ESE-2016

Detailed Exam Solutions
(Objective Paper-I)
Civil Engineering

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OFFICE
F-126, Katwaria Sarai, N.D-16. Ph : 011-41013406, 9711853908, 8130909220
Email : ies_master@yahoo.co.in,http://www.iesmaster.org

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Explanation of Civil Engg. Objective Paper-I (ESE - 2016)

SET - A

1. Consider the following statements :

1. There will be no defects in select grade timbers.
2. The codal values for strength of grade-II timer without defects may be reduced by 37.5%.
3. For timber used as columns, the permissible stress in ungraded timbers is adopted with a multiplying factor of 0.50.
4. In case of wind force and earthquakes, a modification factor of 1.33 is adopted.

Which of the above statements are correct ?

(a) 1 and 3 only (b) 1 and 4 only
(c) 2 and 4 only (d) 2 and 3 only

Ans. (c)

Sol. Some defects are permitted in all grades of timber and all other defects unlikely to affect any of the mechanical strength properties.

- As IS: 1331 –1971 provides for reduction in strength of Grade-II timber without defects not by more than 37.5%.
- Permissible stress in ungraded timbers is adopted with a multiplying factor of 0.80.
- Modification factor of 1.33 is adopted in case of wind and earthquake forces

2. Consider the following statements regarding timber :

1. The strength of timber increases by Kiln seasoning.
2. Cutting of wood is to be done prior to treatment.
3. Water seasoning is good for prevention of warping.
4. ASCU treatment enhances the strength of wood.

Which of the above statements are correct ?

(a) 1, 2 and 3 only (b) 2, 3 and 4 only
(c) 1, 3 and 4 only (d) 1, 2, 3 and 4

Ans. (a)

Sol. Seasoning of timber causes increases in strength, durability, workability and resilience.

Timber for treatment must be sound and dried to an appropriate moisture content. All wood working processes like cutting to size, boring, etc. shall be done prior to treatment.

Seasoning reduces shrinkage and warping

ASCU treatment is a method of preservation of timber, which results in durability of wood and not strength.

3. Gase(s) emitted during rotting or decomposition of timber is /are mainly

(a) Methane and Hydrogen
(b) Hydrogen Sulphide
(c) Carbonic acid and Hydrogen
(d) Ammonia

Ans. (c)

Sol. Rot in timber is decomposition or putrefaction generally caused by damp atmosphere which causes emission of gasses mainly carbonic acid & hydrogen.

4. Efflorescence of bricks is due to

(a) Excessive burning of bricks
(b) High silt content in brick clay

(c) High porosity of bricks

(d) Soluble salts present in parent clay

Ans. **(d)**

Sol. Efflorescence is caused because of alkalies present in clay. Salts such as sulphates of soidum and potassium, if present in clay are dissolved by the absorbed water. On drying grey or white powder patches appear on the brick surface, which is called as efforescence.

5. Disintegration of bricks masonry walls is primarily due to

1. Efflorescence
2. Magnesium sulphate in bricks
3. Calcined clay admixtures
4. Kankar nodules

Which of the a above statements are correct ?

(a) 1, 2 and 3 only (b) 1, 2 and 4 only

(c) 3 and 4 only (d) 1, 2, 3 and 4

Ans. **(d)**

6. Consider the following test :

1. Transverse strength test
2. Water absorption test
3. Impact test
4. Breaking strength test

Which of the above are relevant to testing of tiles ?

(a) 1, 2 and 3 only

(b) 1, 2 and 4 only

(c) 3 and 4 only

(d) 1, 2, 3 and 4

Ans. **(d)**

Sol. As per IS 13630 : 2006, all the four tests are performed.

7. Which of the following statements is/are correct regarding the strength of cement ?

1. Particle sizes less than 3μm increases the viscous nature of the cement.
2. Finer particles in cement can be replaced by fly-ash to improve the strength.

(a) 1 only (b) 2 only

(c) Both 1 and 2 (d) Neither 1 nor 2

Ans. **(c)**

Sol.
- As particle size decreases viscous nature of cement decreases.
- Fly ash reacts with available lime and alkali in concrete, producing additional cementitious compounds as calcium silicate hydrate (C–S–H) binder.

  This additional binder produced by fly ash reaction with available binder allows fly ash concrete to gain strength over time. This will ultimately exceed the strength of fly ash concrete than of cement concrete mixes.

8. The constituent compound in Portland cement which reacts immediately with water, and also sets earliest, is

(a) Tricalcium silicate

(b) Dicalcium silicate

(c) Tricalcium aluminate

(d) Tetracalcium aluminoferrite

Ans. **(a)**

Sol. Rate of hydration is

$C_3A > C_4AF > C_3S > C_2S$

C_4AF and C_3A are responsible for flash set. When water is added to the cement, the quickest to react with water is C_3A.

9. Which of the following statements are correct with regard to cement mortar ?

1. Workability of cement mortar can be improved by addition of lime.
2. Fly-ash cement is economical in plastering jobs.
3. Addition of saw dust improves workability.
4. Sand in mortar can be replaced by finely crushed fire bricks.

(a) 1, 2, 3 and 4
(b) 1, 2 and 3 only
(c) 3 and 4 only
(d) 1, 2 and 4 only

Ans. (d)

Sol. Addition of saw dust decreases the workability because of water absorption.

10. In a concrete mix of proportion 1 : 3 : 6, the actual quantity of sand, which is judged to have undergone 15% bulking, per unit volume of cement, will be

(a) 3.00 (b) 3.45
(c) 4.50 (d) 6.00

Ans.(b)

Sol. Mix proportion = 1 : 3 : 6

Let the volume of cement = 1 m^3
(unit volume of cement)

Volume of sand = 3 m^3

Volume of aggregate = 6 m^3

Actual volume of sand = $3\left(1+\frac{15}{100}\right)=3.45m^3$

11. The Rheological behavior of concrete, when represented by shear stress vs rate of shear, is characterized as

(a) $\tau=\tau_0+\mu.\dot{\gamma}$ (b) $\dot{\tau}_0=\tau+\mu.\dot{\gamma}$
(c) $\frac{\tau}{\tau_0}=\mu.\dot{\gamma}$ (d) $\tau=\mu.\dot{\gamma}$

where : τ = shear stress,
τ_0 = (initial) yield value,
μ = at-point plastic viscosity
$\dot{\gamma}$ =at-point rate of shear

Ans. (a)

Sol. Concrete is most often assumed to behave as a bingham fluid.

Hence, $\tau=\tau_0+\mu\dot{\gamma}$

12. Which method of curing of concrete is recommendable for rapid gain of strength of concrete ?

(a) Sprinkling water
(b) Membrane curing
(c) High-pressure steam curing
(d) Infrared radiation curing

Ans. (c)

Sol. High pressure steam curing is generally recommended for rapid gain of strength of concrete.

13. Which of the following is appropriate as simple field method for assesing consistency of concrete ?

(a) Compacting factor (b) Slump test
(c) Vee-Bee test (d) Kelly Ball test

Ans. (d)

Sol. Kelly ball test is field method for assessing consistency of concrete while compaction factor test, slump test and vee-Bee test is used to measure workability of concrete.

14. Which of the following are relatable to Autoclaved Aerated Concrete ?

1. Light weight
2. Strong

3 Inorganic
4. Nontoxic

(a) 1, 2 and 3 only (b) 1, 2 and 4 only
(c) 3 and 4 only (d) 1, 2, 3 and 4

Ans. (d)

Sol. Properties of autoclaved aerated concrete are as follows :

(i) Thermal efficiency

(ii) Superior fire resistance

(iii) Light weight

(iv) Great ventilation

(v) Non toxic

(vi) Strong

(vii) Inorganic

15. The workability of concrete becomes more reliable depending on

1. Aggregate-cement ratio
2. Time of transit
3. Grading of the aggregate

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

Ans. (d)

Sol. Workability of concrete depends upon all the three components.

16. The longitudinal strain of cylindrical bar of 25 mm diameter and 1.5 m length is found to be 3 times its lateral strain in a tensile test. What is the value of Bulk Modulus by assuming E = 1×10^5 N/mm^2 ?

(a) 2×10^5 N/mm^2 (b) 1.1×10^5 N/mm^2
(c) 1×10^5 N/mm^2 (d) 2.1×10^5 N/mm^2

Sol. (c)

Ans.

|longitudinal strain| = 3 × |lateral strain|

Possions ratio $\mu = \left|\dfrac{\text{lateral strain}}{\text{longitudinal strain}}\right|$

$$\mu = \frac{1}{3}$$

Bulk modulus $K = \dfrac{E}{3(1-2\mu)}$

$$K = \frac{E}{3\left(1-2\times\frac{1}{3}\right)}$$

$$K = E = 1 \times 10^5 \text{ N/mm}^2)$$

17. For an elastic material, Poisson's ratio is μ, Modulus of Elasticity is E, Modulus of Rigidity is C and Bulk Modulus is K. μ is expressible in terms of K and C as

(a) $\dfrac{6K-2C}{3K-2C}$ (b) $\dfrac{6K+2C}{3K-2C}$

(c) $\dfrac{6K-2C}{6K+2C}$ (d) $\dfrac{3K+2C}{6K+2C}$

Ans. (c)

Sol. Poisson ratio, $\mu = \dfrac{3K-2G}{6K+2G}$

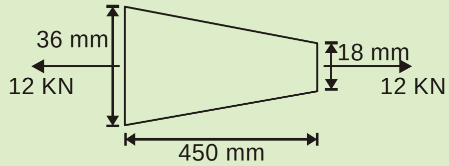
18. A mild steel bar of length 450 mm tapers uniformly. The diameters at the ends are 36 mm and 18 mm, respectively. An axial load of 12kN is applied on the bar. E = 2×10^5 N/mm^2. The elongation of the bar will be

(a) $\dfrac{1}{3\pi}$mm (b) $\dfrac{1}{6\pi}$mm

(c) $\dfrac{3\pi}{2}$mm (d) $\dfrac{2}{3\pi}$mm

Ans. (b)

Sol.



