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MPSC - 2018 (MAIN)

Questions with Detailed Solutions

CIVIL ENGINEERING

PAPER - II

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MPSC – 2018 (MAIN) Examination

Paper –II (Questions with Detailed Solutions)

01. For finding out time 't_2' required to achieve 50% consolidation of 1 m thick clayey strata resting on impermeable rock at bottom and sandy soil at top, a laboratory consolidation test was carried out, using 1 cm thick sample obtained from the same strata. Time 't_1' was taken by it to achieve 25% consolidation, under double drainage condition, in the laboratory.

Choose the correct value of ratio $\left(\frac{t_2}{t_1}\right)$ from the following:

(a) 4,00,000 (b) 16,000

(c) 1,60,000 (d) None of the above

01. Ans: (d)

02. The distance 'D' between centers of piles with top diameter 'd' should not be less than (from practical consideration)

(a) 2d (b) 3d (c) 4d (d) 5d

02. Ans: (b)

03. Match List-I and List-II and select the correct answer using the codes given below:

List-I (Construction Type)

A. Cut-off trench of a dam to be constructed across flowing river

B. Shallow foundation of a bridge pier

C. Sequential repetition of underwater foundation work

D. Control of groundwater to prevent entry into deep excavation

List-II (Suitable Cofferdam Type)

1. Cellular sheet pile cofferdam
2. Embankment type of cofferdam
3. Single wall sheet pile cofferdam
4. Floating steel cylinder cofferdam

Codes:

	A	B	C	D		A	B	C	D
(a)	4	3	2	1	(b)	2	1	4	3
(c)	2	3	1	4	(d)	3	4	2	1

03. Ans: (c)

04. The void ratio and porosity of a soil sample having equal volume of solids and volume of voids are

Void ratio	**Porosity**
(a) 1.0	100%
(b) 0.5	50%
(c) 1.0	50%
(d) 0.5	100%

04. Ans: (c)

Sol: Given $V_s = V_v$

$$e = \frac{V_v}{V_s} = 1$$

$$\text{Porosity} = \frac{e}{1+e} = \frac{1}{1+1} = \frac{1}{2} = 0.5$$

05. Let E_2 and E_1 represent compaction energy deployed for compacting soil as per modified compaction test and standard compaction test, as per IS:

Choose from the following correct ratio of $\left(\frac{E_2}{E_1}\right)$:

(a) About $4\frac{1}{2}$ times

(b) About $3\frac{1}{2}$ times

(c) About 2 times

(d) None of the above

05. Ans: (a)

Sol: $$\frac{\text{Modified compaction test}}{\text{Standard compaction test}} = \left(\frac{E_2}{E_1}\right)$$

$$= \frac{2682\ (\text{kg}/\text{m}^3)}{596(\text{kg}/\text{m}^3)} = 4.5 \text{ times}$$

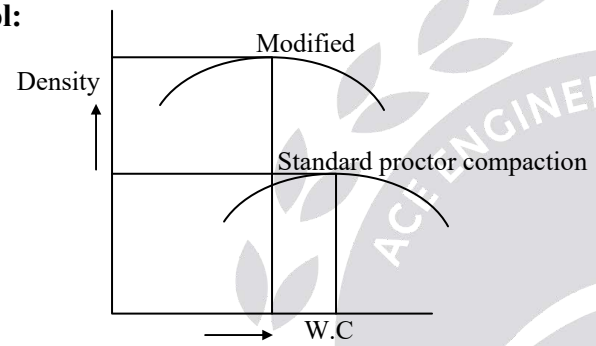
06. On the same soil sample, both Standard and Modified Proctor compaction tests are conducted in the laboratory. The values of Optimum Moisture Content (OMC) and Maximum Dry Density (MDD) for modified test compared to those for standard compaction test will respectively

(a) Increase, Increase (b) Decrease, Increase

(c) Increase, Decrease (d) No change, Increase

06. Ans: (b)

Sol:



OMC decrease

MDD increase

07. If the permeability, shrinkage and swelling of a compacted soil having same density on dry side of optimum moisture content is compared with compaction on wet side of optimum, the variation in these properties will be

(a) more, less, higher (b) more, more, higher

(c) more, more, less (d) less, less, higher

07. Ans: (b)

Sol: During drying, soil compacted in the wet side tend to show more shrinkage than those compacted in the dry side.

Swelling: Due to higher water deficiency and partially developed water films in the dry side, when given access to water, the soil will soak in much more water and then swell more.

Permeability is also more.

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08. An embankment has a slope of 30^o which was constructed with soil having C = 30 kN/m^2, $\phi = 20^o$ and γ = 15 kN/m^3. The height of embankment is 20 m. Using Taylor's stability no. $\frac{1}{40}$, the factor of safety with respect to cohesion is

(a) 0.25 (b) 2

(c) 4 (d) 1.5

08. Ans: (c)

Sol: $S = \frac{C}{F_c \gamma H}$

$$\frac{1}{40} = \frac{30}{F_c \times 15 \times 20}$$

$F_c = 4$

09. The degree of consolidation depends upon

(a) thickness of clay layer

b) coefficient of permeability

(c) co-efficient of consolidation

d) All the above

09. Ans: (d)

Sol: Degree of consolidation depends upon

1. Thickness of clay layer
2. Coefficient of permeability
3. Coefficient of consolidation

10. The loss of head due to sudden expansion of a pipe is given by

(a) $h_L = \frac{V_1^2 - V_2^2}{2g}$ (b) $h_L = \frac{0.5V^2}{2g}$

(c) $h_L = \frac{(V_1 - V_2)^2}{2g}$ (d) None of the above

10. Ans: (c)

Sol: Head loss at entrance to pipe = $0.5\frac{V_1^2}{2g}$

Head loss at sudden enlargement $h_L = \frac{(V_1 - V_2)^2}{2g}$

11. Bernoulli's equation is derived making assumption that
   (a) the flow is uniform and incompressible
   (b) the flow is non-viscous, uniform and steady
   (c) the flow is steady, non-viscous, incompressible and irrotational
   (d) None of the above

11. Ans: (c)

Sol: Assumption made in Bernoulli's equation

1. Ideal fluid
2. Stream lined flow
3. Irrotational flow
4. The gravity force and pressure force are only considered
5. Incompressible
6. Invisicid

12. For the laminar flow through a circular pipe
   (a) the maximum velocity = 1.5 times the average velocity
   (b) the maximum velocity = 2.0 times the average velocity
   (c) the maximum velocity = 2.5 times the average velocity
   (d) None of the above

