MEGA MOCK CHALLENGE

gradeup

BPSC AE

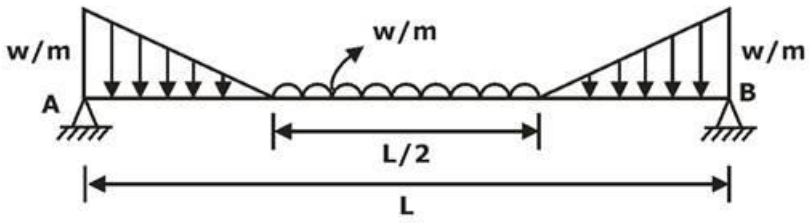
Civil Engineering

Mini Mock Challenge

(August 26th - August 27th 2021)

Questions & Solutions

1. Calculate bending moment at mid span of simply supported beam as shown.



A. $\frac{13}{96}WL^2$

B. $\frac{12}{96}WL^2$

C. $\frac{5}{48}WL^2$

D. $\frac{25}{48}WL^2$

Ans. C

Sol. $2R_A = \frac{WL}{2} + 2 \times \frac{1}{2} \times W \times \frac{L}{4} = \frac{3}{4}WL$

$R_A = \frac{3}{8}WL$

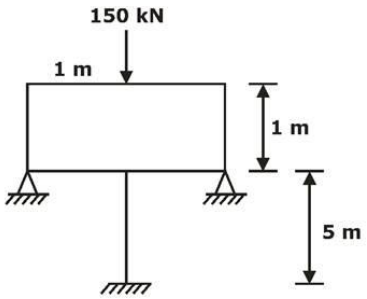
B.M. at Midspan :

$\Rightarrow \frac{3}{8}WL \times \frac{L}{2} - \frac{1}{2} \times W \times \frac{L}{4} \times \left(\frac{L}{4} + \frac{2}{3} \times \frac{L}{4}\right) - \frac{WL}{4} \times \frac{1}{8}$

$\Rightarrow \frac{3WL^2}{16} - \frac{5WL^2}{96} - \frac{WL^2}{32}$

$\Rightarrow \frac{5WL^2}{48}$

2. What is the bending moment at fixed support?



A. 150 kN-m

B. 75 kN-m

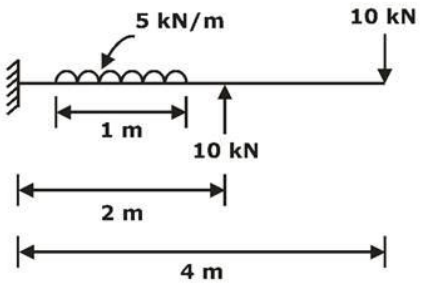
C. 300 kN-m

D. Zero

Ans. D

Sol. Since applied load is passing through fixed support, so this will generate zero bending moment. Also reaction supports at left and right side must be equal and they counter the bending moment at fixed end. Hence bending moment at fixed end should be zero.

3. Calculate fixed end moment for beam shown in figure.



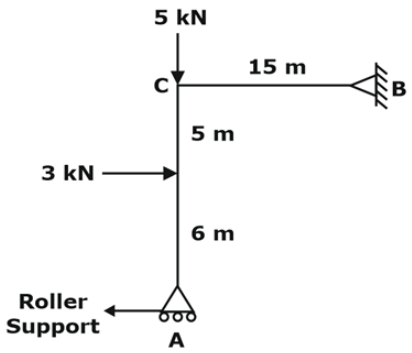
A. 25 kN-m
B. 50 kN-m
C. 100 kN-m
D. 40 kN-m

Ans. A

Sol. $M_{fix} + 10 \times 4 - 10 \times 2 + (5 \times 1) \times 1 = 0$

$M_{fix} = -25$ kN-m

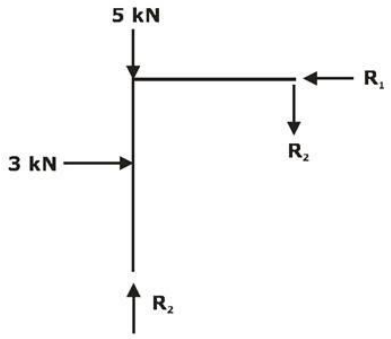
4. Calculate bending moment at C.



A. 30 kN-m
B. 15 kN-m
C. Zero
D. 7.5 kN-m

Ans. B

Sol.