Elongation of bar $= \dfrac{4PL}{\pi d_1 d_2 E}$

$= \dfrac{4 \times 12 \times 10^3 \times 450}{\pi \times 36 \times 18 \times 2 \times 10^5}$

$= \dfrac{1}{6\pi}$ mm

19. Which of the following statements are correct for stresses acting on mutually perpendicular faces of a plane element ?

1. The sum of the normal stresses in mutually perpendicular planes is equal to the sum of the principal stresses.
2. The shearing stresses in two mutually perpendicular planes are equal in magnitude and direction.
3. Maximum shear stress is half of the difference between principal stresses.

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

Ans. (d)

Sol. Shearing stresses in two mutually perpendicular planes are equal in magnitude but not same in direction.

Statement-I and III are true.

20. Which of the following statements are correct?

1. Strain in the direction of applied stress is known as longitudinal strain.
2. Tensile stress results in tensile strain in linear and lateral directions.
3. Strains in all directions perpendicular to the applied stress are known as lateral strain.
4. Ratio of change in volume to original volume is known as volumetric strain.

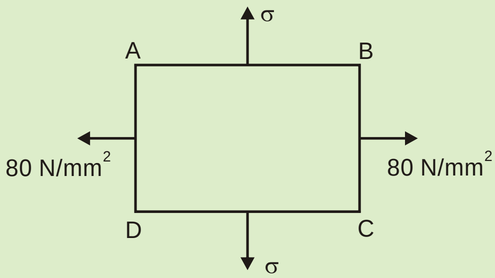
(a) 1, 2 and 3 only
(b) 1, 3 and 4 only
(c) 3 and 4 only
(d) 1, 2, 3 and 4

Ans. (b)

Sol. Tensile stress results in tensile strain in longitudinal and compressive strain in lateral directions.

Statement I, III and IV are true.

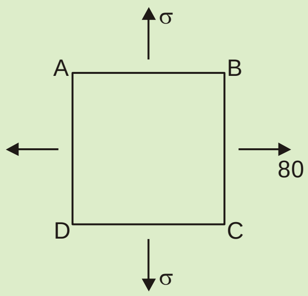
21. The state of stress on an element is as shown in the figure. If E = 2×10^5 N/mm^2 and Poisson's ratio = 0.3, the magnitude of the stress σ for no strain in BC is



(a) 84 N/mm^2 (b) 64 N/mm^2
(c) 34 N/mm^2 (d) 24 N/mm^2

Ans. (d)

Sol.



$$E = 2 \times 10^5 \text{ N/mm}^2$$

$$\mu = 0.3$$

for no strain in BC

$$\frac{\sigma_1}{E} - \frac{\mu\sigma_2}{E} = 0$$

$$\Rightarrow \quad \sigma_1 = 0.3 \times 80$$

$$\Rightarrow \quad \sigma_1 = 24 \text{ N/mm}^2$$

22. In the cross-section of a timber, cambium layer can occur in

(a) Inner Bark and Sap Wood
(b) Pith and Heart Wood
(c) Sap Wood and Heart Wood
(d) Outer Bark and Sap Wood

Ans. (a)

Sol. Cambium layer occurs in innerbarks and sap wood.

23. Consider the following statements :

1. In the infinitesimal strain theory, dilatation is taken as an invariant.
2. Dilatation is not proportional to the algebraic sum of all normal stresses.
3. The shearing modulus is always less than the elastic modulus.

Which of the above statements is/are correct ?

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

Ans. (d)

Sol. $\frac{E}{3} \le G \le \frac{E}{2}$

In infinitesimal strain theory displacement of material is much smaller than any relevant dimension of the body so that its geometry and properties of material can be assumed to be unchanged (i.e. dilation is taken as invariant).

24. Which one of the following represents constitutive relationship ?

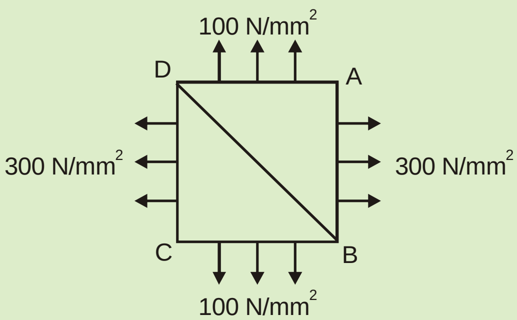
(a) Vertical displacements in a structure
(b) Rotational displacements in a structure
(c) System of forces in equilibrium
(d) Stress-strain behavior of a material

Ans. (d)

Sol. Constitutive relation is relation between two physical quantities that is specific to the material.

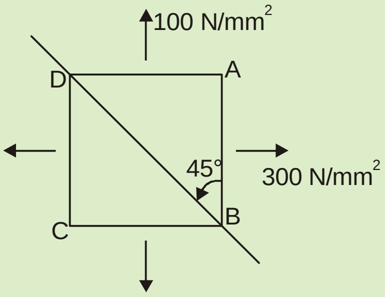
Hence stress strain behaviour of solid material is constitutive relationship.

25. A square element of a structural part is subjected to biaxial stresses as shown in the figure. On a plane along BD, the intensity of the resultant stress due to these conditions will be



(a) $25\sqrt{5}$ N/mm^2 (b) $50\sqrt{5}$ N/mm^2
(c) $75\sqrt{5}$ N/mm^2 (d) $100\sqrt{5}$ N/mm^2

Ans. (d)



Hence BD is plane of maximum shear stress

$$\tau = \frac{\sigma_1 - \sigma_2}{2}$$

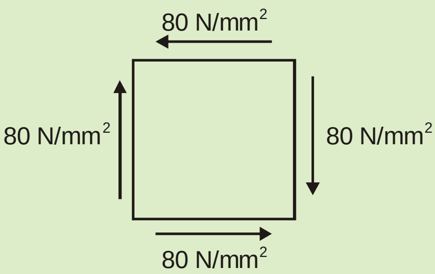
Shear stress $\tau = \dfrac{300-100}{2} = 100 \text{ N/mm}^2$

Normal stress $\sigma = \dfrac{\sigma_1+\sigma_2}{2} = 200 \text{ N/mm}^2$

Resultant stress $= \sqrt{(100)^2+(200)^2}$

$= 100\sqrt{5} \text{ N/mm}^2$

26. A structural element is subjected to pure shear of 80 N/mm², as shown in the figure. The yield stresses both in tension and in compression are 240 N/mm². According to the maximum normal stress theory, the factors of safety in tension and compression are, respectively



(a) 2 and 2 (b) 2.5 and 2.5

(c) 3 and 3 (d) 4 and 4

Ans. (c)

Sol. This is a case of pure shear.

Principal streses in this case is $(+\tau, -\tau)$

$\sigma_1 = 80 \text{ N/mm}^2$ (Tension)

$\sigma_2 = -80 \text{ N/mm}^2$ (Compresion)

Given $\sigma_y = 240 \text{ N/mm}^2$

Factor of safety as per maximum normal stress theory $= \dfrac{\sigma_y}{\sigma}$

$= \dfrac{240}{80} \quad [\because |\sigma_1| = |\sigma_2|]$

$= 3$

27. Principal stresses at a point are 80 N/mm² and 40 N/mm², both tensile. The yield stress in simple tension for this material is 200 N/mm². The values of factors of safety according to maximum principal stress theory and maximum shear stress theory, respectively, are

(a) 2.5 and 2.5 (b) 2.5 and 5

(c) 5 and 5 (d) 5 and 1.67

Ans. (a)

Sol. Given $\sigma_1 = 80 \text{N/mm}^2$, $\sigma_2 = 40 \text{N/mm}^2$

$\sigma_y = 200 \text{ N/mm}^2$

Max. principal stress = 80 N/mm² = σ_P

FOS as per Max. principal stress Theory

$= \dfrac{\sigma_y}{\sigma_P}$

$= \dfrac{200}{80} = 2.5$

Max. shear stress = Max. of $\left(\dfrac{\sigma_1-\sigma_2}{2}, \dfrac{\sigma_1}{2}, \dfrac{\sigma_2}{2}\right)$

$= \text{Max. of} \left(\dfrac{80-40}{2}, \dfrac{80}{2}, \dfrac{40}{2}\right)$

$= \text{Max. of } (20, 40, 20)$

$= 40 \text{ N/mm}^2$

FOS as per Max. shear stress theroy $= \dfrac{\tau_{max}}{\tau}$

$= \left(\dfrac{200/2}{40}\right)$

$= 2.5$

28. The principal stresses at a point are 2σ (tensile) and σ (compressive), and the stress at elastic limit for the material in simple tension is 210 N/mm^2. According to maximum shear strain theory, the value of σ at failure is

(a) 70 N/mm^2 (b) 105 N/mm^2

(c) 140 N/mm^2 (d) 210 N/mm^2

Ans. (a)

Sol. Given $\sigma_1 = 2\sigma,\ \sigma_2 = -\sigma$

$\sigma_y = 210 \text{ N/mm}^2$

As per Max. shear strain theory.