12. Ans: (b)

Sol: $U_{max} = 2\ U_{avg}$

$U_{avg} = \frac{U_{max}}{2}$

13. Depth at which specific energy is minimum is known as

(a) Critical depth

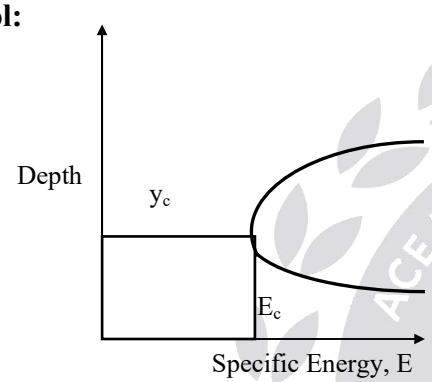
(b) Conjugate depth

(c) Alternate depth

d) Normal depth

13. Ans: (a)

Sol:



The critical depth has a Froude number equal to one and corresponds to the minimum energy a flow can posses for a given discharge.

14. In a rectangular channel section, if the channel depth is 2.0 m, the specific energy at critical depth is

(a) 3.0 m (b) 1.33 m

(c) 2.5 m (d) 1.5 m

14. Ans: (a)

Sol: $E_c = \frac{3}{2} y_c$

$= \frac{3}{2} \times 2$

$E_c = 3$ m

15. Which of the following statements is correct?
    (a) Centrifugal pumps convert mechanical energy into hydraulic energy by thrust of piston
    (b) Reciprocating pumps convert mechanical energy into hydraulic energy by means of centrifugal forces
    (c) Centrifugal pumps convert mechanical energy into hydraulic energy by means of centrifugal force
    (d) Reciprocating pumps convert hydraulic energy into mechanical energy

15. Ans: (c)

16. Dynamic viscosity (μ) has the dimensions as
    (a) MLT^{-2} (b) $ML^{-1}T^{-1}$
    (c) $ML^{-1}T^{-2}$ (d) $M^{-1}L^{-1}T^{-1}$

16. Ans: (b)

Sol: $\mu \rightarrow$ S.I Units kg/m-s
$\Rightarrow ML^{-1}T^{-1}$

17. The submerged body will be in stable equilibrium if
    (a) The centre of buoyancy B is below the centre of gravity G
    (b) The centre of buoyancy B coincides with G
    (c) The centre of buoyancy B is above the metacentre M
    (d) The centre of buoyancy B is above G

17. Ans: (d)

Sol: Submerged bottom heavy body is in stable equation.

18. Continuity equation deals with law of conservation of
    (a) mass (b) momentum
    (c) energy (d) None of the above

18. Ans: (a)

19. The discharge through a single-acting reciprocating pump is

(a) $Q = \frac{ALN}{60}$

(b) $Q = \frac{2ALN}{60}$

(c) $Q = ALN$

(d) $Q = 2ALN$

Where

A = cross-sectional area of cylinder or piston

L = length of stroke

N = r.p.m of the crank

19. Ans: (a)

20. A turbine is called impulse if at the inlet of the turbine

(a) total energy is only kinetic energy

(b) total energy is only pressure energy

(c) total energy is the sum of kinetic energy and pressure energy

(d) None of the above

20. Ans: (a)

21. During suction stroke of a reciprocating pump, the separation may take place

(a) at the end of suction stroke (b) in the middle of suction stroke

(c) at the beginning of suction stroke (d) None of the above

21. Ans: (c)

22. The specific speed (N_s) of a pump is given by the expression

(a) $N_s = \frac{N\sqrt{Q}}{H_m^{5/4}}$ (b) $N_s = \frac{N\sqrt{P}}{H_m^{3/4}}$

(c) $N_s = \frac{N\sqrt{Q}}{H_m^{3/4}}$ (d) $N_s = \frac{N\sqrt{P}}{H_m^{5/4}}$

22. Ans: (c)

23. Kaplan turbine is a/an

(a) impulse turbine

(b) radial flow impulse turbine

(c) axial flow reaction turbine

(d) radial flow reaction turbine

23. Ans: (c)

Sol: Kaplan turbine is an axial flow reaction turbine with adjustable blades.

24. A turbine is a device which converts

(a) Hydraulic energy into mechanical energy

(b) Mechanical energy into hydraulic energy

(c) Kinetic energy into mechanical energy

(d) Electrical energy into mechanical energy

24. Ans: (a)

Sol: Turbine is a device which converts hydraulic energy into mechanical energy.

25. In the inlet part of the jet impinging on a Pelton bucket, the velocity of whirl V_{w1} is equal to
    (a) absolute velocity of jet at inlet V_1 (b) relative velocity of jet at inlet V_{r1}
    (c) zero (d) None of the above

25. Ans: (a)

Sol: $V_{w1} = V_1$

26. If the turbine has kinetic energy and pressure energy of water at its inlet, then such turbine is known as
    (a) impulse turbine (b) reaction turbine
    (c) Pelton wheel turbine (d) low head turbine

26. Ans: (b)

Sol: Refer solution of Q.27

27. Which component is not provided to Pelton wheel turbine?
    (a) Penstock (b) Jet
    (c) Casing (d) Draft tube

27. Ans: (d)

Sol: In the pelton wheel the pressure remains same at the exit of rotor as well as at the exit of nozzle. It is mainly used in reaction turbines because it uses both pressure and kinetic energy of the fluid.

28. The artesian aquifer is one where
    (a) water surface under the ground is at atmospheric pressure
    (b) water table serves as upper surface of zone of saturation
    (c) water is under pressure between two impervious strata
    (d) None of the above

28. Ans: (c)

Sol: Confined Aquifer: It is also known as ***'artesian aquifer'.*** An aquifer confined between two impervious beds such as aquicludes or aquifuges. The water in the confined aquifer will be under pressure and hence the piezometric level will be much higher than the top level of the aquifer.