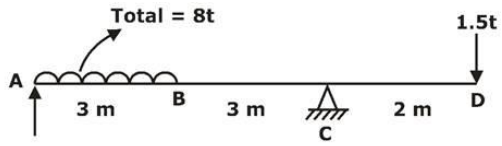
$R_1 = 3$ kN, $R_3 - R_2 = 5$

$(R_3 - 5) \times 15 - 3 \times 5 = 0$

$R_3 = 6$ kN, $R_2 = 1$ kN, $R_1 = 3$ kN

$M_C = R_2 \times 15 = 1 \times 15 = 15$ kN-m

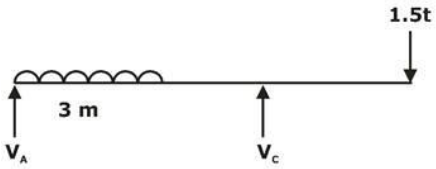
5. Determine the location of maximum bending moment



A. 3 m
B. 5.0625 m
C. 2.0625 m
D. 2.625 m

Ans. C

Sol.



Taking moment about A,

$$V_c \times 6 = 8 \times \frac{3}{2} + 1.5 \times 8$$

V_c = 4t

V_A = 8 + 1.5 – 4 = 5.5t

Maximum bending moment will occur at zero shear force.

Assuming x from end A

$$S.F_x = 5.5 - \frac{8}{3} \times x = 0$$

x = 2.0625 m from A

6. For a circular column section, how much savings in material can be achieved by using a hollow section as compared to a solid section if the external diameter of the hollow section is two times is its internal diameter? Assume all other relevant quantities to be the same.

A. 45
B. 34
C. 23
D. 11

Ans. C

Sol. If everything else is same, the load carrying capacity is a function of moment of inertia of the section.

Let us assume that we're using a hollow section with 200 mm external dia and 100 mm internal dia

For hollow section:

Area = 23562 mm^2

MoI = 73.631×10^6 mm^4.

For solid section: MoI will remain same

MoI = $(\pi/64)d^4$ = 73.631×10^6 mm^4

or, d = 196.8 mm

And, Area = 30418.4 mm^2

% saving = (30418.4-23562)/ 30418.4 = 22.54%

7. The natural frequency of a mass m at the end of the cantilever beam of negligible mass with usual notations will be

A. $\frac{1}{2\pi}\left(\frac{3EI}{mL^3}\right)^{\frac{1}{2}}$ B. $\frac{1}{\pi}\left(\frac{6EI}{mL^3}\right)^{\frac{1}{2}}$

C. $\frac{1}{2}\left(\frac{6EI}{mL^3}\right)^{\frac{1}{2}}$ D. $\frac{1}{\pi}\left(\frac{3EI}{mL^3}\right)^{\frac{1}{2}}$

Ans. A

Sol. $K = \frac{3EI}{l^3}$ = Stiffness of cantilever beam

ω_{nf} = Angular Natural frequency = $\sqrt{\frac{k}{m}}$

Where m = $\omega_{nf} = \sqrt{\frac{3EI}{l^3.m}}$

m = applied mass at the tip of cantilever

$\Rightarrow \omega_{nf} = 2\pi f_n$; f_n = linear × natural frequency

ω_{nf} = Angular Natural frequncy

$\Rightarrow f_n = \frac{1}{2\pi}\sqrt{\frac{3EI}{m.l^3}}$

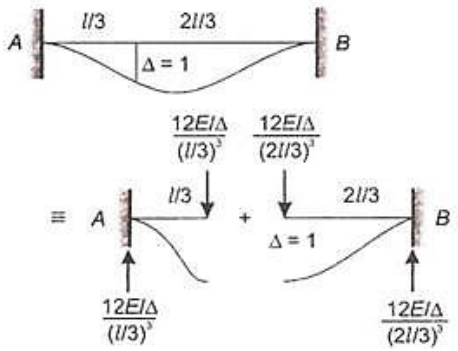
8. The forces required, in N, to produce 1m displacement (translation without rotation) at either one- third point of a fixed beam of span l and of uniform flexural rigidity EI is if EI=1N-m^2 and l = 1m.