$$\frac{\tau_{max}}{G} \le \frac{fy}{2G}$$

$$\tau_{max} = \text{Max. of}\left(\frac{\sigma_1-\sigma_2}{2}, \frac{\sigma_1}{2}, \frac{\sigma_2}{2}\right)$$

$$= \text{Max. of}\left(\frac{2\sigma-(\sigma)}{2}, \frac{2\sigma}{2}, \frac{\sigma}{2}\right)$$

$$= \text{Max. of}\left(1.5\sigma, \sigma, \frac{\sigma}{2}\right)$$

$$= 1.5\sigma$$

$$\frac{1.5\sigma}{G} \le \frac{210}{2G}$$

$$\sigma \le \frac{210}{2\times1.5}$$

$$\sigma \le 70 \text{ N/mm}^2$$

29. A thin steel ruler having its cross-section of 0.0625 cm × 2.5 cm is bent by couples applied at its ends so that its length l equal to 25 cm, when bent, as a circular arc, subtends a central angel $\theta = 60°$. Take E = 2×10^6 kg/cm^2. The maximum stress induced in the ruler and the magnitude is

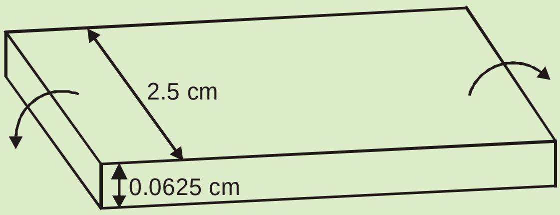
(a) 2618 kg/cm^2 (b) 2512 kg/cm^2

(c) 2406 kg/cm^2 (d) 2301 kg/cm^2

Ans. (a)

Sol. Given :

Cross-section of ruler = 0.0625 cm × 2.5 cm.

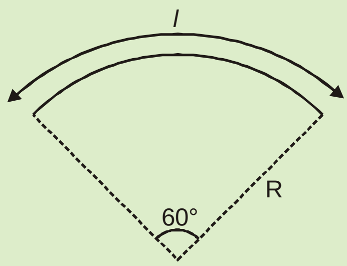


Angle subtended = 60°

$\therefore \quad l = R$

$$25 = R\times\frac{\pi}{180}\times 60$$

$\Rightarrow \quad R = 23.87$ cm



Max. stress in the ruler will be on the extreme end.

$$\therefore \quad \frac{f}{y} = \frac{E}{R}$$

$$\frac{f}{\frac{0.0625}{2}} = \frac{2\times10^6}{23.87}$$

$\Rightarrow \quad f = 2618$ Kg/cm^2

30. Which of the following statements are correct ?

1. Cranes are employable in moving and/or hoisting loads.
2. With the use of dipper and stick, power shovels can be used as hoes.
3. Ovedrive for higher speeds is a facility often used comfortably in the working of a tractor.
4. Clam shells are less desirable than draglines if the material is water-saturated.

(a) 1 and 4 only (b) 1 and 2 only
(c) 2 and 3 only (d) 3 and 4 only

Ans. (a)

31. Two similar bars of Steel and Aluminium are heated to a same temperature. Forces are applied at the ends of the bars to maintain their lengths unaltered. If the ratio of Young's moduli of Steel and Aluminium is 3, and the ratio of the coefficients of thermal expansion of Steel to that of aluminium is 0.5, what is the stress on the Aluminium bar if the stress on the Steel bar is 100 MPa ?

(a) 16.7 MPa (b) 66.7 MPa
(c) 136.7 MPa (d) 150.0 MPa

Ans. (b)

Sol. Given : $\frac{E_{steel}}{E_{Alumi}} = 3,\ \frac{\alpha_{steel}}{\alpha_{alumi}} = 0.5$

$$\sigma_{steel} = 100\text{MPa} \quad \sigma_{Aluni} = ?$$

We know,

$$\sigma = E\in$$

Here, $\in = \alpha T$

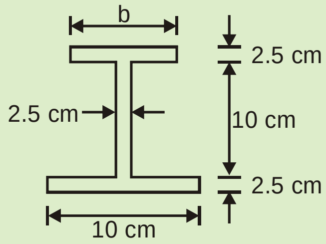
$$\therefore \quad \frac{\sigma_1}{\sigma_2} = \frac{E_1 \in_1}{E_2 \in_2}$$

$$\frac{\sigma_{steel}}{\sigma_{Alumi}} = \frac{E_{steel} \times \alpha_{steel} \times T}{E_{Alumi} \times \alpha_{Alumi} \times T}$$

$$\frac{100}{\sigma_{Alumi}} = 3 \times 0.5$$

$$\sigma_{Alumi} = \frac{100}{1.5} = 66.7\text{MPa}$$

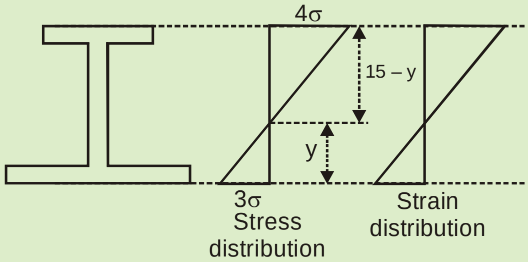
32. In order that the extreme fibre stresses in bending will be in the ratio 4:3 in the beam shown in the following figure, the width b of the upper flange (b < 10cm) of the beam section is to be



(a) 6.1 cm (b) 6.6 cm
(c) 5.1 cm (d) 5.6 cm

Ans. (d)

Sol. Since b < 10 cm, top fibre will have higher stress.



Let the stress in extreme fibres be 4σ and 3σ.

Let the distance of neutral axis from bottom = y. We know $\frac{f}{y} = \frac{M}{I} = \frac{E}{R}$

$$\therefore \quad \frac{4\sigma}{15-y} = \frac{3\sigma}{y}$$

$$4y = 45 - 3y$$

$$7y = 45$$

$y = 6.428$ cm from bottom

C.G. from bottom

$$= \frac{10\times2.5\times1.25+10\times2.5\times7.5+b\times2.5\times13.75}{10\times2.5+10\times2.5+b\times2.5}$$

$$= \frac{87.5+13.75b}{20+b}$$

Now, $\frac{87.5+13.75b}{20+b} = 6.428$

$\Rightarrow \quad 87.5+13.75b = 128.56+6.428b$

$7.322b = 41.06$

$\Rightarrow \quad b = 5.6$ cm

33. A structural steel beam has an unsymmetrical I-cross-section. The overall depth of the beam is 200 mm. The flange stresses at the top and bottom are 120 N/mm^2 and 80 N/mm^2, respectively. The depth of the natural axis from the top of the beam will be

(a) 120 mm (b) 100 mm
(c) 80 mm (d) 60 mm

Ans. (a)

Sol. Overall depth = 200 mm.

$\sigma_{top} = 120$ N/mm^2

$\sigma_{bottom} = 80$ N/mm^2

Let the depth of netural axis from top = y

$\because \quad \frac{f_1}{y_1} = \frac{f_2}{y_2}$

$$\frac{120}{y} = \frac{80}{200-y}$$

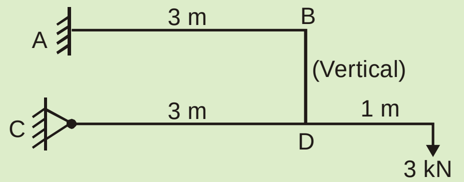
$2(200 - y) = 2y$

$600 - 3y = 2y$

$$y = \frac{600}{5}$$

= 120 mm from top.

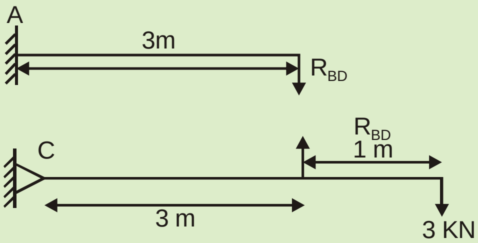
34. The bending moment at A for the beam shown below (With BD being a rigid bar) is



(a) Zero (b) 12 kN-m
(c) 8 kN-m (d) 6 kN-m

Ans. (b)

Sol.



Since, there is a hinge at C,

$\therefore \quad \Sigma M_C = 0$

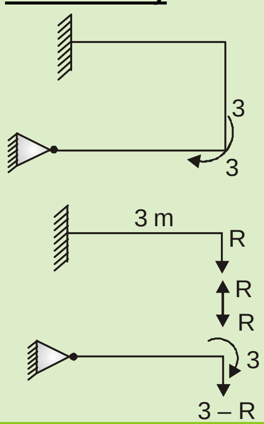
$3\times4 - R_{BD}\times3 = 0$

$\Rightarrow \quad R_{BD} = 4$ KN

Now,

$M_A = R_{BD} \times 3$
$= 4 \times 3$
$= 12$ KNm

Alternatively

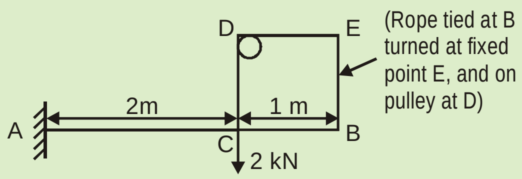


$\Rightarrow (3 - R) \times 3 + 3 = 0$

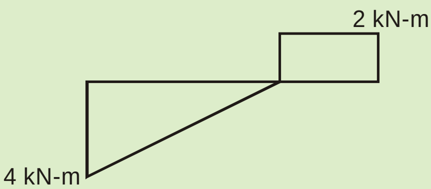
$\Rightarrow \quad R = 4$

$\Rightarrow \quad M_A = 4 \times 3 = 12$ kNm

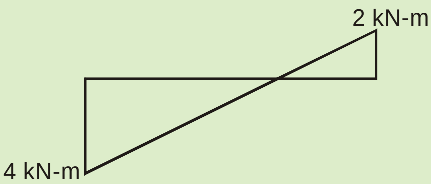
35. The bending moment diagram for the beam shown below is



