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# UPPSC-AE

## CIVIL ENGINEERING (Paper-1)

**Part - B : Technical Questions  
and Detailed Solution**

**Exam Held on  
29 May 2022**

**Corporate office :**

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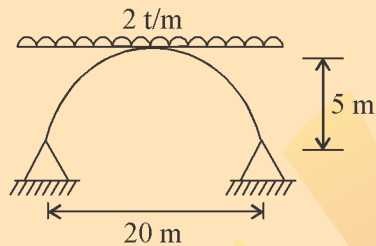
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26. A symmetrical parabolic arch of span 20 meters and rise 5 meters is hinged at the springings. It supports a uniformly distributed load of 2 tonnes per meter run of the span. The horizontal thrust in tonnes at each of the spring is

(a) 16 (b) 20  
(c) 8 (d) 0

• **Ans. (b)**



$$H = \frac{wl^2}{8h} = \frac{2 \times 20^2}{8 \times 5} = 20$$

27. CPM Network is updated

(a) At fixed times  
(b) At any times  
(c) At regular intervals  
(d) Whenever there is difference in the planned and actual performance

• **Ans. (d)**

28. Which is NOT the graphical method for locating principal axes ?

(a) Circle of inertia (b) Ellipse of inertia  
(c) Mohr - circle (d) Dyadic circle

• **Ans. (b)**

29. The bond strength of concrete increases with

(a) The tensile strength of steel  
(b) The grade concrete  
(c) The quantity of steel  
(d) The quantity of concrete

• **Ans. (b)**

Grade of concrete	M20	M25	M30	M35	M40 & above
$\tau_{bd}$	1.2	1.4	1.5	1.7	1.9

30. For placing of concrete under water, which principal technique (s) is NOT used ?

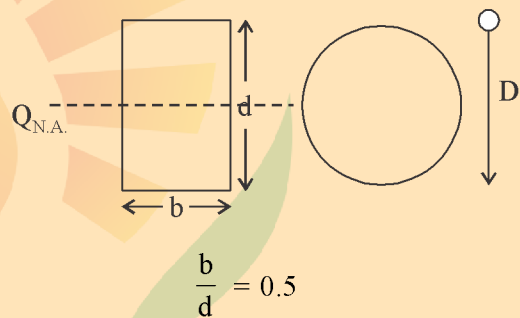
(a) Bucket method  
(b) Prepacked concrete method  
(c) Tremie method  
(d) Packer's method

• **Ans. (d)**

31. A rectangular section with  $b/d$  ratio of 0.5 and a circular section have same area of cross section  $10,000 \text{ mm}^2$ . The ratio of moment of resistance of rectangle to that of circle is

(a) 0.6 (b) 1.0  
(c) 1.67 (d) 0.5

• **Ans. (c)**



area same

$$bd = \frac{\pi}{4} D^2 \quad \dots\dots(1)$$

$$\therefore b = 0.5 d \quad \dots\dots(2)$$

$$0.5d^2 = \frac{\pi}{4} D^2$$

$$\frac{d}{D} = \sqrt{\frac{\pi}{2}} = 1.253$$

Section modulus of rectangular ( $Z_R$ )

$$(Z_R) = \frac{bd^3}{12 \times \frac{d}{2}} = \frac{bd^2}{6}$$

$$Z_R = \frac{0.5d \times d^2}{6} = \frac{d^3}{12}$$

Section modulus of circle

$$(Z_L) = \frac{\pi D^4}{64 D/2}$$

$$= \frac{\pi D^3}{32}$$

$$\frac{Z_R}{Z_C} = \frac{d^3}{12 \times \frac{\pi D^3}{32}}$$

$$= \frac{32}{12\pi} \left( \frac{d}{D} \right)^3 = \frac{32}{12\pi} (1.253)^3$$

$$\frac{Z_R}{Z_C} = 1.67$$

32. In PERT analysis, the probability of completion of the project in 40 days will be (given : earliest expected time,  $T_E$  of last event is 40 days)

(a) 50 % (b) Less than 100  
(c) 100 % (d) 0 %

• **Ans. (a)**

33. The effective length of compression flange of a simply supported beam not restrained against torsion at ends is K times the span where K is

(a) 0.85 (b) 1.00  
(c) 0.70 (d) 1.20

• **Ans. (d)**

34. A high strength concrete generally requires a

(a) Water reducing agent  
(b) Sand reducing agent  
(c) Water increasing agent  
(d) Sand increasing agent

• **Ans. (a)**

35. Deflection in truss depends Flexural rigidity

(a) Flexural rigidity  
(b) Axial and Flexural rigidity  
(c) Axial rigidity  
(d) None of the above

• **Ans. (c)**

Deflection of truss calculated using virtual work principle as

$$\Delta = \sum K \frac{P}{\left( \frac{AE}{L} \right)} = \sum K \frac{P}{\text{Axial rigidity}}$$

36. If  $M_t$  is torsional moment,  $T_u$  is the bending moment and  $M_U$  is factored bending moment at the cross section. Flexural compression reinforcement is provided in structural member, when

(a)  $M_t = M_U$  (b)  $M_t > M_U$   
(c)  $M_t > M_U$  (d) None of these

• **Ans. (c)**

( $M_t > M_U$ )

$$M_t = \frac{T_u(1 + D/b)}{1.7} \quad (0)$$

37. If ' $I_b$ ' is moment of inertia of the rolled beam section, ' $A_p$ ' is the area of cover plates in one flange and ' $h$ ' is the distance between the centroid of the top and bottom flange plates, moment of inertia of built up plate girder is given by

(a)  $I = I_b + 2A_p \left( \frac{h}{2} \right)^3$

(b)  $I = I_b + 2A_p \left( \frac{h}{2} \right)$

(c)  $I = I_b + 2A_p \left( \frac{h}{2} \right)^2$

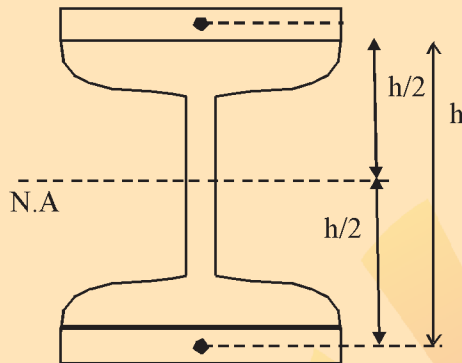
(d)  $I = I_b + A_p \left( \frac{h}{2} \right)^2$

• Ans. (c)

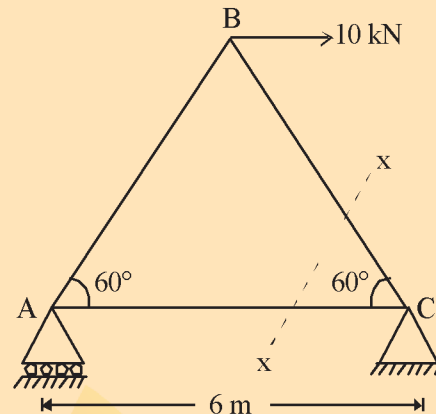
$$I = I_b + A_p(h/2)^2 + A_p(h/2)^2$$

$$I = I_b + 2A_p(h/2)^2$$

Parallel axis theorem



• Ans. (a)