29. Lysimeter is used to measure

(a) Infiltration

(b) Evaporation

(c) Evapotranspiration

(d) Vapour pressure

29. Ans: (c)

Sol: Transpiration: Phytometer

Evapotranspiration: Lysimeter

30. Horton's infiltration capacity is given as

(a) $f = f_o + [f_c - f_o]e^{-kt}$

(b) $f = f_o - [f_c + f_o]\, e^{-kt}$

(c) $f = f_o - [f_c - f_o]\, e^{-kt}$

(d) $f = f_c + [f_o - f_c]\, e^{-kt}$

30. Ans: (d)

Sol: The infiltration rate (f_t) at any time 't' is given by Horton's equation.

$$f_t = f_c + (f_o - f_c)\, e^{-k.t}$$

Where,

f_o= initial rate of infiltration capacity

f_c = final constant rate of infiltration at saturation

k = a constant depending primarily upon soil and vegetation

e = base of the Napierian logarithm

t = time from beginning of the storm

31. Weibull formula is

(a) $P = \left(\frac{m}{N+1}\right)$ (b) $P = \left(\frac{m}{N-1}\right)$

(c) $P = \left(\frac{N+1}{m}\right)$ (d) $P = \left(\frac{N-1}{m}\right)$

(where m is order number and N is number of years of record)

31. Ans: (a)

Sol: California formula P=m/N

Hazen formula P=m-0.5/N

Weibull formula $P = \frac{m}{N+1}$

32. The term base flow denotes

(a) delayed groundwater flow reaching a stream

(b) delayed groundwater and snowmelt reaching a stream

(c) delayed groundwater and interflow

(d) the annual minimum flow in a stream

32. Ans: (a)

Sol: Base flow:

- The delayed flow that reaches a stream essentially as ground water flow.
- It includes ground water flow, delayed interflow

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33. Flowing is not the method of apportionment of total cost of multipurpose reservoir

(a) Remaining benefit method (b) Use of facilities method

(c) Equal apportionment (d) Direct method

33. Ans: (d)

Sol: The method of apportionment of total cost of multipurpose reservoir

1. Remaining benefit method
2. Use of facilities method
3. Equal apportionment
4. Alternative justifiable expenditure method

34. Owing to the storage effect, the peak of the outflow hydrograph will be smaller than that of the inflow hydrograph. This reduction in peak value is known as

(a) Lag (b) Attenuation

(c) Routing (d) Prism storage

34. Ans: (b)

Sol: Attenuation: When a flood hydrograph is routed through a reservoir, owing to the storage effect, the peak of the outflow hydrograph will be smaller than that of the inflow hydrograph. This reduction in the peak value is called 'attenuation'.

35. An IUH is a direct runoff hydrograph

(a) of one cm magnitude due to rainfall excess of 1-h duration

(b) that occurs instantaneously due to a rainfall excess of 1-h duration

(c) of unit rainfall excess precipitating instantaneously over the catchment

(d) occurring at any instant in long duration

35. Ans: (c)

Sol: Instantaneous unit Hydrograph (IUH):

- It is a UH of zero duration.
- It is a fictitious, conceptual UH.

It is independent of rainfall duration and indicates the catchment storage characteristics

36. The example of aquifuge is

(a) Clay layer (b) Sandy layer

(c) Solid granite rocks (d) Silty clay layer

36. Ans: (c)

Sol: Aquifuge: It is a geological formation which neither contains water nor transmits through it.

Eg: Compact rock

37. The ratio of the quantity of water stored in the root zone of the crops to the quantity of water actually delivered in the filed is

(a) Water conveyance efficiency

(b) Water application efficiency

(c) Water use efficiency

(d) None of the above

37. Ans: (b)

Sol: Water application efficiency (η_a):

$$\eta_a = \frac{Q_{plant}}{Q_{field}} \times 100$$

Q_{plant} = discharge to the root zone of soil during irrigation

Q_{field} = discharge delivered to field

38. In border strip method of irrigation, the width of strip is

(a) 5-10 m (b) 10-20 m

(c) 20-30 m (d) 25-30 m

38. Ans: (b)

Sol: Border strip method: Land to be irrigated is divided in to a series of long narrow strips about 10 to 20 m wide and 100 to 300 m long separated from each other by low levels or bunds and each strip is supplied water by the field channel

39. The duty of irrigation water for a given crop is maximum

(a) on the field (b) at the head of main canal

(c) at the head of water course (d) near the distributary

39. Ans: (a)

Sol: Duty of Water (D):

(a) Duty of water is defined as area of land irrigated per unit discharge of water

A = ha, Q = cumec, D = ha/cumec

(b) Duty is the most important factor in Water Resource Engineering.

(c) Duty of water varies from place to place, minimum at source and maximum at the utilisation point, i.e., the field.

40. A channel designed by Lacey's theory has a mean velocity of one m/s. The silt factor is unity. The hydraulic mean radius will be

(a) 2.5 m (b) 2.0 m

(c) 1.0 m (d) 0.5 m

40. Ans: (a)

Sol: Lacey's regime theory V = 1 m/s, f = 1

Hydraulic mean radius $R = 2.5\frac{V^2}{f} = 2.5 \times \frac{1}{1} = 2.5\,m$

41. In design of spillway when $H_e = H_d$, the value of 'C' is

(a) 1.00 (b) 1.33

(c) 2.00 (d) 2.20

41. Ans: (d)

Sol: Coefficient of discharge (C_d) depends upon height of Ogee spillway (H_e) and design head over the spillway (H_d).

$\frac{H_e}{H_d} = 1.0 \Rightarrow C_d = 2.2$

42. Hygroscopic water is defined as the

(a) readily available water for the use of plants

(b) water which is adsorbed by the particles of the dry soil from the atmosphere

(c) total water content of the soil when all pores are filled with water

(d) water held by the soil under capillary action

42. Ans: (b)

Sol: Hygroscopic Water:

- It is the unavailable water
- It is the water adsorbed by particles of dry soil from the atmosphere and is held as a thin film on the surface of soil particles.

43. In case of non-availability of space due to topography, the most suitable spillway is

(a) Straight drop spillway (b) Shaft spillway

(c) Chute spillway (d) Ogee spillway

43. Ans: (b)

Sol: Shaft spillway:

- Also called "drop inlet spillway " or "morning glory spillway".
- It has horizontally positioned lip through which water enters and then drops through a vertical or sloping shaft, and then to as horizontal conduit which conveys the water past the dam.
- A shaft spillway can be used where there is no adequate space for other types of spillways.
- On an earth dam location, if there is no enough space or if the topography prevents the use of the chute spillway, the best alternative would be the use "shaft spillway".

44. The channel after obtaining its section and longitudinal slope will be said to be in

(a) Initial regime

(b) Permanent regime

(c) Final regime

(d) Absolute regime

44. Ans: (c)

Sol: Lacey's Regime Theory: Lacey defined three regime conditions

Initial regime: When the channel has formed its section only, but not yet secured the longitudinal slope.