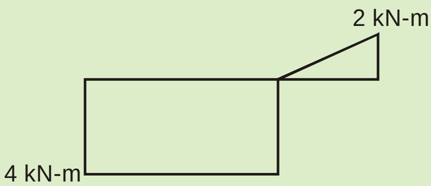
(a)



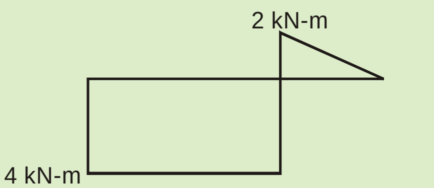
(b)



(c)



(d)



Ans. (*)

36. A circular shaft rotates at 200 rpm and is subject to a torque of 1500 Nm. The power transmitted would be

(a) 10πkW (b) 15πkW

(c) 20πkW (d) 30πkW

Ans. (a)

Sol. Given N = 200 rpm, T = 1500 Nm

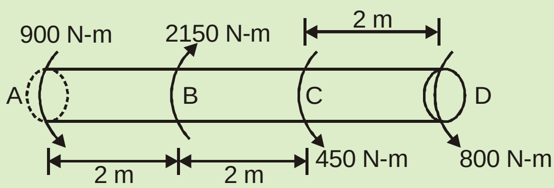
$$\omega = \frac{2\pi N}{60} = \frac{2\pi \times 200}{60} = \frac{20}{3}\pi \text{ rad/s}$$

$$P = T.\omega$$

$$= 1500 \times \frac{20\pi}{3} = 10000\pi \text{ watt}$$

$$= 10\pi \text{ kW}$$

37. Torques are transmitted to the solid circular shaft as shown in the figure below. If the corresponding permissible stress in the shaft is 60 N/mm^2, the diameter of the shaft is nearly.

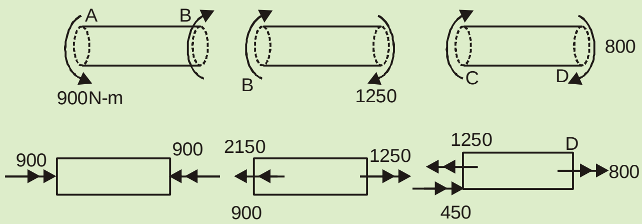


(a) 57.3 mm (b) 47.3 mm

(c) 37.3 mm (d) 27.3 mm

Ans. (b)

Sol.



Max. torque at ny section = 1250 N – m

$$\tau_{perm} = 60\text{N/m}^2$$

$$\because \quad \frac{\tau}{r} = \frac{T}{J}$$

$$\therefore \quad \frac{60}{d/2} = \frac{1250 \times 1000}{\pi d^4/32}$$

$$\Rightarrow \quad d = 47.34 \text{ mm}$$

38. A solid circular shaft has a diameter d. It polar modulus will be

(a) $\frac{\pi}{16}d^2$ (b) $\frac{\pi}{64}d^3$

(c) $\frac{\pi}{16}d^3$ (d) $\frac{\pi}{32}d^2$

Ans. (c)

Sol. Polar moment of inertia for a

$$\text{Circular saft} = \frac{\pi d^4}{32}$$

$$\text{Plar modulus} = \frac{J}{y} = \frac{\pi d^4}{32 \times \frac{d}{2}}$$

$$= \frac{\pi d^3}{16}$$

Where y = distance of maximum stress fibre from centre.

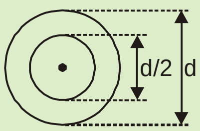
39. A hollow steel shaft has outside diameter and inside diameter d/2. The value of d for the shaft, if it has to transmit 200 hp at 105 rpm with a working shear stress of 420 kg/cm^2, is

(a) 5.6 cm (b) 2.6 cm

(c) 12.1 cm (d) 15.5 cm

Ans. (a)

Sol.



Given, $P = 200$ hP,

$N = 105$ rpm

$\tau_{max} = 420$ Kg/cm^2

$$P = T.\omega$$

$$200 \times 746 = T \times \frac{2\pi \times 105}{60}$$

$$T = 13569 \text{ N-m}$$

As we know,

$$\frac{\tau}{r} = \frac{T}{J}$$

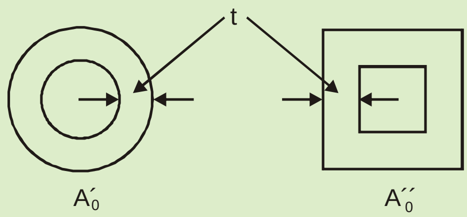
$$\frac{420}{d/2} = \frac{13569}{\frac{\pi}{32}\left(d^4 - \left(\frac{d}{2}\right)^4\right)}$$

$$\frac{840}{d} = \frac{13569}{\frac{\pi}{32} \times \frac{15}{16} \times d^4}$$

$$\Rightarrow \quad d = 5.6 \text{ cm}$$

40. Two thin-walled tubular members made of the same material have the same length, same wall thickness and same total weight and are both subjected to the same torque of magnitude T. If the individual cross-sections are circular and square, respectively, as in the figures, then the ratios of the shear stress τ reckoned for the circular member in relation to the square member will be

Figures not to scale



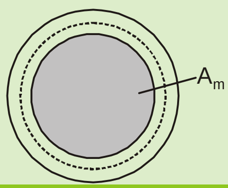
(a) 0.785 (b) 0.905

(c) 0.616 (d) 0.513

Ans. (a)

Sol. For thin walled section shear stress $\tau = \frac{T}{2tA_m}$

A_m = mean area



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unloading and turnaround, etc., is 30 seconds. What is its effective cycle time ?

(a) 157 seconds (b) 161 seconds

(c) 173 seconds (d) 182 seconds

Ans. (b)

Sol. Running speed of loaded tractor

$= 200 \times 0.8 = 160$ m/minute

Running speed of unloaded tractor

$= 200 \times 1.25 \times 0.8$

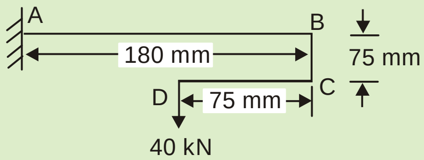
$= 200$ m/minute

Total time for the trip

$$= \frac{120 \times 60}{160} + \frac{120 \times 60}{200} + 50 + 30$$

$= 161$ seconds

44. The bending moment at A for the beam shown below (not to scale) is

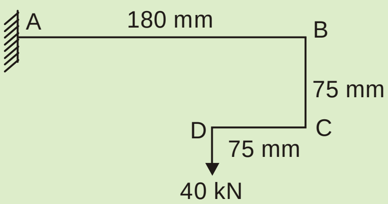


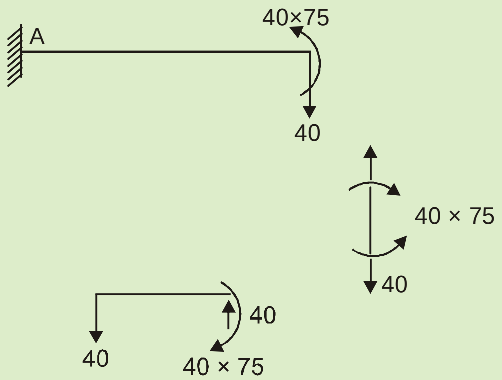
(a) 3200 kN.mm (b) 3600 kN.mm

(c) 4200 kN.mm (d) 4800 kN.mm

Ans. (c)

Sol.

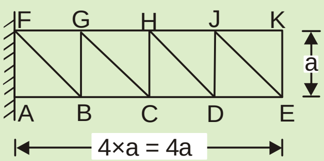




$M_A = 40 \times 45 - 40 \times 180$

$= -4200$ kNmm

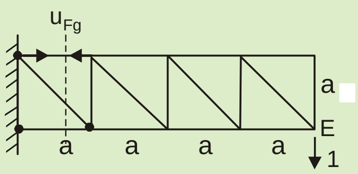
45. In the pin-end cantilever truss shown below, member FG had been fabricated 10 mm longer than required. How much will point E deflect vertically ?



(a) 10 mm (b) 20 mm

(c) 30 mm (d) 40 mm

Ans. (c)



$U_{Fg} \times a = 1 \times 3a$

$U_{Fg} = 3$

$\delta_E = \Sigma u_i \lambda_i = 10 \times 3 = 30$ mm

46. The purpose of lateral ties in a short RC column is to

(a) Avoid buckling of longitudinal bars

(b) Facilitate compaction of concrete

(c) Increase the load carrying capacity of the column

(d) Facilitate construction

Ans. (a)

Sol. Lateral ties are provided to avoid buckling of longitudinal bars.

47. When a two-hinged parabolic arch is subjected to a rise in ambient temperature, the horizontal thrust at the support will

(a) Increase

(b) Decrease

(c) Remain same

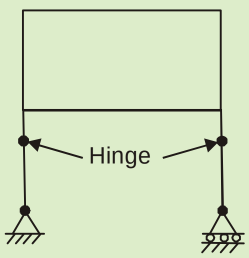
(d) Increase or decrease depending on the span

Ans. (a)

Sol. Horizontal thrust due to increases in temperature by ΔT

$$H = \frac{\alpha \cdot \Delta t \cdot l}{\int_0^l \frac{y^2 ds}{EI}}$$

48. The degree of static indeterminacy for a rigid frame as shown below is

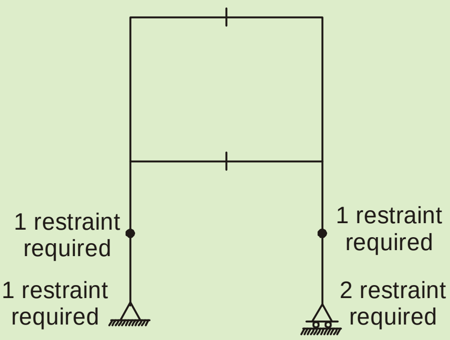


(a) 0 (b) 1

(c) 2 (d) 3

Ans. (b)

Sol.