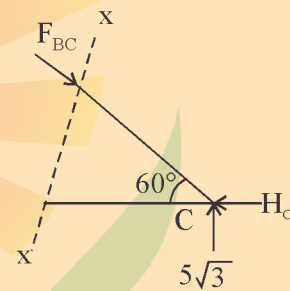


$$\Sigma M_A = 0$$

$$R_C \times 6 - 10 \times (\sqrt{6^2 - 3^2}) = 0$$

$$R_C = 5\sqrt{3}$$

$$\Sigma F_Y = 0 \text{ at } C$$



$$-F_{BC} \sin 60^\circ + 5\sqrt{3} = 0$$

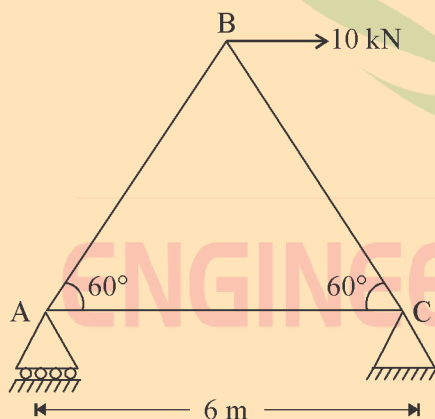
$$F_{BC} = 10 \text{ kN (compressive)}$$

38. Concrete can be pumped upto a distance without any loss of its property

- (a) 150 m                      (b) 250 m  
(c) 100 m                      (d) 350 m

• Ans. (a)

39. What is the force in the member BC of the 39 plane frame shown below ?



- (a) 10 kN compressive force  
(b) 5.796 kN compressive force  
(c) 10 kN tensile force  
(d) Zero

40. The main reinforcement of a RCC slab consists of 10 mm bar at 100 mm spacing. If it is desired to replace 10 mm bars by 12 mm bars, then spacing of 12 mm bars should be

- (a) 150 mm                      (b) 140 mm  
(c) 120 mm                      (d) 160 mm

• Ans. (b)

$$\phi_1 = 10 \text{ mm}$$

$$\phi_2 = 12 \text{ mm}$$

$$s_1 = 100 \text{ mm}$$

$$\frac{s_2}{s_1} = \left( \frac{d_2}{d_1} \right)^2$$

$$s_2 = \frac{(12)^2}{(10)^2} \times 100 = 144 \text{ mm}$$



1  
RANK



Suresh Choudhary  
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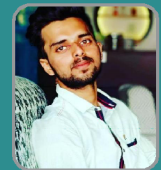
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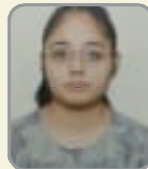
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41. A soil sample having a void ratio of 1.3, water content of 50 % and specific gravity of 2.60 is in a state of

(a) Saturated (b) Wet  
(c) Dry + sal (d) Moist

• **Ans. (a)**

$$e = 1.3$$

$$w = 50 \%$$

$$G = 2.6$$

$$Se = wG$$

$$S \times 1.3 = 0.5 \times 2.6$$

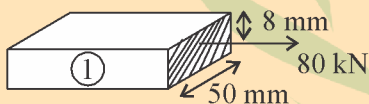
$$S = \frac{0.5 \times 2.6}{1.3}$$

$$S = 100 \%$$

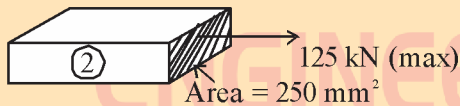
42. A tie bar 50 mm × 8 mm is to carry a load of 80 kN. A specimen of the same quality steel of cross sectional area is 250 mm<sup>2</sup>. For a maximum load of 125 kN carried by the specimen, the factor of safety in the design will be

(a) 2.5 (b) 2.0  
(c) 3.0 (d) 1.5

• **Ans. (b)**



$$\text{Working stress} = \frac{80}{50 \times 8} = \frac{80}{400} = 0.2 \text{ kN/mm}^2$$



Material (1) and (2) are same

$$\text{Strength} = \frac{125}{250} = 0.5 \text{ kN/mm}^2$$

$$\text{FOS} = \frac{\text{Strength}}{\text{stress}} = \frac{0.5}{0.2}$$

$$= 2.5$$

43. The maximum crushing values of aggregate to be used in concrete for road or runways should be

(a) 25 % (b) 30 %  
(c) 20 % (d) 45 %

• **Ans. (b)**

The Aggregate crushing value should not exceed 45% for aggregate used for concrete other than for wearing surfaces and 30% for concrete for wearing surfaces such as run ways roads for pavements.

44. To provide safety against piping failure with a factor of safety of 5, what should be the maximum permissible exit gradient for soil with specific gravity of 2.5 and porosity of 0.35 ?

(a) 0.167 (b) 0.195  
(c) 0.155 (d) 0.213

• **Ans. (b)**

$$i_c = \frac{G-1}{1+e}$$

$$e = \frac{n}{1-n}$$

$$= \frac{0.35}{0.65}$$

$$i_c = \frac{2.5-1}{1+\frac{0.35}{0.65}}$$

$$= 1.5 \times 0.65$$

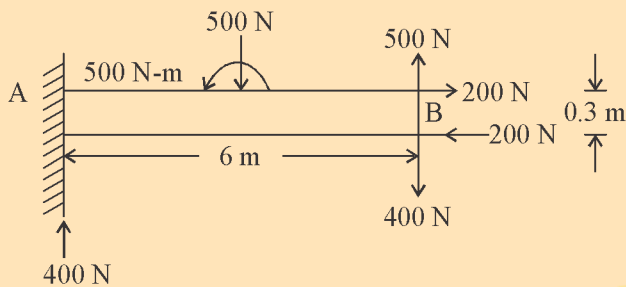
$$= 0.975$$

$$\text{FOS} = \frac{i_c}{i}$$

$$i = \frac{0.975}{5}$$

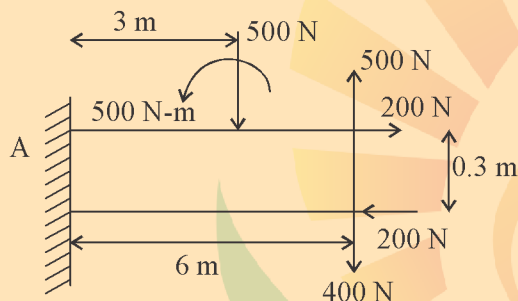
$$= 0.195$$

45. Determine the net couple moment acting on the following beam shown in figure



- (a) 960 N-m (b) 840 N-m  
(c) 3960 N-m (d) None of these

• **Ans. (d)**



Net moment

$$= 500 \times 3 - 500 - (500 \times 6) + 400 \times 6 + 200 \times 0.3$$

$$\text{Net moment} = 460 \text{ Nm}$$

46. For a singly reinforced balanced section  $M_{u,lim} = R_u b.d^2$  for  $M_{20}$  concrete and Fe 415 steel  $R_u$  is