Final regime: When the channel attains its section and longitudinal slope.

True regime: A channel which satisfies the following conditions will be in true regime:

i. Discharge is constant
ii. Flow is uniform
iii. Silt charge and silt grade are constant
iv. Channel flows in incoherent alluvial soil
v. The alluvium soil is of same grade as transported.

45. The silt load in the stream does not depend upon

(a) nature of the soil in the catchment area (b) topography of the catchment area
(c) intensity of rainfall (d) alignment of dam

45. Ans: (d)

46. Match the design speed recommended for various roads by IRC 86:1983

List-I	**List-II**
A. Collector roads	1. 30 kmph
B. Local roads	2. 80 kmph
C. Arterial roads	3. 60 kmph
D. Sub-arterial roads	4. 50 kmph

Codes:

	A	**B**	**C**	**D**		**A**	**B**	**C**	**D**
(a)	2	1	4	3	(b)	3	1	2	4
(c)	4	1	2	3	(d)	2	4	3	1

46. Ans: (c)

Sol: As per IRC-86:1983 for urban roads

Road Classification	Design speed, kmph
Arterial roads	80
Sub-arterial roads	60
Local roads	50
Collector roads	30

47. IRC recommended % value of camber for different types of road surface can be arranged in descending order of following roads

1. Water bound macadam road
2. Thin bituminous surface road
3. Cement-concrete road
4. Earth road

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

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

47. Ans: (c)

Sol: Recommended values of camber for different types of road surfaces:

S.No	Type of road surface	Range of camber in areas of rainfall range	
		Heavy	Light
1	Cement concrete and high type bituminous surface	1 in 50 (2%)	1 in 60 (1.7%)
2	Thin bituminous surface	1 in 40 (2.5%)	1 in 50 (2.0 %)
3	WBM, gravel	1 in 33 (3%)	1 in 40 (2.5%)
4	Earth road	1 in 25 (4%)	1 in 33 (3%)

48. The expression for the length of a transition curve (L_s) in meters is

(a) $L_s = \frac{V^3}{CR}$ (b) $L_s = \frac{V^3}{16CR}$

(c) $L_s = \frac{V^3}{24CR}$ (d) $L_s = \frac{V^3}{46.5CR}$

where

C = Rate of change of radial acceleration in m/s^3

R = Radius of the circular curve in metres, and

V = Speed of vehicle in kmph

48. Ans: (a)

Sol: Length of Transition Curves (L_s) based on rate of change of radial (or centrifugal) acceleration:

$$L_s = \frac{v^3}{CR}$$

Where,

v = Velocity in 'm/sec'

R = radius of curve in 'm'

C = rate of change of centrifugal acceleration in m/s^3

$$L_s = \frac{v^3}{CR} = \left(\frac{V}{3.6}\right)^3 \times \frac{1}{CR} = \frac{V^3}{46.656CR} \simeq \frac{V^3}{46.5CR}$$

Where,

C = Rate of change of radial acceleration in m/s^3

R = Radius of the circular curve in metres, and

V = Speed of vehicle in kmph

49. The design speed adopted for design of rotaries in urban areas of India is

(a) 30 kmph (b) 40 kmph

(c) 50 kmph (d) 60 kmph

49. Ans: (a)

Sol: As per IRC code, Design Speed for Rotary Islands is as follows

30 kmph in urban areas

40 kmph in rural areas

50. Match the following:

List I	**List II**
A. Stop signs	1. Circular in shape
B. Give way signs	2. Equilateral triangle with its apex pointing upwards
C. Speed limit signs	3. Octagonal shape
D. Warning signs	4. Inverted triangle with its apex pointing downwards

Codes:

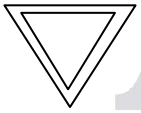
	A	**B**	**C**	**D**		**A**	**B**	**C**	**D**
(a)	1	2	3	4	(b)	2	1	3	4
(c)	3	4	1	2	(d)	4	3	2	1

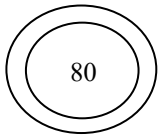
50. Ans: (c)

Sol:

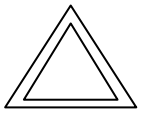
→ Stop Sign 

Octogonal shape

→ Give way sign  Inverted triangle with apex pointing downward

→ Speed Limit 

Circular shape

→ All warning signs  Triangle with its apex upwards

∴ Correct matching is A-3, B-4, C-1, D-2

51. The dowel bars are used in rigid pavements for

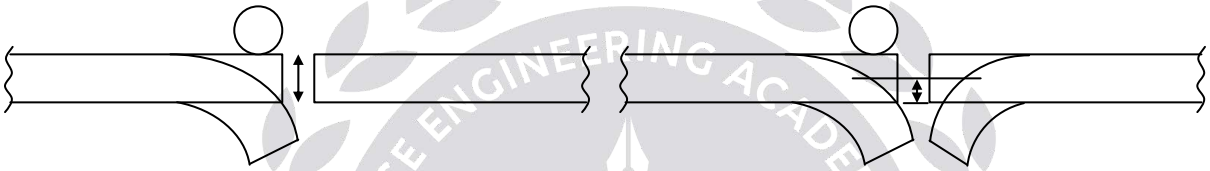
(a) resisting tensile stresses (b) resisting bending stresses

(c) resisting shear stresses (d) transferring load from one portion to another

51. Ans: (d)

Sol: Purpose of dowel bars is

1. to transfer the loads from one panel to other
2. To reduce differential deformation of two panels at transverse joint.



52. Group index method of designing flexible pavement is based on

1. Plasticity index
2. Shear strength
3. CBR value
4. Percent fines

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

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

52. Ans: (c)

Sol: Group Index (GI) of subgrade soil will be calculated as follows for the design of flexible pavement.

$GI = 0.2a + 0.005ac + 0.01bd$

$a = p - 35 \nearrow 40$; $b = p - 15 \nearrow 40$

$c = w_L - 40 \nearrow 20$; $d = I_p - 10 \nearrow 20$

$p \rightarrow$ % Fines passing 75μ sieve

$w_L \rightarrow$ Liquid limit

$I_p \rightarrow$ Plasticity index

53. Grade separation

1. is for crossing traffic
2. is to minimize delay and hazard
3. a cheaper option
4. increases discomfort and inconvenience

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

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

53. Ans: (c)

Sol:

- Grade separated intersections cause less hazard and delay.
- Main objective of grade separated intersection is to eliminate all grade crossing conflicts and to accommodate other intersecting maneuvers by merging, diverging and weaving at low relative speed.

