D = \frac{8.64 \times 90}{(0.9)} = 864 \text{ ha/cumec}$$

$$\Delta = 105 - 15 = 90 \text{ cm} = 0.9 \text{ m}$$

*No use of area given.

31. (b)

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

$$\theta = \frac{ML}{4EI}$$

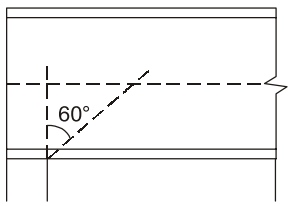
$$\frac{M}{\theta} = K = \frac{4EI}{L}$$

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

$$\theta = \frac{ML}{3EI}$$

$$\frac{M}{\theta} = \frac{3EI}{L}$$

32. (b)



33. (a)

Sway calculation and non-sway calculations are carried out in a single operation in Kani's method.

34. (a)

Eddy's theorem for 3-hinged arch states that - The bending moment at any section an arch is proportional to the vertical interrupt between the linear arch (or theoretical arch) and the centre line of actual arch.

35. (c)

Live loads on roof as per IS-875 are given as:

(i) Access provided only for maintenance - 750 N/m^2.

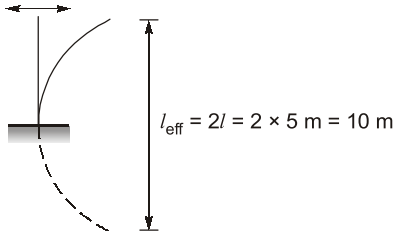
(ii) General access provided with roof angle <10° - 1500 N/m^2.

36. (c)

Load carried by lacing = 2.5% of structure load

$$= \frac{2.5}{100} \times 125 = 3.125 \text{ kN}$$

37. (d)



39. (b)

According to clause 3.8 of IS 800 : 2007, maximum effective slenderness ratio for a member carrying compressive load resulting from dead and imposed leads is 180.

39. (b)

The minimum thickness of web plate from corrosion point of view should be 6 mm.

40. (a)

For same I_{eff}, a box section is preferred since it will give maximum moment of inertia.

42. (d)

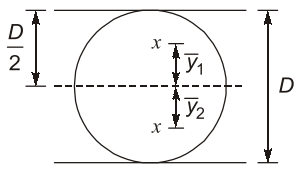
Column are not part of truss.

Beam is a flexural member.

Stanchion is a bar or post forming a support.

Strut are part of truss that carry compressive loads.

43. (d)



$$\bar{y}_1 = \bar{y}_2 = \frac{4\times\frac{D}{2}}{3\pi} = \frac{2D}{3\pi}$$

$$Z_p = \frac{A}{2}\cdot[\bar{y}_1\cdot\bar{y}_2] = \frac{\frac{\pi}{4}D^2}{2}\cdot\left(\frac{2D}{3\pi}+\frac{2D}{3\pi}\right)$$

$$= \frac{D^2}{8}\times\frac{4D}{3} = \frac{D^3}{6}$$

$$Z_e = \frac{\frac{\pi D^4}{64}}{\frac{D}{2}} = \frac{\pi D^3}{32}$$

$$\therefore \text{ Shape factor } (S) = \frac{Z_P}{Z_e} = \frac{\frac{D^3}{6}}{\frac{\pi D^3}{32}} = \frac{32}{6\pi}$$

$$S = \frac{16}{3\pi}$$

44. (b)

Minimum pitch = 2.5 d_0

It is to ensure that failure do not take place by unbuttoning of joints.

45. (a)

Loss of stress with time at constant strain in steel is called relaxation loss.

Creep is the deformation due to sustained loadings.

46. (d)

As per IS : 456 clause 34.2

The critical section of maximum bending moment for the purpose of designing an isolated concrete footing which supports a column, pedestal or wall shall be:

(i) At the face of the column, pedestal or wall for footing supporting a concrete column. Pedestal or reinforced concrete wall.

(ii) Halfway between the centre line and the edge of the wall, for footing under masonary.

47. (a)

Minimum R/F in column - 0.8% - to ensure ductility.

Maximum R/F in column - 6% - for proper compaction of concrete.