No. of cuts required = 2

No. of restraint required = 1 + 2 + 2 = 5

Degree of static

indeterminacy = 3C – r

= 3 × 2 – 5 = 1

49. In the slope-deflection equations, deformations are considered to be caused by

(a) Shear forces and bending moments only

(b) Axial forces, shear forces and bending moments

(c) Axial forces and bending moments only

(d) Bending moments only

Ans. (d)

Sol. In slope deflection equation, deformation are considered to be caused by bending moments only.

50. The maximum bending moment caused by a set of concentrated moving loads is

(a) Always at the midpoint of span

(b) Between the midpoint and concentrated load next to the midpoint of the span

(c) Not definable

(d) Always under a load close to the centroid of the set of loads

(c) Width of flanges

(d) Column action of web

Ans. (b)

Sol. Web crippling is actually local buckling that occur when the web is slender. It occur due to high magnitude of point load which result in stress concentration and bearing failure.

57. The block shear failure of a bolted joint in tension occurs because of

1. Use of higher shear strength bolts
2. Use of paltes with higher bearing strength

(a) 1 only (b) 2 only

(c) Both 1 and 2 (d) Neithter 1 nor 2

Ans. (c)

Ans. When high shear strength bolt and high bearing strength plates are used, length of connection gets reduced leading to block shear failure

58. As per IS code, the maximum longitudinal pitch allowed in bolted joints of tension members is nominally

(a) 12 times the thickness of the plate

(b) 12 times the diameter of the bolt

(c) 16 times the thickness of the plate

(d) 16 times the diameter of the bolt

Ans.(c)

Sol. maximum longitudinal pitch allowed is 16 times the thickness as the plate

59. ISMB 100 (r_x = 40 mm, r_y = 10 mm) has been used as a column in a industrial shed. Along the minor axis, the the column has restraints in the form of purlins at 1.0 m intervals. Effective length factor along major and minor axes are 1.2 and 1.0, respectively. If the slenderness ratio is restricted to 120, the maximum column height will be

(a) 1.0 m (b) 2.4 m

(c) 4.0 m (d) 4.8 m

Ans. (c)

Sol. $S_r = 1.2 \times \frac{L}{r_y}$

$$120 = 1.2 \times \frac{L}{40}$$

L = 4.0 m

60. As per IS 800 – 2007, the permitted slenderness ratio for a bracing member in case of hangers shall be

(a) 140 (b) 145

(c) 150 (d) 160

Ans. (d)

Sol. Clause 12.8.2.2 of IS 800 : 2007

61. A rectangular beam of depth d is under bending. Load has been gradually increased when the top fibre has obtained five times the strain at the first yield. What detph of the beam will still respond by elastic conditions?

(a) 0.16 d (b) 0.20 d

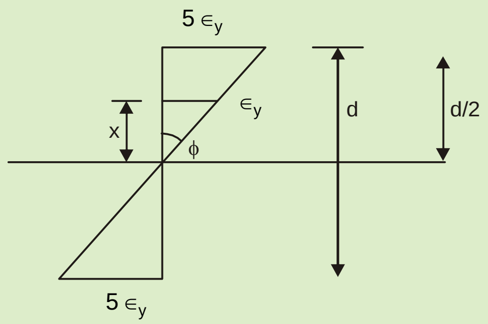
(c) 0.25 d (d) 0.40

Ans. (b)

Sol. $\phi = \frac{5 \in y}{\frac{d}{2}} = \frac{\in y}{x}$

$$x = \frac{d}{10} = 0.1d$$

depth of elastic section = 2x = 0.2d



62. The ultimate moment capacity of a mild steel section is usually

(a) Equal to the plastic moment capacity

(b) More than the yield moment capacity

(c) Let than the yield moment capacity

(d) More than the plastic moment capacity

Ans. (a)

63. The portal bracing in a truss-bridge is used to

(a) Transfer load from top of end posts to bearings

(b) Maintain the rectangular shape of the bridge cross-section

(c) Stiffen the structure laterally

(d) Prevent the buckling of top chord under side sway

Ans. (c)

Sol. Portal bracing stiffens the structure laterally and transfer the wind and seismic load from top of end posts to bearing.

64. Consider the following cases in the design of reinforced concrete members in flexure:

1. Over-reinforced section
2. Tension failure
3. Compression failure
4. Under-reinforced section

Which of the above cases are considered for safe design of R.C members in flexure?

(a) 1 and 2 only (b) 2 and 4 only

(c) 3 and 4 only (d) 1 and 3 only

Ans. (b)

Sol. Under-reinforced section which result in tension failure give ample warning before collapse.

65. The bond between steel and concrete is mainly due to

1. Mechanical resistance
2. Pure adhesive resistance
3. Frictional resistance

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

(c) 2 and 3 only (d) 1, 2 and 3

Ans. (d)

Sol. 1. Mechanical resistacne is developed due to bearing stress against the rib. whereas friction and adhesive property develop at the contact of steel and concrete.

66. The carbonation process is demonstrated more by

(a) Atmospheric corrosion

(b) Choloride corrosion

(c) Stress corrosion

(d) Hydrogen embrittlement

Ans. (a)

Carbonation occure when carbon dioxide from the air penetrates the concrete and reacts with hydroxides such as cacium hydroxide to form cabonates

$$Ca(oH)_2 + CO_2 \longrightarrow CaCo_3 + H_2O$$

This reaction reduces the pH of the pore solution as low as 8.5, at which the passive film on the steel is not stable.

67. When a sprially reinforced short column is loaded axially, the concrete inside the core is subjected to

(a) Bending and compression

(b) Biaxial compression

(c) Triaxial compression

(d) Uniaxial compression

Ans. (c)

The concrete inside the core is subjected to tri-axial compression. It is confined by hoop stress in spiral reinforcement and axial load transfer path.

68. In a reinforced concrete section, shear stress distribution is diagrammatically

(a) Wholly Parabolic

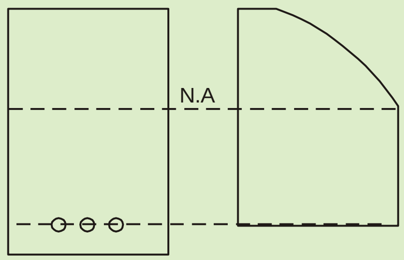
(b) Wholly Rectangular

(c) Parabolic above NA and Rectangular below NA

(d) Rectangular above NA and Parabolic below NA

Ans. (c)

Sol.



69. As per IS 456 – 2000, the maximum permissible shear stress, τ_{Cmax}, is based on

(a) Diagonal tension failure

(b) Diagonal compression failure

(c) Flexural tension failure

(d) Flexural compression failure

Ans. (b)

Sol. τ_{cmax} is based on diagonal compression failure.

70. Footings shall be designed to sustain the

1. Applied loads
2. Moments and forces under relatable loading conditions
3. Induced reactions

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

(c) 2 and 3 only (d) 1, 2 and 3

Ans. (d)

Sol. As per IS 456 : Clause 34.1

71. Reinforced concrete slabs are designed for

1. Shear
2. Flexure
3. Positive bending moment
4. Negative bending moment

(a) 1, 2 and 3 only (b) 1 and 4 only

(c) 2, 3 and 4 only (d) 1, 2, 3 and 4

Ans. (c)

Sol. Slabs are designed for bending and deflection and not designed for shear because

(i) Slabs have much small depth than beams.

(ii) Most of slabs subjected to uniformly distributed loads.

72. As compared to the working stress method of design, the limit state method of design premises that the concrete can admit

(a) A lower stress level

(b) A higher stress level

(c) Occasionally higher, but usually lower, stress level

(d) Only the same stress level

Ans. (b)

73. The bending stress in a T-beam section is maximum

1. At top fibre
2. At centroidal fibre
3. At bottom fibre

(a) 1 only (b) 2 only

(c) 3 only

(d) At a level which is dependent on the loading condition.

Ans. (d)

Sol. At lower stress value bottom fibre has maximum stress whereas if we increase loading, concrete under tension undergoes cracking in such condition maximum bending stress can be at top fibre

74. If the loading on a simply supported pre-stressed concrete beam is uniformly distributed, the centriod fo the pre-stressing tendon should be as

(a) A straight profile along the lower edge of the kern

(b) A parabolic profile with convexity downward

(c) A straight profile along the centriodal axis

(d) A circular profile with convexity upward

Ans. (b)

Sol. The centriod profile as tendon must be provided such that section is under uniform compression. For uniformly destributed loading a parabolic profile with convexity downward is provided.

75. In a post-tension pre-stressed concrete beam, the end block zone is in between the end of the beam and the section where

(a) The shear stresses are maximum

(b) Only shear stresses exist

(c) No lateral stresses exist

(d) Only longitudinal stresses exist

Ans. (d)

Sol. The zone between the end of the beam and the section where only longitudinal stress exist is generally referred to as the anchorage zone or end block zone.

76. In the pre-tensioning method

1. Tension in concrete is induced directly by external force
2. Tension is induced in the tendons before concreting
3. Concrete continues to be in tension after pre-stressing

(a) 1 only (b) 2 only

(c) 3 only (d) 1 and 3 only

Ans. (b)

Sol. In pretensioning, tension is induced in the tendons before concreting. Once the concrete sets and hardens, tendons are cut and prestress is transferred to concrete. Hence after application of prestress, concrete is in compression.