∴ Statements 1 and 2 are true

54. Consider the following statements:

Collision diagram is used to

1. study accident patterns
2. eliminate accidents
3. determine remedial measures
4. make statistical analysis of accidents

(a) 1 and 2 are correct (b) 1 and 3 are correct

(c) 3 and 4 are correct (d) 2 and 4 are correct

54. Ans: (b)

Sol: Collision diagrams will represent the nature/pattern of accidents, based on which remedial measures can be proposed.

Conflict points are used to make statistical analysis of accidents.

Hence Statement 2 and 4 are wrong

Statement 1 and 3 are correct

55. A bridge has a linear waterway of 150 metres constructed across a stream whose natural linear waterway is 200 metres. If the average flood depth is 3 metres and average flood discharge is 1200 m^3/sec, the velocity of approach is

(a) 2.0 m/sec (b) 2.66 m/sec

(c) 6.0 m/sec (d) 8.0 m/sec

55. Ans: (b)

Sol: Linear water way, L = 150 m

Let A → Waterway

Average depth of flood, d = 3 m

Flood discharge, Q = 1200 m^3/s

We've $L = \frac{A}{d} \Rightarrow A = L \times d = 150 \times 3 = 450\ m^2$

$A = \frac{Q}{v} \Rightarrow v = \frac{Q}{A} = \frac{1200}{450} = 2.67$ m/s

56. The width of carriageway required will depend on the intensity and volume of traffic anticipated to use the bridge.

1. Except on minor village roads all bridges must provide for at least two lane width
2. The minimum width of carriageway is 4.25 m for one lane bridge
3. The minimum width of carriageway is 3.75 m for one lane bridge
4. The minimum width of carriageway is 7.5 m for two lane bridge

Which of the statements given above is/are *incorrect*?

(a) Only 1 (b) Only 1 and 3

(c) Only 1, 3 and 4 (d) Only 3

56. Ans: (d)

Sol: On bridges, carriage way width(CW) with rised kerbs will be used.

Hence width of CW = 4.25 m for one-lane bridge

= 7.5 m for two-lane bridge

= n × 3.5 + 0.5 for multi-lane bridge

Hence Statements 1 and 4 are true

and statement '3' is false.

And as per IRC, minimum 2-lane width will be taken for bridges except minor village road bridges

Statement '1' is correct.

57. Which of the following shall be considered while designing high level bridges for buoyancy effect?

(a) Full buoyancy for the superstructure

(b) Full buoyancy for the abutments

(c) Buoyancy forces due to submerged part of the substructure and foundation

(d) Partial buoyancy for superstructure

57. Ans: (c)

Sol: As per IRC, Buoyancy forces due to submerged part of the substructure and foundation will be used in design.

58. The normal depth of scour for alluvial rivers is determined by Lacey's formula

(a) $\sqrt{0.475}\left(\frac{f}{Q}\right)$ (b) $0.475\left(\frac{Q}{f}\right)^3$

(c) $0.475\sqrt[3]{\frac{f}{Q}}$ (d) $0.475\sqrt[3]{\frac{Q}{f}}$

58. Ans: (d)

Sol: Lacey's formula for normal scouring depth in alluvial streams

$$d = 0.475\left(\frac{Q}{f}\right)^{1/3} \times K = 0.475\sqrt[3]{\frac{Q}{f}} \times K$$

Where,

d = Depth of scouring in metres

Q = Discharge in cumecs

f = Lacey's silt factor

K = a constant. It varies according to the type of river flow

59. Roller bearings are used in bridges for the span of

(a) 18 to 24 m (b) 12 to 18 m

(c) 6 to 12 m (d) Up to 6m

59. Ans: (a)

Sol: Roller bearings are used in bridges for the span of 18 to 24 m.

60. The maximum scour depth dm for condition of flow at noses of piers is

(a) 1.50 d (b) 1.75 d

(c) 2.00 d (d) 2.75d

60. Ans: (c)

Sol: Lacey's formula for normal scouring depth in alluvial streams

$$d_{max} = K \times d$$

Where,

d = normal scouring depth

K = a constant. It varies according to the type of river flow

K = 1.27 for straight reach

= 1.50 for moderate bend

= 1.75 for sharp/severe bend

= **2.00 for 90° bend and at the nose of piers**

= 2.75 for up stream noses of guide banks.

Therefore **2times** maximum scour depth.

61. For high level bridges, the freeboard should not be less than

(a) 200 mm

(b) 400 mm

(c) 600 mm

(d) 800 mm

61. Ans: (c)

Sol: As **per IRC**

S.No	Type of Bridge	Free Board
1.	Arch bridges	30 cm
2.	Girder bridges	60–90 cm
3.	Navigable rivers	240–300 cm
4.	High level bridge	**60 cm = 600 mm**

62. As per IRC specifications, the minimum cement content in concrete is _____ for major bridges.

(a) 340 kg/m^3 (b) 350 kg/m^3

(c) 360 kg/m^3 (d) 370 kg/m^3

62. Ans: (c)

Sol: As per IRC 112:Code of practice for concrete road bridges

Minimum cement content for PCC is

- 250 kg/m^3 - for minor works
- 360 kg/m^3 - for major bridges

Minimum cement content for RCC is

- 310 kg/m^3 - for minor works
- 380 kg/m^3 - for major bridges

63. For IRC class A and B loading, the impact factor, for R. C. C. bridges having spans more than 45 metres, is taken as

(a) 0.078

(b) 0.088

(c) 0.098

(d) 0.154

63. Ans: (b)

Sol: For IRC class A and Class B loading, Impact factor is

$$I_f = \frac{A}{B+L}$$

$L \rightarrow$ span in 'm'

A = 4.5 - for RCC bridges

= 9 for steel bridges

B = 6 - for RCC bridges

= 13.5 - for steel bridges

Given RCC bridge of span 45 m

$\therefore$ L = 45 m; A = 4.5 and B = 6

$$I_f = \frac{4.5}{6+45} = 0.08823$$

64. Which pattern of the drilling is not used for shafts?

(a) Central wedge cut (b) End wedge cut

(c) Vertical wedge cut (d) Alternate wedge cut

64. Ans: (c)

Sol: For shafts:

- The most commonly used drilling patterns is central wedge cut for square and rectangular sections.
- For circular sections, sometimes wedge cut (or) pyramid cut is also used (end cut).
- When shafts are very large, drilling may be done in alternate wedge cut.