- (a) 2.660 (b) 2.761  
(c) 1.995 (d) 2.978

• **Ans. (b)**

$$R_{u,lim} = 0.138 \times f_{ck} = 0.138 \times 20 = 2.76$$

(Fe-415)

$$\text{Fe-250 :- } R_u = 0.148 f_{ck}$$

$$\text{Fe-415 :- } R_u = 1.38 f_{ck}$$

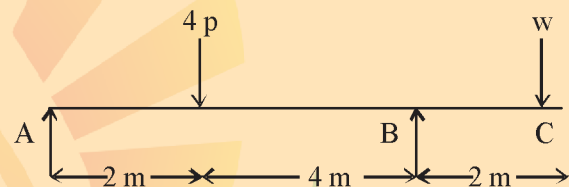
$$\text{Fe-500 :- } R_u = 0.133 f_{ck}$$

47. Blast furnace slag has approximately  
(a) 50 % alumina and 20 % calcium oxide  
(b) 25 % magnesia and 15 % silica  
(c) 45 % calcium oxide and 35 % silica  
(d) 25 % calcium sulphate and 15 % alumina

• **Ans. (c)**

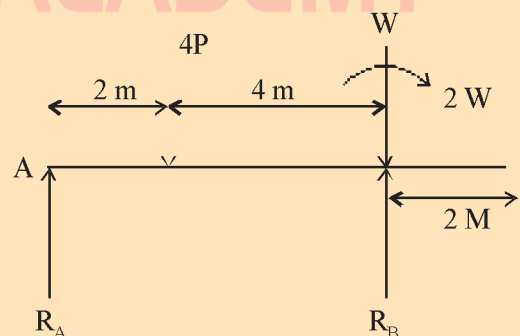
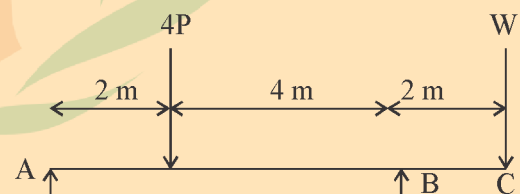
Blast furnace slag is used for water retaining structures.

48. A beam ABC is simply supported at A and B with an overhang BC as shown in figure below. It carries loads as shown in figure. If both the reactions are equal, then W will be equal to



- (a)  $\frac{5p}{8}$  (b)  $\frac{5p}{4}$   
(c)  $\frac{8p}{5}$  (d)  $\frac{4p}{5}$

• **Ans. (d)**



## Scheme of Examination : SSC-JE

Papers	Mode of Examination	Subject	Maximum Marks	Duration
Paper-I Objective Type	Computer Based Mode	General Intelligence & Reasoning	50	2 Hours
		General Awareness	50	
		General Engineering (CE, EE, ME)	100	
Paper-II Conventional Type	Written Examination	General Engineering (EE, ME, CE)	300	2 Hours

## Scheme of Examination : RRB-JE

### CBT-1

Name of the Sections	No. of Questions	Marks	Duration
Mathematics	30	30	90 min
General Intelligence & Reasoning	25	25	
General Awareness	15	15	
General Science	30	30	
<b>Total</b>	100	100	

### CBT-2

Name of the Sections	No. of Questions	Marks	Duration
General Awareness	15	15	120 min
Physics & Chemistry	15	15	
Basics of Computers & Applications	10	10	
Basics of Environment & Pollution Control	10	10	
Technical Abilities	100	100	
<b>Total</b>	150	150	

## SSC-JE • RRB-JE • STATE -JE & Junior ENGINEERS SYLLABUS

### Civil Engineering

- Strength of Materials
- Fluid Mechanics
- Reinforced Cement concrete
- Structural Analysis
- Soil & Foundations
- Environmental Engineering
- Water Resources Engineering
- Surveying
- Transportation Engineering
- Building Materials
- Design of Steel Structure
- Estimate, Quantity, Valuation

### Mechanical Engineering

- Strength of Materials
- Fluid Mechanics
- Hydraulic Machines
- Machine Design
- Thermodynamics
- Power Plant
- I C Engine
- Heat Mass Transfer
- Refrigeration & Air Conditioning
- Production Engineering
- Materials Sciences
- Engineering Mechanics
- Theory of Machine

### Electrical Engineering

- Basics Electrical Engg.
- Network Theory
- Power Systems
- Power Electronics
- Electrical Machine
- Control Systems
- Electronics Devices & Circuits
- Measurement
- Microprocessor
- Digital Electronics
- Signals & Systems
- Basics Engineering

### Electronics Engineering

- Basics Electrical Engg.
- Network Theory
- Electromagnetic Theory
- Power Electronics
- Communication Systems
- Control Systems
- Electronics Devices & Circuits
- Measurement
- Microprocessor
- Digital Electronics
- Signals & Systems
- Basics Engineering

### Non Technical Subjects / Syllabus

- General Intelligence & Reasoning
- Maths (Only Arithmetic)
- General Awareness (Geography, Polity, History, Economics)

- Basics of Computers & Applications
- General Science (Physics, Chemistry, Biology)

- Basics of Environment & Pollution Control
- Current Affairs

**Note :** Syllabus will be Covered as per Examination Notifications.

$$R_A = \frac{4P \times 4}{6} - \frac{2w}{6} = \frac{16P}{6} - \frac{2w}{6}$$

$$R_B = \frac{4P \times 2}{6} + w + \frac{+2w}{6} = \frac{8P}{6} + \frac{8w}{6}$$

$$\therefore R_A = R_B$$

$$\frac{16P}{6} - \frac{2w}{6} = \frac{8P}{6} + \frac{8w}{6}$$

$$16P - 2w = 8P + 8w$$

$$16P - 2w = 8P + 8w$$

$$8P = 10w$$

$$w = \frac{8P}{10} = \frac{4}{5}P$$

49. Critical activities have

- (a) Minimum float (b) Negative float  
(c) Maximum float (d) Zero float

• **Ans. (d)**

50. Stability of brick wall is NOT checked for

- (a) Against overturning  
(b) Against stress  
(c) Against sliding  
(d) None of these

• **Ans. (a)**

51. How many times the compactive energy is used in IS heavy compaction test in comparison to IS light compaction test ?

- (a) 3.56 (b) 2.56  
(c) 4.56 (d) 1.56

• **Ans. (c)**

$$\frac{E_{\text{heavy}}}{E_{\text{light}}} = \frac{n_1 \times m_1 g h_1 \times N_1}{n_2 \times N_2 \times m_2 g h_2}$$

$$\frac{E_{\text{heavy}}}{E_{\text{light}}} = \frac{4.9 \times 9.81 \times 450 \times 25 \times 5}{2.6 \times 9.81 \times 310 \times 25 \times 3}$$

$$= 4.5$$

52. The forces which meet at one point, but their line of action do not lie in a plane are called

- (a) Non - coplanar concurrent forces  
(b) Non - coplanar non - concurrent forces  
(c) Coplanar non - concurrent forces  
(d) Intersecting forces

• **Ans. (a)**

When two or more forces are acting at a single point then it is called concurrent forces if they all acting in same plane then it is called concurrent and coplanar

53. The basic action involved in sheep foot rolling is

- (a) Pressing  
(b) Tamping  
(c) Kneading  
(d) Vibration

• **Ans. (c)**

54. The actual neutral axis of under reinforced section is

- (a) on the critical neutral axis  
(b) above the critical neutral axis  
(c) below the critical neutral axis of a balanced section  
(d) none of the above A

• **Ans. (b)**

Above the NA.