77. Flexural collapse in over-reinforced beams is due to

(a) Primary compression failure

(b) Secondary compression failure

(c) Primary tension failure

(d) Bond failure

Ans. (b)

Sol. Over reinforced beam undergo compression failure which is a sudden failure due to crushing of concrete in compression zone. this type of failure of compression zone is called secondary compression failure.

78. If a beam is likely to fail due to high bonding stresses, then its bond strength can be increased most economically by

(a) Providing vertical stirrups

(b) Increasing the depth of the beam

(c) Using smaller diameter bars in correspondingly more numbers

(d) Using higher diameter bars by reducing their numbers

Ans. (c)

Sol. To increase bond strength we should use smaller diameter bars in correspondingly large numbers (such that area of steel remains same). This would effectively increase surface area of contact between steel and concrete.

Stirrups are used in beams to counter shear force. Increase in depth of beam would not bring any change in bond strength.

79. A single-acting reciprocating pump has a stroke of 25 cm, speed of 135 rpm, and a piston of 30 cm diameter. If its slip has been estimated as 4% at a particular operating condition, what is the corresponding realized discharge through a height of 14 m?

(a) $33\cdot2$ *l*ps (b) $35\cdot6$ *l*ps

(c) $37\cdot0$ *l*ps (d) $38\cdot2$ *l*ps

Ans. (d)

Sol.

L = Stroke length = 25 cm

N = speed = 135 rpm

D = Dia. of piston = 30 cm

Slip = 4%

$$\%\ \text{slip} = \left(1 - \frac{Q_{acutal}}{Q_{Theotical}}\right)\times 100$$

$$\Rightarrow \quad 4 = \left(1 - \frac{Q_{acutal}}{\dfrac{ALN}{60}}\right)\times 100$$

$$4 = \left(1 - \frac{Q_{ac}}{\dfrac{\pi}{4}(D)^2 \times L \times \dfrac{N}{60}}\right)\times 100$$

$$(1-0.04)\frac{\pi}{4}(0.3)^2 \times 0.25 \times \frac{135}{60} = Q_{ac}\ (m^3/s)$$

$$= 38.17\ l/s$$

80. In the design of pre-stressed concrete structures, which of the following limit states will qualilfy as the limit states of serviceability?

1. Flexural
2. Shear
3. Deflection
4. Cracking

(a) 1 and 2 only (b) 3 and 4 only

(c) 1 and 4 only (d) 2 and 3 only

Ans. (b)

Sol. In the method of design based on limit state concept, the structure shall be designed to safely all loads liable to act on it. The resistance to bending, shear, torsion and axial loads at every section shall not be less than the appropriate value at that section produced by the probable most unfavorable combination of loads on the structure using the appropriate partial safety factors. This constitutes assessing limit state of collapse.

The structure shall also satisfy limit states of serviceability requirements, such as limitations on deflection and cracking.

81. Consider the following statements:

1. Pumps used in series are generally of the centrifugal type.
2. Centrifugal pumps, though yielding comparatively smaller discharges than axial flow pumps, yield higher heads (at each stage) compared to axial flow pumps.

Which of the above statements is/are correct?

(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

Ans. (c)

82. When steel reinforcing bars are provided in masonry, the bars shall have an embedment with adequate cover in cement-sand mortar not leaner than

(a) 1 : 3 (b) 1 : 4
(c) 1 : 5 (d) 1 : 6

Ans. (a)

Nature of work	Type of Cement Mortar	Type of Line Mortar
Reinforced Brikwork	1:3 which means 1 part cemnt. 3 part Scmed (in term of volume)	
Plaster work	1:3 to 1:4	1:2
Stone Masonary with ordinary stones	1:6	1:2 lime being hydraulic lime
Stone Masonary with best variety of stones		1:2 lime being hydraulic lime
Think joints in brickwork		1:3; lime being fat lime
General RCC works	1:3	
Construction work in water logged areas & exposed conditions	1:3	1:3 lime being hydraulic lime
Damp proof courses and cement - concrete roads	1:2	

83. The efficacy of pumpcrete is based primarily on

1. The capacity of pump
2. The aggregate size, which should not exceed 8 cm
3. The diameter of pipe being large, with more than 30 cm being desirable
4. The performance of the agitator

(a) 1 and 4 only (b) 1 and 2 only
(c) 3 and 4 only (d) 2 and 3 only

Ans. (a)

Sol. Efficiency of concrete pump depends on

- Length of horizontal pipe–300 to 400 m
- Length of vertical pipe

- Number of bends
- Diameter of pipe line (150 mm – 200 mm)
- Slump of concrete (> 75 mm)
- Capacity of pump
- Maximum size of Aggregate = 40 mm
- Performance of Agitation

84. In a non-tilting type drum mixer,

1. Large size aggregate up to 20 – 25 cm can be handled
2. Mixing time is less than 2 minutes
3. Discharge is through buckets onto the platform
4. For large size mixers, the mixing time should be slightly increased if handling more than 800 litres of the mix

Which of the above statements are correct?

(a) 1 and 2 only (b) 2 and 3 only
(c) 1, 2 and 4 only (d) 3 and 4 only

Ans. (d)

Sol. In Non tilting mixtures large size of aggregates upto 80 mm can be used.

As per IS-456 : 2000 mixing time shall be closer to 2 min

85. How many impellers are required for a multi-stage pump to lift 4000 *l*pm against a total head of 80 m at a speed of 750 rpm; given that N_s for each impeller should be between 720 to 780 units?

(a) 6 (b) 5
(c) 4 (d) 3

Ans. (b)

Sol.

$$N_S = \frac{N\sqrt{Q}}{H_m^{3/4}}$$

$$\frac{720+780}{2} = \frac{750\times\sqrt{4000/60}}{H_n^{3/4}}$$

$$\Rightarrow \quad H_m = 16 \text{ m}$$

$$\Rightarrow \quad \text{No. of impellers} = \frac{80}{16} = 5$$

86. A 15 cm centrifugal pump delivers 6 *l*ps at a head of 26 m running at a speed of 1350 rpm. A similarly designed pump of 20 cm size runs at the same speed. What are the most likely nearest magnitudes of discharge and delivery head provided by the latter pump?

(a) 11 *l*ps and 46 m (b) 14 *l*ps and 52 m
(c) 11 *l*ps and 52 m (d) 14 *l*ps and 46 m

Ans. (d)

Sol.

Pump 1	Pump 2
$D = 15$ cm	$D_1 = 20$ cm
$Q = 6$ *l*ps	$Q_1 =$
$H = 26$ m	$H_1 =$
$N = 1350$ rpm	$N_1 = 1350$ rpm

$$\frac{ND}{\sqrt{H}} = \frac{N_1D_1}{\sqrt{H_1}}$$

$$\frac{15}{\sqrt{26}} = \frac{20}{\sqrt{H_1}}$$

$$H_1 = 46.22 \text{ m}$$

Also $$\frac{Q}{D^3N} = \frac{Q_1}{D_1^3N_1}$$

$$\Rightarrow \quad Q_1 = 6\times\left(\frac{20}{15}\right)^3$$

$$= 14.22 \text{ lps}$$

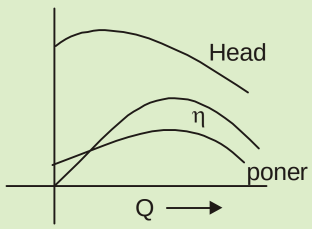
87. Which fo the following statements are correct as operating characteristics of centrifugal pump?

1. As discharge increases from zero value, head slightly increases; then the head declines gently; and beyond a certain discharge, the head falls steeply.
2. As discharge increases, efficiency increases from zero, rising fast to a maximum value and then falls rapidly, more rapidly than the head-discharge curve.
3. BHP increases from a non-zero (positive) value at zero discharge, the increase being only moderate before it starts falling beyond a certain discharge.

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

Ans. (a)

Sol.



88. Engines used in earthwork equipment are qualified by the power developed under sepcified conditions. As operating conditions change, the power developed will increase with local ambience, if

1. Ambient temperature increases
2. Ambient temperature decreases
3. Ambient pressure increases
4. Ambient pressure decreases

Which of the above statements are correct?

(a) 1 and 3 only (b) 1 and 4 only
(c) 2 and 3 only (d) 2 and 4 only

Ans. (c)

Sol. $H_0 = H_S \times \frac{P_0}{P_S} \times \sqrt{\frac{T_S}{T_0}}$

H_0 = Observed horse power
H_S = Standard horse power
P_0 = Observed barometric pressure
P_S = Standard barometric pressure
T_S = Absolute temperature for standard conditions
T_0 = Absolute temperature for observed condition.

Power increases when pressure increases and temperature decreases.

89. Manometric head developed h_m in m, and discharge Q in *l*ps in respect of two pumps, 1 and 2, are tabulated. The pumps are connected in series against a static head of 100 m. Total head losses for a discharge of Q are as $\frac{Q^2}{100}$ (m). What is the delivered discharge?

Q in *l*ps	15	18	20	22	25
h_{m1} in m	60·6	61·2	62·0	55·0	48·0
h_{m1} in m	50·8	51·0	48·8	45·8	40·0

(a) 20·15 *l*ps (b) 21·25 *l*ps
(c) 21·95 *l*ps (d) 22·20 *l*ps

Ans. (b)

Sol.

Q	Available head	Required head $\left(100+\frac{Q^2}{100}\right)$ neglecting velocity head $\frac{V_d^2}{2g}$
15	111.4	102.25
18	112.2	103.24
20	110.8	104.0
21	105.8	104.41
21.5	103.3	104.615
22	100.8	104.82
25	88.0	106.25

Hence, discharge Q will lie between 21 and 21.5.