65. From the economy point of view, tunneling is advisable when the depth of open cut is more than

(a) 6 m (b) 12 m

(c) 18 m (d) 24 m

65. Ans: (c)

Sol: AS per economy consideration, tunnel is advisable if the depth of open cut is more than 60 ft (= 18.3m).

66. Match the following:

List I	List II
A. Firm ground	1. Needing instant support all round
B. Running ground	2. Needing instant support for roof
C. Self-supporting ground	3. No need of instant support for roof
D. Soft ground	4. Soil stands supported for short period and short length

Codes:

	A	B	C	D
(a)	1	2	3	4
(b)	4	2	1	3
(c)	3	1	4	2
(d)	4	3	2	1

66. Ans: (c)

Sol: Methods of tunnelling based on soil type

I. Soft soil which requires temporary support during and after construction.

II. Hard rocks (or) fully self supporting soil

I. Soft Soil Classification:

a. Running Ground: Needs instant support during excavation. Eg. Dry sand, gravel and silt etc.

b. Soft Ground: Roof needs instant support after excavation.

- Walls can withstand without support only for few minutes. Eg. Soft earth, clay and damp sand etc.

c. Firm Ground: Roof can withstand without support for few minutes.

- Walls can withstand for 1-2 hrs after excavation.

Eg. Dry earth, firm clay and cemented sand etc.

d. Self supporting Ground: Ground can stand unsupported while excavation is done for 1.5 to 5 m.

Eg. Sand stone, hard clay etc.

$\therefore$ Correct matching is A-3, B-1, C-4, D-2

67. Which of the following methods is suitable for the construction of large-sized railway or highway tunnels?

(a) Forepoling method (b) American method

(c) Case method (d) Full face method

67. Ans: (b)

Sol: Forepoling Method:

- Slow and tedious method requiring skilled miners.
- Suitable for tunnels of small dimension, for laying of sewers, gas pipes at ordinary depths.

American Method:

- Suitable for large sized railway/highway tunnels.

Case/Army Method:

- Suitable for constructing tunnels of small length and fairly shallow depth.
- Simple and economical method
- Mainly used for laying underground sewers.

Full Face method:

Adopted when length of tunnel is more than 3 m

Used for large sized tunnels in rocks.

68. Match the List I (Shape of Tunnel) with List II (Characteristics):

List I	**List II**
A. Circular section	1. Provides more working space
B. Horseshoe section	2. Provides greatest cross-sectional area for least perimeter
C. Egg shape	3. Vertical sides with flat floor
D. Segmental cross-section	4. Provides least cross-section area at the bottom

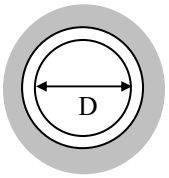
Codes:

	A	B	C	D		A	B	C	D
(a)	2	1	4	3	(b)	1	2	3	4
(c)	3	4	1	2	(d)	4	3	2	1

68. Ans: (a)

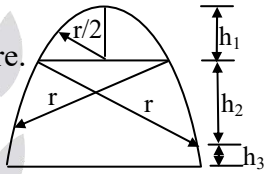
Sol: Circular Shape:

- Best theoretical section for resisting internal and external pressures.
- Provides great cross section area for least perimeter.
- Best suited in non cohesive soils.



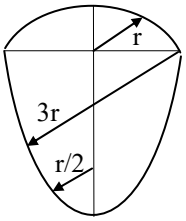
Horse Shoe Section:

- Most suitable for soft rocks
- When lined, this section offers a good resistance to external ground pressure.
- Since the floor is almost flat, more working space will be available to store materials during construction.



Egg Shape:

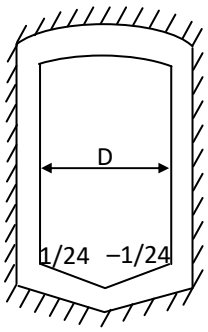
- Maintains self-cleaning velocity of flow of sewage in dry and rainy seasons.
- Circular side walls resists internal and external pressures.
- Lesser cross section at bottom and higher cross section at top.



Segmental Roof Section (D-Section):

- Roof takes external loads and transfer to the vertical RCC side walls.
- Most suited in rock tunnels.
- Additional working floor space is helpful during driving

∴ Correct matching is A-2, B-1, C-4, D-3



69. In order to maintain the desired shape of the tunnel, the cross section of the tunnel must be checked at a regular interval of

(a) 2 m to 3 m (b) 4 m to 6 m

(c) 5 m to 7 m (d) 8 m to 15 m

69. Ans: (a)

Sol: Cross section of tunnel must be checked at regular interval of 2-3 m for maintaining shape of tunnel.

70. ***Assertion (A):*** Faces for attacking the excavation and construction of tunnels are opened by constructing pilot tunnels.

***Reasoning (R)*:** Pilot tunnels are suitable at locations when horizontal approach to the centre line of tunnel is shorter than deep vertical shafts.

(a) Both (A) and (R) are true and (R) is the correct explanation of A

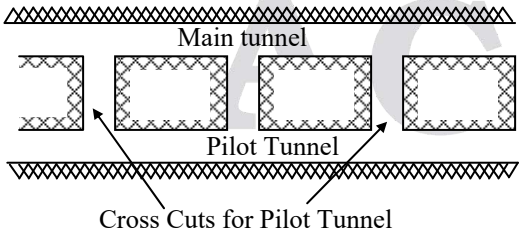
(b) (A) is true and (R) is false

(c) (A) is false and (R) is true

(d) Both (A) and (R) are false.

70. Ans: (a)

Sol: Pilot tunnels are used in locations, where horizontal approach to the centreline of the tunnel is shorter than deep vertical shaft, which will obtain additional faces for attack.



Hence Reason (R) is true.

Because of these pilot tunnels additional faces for attack will be opened (or) obtained as shown in fig.

Hence Assertion (A) is true.

And (R) is correction explanation of (A)

71. Which of the following methods is generally considered the most efficient system for ventilation of tunnels?

(a) Driving a shaft through the tunnel

(b) Driving a drift through the top portion

(c) Blow in method

(d) Combination of blowing and exhausting

71. Ans: (d)

Sol: Natural ventilation system (by shafts at regular interval and drift from portal to portal) are effective only for short tunnels.

Mechanical ventilation uses devices like electric fans, exhaust and blowers.

Types:

(a) Blowing: Fresh clean air is blown to the working face, with the help of pipes.

- When it flows back to the portal, it takes dust and gases with it.