55. Crown glass is an example of

- (a) Lead glass  
(b) Boro - silicate glass  
(c) Soda - lime glass  
(d) Sheet glass

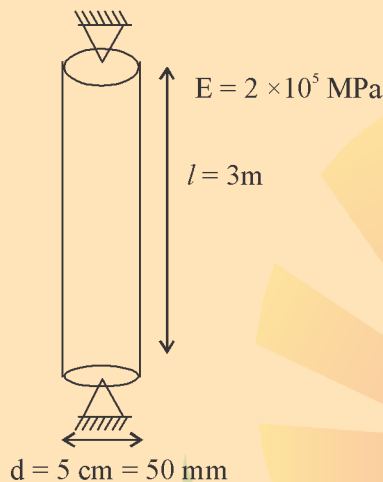
• **Ans. (c)**

This glass is very durable

56. A solid round bar 3 m long and 5 cm in diameter is used as a strut with both ends hinged. If  $E = 2 \times 10^5 \text{ N/mm}^2$  crippling load is

(a) 134.56 kN (b) 33.64 kN  
(c) 67.28 kN (d) 16.82 kN

• **Ans. (c)**



$$l_{\text{eff}} = l = 3\text{m}$$

$$P_{\text{cr}} = \frac{\pi^2 E I_{\text{min}}}{l_{\text{eff}}^2}$$

$$= \frac{\pi^2 \times 2 \times 10^5 \times \pi \times 50^4}{(3000)^2 \times 64}$$

$$P_{\text{cr}} = 67287.92 = 67.287 \text{ kN}$$

$$P_{\text{cr}} = 67.28 \text{ kN}$$

57. Piping in soil occurs, when
- (a) Sudden change in permeability  
(b) Effective pressure becomes zero  
(c) Soil is highly porous  
(d) Soil is highly stratified

• **Ans. (b)**

$$\bar{\sigma}_{\text{net}} = 0$$

$$\bar{\sigma} - p_s = 0$$

58. The slenderness ratio of component column in a lacing column is limited to

(a) 180 (b) 145  
(c) 250 (d) 50

• **Ans. (d)**

The slenderness ratio of component in a latticed column  $\leq 50$

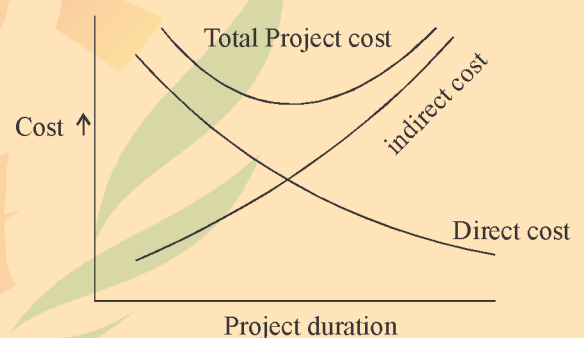
$$\leq 0.7 \lambda_{(\text{whole lattice column})}$$

59. Which of the following statements are correct ?

A. Direct cost increases with duration.  
B. Direct cost decreases with duration  
C. Indirect cost increases with duration  
D. Indirect cost decreases with duration

(a) B and C (b) B  
(c) A and B (d) C

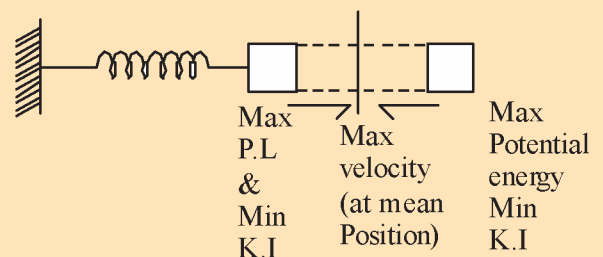
• **Ans. (a)**



60. If a particle is moving with simple harmonic motion, the velocity is position at the mean

(a) Maximum (b) Minimum  
(c) Zero (d) None of these

• **Ans. (a)**





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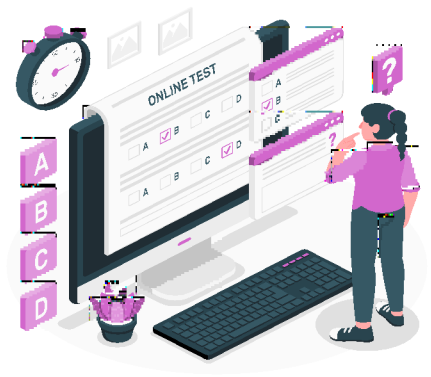
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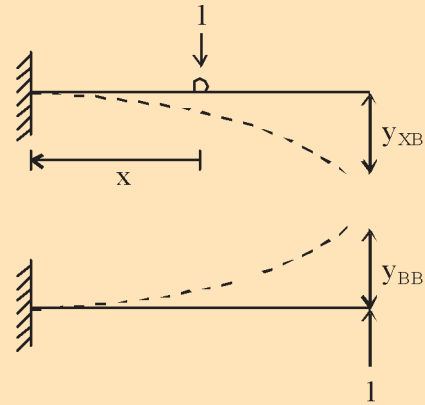
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61. Differential settlement for isolated foundation on plastic clay in case of RCC structure

- (a)  $0.0025 L$  (b)  $0.0035 L$   
(c)  $0.0015 L$  (d) None of the above

• **Ans. (c)**

	Total settlement	Differential Settlement (mm)	Angular Distortion (mm)
Isolated footing on clay	65	$0.0015L$	$1/666$
Isolated footing on sand	40	$0.0015L$	$1/666$
Raft on clay	65-100	$0.0021L$	$1/500$
Raft on sand	40-65	$0.0021L$	$1/500$



using compatibility at B

$$Y_{xB} - R_B y_{BB} = 0$$

$$R_B = \frac{Y_{xB}}{Y_{BB}}$$

$$Y_{BB} = \frac{1 \cdot L^3}{3EI} \text{ (Standard result)}$$

$$Y_{xB} = \frac{1 \cdot x^3}{3EI} + \frac{x^2}{2EI} (L - x)$$

$$= \frac{x^3}{3EI} + \frac{x^2 L}{2EI} - \frac{x^3}{2EI}$$

$$R_B = \frac{y_{xb}}{y_{bb}} = \left( \frac{x^3}{3} + \frac{x^2 L}{2} - \frac{x^3}{2} \right) \frac{3}{L^3}$$

For Area of ILD diagram -

$$\text{Area} = \int_0^L \left( \frac{x^3}{3} + \frac{x^2 L}{2} - \frac{x^3}{2} \right) \frac{3}{L^3} dx$$

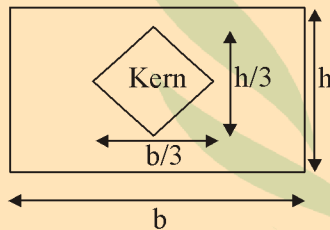
$$= \frac{3}{8} L$$

62. The Kernel of a short column of rectangular cross section is a

- (a) Square 1 (b) Rhombus  
(c) Rectangle (d) Parallelogram B

• **Ans. (b)**

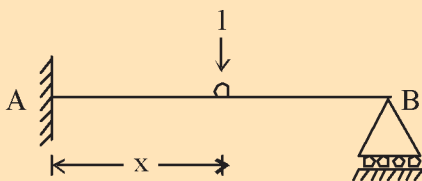
$$\frac{e_x}{b/6} + \frac{e_y}{h/6} \leq 1$$



63. What is the area (  $m^2$  ) of influence line diagram for the reaction at the hinged end of a uniform propped cantilever beam of span  $L$  m ?