90. A reciprocating pump has a stroke of 30 cm, spped of 100 rpm, and a piston of $22 \cdot 5$ cm diameter. It discharge and $18 \cdot 9\, l\text{ps}$. What is the slip of the pump?

(a) 3.12 % (b) $3 \cdot 54\%$

(c) $4 \cdot 15\%$ (d) $4 \cdot 95\%$

Ans. (d)

Sol.

$$\%\text{slip} = \left(1-\frac{Q_{ac}}{Q_{th}}\right)\times 100$$

$$Q_{th} = \frac{ACN}{60} = \frac{\pi}{4}(0.225)^2 \times 0.3 \times \frac{100}{60}\ m^3/s$$

$$= 0.01987\ m^3/s$$

$$= 19.87\ l/s$$

$$Q_{ac} = 18.9\ l/s$$

$$\Rightarrow \%\ \text{slip} = \left(1-\frac{18.9}{19.87}\right)\times 100 = 4.95\%$$

91. The following data were recorded when a centrifugal pump worked at its maximum efficiency: Q = $40\ l\text{ps}$; Manometric head developed = 25 m; Input shaft horse power = 11.9 W. What is the non-dimensional specific speed of the pump it it was running at 1500 rpm? (May adopt the following (all in S.I. units):

$g^{1/4} = 1 \cdot 77$, $g^{1/2} = 3 \cdot 132$, $g^{3/4} = 5 \cdot 544$,

$\sqrt{2} = 1 \cdot 414$, $\sqrt{5} = 2.236$ and $\sqrt{10} = 3 \cdot 162$)

(a) 165 (b) 155

(c) 145 (d) 135

Ans. (b)

Sol. Given that ϕ = 40 lps (centrifugal pump)

manometric head, H_m = 25 m

Non dimensional specific speed $N_s = \frac{N\sqrt{Q}}{(gH_m)^{3/4}}$

$$N_S = \frac{1500\times\sqrt{40}}{(9.81\times 25)^{3/4}}$$

$$N_S = 153.07\ \text{rpm}$$

(Discharge has been taken in lps instead of m^3/s which is actually not correct).

92. The total head to be developed by a centrifugal pump is expected to be up to 50 m. The normal ratio of radii of impeller rim and impeller eye of 2 is maintained. The design is for a speed of 1300 rpm, What is the nominal diameter of the impeller? Take $\sqrt{g} = 3 \cdot 13$ and $\frac{1}{\pi} = 0 \cdot 318$.

(a) 53 cm (b) 57 cm

(c) 60 cm (d) 64 cm

Ans. (a)

For starting of pump min centrifugal head developed $\geq H_m$

Hence,

$$H_m = \frac{\left(\frac{\pi D_B N}{60}\right)^2 - \left(\frac{\pi D_A N}{60}\right)^2}{2g} = 50\text{ m}$$

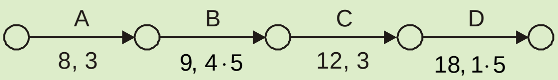
Given that $\dfrac{D_B}{D_A} = 2$

$$\left(\frac{\pi D_B N}{60}\right)^2 \left[1 - \left(\frac{D_A}{D_B}\right)^2\right] = 2g \times 50$$

$$\left(\frac{\pi D_B \times 1300}{60}\right)^2 = \frac{2 \times 9.81 \times 50}{(1 - 0.5^2)}$$

$$\boxed{D_B = 53\text{ cm}}$$

93. Activities A, B, C and D constitute a small project; their interrelationship, expected duration and standard deviation of this expected duration are shown in the figure, respectively.



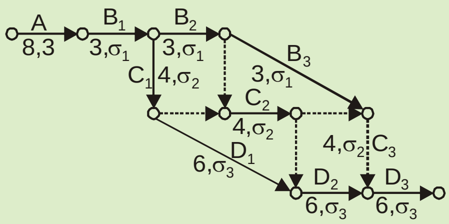
With a view to improving the speed of implementation, each of B, C and D are split into three equal segments, maintaining appropriate inter-relationships between A and each of these nine segments. What will be the standard deviation of the modified project duration after segmentation (to the nearest $\frac{1}{10}$ unit)?

(a) 6·2 (b) 5·6

(c) 5·2 (d) 4·6

Ans. (b)

Sol.



If activity B is divided into 3 equal parts then each part will have duration 3 units and standard deviation σ_1

where $4.5 = \sqrt{\dfrac{\sigma_1^2 + \sigma_1^2 + \sigma_1^2}{(3-1)}}$

$\Rightarrow \sigma_1 = \sqrt{\dfrac{2}{3}} \times 4.5$

Similarly, S.D. of C_1, C_2, $C_3 = \sigma_2 = \sqrt{\dfrac{2}{3}} \times 3$ each

S.D. of D_1, D_2, $D_3 = \sigma_3 = \sqrt{\dfrac{2}{3}} \times 1.5$ each

Modified project duration

= 8 + 3 + 4 + 6 + 6

= 33 units

Modified project S.D.

$$= \sqrt{3^2 + \frac{2}{3} \times 4.5^2 + \frac{2}{3} \times 3^2 + \left(\frac{2}{3} \times 1.5^2\right) \times 3}$$

= 5.7

94. Which of the following is/are the main drawback(s) in adopting bar charts?

1. All the activities are shown as being independent of each other
2. The sequence of activities is not defined at all

3. It is difficult to judge whether an activity is completed or not

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

Ans. (d)

Sol. Bar chart does not show intedependency of activities. Hence they seem to be independent of each other and their sequence is not shown.

Bar chart does not depeict review of project progress hence it is difficult to judge whether an activity is complete or not.

95. The purpose of work-break-down structure in project planning is mainly to

1. Facilitate and improve the decision-making on procurement of resources
2. Relate activities under particular trade specializations to help in organizing for project staff
3. Co-ordinate regarding milestone events across trade specializations to improve the synergy between the trades

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

Ans. (d)

96. Which of the following statements is/are correct?

1. An activity is in between two node numbers, which need not be in an increasing order in the activity progress sequence.
2. The length of the arrow in a network has certain significance.
3. Concurrent acitvities are mutually independent and can possibly be taken up simultaneously.

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

Ans (b)

Sol. Length of arrows in network diagram has no significance.

An activity lies between two nodes. Number of nodes increase as the activity progresses.

97. Which of the following statements are implicit in developing the critical path network?

1. Only one time estimate is required for any activity
2. Time only is the controlling factor at this stage
3. Time and cost both are controlling factors at this stage
4. Critical events may have positive, negative, or zero float

(a) 1 and 2 only (b) 1 and 3 only
(c) 1 and 4 only (d) 2 and 4 only

Sol. (b)

Ans. In CPM only one time estimate is given for each activity.

In CPM time and cost both are controlling factors.

Float is associated with activity hence 4th statement is wrong.

98. In the crtical path method of project planning, free float can be

(a) Greater than independent float

(b) Greater than total float

(c) Less than independent float

(d) Equal to total float

Ans. (a)

Sol. In critical path method.

Total float = LFT – EFT = LST – EST

Directions: Each of the next **twenty (20)** items consists of two statements, one labelled as the 'statement (I)' and the other as 'statement (II)'. examine these two statements carefully and select the answers to thse items using the codes given below:

Codes:

(a) Both statement (I) and statement (II) are individually true and statement (II) is the correct explanation of statement (I)

(b) Both statement (I) and statement (II) are individually true but statement (II) is not the correct eplanation of statement (I)

(c) Statement (I) is true but statement (II) is false

(d) Statement (I) is false but statement (II) is true.

101. Statement (I): Splitting of fibres is a type of seasoning defect in wood.

Statement (II): Seasoning of timber is a general requirement for structural purposes.

Ans. (b)

Sol. Spliting is separation of fibers along the grain and extends from one end of the blank to the other end it is due to seasoning defect.

Seasoning of timber is a general requirement for structural purpose because it helps in

1. Reducing tendency to sphit warp and shrink.
2. Immune from attack by insects.
3. Increasing strength durability, workability and resilience.
4. Reduce weight and minimize cost of transportation.
5. Readily burning of timber, if used as fuel.

102. Statement (I): Hardwoods are used in special purpose heavy constrctions.

Statement (II): Hardwoods too are porous in nature.

Ans. (b)

Sol. Hardwoods are used in special purpose heavy construction because they are strong in tension, compression and shear, strong along and across the grains.

All hardwoods have vessels (little pipelines) that are used in sap production. When the vessels are cut across the end grain, they are referred to as pores, thus hardwoods are known as "porous woods".

103. Statement (I): In general, bricks cannot be used in industrial foundations.

Statement (II): Heavy duty bricks can withstand higher temperatures.

Ans. (b)

104. Statement (I): In multistoried constructions, burnt clay perforated bricks are used to reduce the cost of construction.

Statement (II): Perforated bricks are economical and they also provide thermal insulation.

Ans. (a)

105. Statement (I): Positive displacement pumps can be used for pumping of ready-mixed concrete.

Statement (II): The coarse aggregate in the mix is unlikely to be crushed during positive displacement.

Ans. (a)

106. Statement (I): Fire resistance of plastering can be achieved by mixing surkhi to the cement mortar.

Statement (II): Insulation against sound and fire be achieved by adding sufficient water in-situ just before applying the mortar.

Ans. (c)

107. Statement (I): Water containing less than 2000 ppm of dissolved solids can generally be used satisfactorily for making concrete.

Statement (II): The presence of any of zinc, manganese, tin, copper or lead reduces the strength of concrete considerably.