(b) Exhausting:

- It incorporates an exhausting duct near the working face, into which, the foul air and dust are let out.
- By this fresh air is maintained within the tunnel.

(c) Combination of Blowing and Exhausting:

- This concept is developed, so that advantages of each system can be combined to make system of higher performance.
- After explosion (or) blasting, the exhaust system will operate for 15 to 30 minutes. This will remove harmful air immediately.
- After this, the blowing system works continuously to supply the fresh air till the next blasting.

72. In case of long tunnels, the drainage system consists of sump wells which are located at regular intervals of about

(a) 50 m to 100 m (b) 100 m to 200 m

(c) 200 m to 300 m (d) 300 m to 500 m

72. Ans: (d)

Sol: Temporary Drainage Systems:

Employed during construction of a tunnel.

Types

1. Open ditch drainage system:

- Simplest method
- Water may be moved in open ditches with proper slopes

2. Pumping system:

- Quantity of water that accumulates is collected in sumpwell and pumped out of the tunnel.
- For long tunnel it may be necessary to have more than one sumpwell.
- Usually sumps are located at regular interval of 300 to 500 m, a series of pump at each sump, will pick up the water and pumps back to the next sump.

73. Air valves or Air-relief valves are provided at

(a) Summits (b) Valleys

(c) All joints (d) None of the above

73. Ans: (a)

74. Which of the following treatments reduces salinity of water?

1. Alum coagulation, flocculation and settling
2. Carbon filtration
3. Reverse osmosis
4. Electro dialysis

(a) Only 1 and 2

(b) Only 2 and 3

(c) Only 3 and 4

(d) Only 2, 3 and 4

74. Ans: (c)

75. The minimum velocity of flow in a sewer should be ideally
    (a) equal to self-cleansing velocity
    (b) equal to non-scouring velocity
    (c) less than self-cleansing velocity
    (d) more than non-scouring velocity

75. Ans: (a)

76. Sewer lines having difference of more than 600 mm in the water lines and invert level of two sewers are connected with a
    (a) Siphon (b) Manhole
    (c) Inspection chamber (d) Drop manhole

76. Ans: (d)

77. Generally the period chosen for a standard B. O. D. test is
    (a) 1 day (b) 5 days
    (c) 8 days (d) 20 days

77. Ans: (b)

78. For rapid sand filter, sand should have the following specifications:
    (a) Effective size 0.1 – 0.5 mm
    Uniformity co-efficient = 2 to 4
    (b) Effective size 0.2 – 0.5 mm
    Uniformity co-efficient = 2 to 3
    (c) Effective size 0.45 – 0.7 mm
    Uniformity co-efficient = 1.3 to 1.7
    (d) Effective size 0.7 – 0.9 mm
    Uniformity co-efficient = 1 to 5

78. Ans: (c)

79. If waste water is disposed off into a natural stream, the maximum dissolved oxygen depletion occurs in the zone of

(a) degradation (b) active decomposition

(c) clearer water (d) recovery

79. Ans: (b)

Sol: The dissolved oxygen reduce to 0 in the zone of active decomposition.

80. In a sedimentation tank design, surface overflow rate (S.O.R.) is calculated as

(a) Surface area/velocity of water Q/V/V

(b) Discharge/plan area Q/B×L

(c) Volume of tank/discharge V/Q

(d) Surface area/settling velocity of the particle A/V_s

80. Ans: (b)

Sol: $\frac{SOR}{SLR}(V_o) = \frac{Q}{\text{Surface area}}$

$= \frac{Q}{B \times L}$

81. The waste water treatment unit which is installed to remove floating substances like grease, oil, fats, waxes, etc. is

(a) skimming tank

(b) detritus tank

(c) sedimentation tank

(d) None of the above

81. Ans: (a)

Sol: A skimming tank is a chamber so arranged that the floating matter like oil, fat, grease etc. rise and remain on the surface of the waste water (sewage) until removed, while the liquid floors out continuously under partitions (or) baffles.

82. An alidade in which one edge is bevelled is called as

(a) Soft edge (b) Fiducial edge

(c) Telescopic edge (d) Swivel edge

82. Ans: (b)

83. Contour interval is the

(a) vertical distance between two consecutive contours

(b) horizontal distance between two consecutive contours

(c) vertical distance between two points on the same contour

(d) horizontal distance between two points on the same contour

83. Ans: (a)

Sol: Contour Interval:

- The vertical distance between consecutive contours is termed as 'Contour interval'.
- It is desirable to have a constant contour interval throughout the map.

84. The length of a simple circular curve of radices R metres and intersection angle D degrees will be

(a) $R.\frac{D}{2}$ (b) $\frac{\pi}{180}.R.\frac{D}{2}$

(c) $\frac{\pi}{180}.R.\frac{D}{4}$ (d) $\frac{\pi}{180}.R.D$

84. Ans: (d)

Sol: Length of the curve:

Let the length of the curve $T_1 CT_2$ be l and let R be its radius.

Hence $l = R\Delta \Rightarrow$ ' Δ' radians

$= R\Delta \times \frac{\pi}{180^o} \Rightarrow \Delta$ is in degrees

85. The height of an instrument is the

(a) Height of the instrument above the ground

(b) Height between ground and telescope

(c) Elevation of the plane of sight

(d) Reduced level of station

85. Ans: (c)

Sol: Height of Instrument is the elevation of plane of sight with reference.

86. If a tachometer is fitted with an anallactic lens, then,

(a) Additive constant is 100 and multiplying constant is zero

(b) Multiplying constant is 100 and additive constant is zero

(c) Both additive and multiplying constants are 100

(d) Both multiplying and additive constants are 50

86. Ans: (b)

Sol: Anallactic lens:

In externally focusing telescope anallactic lens is a convex lens fitted between the diaphragm and the objective at a fixed distance from objective.

➤ The meaning of anallactic means un-alterable or invariable.

➤ By using anallactic lens the **multiplying constant (K) = 100 and**

Additive constant (C) = 0

87. Following is constant for a contour map:

(a) Horizontal equivalent (b) Benchmark

(c) Contour interval (d) Topography

87. Ans: (c)

Sol: Contour Interval:

➤ The vertical distance between consecutive contours is termed as 'Contour interval'.