- (a)  $\frac{L}{2}$  (b)  $\frac{L}{4}$   
(c)  $\frac{L}{8}$  (d)  $\frac{3L}{8}$

• **Ans. (d)**



64. Sinking effort in well foundation is the ratio of weight of well staining to that of skin friction developed on the sides and should preferably be

- (a) Equal to one (b) More than one  
(c) Less than one (d) More than two

• **Ans. (d)**



65. As per IS : 2911 ( Part III ) the bulbs in piles can not be installed in under water level.

(a) Sandy soils (b) Clay soils  
(c) Silty soils (d) Black cotton soils

• **Ans. (a)**

66. In CPM Network , an estimate that is required to complete a job in absolute minimum time is called

(a) Crash estimate  
(b) Minimum time estimate  
(c) Normal estimate  
(d) Threshold estimate

• **Ans. (a)**

67. In plastic design of structures if degree of static indeterminacy is 'j' , the members of hinges 'p' required to convert the structure into mechanism is given by

(a)  $P = j + 2$  (b)  $p = j + 1$   
(c)  $p = j + 3$  (d)  $p = j$

• **Ans. (b)**

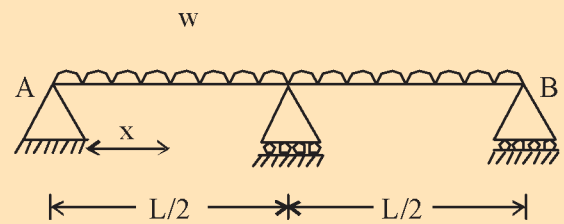
No. of plastic hinge required =  $D_s + 1$  For full collapse of structure

$D_s$  = static indeterminacy

68. A simply supported beam of span 'L' carrying a UDL of W per unit length . If the beam is propped at its centre then in bending moment diagram , the bending moment is zero at a distance of

(a)  $\frac{3l}{8}$  from both ends  
(b)  $\frac{3l}{4}$  from both ends  
(c)  $\frac{2l}{8}$  from both ends  
(d)  $\frac{3l}{2}$  from both ends

• **Ans. (a)**



By compatibility at c and principle of super position

$$\frac{5wl^4}{384EI} - \frac{R_C L^3}{48EI} = 0$$

$$R_C = \frac{5}{8}wl$$

$$M_x = R_A x - \frac{wx^2}{2}$$

$$R_A = \frac{\left( wl - \frac{5}{8}wl \right)}{2} \quad (\text{using symmetry})$$

$$R_A = \frac{3}{16}wl$$

For point of contraflexure  $M_x = 0$

$$\frac{3}{16}wl \cdot x - \frac{wx^2}{2} = 0$$

$$x = \frac{3}{8}l$$

69. A load 'p' is applied to a wire of diameter 'd' . If the radius of a wire is doubled and reduced the load to half , then its Young's modulus will be

(a) Halved  
(b) Remain unaffected  
(c) Doubled OF OCE id  
(d) Become one fourth 025 0

• **Ans. (b)**

Modulus of leastricity material property so it does not change by shape of x-sec & applied load.

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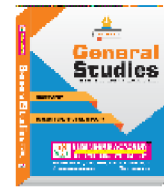
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70. Factor of safety against stability of the footing when dead load, live load and earth pressure are considered for shallow foundation

- (a)  $> 1.75$  against sliding
- (b)  $< 2.0$  against overturning
- (c)  $< 1.75$  against sliding
- (d) None of the above

• **Ans. (a)**

FOS  $> 1.5$  (against over turning)

FOS  $> 1.75$

71. The utilization of concrete in tension zone of prestressed concrete member saves concrete ranging between

- (a) 20 to 50 %
- (b) 35 to 60 %
- (c) 15 to 30 %
- (d) 10 to 20%

• **Ans. (c)**

Saves concrete = 15-30%

Saves Steel = 60-80 %

72. The plasticity characteristic of clay are due to

- (a) Free water
- (b) Capillary rise
- (c) Adsorbed water
- (d) None of the above

• **Ans. (c)**

73. If an element of a specimen of brittle material is subjected to shear stress, the crack propagation if occurs, will be inclined to the sides of the element at

- (a)  $90^\circ$
- (b)  $30^\circ$
- (c)  $45^\circ$
- (d)  $60^\circ$

• **Ans. (c)**

Brittle material fail due to normal stress (tension) so in pure shear tension comes at  $45^\circ$ .

74. According to IS : 399-1963, weight of timber is specified at

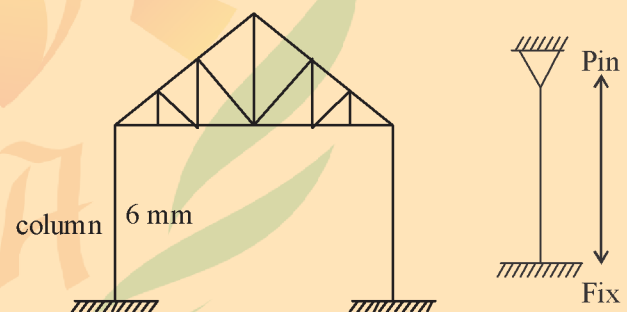
- (a) 10 % moisture content
- (b) 12 % moisture content
- (c) 8 % moisture content
- (d) 14 % moisture content

• **Ans. (b)**

75. A column bearing truss in an open industrial shed is of 6 m height between its own base and bottom of the truss, what is the effective height of the column taken for calculation of compressive strength ?

- (a) 6.0 m
- (b) 7.2 m
- (c) 4.8 m
- (d) 9.0 m

• **Ans. (c)**



$$l_{\text{eff}} = \frac{l}{\sqrt{2}} = 0.71 = 0.8l \text{ as per code}$$

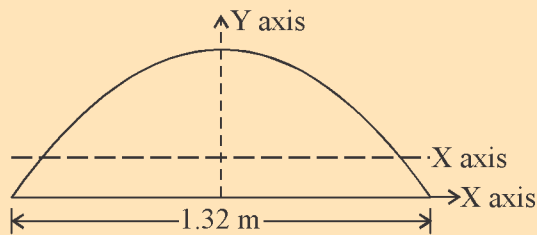
$$l_{\text{eff}} = 0.8 \times 6 = 4.8 \text{ m}$$

76. Aerated concrete is provided by addition of

- (a) Aluminium powder
- (b) Sodium silicate
- (c) Copper sulphate
- (d) Zinc sulphate

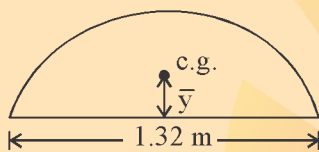
• **Ans. (a)**

77. The Y axis of centre of gravity of semicircular plate 1.32 m diameter from its base as shown in figure



- (a) 0.14 m (b) 0.28 m  
(c) 0.21 m (d) None of these

• **Ans. (b)**



$$\bar{y} = \frac{4r}{3\pi} = \frac{2D}{3\pi}$$

$$\bar{y} = \frac{2 \times 1.32}{3\pi} = 0.28 \text{ m}$$

78. In case of stratified soil layers the best equation that can be adopted for computing the pressure distribution is

- (a) Skempton's (b) Westergaard's  
(c) Prandtl's (d) Boussinesq's

• **Ans. (b)**

Westergaard's assume non-Isotropic soil.