Ans. (b)

108. Statement (I): Though a non-elastic material, yet concrete exhibits a linear relationship between stress and strain at low values of stress.

Statement (II): The modulus of elasticity of concrete is dependent on the elastic properties of aggregate and on curing.

Ans. (b)

109. Statement (I): Finer the cement, greater is the need for water for hydration and workability.

Statement (II): Bleeding of a mix occurs due to low water-cement ratio.

Ans. (c)

110. Statement (I): The failure of a mild steel specimen of circular cross-section, subjected to a torque occurs along its cross-section.

Statement (II): The failure occurs on a plane of the specimen subjected to maximum shear stress; and mild steel is relatively weak in shear.

Ans. (a)

111. Statement (I): In elastic analysis of structures, the neutral axis is the intersection between the plane of bending and the neutral plane.

Statement (II): Neutral axis in the context of plastic analysis of structures is always the Equal area axis of the cross-section.

Ans. (d)

112. Statement (I): Whereas shutter vibrators are preferred for use with pre-stressed beams, needle vibrators are preferred in foundation concreting.

Statement (II): Needle vibrators are susceptible to get dysfunctional with leaking-in of cement slurry – which is not the case with the shutter vibrator.

Ans. (b)

113. Statement (I): The forward edge of wheels or outriggers acts as a fulcrum in determining the lifting capacity of a mobile crane.

Statement (II): There is in-build security and safety against sudden dropping of load, as well as against abrupt swinging, in the working of a mobile crane.

Ans. (b)

Sol. The stability-limited rated load for a mobile crane supported on outriggers is 85% of tipping load.

$\because$ Tipping takes about fulcrum.

114. Statement (I): Hand-operated chain-hoists include differential screw-geared types within their range.

Statement (II): In case of a hoist-winch, the capacity of the hoist is increased by a number of gear reductions.

Ans. (b)

Sol. Hand operated chain hoist are screw geared and differential type i.e., they are self locking and will automatically hold a load in position.

Winch is used for pulling and hoisting objects, lower is the gear ratio higher is the power.

115. Statement (I): When employing weigh-batching for mix preparation, bulking of sand has to be accounted for.

Statement (II): Bulked sand will affect the proportional composition of the ingredients to be used in making wet concrete of the desired eventual strength.

Ans. (d)

116. **Statement (I):** Critical path(s) through a CPM network can be identified even without working out the backward pass computations by a competent user.

Statement (II): Critical path is the progressive chain of activities from start to finish (not excluding between splitting and merging nodes) through the network where total float is absent throughout (including through dummy arrrows, if appropriate).

Ans. (b)

Sol. Critical path is the longest path time wise which canbe determined from forward path method only

117. **Statement (I):** For implementing weigh-batching, separate compartments are made for storing large quantities of the aggregates. Besided lifting and loading equipments, there must be regular assessment of grading and also of moisture content.

Statement (II): Whereas eventual strength of the mix depends also on the grading of the ingredients, the water needs too must be properly computed and implemented.

Ans. (b)

118. **Statement (I):** Resources optimization is largely a pre-implementation pursuit whereas resources allocation is a through-implementation dynamic process.

Statement (II): Resources allocation has a larger bearing on inventory management than resoures optimization.

Ans. (b)

119. **Statement (I):** Crashing of project duration always increases the cost of the project on its completion, no matter what the indirect, or overhead, costs are.

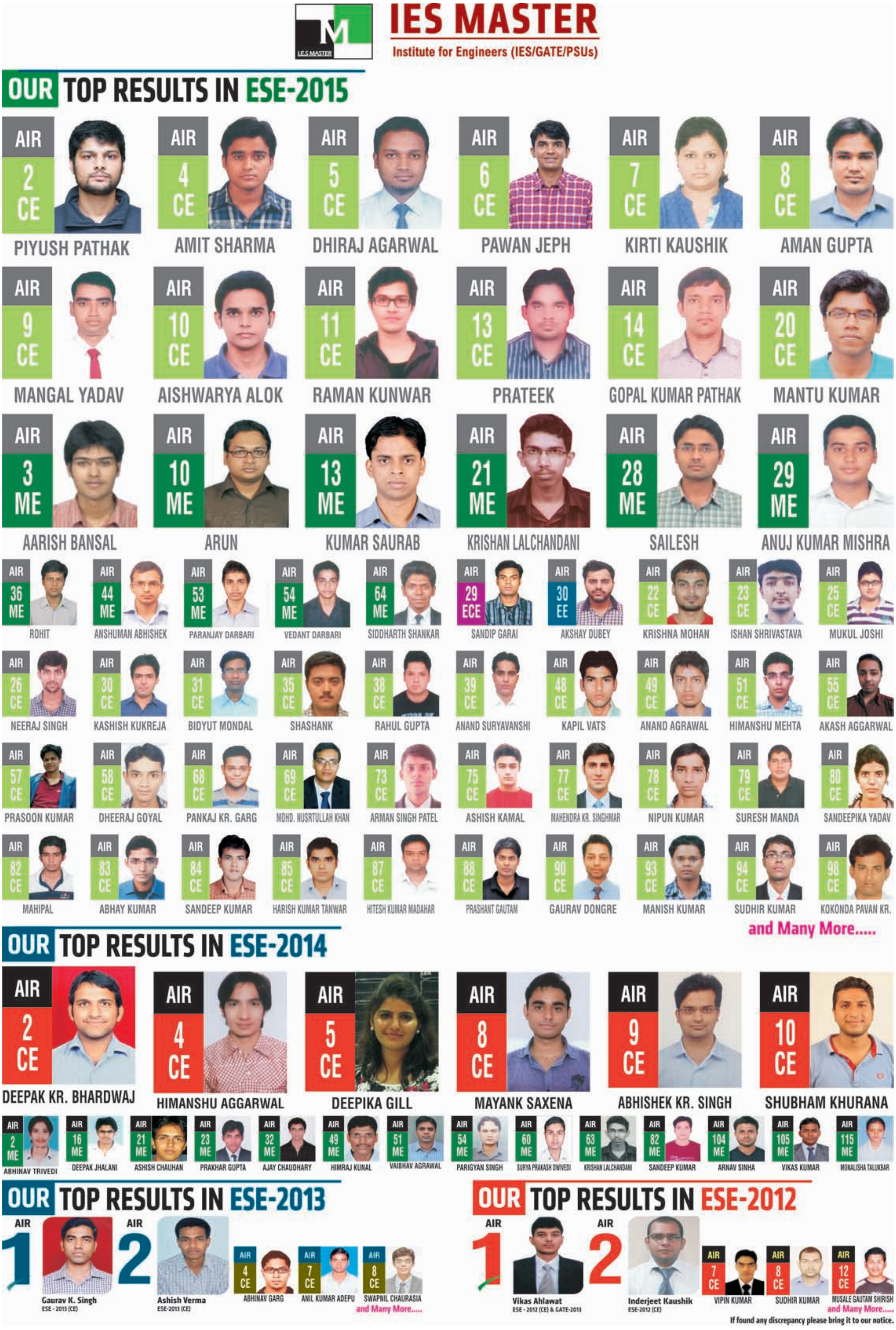
Statement (II): The critical path along the project activities network diagram is compressed in the process of investigating the crashing of the project duration, and not the non-critical activities, up to a certain stage of crashing.

Ans. (d)

120. **Statement (I):** In the operation of reciprocating pumps, slip can sometimes be negative.

Statement (II): Under conditions of high speed, long suction pipes (without cavitation) and short delivery pipes, inertia pressure can be relatively rather high, causing the delivery value to open before the discharge stroke begins.

Ans. (a)



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AIR 4 CE AMIT SHARMA
AIR 5 CE DHIRAJ AGARWAL
AIR 6 CE PAWAN JEPH
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AIR 8 CE AMAN GUPTA
AIR 9 CE MANGAL YADAV
AIR 10 CE AISHWARYA ALOK
AIR 11 CE RAMAN KUNWAR
AIR 13 CE PRATEEK
AIR 14 CE GOPAL KUMAR PATHAK
AIR 20 CE MANTU KUMAR
AIR 3 ME AARISH BANSAL
AIR 10 ME ARUN
AIR 13 ME KUMAR SAURAB
AIR 21 ME KRISHAN LALCHANDANI
AIR 28 ME SAILESH
AIR 29 ME ANUJ KUMAR MISHRA
AIR 36 ME ROHIT
AIR 44 ME ANSHUMAN ABHISHEK
AIR 53 ME PARANJAY DARBARI
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AIR 64 ME SIDDHARTH SHANKAR
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AIR 30 EE AKSHAY DUBEY
AIR 22 CE KRISHNA MOHAN
AIR 23 CE ISHAN SHRIVASTAVA
AIR 25 CE MUKUL JOSHI
AIR 26 CE NEERAJ SINGH
AIR 30 CE KASHISH KUKREJA
AIR 31 CE BIDYUT MONDAL
AIR 35 CE SHASHANK
AIR 38 CE RAHUL GUPTA
AIR 39 CE ANAND SURYAVANSHI
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AIR 49 CE ANAND AGRAWAL
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AIR 57 CE PRASOON KUMAR
AIR 58 CE DHEERAJ GOYAL
AIR 68 CE PANKAJ KR. GARG
AIR 69 CE MOHD. NUSRTULLAH KHAN
AIR 73 CE ARMAN SINGH PATEL
AIR 75 CE ASHISH KAMAL
AIR 77 CE MAHENDRA KR. SINGHMAR
AIR 78 CE NIPUN KUMAR
AIR 79 CE SURESH MANDA
AIR 80 CE SANDEEPIKA YADAV
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AIR 12 CE MUSALE GAUTAM SHIRISH
and Many More.....
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