➤ It is desirable to have a **constant** contour interval throughout the map

88. The combined correction due to curvature and refraction is given by

(a) $0.095\ d^2$ (b) $0.01122\ d^2$

(c) $0.06735\ d^2$ (d) $0.572\ d^2$

(where d is in km)

88. Ans: (c)

Sol: Curvature and Refraction:

(i) Combined Correction (C): ***(Negative)***

$$C = \frac{6}{7}\frac{d^2}{2R}\ (-ve)$$

$C = 0.06735\ d^2$ meters (–)

where 'd' is in 'km'

89. Reiteration method is also called as

(a) Method of series (b) Repetition method

(c) Direction method (d) Both (a) and (c)

89. Ans: (d)

90. The expression for sensitivity of the bubble tube (α) can be taken as, _____

Where n = No. of divisions s = Net staff reading

d = Distance R = Radius of curvature

l = Length of one division

(a) $\alpha = \frac{s}{nd} \times 206265\ \text{seconds}$

(b) $\alpha = \frac{d}{ns} \times 206265\ \text{seconds}$

(c) $\alpha = \frac{n\ell D}{R}\ \text{radiance}$

(d) $\alpha = \frac{s}{nR}.\frac{\ell}{D}$

90. Ans: (b)

Sol: Sensitivity of Bubble Tube:

Let α' = sensitivity of the bubble tube i.e angular value of one division, is given by

$$\therefore\ \alpha' = \frac{\ell}{R} \text{ radians}$$

$$\text{i.e } \alpha' = \frac{\ell}{\frac{n\ell D}{s}} = \frac{s}{nD} \text{ radians} \quad = \frac{s}{nD} \times 206265 \text{ seconds}$$

91. Closing error in theodolite traverse survey is given as

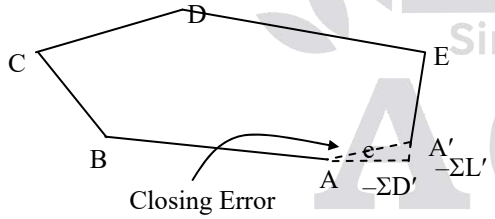
(a) $e = \sqrt{(\sum L^2 + \sum D^2)^2}$ (b) $e = \sqrt{(\sum L)^2 + (\sum D)^2}$

(c) $e = \sqrt{\sum L + \sum D}$ (d) $e = \sqrt{(\sum L)^2 - (\sum D)^2}$

91. Ans: (b)

Sol: Closing error:

If a closed traverse is plotted according to the field measurements, the end point of traverse will not coincide exactly with the starting point, owing to the errors in the field measurements of angles and distances. Such an error is known as closing error.



Closing error, $e = \sqrt{(-\sum L')^2 + (-\sum D')^2}$

92. If the length of 16 mm diameter bar is 10 m, then its weight is

(a) 16.5 kg (b) 16.9 kg

(c) 15.8 kg (d) 16.2 kg

92. Ans: (c)

Sol: Length of bar 'l' = 10 m

Diameter of bar 'd' = 16 mm = 0.016 m

Total weight of bar = ?

Formula

$$\text{Total weight} = \frac{d^2}{162} \times \ell \quad \text{('d' in mm, '}l\text{' in m)}$$

$$\text{Total weight} = \frac{16^2}{162} \times 10 \quad \text{('d' in 'mm' only)}$$

Total weight = 15.8 kg

93. Security deposit is

(a) deposited at the time of filling tender

(b) deposited by the contractor whose tender is accepted

(c) deposited at the time of opening tenders

(d) deposited for fair competition

93. Ans: (b)

Sol: Security deposit is deposited by the contractor whose tender is accepted in order to do the work effectively and refunded after one monsoon season/6 months which ever is more time period.

94. In order to compute the quantities of R.C.C. beams, lengths of beams are measured to the

(a) nearest millimetre

(b) nearest half centimetre

(c) nearest centimeter

(d) nearest inch

94. Ans: (a)

Sol: For accurate estimation the length, breadth and height are measured to the nearest 0.001 m = nearest millimeter.

95. In case of which type of contract, unbalanced tender is ***not*** possible?

(a) Open tender (b) Item rate contract

(c) Percentage rate contract (d) Unit price contract

95. Ans: (b & d)

Sol: In item rate contract rates are fixed for each item separately

- The amount to be received by the contractor depends on the work done.
- If any imbalances happens in the rates the contractor may stop the work so unbalanced tender is not possible.

96. Which of the following types of contract is used for execution of large works financed by public bodies or the government?

(a) Item rate contract (b) Percentage rate contract

(c) Cost plus type contract (d) Target contract

96. Ans: (b)

Sol:

- In Government works profit percentage is given as profit to the contractor'
- Cost plus is not used in government works and item rate, target cannot be fixed for huge projects perfectly.

97. ***Assertion (A):*** Earnest money deposit is usually 1% to 2% of the total estimated cost of work.

Reasoning (R):Earnest money deposit prevents unnecessary and unhealthy competition.

(a) Both (A) and (R) are true (b) Both (A) and (R) are false

(c) (A) is true and (R) is false (d) (A) is false and (R) is true

97. Ans: (a)

Sol: Earnest Money Deposit (EMD) is must (1-2)% of project cost and is need to be submitted along with tender document so that only worthy persons goes for tendering.

EMD is refundable for those who do not get contract.

98. Equation for cement requirement in tones for four-storey R.C.C. framed building (super structure) recommended by C. B. R. I. is

(a) 0.153 A + 0.57 (b) 0.145A + 0.54

(c) 0.182 A – 0.35 (d) 2.26A + 66.8

(where A is plinth area in sq.mt)

98. Ans: (c)

Sol: Cement required in tonnes = 0.0204A – 0.014

A = plinth area

Approximately answer is (c).

99. While submitting tender by three envelope method, which envelope contains rates/amount offered by the tenderer?

(a) Envelop :3 (b) Envelop nos: 1 and 2

(c) Envelop :1 (d) None of the above

99. Ans: (a)

Sol: Envelope I - Document related to eligibility criteria

Envelope II - Technical bid

Envelope III - Financial bid

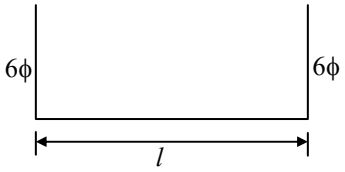
100. The length of L-bend for Tor steel to be provided at each end of the reinforcing bars is

(a) 12 times diameter (b) 6 times diameter

(c) 3 times diameter (d) 150 mm

100. Ans: (b)

Sol:



Total length = $l + 6\phi + 6\phi = l + 12\phi$

For one 'L' bend the length required is 6ϕ (ϕ-diameter)

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