79. Effective length for batten column shall be increased by

- (a) 10 % (b) 15 %  
(c) 5 % (d) 20 %

• **Ans. (a)**

Effective length of batten column increase to 10% while in latticed column effective length increase by 5%.

80. Which of the following is NOT network technique of project management ?

- (a) CPM (b) UNETICS  
(c) PERT (d) BAR CHART

• **Ans. (d)**

81. The most efficient section to resist bending stress is

- (a) I - section  
(b) T - section  
(c) Rectangular section  
(d) Circular section

• **Ans. (a)**

I-sec is the best for moment resisting because, the moment of inertia of I-sec is max,

82. For a saturated clay soil Skempton's pore pressure parameter 'B' is

- (a) 0.5 (b) 1.0  
(c) 0.1 (d) 2.0

• **Ans. (b)**

For saturation

$$B = 1$$

For dry

$$B = 0$$

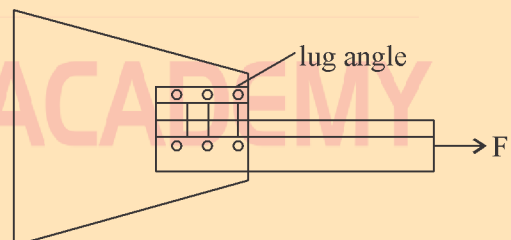
For partially saturated

$$0 < B < 1$$

83. Lug angles are

- (a) Angles to reduce the length of connection  
(b) Angles with bulb on one leg  
(c) Provided to take heavy moment  
(d) Angles subjected to reversal of stress

• **Ans. (a)**



Lug angle reduce the length of connection because it provide the support to the outstanding letg of main angle. So the shear leg effect will reduces and force sharing cabacity of out standing leg of main angle increase, so length of connection will reduce



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84. The moment resisting capacity of the cross section of a beam is termed as of the beam .

- (a) Modulus (b) Inertia  
(c) Stiffness (d) Strength

• **Ans. (d)**

85. The maximum permissible eccentricity of a retaining wall of width ' B ' to avoid failure in tension is

- (a)  $B / 3$  (b)  $B / 6$   
(c)  $B / 2$  (d)  $B / 12$

• **Ans. (b)**

$$e = B/6$$

86. The ratio of distance moved by effort to distance moved by load is called

- (a) Velocity ratio  
(b) Effect ratio  
(c) Mechanical advantage  
(d) Resistance of machine

• **Ans. (a)**

$$\text{Velocity ratio} = \frac{\text{distance moved by effort}}{\text{distance moved by load}}$$

87. Self compacting concrete is characterised by

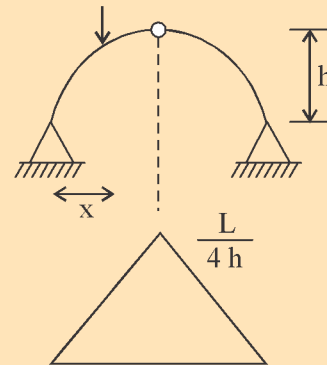
- (a) High water - powder ratio  
(b) Cementitious materials upto 30 %  
(c) High powder component  
(d) Rough surface finish

• **Ans. (c)**

88. The shape of the influence line diagram for horizontal thrust in a symmetrical three hinged parabolic arch is

- (a) Trapezoidal (b) Triangular  
(c) Parabolic (d) Rectangular

• **Ans. (c)**



89. Unit weight of common burnt clay bricks in  $\text{kN} / \text{m}^3$  ranges between

- (a) 18.85 - 23.50 (b) 6.85 - 14.30  
(c) 15.70 - 18.85 (d) 9.9 - 12.35

• **Ans. (c)**

90. Economic saving of time results by crashing

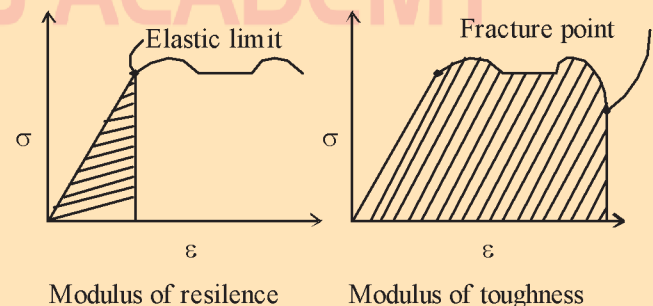
- (a) Cheapest noncritical activity  
(b) Costliest critical activity  
(c) Cheapest critical activity  
(d) Costliest noncritical activity

• **Ans. (c)**

91. The area under stress - strain curve represent

- (a) Toughness of material  
(b) Hardness of material  
(c) Breaking strength of material  
(d) Energy required to cause failure

• **Ans. (a)**





92. A load of  $16 \text{ kN/m}^2$  is uniformly distributed over a circular area of  $6 \text{ m}$  diameter at the ground surface. The vertical stress at a point P, which is at a depth of  $5 \text{ m}$  directly below the centre of the loaded area will be

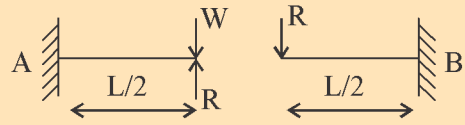
- (a)  $7.35 \text{ kN/m}^2$  (b)  $6.45 \text{ kN/m}^2$   
(c)  $5.35 \text{ kN/m}^2$  (d)  $3.45 \text{ kN/m}^2$

• **Ans. (\*)**

$$\sigma_z = q \left[ 1 - \left( \frac{1}{\left( 1 + \frac{R}{Z} \right)^2} \right)^{3/2} \right]$$

$$= 16 \left[ 1 - \left( \frac{1}{\left( 1 + 3/5 \right)^2} \right)^{3/2} \right]$$

Free body diagram



By compatibility at c

$$\frac{(W - R) \left( \frac{L}{2} \right)^3}{3EI} = \frac{R \left( \frac{L}{2} \right)^3}{3EI}$$

$$R = \frac{W}{2}$$

$$M_A = \left( W - \frac{W}{2} \right) \times \frac{L}{2} = \frac{WL}{4}$$

93. A compacting factor of  $0.88$  for a fresh concrete sample indicates a mix of

- (a) medium workability  
(b) low workability  
(c) high workability  
(d) very low workability

• **Ans. (a)**

$0.85 - 0.92$  (Medium)  
 $> 0.92$  (High)

95. Multi under reamed piles are generally provided in

- (a) Sandy soil  
(b) Expansive clayey soil  
(c) Silty soil  
(d) Gravelly sandy soil

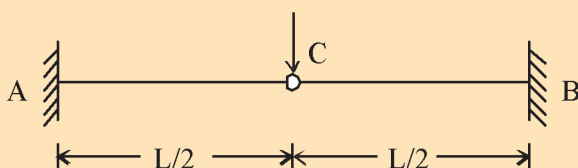
• **Ans. (b)**

Expansive clayey soil  
(Black cotton soil)

94. The fixed beam AB of span 'L' has a hinge C at mid span, a concentrated load W is applied at C, what is the fixed end moment  $M_A$ ?  $WL$

- (a)  $\frac{WL}{2}$  (b)  $\frac{WL}{4}$   
(c)  $WL$  (d)  $\frac{WL}{8}$

• **Ans. (b)**



96. Which theorem/principle may be started as the net external forces acting on the system and the resultant reversed effective forces (internal forces) are in equilibrium?