48. (a)

The deflection in PSC beam as compared to RCC beam will be less because a moment due to prestressed cable produces deflection in direction opposite to that of live loads.

49. (a)

Impact factor decreases as bridge span increases. Impact factor is just a function of span length or the first vibration frequency of the bridge.

50. (c)

Neutral axis is the axis where the strain in the section is zero. It passes through centroid of the transformed section.

51. (c)

According to IS code provisions, minimum size of R/F bar in RCC column is taken as 12 mm.

52. (c)

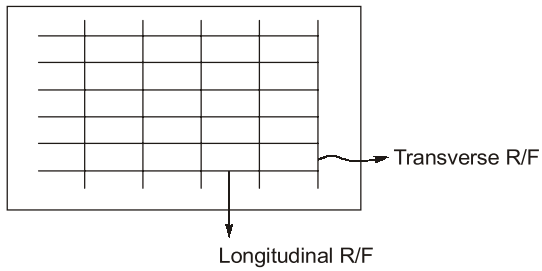
Lateral ties provided in RCC columns binds the longitudinal R/F in the column and ensure lateral stability against buckling.

53. (a)

In under reinforced section, the quantity of steel provided is less than that required at balanced condition, hence stress in steel reaches first causing a ductile failure.

54. (d)

In a slab, transverse R/F are provided at right angle to the span of the slab. The transverse R//F is provided to take care of temperature stresses.



55. (b)

For column if $\frac{L_{eff}}{LLD} < 15$ it is termed as a short column.

56. (d)

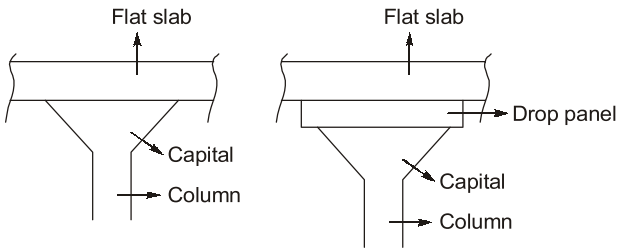
Concrete section is strong in compression and weak in tension, hence compressive stresses are induced to counter the tensile stresses generated in concrete.

57. (d)

The losses in PSC members are very high of the order of 200-300 MPa in steel and 20-30 MPa in concrete. Hence, high strength concrete and steel members have to be used so as to counter these losses.

58. (c)

Drops are provided to resist shear.



59. (a)

Total amount of shrinkage strain for a pretensioned member is of the order of 3×10^{-4}.

60. (c)

The important located on the activities in a bar chart are known as milestones.

61. (d)

PERT stands for Programme evaluation and review technique.

62. (c)

Fulkerson's rule is used in numbering the events of a networks chart.

63. (b)

t_e is given as

$$t_e = \frac{t_o + 4t_l + t_p}{6}$$

$$= \frac{8 + 4 \times 12 + 18}{6} = 12.3$$

64. (a)

PERT is used for new projects such as research work or inventing a medicine for a disease. These projects have no previous record of time estimate and hence are non deterministic in nature. Hence PERT follows probabilistic approach.

65. (b)

Variance is given as

$$\sigma^2 = \left(\frac{t_p - t_o}{6}\right)^2$$

$$= \left(\frac{15 - 4}{6}\right)^2$$

$$= \frac{121}{36} = 3.36$$

66. (d)

Total float F_T = (Maximum time available – Actual time required)

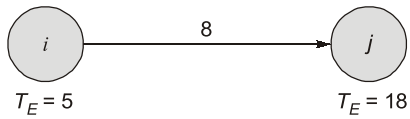
Free float - amount of time by which an activity can be delayed without affecting the succeeding activity.

$$F_F = F_T - S_j$$

Interfering float = S_j

Hence, $F_F = F_T - F_I$

67. (a)



$$F_F = T_E^j - T_E^i - t_{ij}$$

$$= 18 - 5 - 8$$

$$= 5 \text{ days}$$

69. (d)

$$\text{Slack} = T_L^j - T_E^j$$

Slack is the amount by which an activity can be delayed without affecting the total duration of the project.

70. (b)

The direct costs of project decrease with time whereas indirect costs increase with time.