- (a) Lami's theorem  
(b) D'Alembert's principle  
(c) Varignon's theorem  
(d) None of the above

• **Ans. (b)**

D'Alembert's theorem

$\Sigma F_x = 0, \Sigma F_y = 0$  (static equilibrium)

$\Sigma t_x = 0, \Sigma f_y = 0, \Sigma m_2 = 0$  (dynamic equilibrium)

97. Baluster in staircase is the \_\_\_\_\_ member supporting \_\_\_\_\_.

- (a) Vertical, landing
- (b) Horizontal, landing
- (c) Horizontal, hand rail
- (d) Vertical, hand rail

• **Ans. (d)**

98. Internal radius of the bend of hooks of deformed bar should be for mild steel

- (a) 3 times the diameter of bar
- (b) 4 times the diameter of bar
- (c) 2 times the diameter of bar
- (d) 6 times the diameter of bar

• **Ans. (b)**

$R = k\phi$ ,  $\phi$  = diameter of bar

$k = 2$  in case of mild steel

$k = 4$  in case of cold worked steel

99. As per : 10262-2019 ; the water to powder ratio is expected to be between \_\_\_\_\_ for designing of self compacting concrete mix.

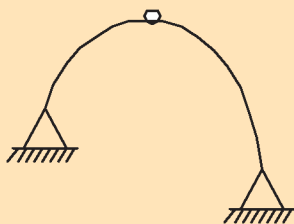
- (a) 0.60 – 1.00
- (b) 0.80 – 1.00
- (c) 0.55 – 0.95
- (d) 0.85 – 1.10

• **Ans. (d)**

100. A three hinges arch supported at different levels is

- (a) Statically indeterminate by 2 degree
- (b) Statically determinate
- (c) Statically indeterminate by 1 degree
- (d) Geometrically unstable

• **Ans. (b)**



Degree of indeterminacy

= No. of unknowns – (equation of equilibrium + extra equation due to release)

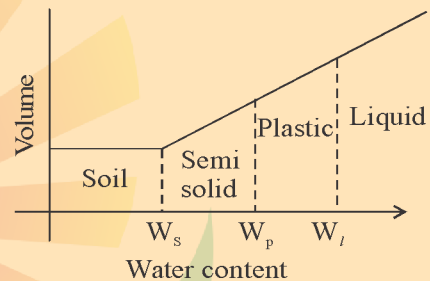
$$4 - (3 + 1) = 0$$

Statically determinate structure

101. When water content in soil is reduced beyond the shrinkage limit, the soil will be in a

- (a) Semi solid state
- (b) Plastic state
- (c) Solid state
- (d) Liquid state

• **Ans. (c)**



102. The commercially successful fibres in fibre reinforced concrete are of

- (a) Glass
- (b) Steel
- (c) Asbestos
- (d) Carbon

• **Ans. (c)**

103. The strain energy stored by an elastic member subjected to bending is given by

(a)  $\int M^2 dx / 2EI$       (b)  $\int M^2 dx / 3EI$

(c)  $\int M^2 dx / EI$       (d)  $\int M^2 dx / 4EI$

• **Ans. (a)**

$$\text{Strain energy due to bending} = \int \frac{m^2 dx}{2EI}$$



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104. Two circular footings of diameter  $D_1$  and  $D_2$  are resting on the surface of same purely cohesive soil. The ratio of their gross ultimate bearing capacities is

- (a) 1.0  
(b)  $\left(\frac{D_1}{D_2}\right)^2$   
(c)  $\frac{D_1}{D_2}$   
(d)  $\frac{D_2}{D_1}$

• **Ans. (a)**

$$q_u = CN_c + qN_q + 0.5 \gamma B N_\gamma$$

For pure clay

$$N_c = 5.7$$

$$N_q = 1$$

$$N_\gamma = 0$$

$$q_u = 5.7 C + \gamma B N_\gamma$$

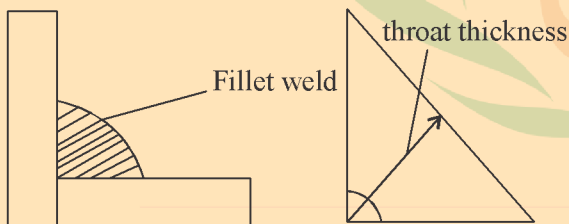
i.e. ultimate bearing capacity not affected by size

$$\frac{(q_u)_1}{(q_u)_2} = 1$$

105. In a fillet welded joint, the weakest area of the weld is

- (a) Root  
(b) Throat  
(c) Toe  
(d) Face

• **Ans. (b)**



Weakest and smallest of fillet weld is throat thickness

106. The angle of internal friction is least for

- (a) angular grained dense sand  
(b) Round grained loose sand  
(c) Angular grained loose sand  
(d) Clays

• **Ans. (d)**

For clay internal friction is least

107. In a particularly material, of the modulus of rigidity is equal to the bulk modulus, then poisson's ratio will be

- (a) 1/4  
(b) 1/2  
(c) 1/8  
(d) 2/3

• **Ans. (c)**

$$\mu = \frac{3k - 2G}{6k + 2G} ; k = G$$

$$\mu = \frac{3 - 2}{6 + 2} = \frac{1}{8}$$

108. Which of the following materials is more suitable to increase the mortar's compressive strength ?

- (a) Portland cement  
(b) Sand  
(c) Mortar Joint's profile  
(d) Lime

• **Ans. (a)**

109. Pick up the incorrect statement from the following

- (a) In the heel slab of retaining wall, reinforcement is provided at the bottom of the slab  
(b) In the toe slab of retaining wall, reinforcement is provided at the bottom of the slab  
(c) In the stem of retaining wall, reinforcement is provided near the earth side  
(d) None of the above

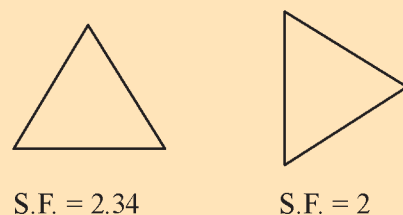
• **Ans. (a)**

• In the heel slab of retaining wall reinforcement is provided at the top of the slab

110. The shape factor of a triangular section is

- (a) 2.3  
(b) 2.0  
(c) 1.5  
(d) 1.07

• **Ans. (a)**



111. The area ratio of thin wall sampler should NOT normally exceed more than

- (a) 40 % (b) 60 %  
(c) 15 % (d) 80 %

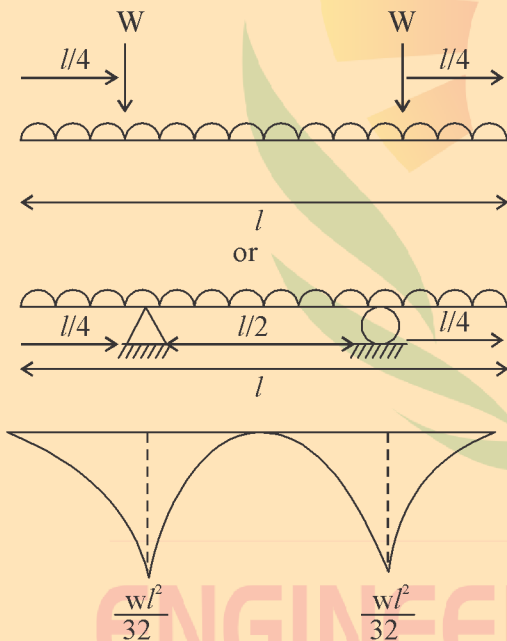
• **Ans. (c)**

$$\text{Area ratio } Ar = \frac{D_2^2 - D_1^2}{D_1^2} \times 100$$

112. Two people weighting 'W' each are sitting on a plank of length 'L' floating on water at L/4 from either end, neglecting the weight of plank the bending moment at centre of plank is

- (a)  $\frac{WL}{12}$  (b)  $\frac{WL}{8}$   
(c)  $\frac{WL}{16}$  (d) zero

• **Ans. (d)**



113. The probability distribution for time estimate of an activity which fits well for PERT analysis is

- (a) Normal distribution  
(b) Alpha distribution  
(c) Beta distribution  
(d) Noen of the above

• **Ans. (c)**

114. The diameter of the column head support of a flat slab is generally kept

- (a) 0.25 times the column diameter  
(b) 4 cm larger than column diameter  
(c) 0.25 times the span length  
(d) 5 cm larger than column diameter

• **Ans. (c)**

0.25 times the span length

115. Distribution of time for project as a whole will be

- (a) Normal distribution  
(b)  $\beta$ -distribution  
(c) Both a and b  
(d) None of the above

• **Ans. (a)**

116. Minimum tension steel in RCC beam needs to be provided to

- (a) Control surface cracks  
(b) Prevent sudden failure  
(c) Control excessive cracks  
(d) Control excessive deflection

• **Ans. (b)**

Tension steel will provide ductility to the structure hence will prevent sudden failure.

117. Ball A of mass 2 kg moving with a velocity of 2 m/s, strikes directly on a ball B of mass 4 kg at rest. The ball A, after striking comes to rest. Find the coefficient of restitution after the collision.

- (a) 0.33 (b) 0.67  
(c) 0.5 (d) 1.00

• **Ans. (c)**

$$\begin{array}{ccc} \textcircled{A} & \textcircled{B} & \xrightarrow{\text{After collision}} \textcircled{A} \quad \textcircled{B} \\ m_1 = 2 \text{ kg} & m_2 = 4 \text{ kg} & V_1 = 0 \quad V_2 = ? \\ \mu_1 = 2 \text{ m/sec} & \mu_2 = 0 & m_1 = \text{kg} \quad m_2 = 4 \text{ kg} \end{array}$$

$$\text{Coefficient of restitution} = \frac{V_a - V_1}{\mu_1 - \mu_2}$$

$$\therefore \begin{aligned} V_1 &= 0 \\ \mu_2 &= 0 \\ \mu_1 &= 2 \text{ m/sec} \end{aligned}$$

Conservation of momentum

$$\begin{aligned} m_1 \mu_1 + m_2 \mu_2 &= m_1 v_1 + m_2 v_2 \\ 2(2) + 4(0) &= 2(0) + 4 V_2 \\ 4 &= 4V_2 \\ V_2 &= 1 \text{ m/sec} \\ e &= \frac{V_2}{2} = \frac{1}{2} = 0.5 \\ e &= 0.5 \end{aligned}$$

118. In two methods A and B of a network analysis, the following methods are true about them,

Method A - Project cost increases if time duration is either increases or decreased.

Method B - Project cost varies directly with time.

Method A and Method B are called respectively.

- (a) CPM, PERT      (b) Both are CPM  
(c) PERT, CPM      (d) Both are PERT

• **Ans. (a)**

119. In the presence of sea water and soils and water of corrosive characters, the cover over structural members should be increased by

- (a) 20 mm      (b) 12 mm  
(c) 8 mm      (d) 15 mm

• **Ans. (a)**

Exposure conditions	Minimum nominal cover
Mild	20 mm
Moderate	30 mm
Severe	45 mm
Very severe	50 mm
Extreme	75 mm

120. The ratio of intensity of stress in case of a suddenly applied load to that in case of a gradually applied loads is

- (a) 1      (b) 2  
(c)  $\frac{1}{2}$       (d) 4

• **Ans. (b)**

$$\frac{1}{2} \frac{\sigma^2 AL}{E} = P \Delta L$$

$$\frac{1}{2} \sigma^2 \frac{AL}{E} = \frac{p \sigma L}{E}$$

$$\sigma = \frac{2P}{A}$$

$\therefore P/A = \text{gradual stress}$

Stress due to sudden load is 2 times the gradual stress

121. In fire proof paints, the main constituents is

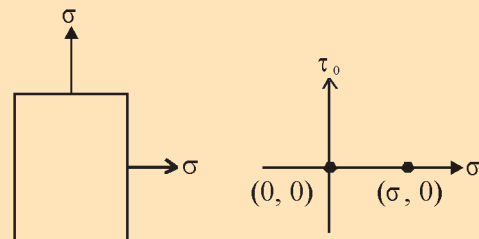
- (a) Red lead  
(b) Copper powder  
(c) Aluminium powder  
(d) Asbestors fibre

• **Ans. (d)**

122. The element is subjected to two equal and like stress ' $\sigma$ ' on two mutually perpendicular planes. The shape of the Mohr's circle will be

- (a) a circle of radius  $\sigma$   
(b) a circle of radius  $\sigma$   
(c) a circle of radius  $2\sigma$   
(d) it will be a point only

• **Ans. (d)**



123. Age factor for gain in strength of concrete with age after 6 months is

- (a) 1.10 (b) 1.15  
(c) 1.00 (d) 1.20

• **Ans. (d)**

124. Deep beams are designed for

- (a) Bending moment only  
(b) Both shear force and bending moment  
(c) Shear force only  
(d) None of the above

• **Ans. (a)**

- Design for Bending moment
- Checked for shear

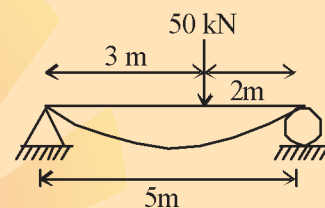
$l/D < 2$  (SSB)

$l/D < 2.5$  (Continuous beam)

125. A simply supported steel beam of s 5 m span carries a concentrated load of 50 kN at 3 m from left support. The beam is of circular cross section with 100 mm diameter. Deflection under point load is

- (a) 350 / EI  
(b) 90 / EI  
(c) 120 / EI  
(d) 210 / EI

• **Ans. (c)**



$$D = \frac{Pa^2b^2}{3EI}$$

$$a = 3\text{m} ; b = 2\text{m}$$

$$D = \frac{50 \times 3^2 \times 2^2}{3 \times 5 \times EI} = \frac{120}{EI}$$

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