A. 729 B. 724

C. 242 D. 364.5

Ans. D

Sol.



$$P=\frac{12EI\Delta}{\left(l/3\right)^2}+\frac{12EI\Delta}{\left(2l/3\right)^2}=\frac{729EI}{2l^3}(\Delta=1)$$

EI=1

l=1

hence P=364.5N

9. The maximum compressive stress in concrete for design purposes is based on a partial safety factor of

A. 1.55 B. 1.50

C. 1.85 D. 2.20

Ans. B

Sol. As per IS 456:2000 FOS for concrete is taken as 1.5

10. The creep strains are

A. caused due to dead loads only

B. caused due to live loads only

C. caused due to both dead load and live loads

D. independent of loads

Ans. A

Sol. Creep occur's due to constant load acting for a long time its load should be constant hence creep strain depends on dead load only.

11. Due to shrinkage stresses, simply supported beam having reinforcement only at the bottom tends to deflect

A. downward B. upward

C. downward or upward D. None of the above

Ans. A

Sol. when there is only tension reinforcement provided at the bottom end the curvature due to shrinkage deflection will be same as the curvature of the reinforcement.

As in a simply supported beam the beam deflects downward due to loading the reinforcement will also deflect downward.

So the deflection due to shrinkage stresses in a simply supported beam having reinforcement only at the bottom ends will occur in downward direction.

12. Normally prestressing wires are arranged in the

A. upper part of the beam B. lower part of the beam

C. centre D. anywhere

Ans. B

Sol. In prestressing beam, the wires are arranged in the lower part of the beam because lower part subjected to tension.

13. A steel column is restrained against both translation and rotation at one end and is restrained only against rotation but free to translate at the other end. Theoretical and design (IS: 800 – 2007) values, respectively, of effective length factor of the column are

A. 1 and 1.2 B. 1.2 and 1.2

C. 1 and 1 D. 1.2 and 1

Ans. A

Sol. A steel column is restrained against both translation and rotation at one end and is restrained only against rotation but free to translate at the otner end. Theoretical and design (IS: 800 2007) values, respectively, of effective length factor of the column are 1 and 1.2.

14. The height to diameter ratio of cylindrical specimen for uniaxial compression test of concrete is :

A. 0.50 B. 0.30

C. 0.25 D. 2.00

Ans. D

Sol. Test specimens recommended for compressive strength test are 150 × 150 × 150 mm cubes or cylinders of 150 mm diameter and 300 mm height.

15. Most chemically active concrete aggregate are from:

A. Igneous rock B. Sedimentary rock

C. Metamorphic rock D. Sand stones

Ans. A

Sol. Most chemically active concrete aggregates are from igneous rocks.

16. As per Indian standard code 1077, the burnt clay building bricks having compressive strength less than _____ N/mm^2 are known as common brunt clay bricks

A. 3.5 B. 12.5

C. 30 D. 40

Ans. D

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

17. The paint which has high reflective property is:

A. cellulose paint B. casein paint

C. bronze paint D. enamel paint

Ans. C

Sol. The paint which has high reflective property is bronze paint which is widely used as radiator paint.

18. If the time required for 60% consolidation of a remolded soil sample of clay with single drainage is 't' then what is the time required to consolidate the same sample of clay with the same degree of consolidation but with double drainage?

A. 4t B. 2t

C. t/2 D. t/4

Ans. D

Sol. For SAME DEGREE of consolidation,

$$\frac{t_1}{t_2} = \left(\frac{d_1}{d_2}\right)^2$$

Single drainage $t_1 = t; d_1 = H$

Double drainage $t_2 = ?; d_2 = H/2$

$$\therefore \quad t_2 = t \times \left(\frac{H/2}{H}\right)^2 = \frac{t}{4}$$

19. A soil having coefficient of permeability 2×10^{-8} cm/sec can be classified as

A. Highly permeable soil B. Medium permeable soil

C. Low permeable soil D. impermeable soil

Ans. D

Sol. The soil having coefficient of permeability less than 10^{-7} cm/s are almost impermeable in nature.

20. A soil sample has shrinkage limit of 6%, and the specific gravity of the soil grains is 2.6. The porosity of soil at shrinkage limit is

A. 7.5% B. 9.5%

C. 13.5% D. 16.5%

Ans. C

Sol. $\omega_s = 6\%\ G_s = 2.6$

At shrinkage limit, soil is fully saturated.

Now $Se = \omega G_s$

$1 \times e = 0.06 \times 2.6$

$e = 0.156$

$$n = \frac{e}{1+e} = \frac{0.156}{1+0.156} = 0.135$$

21. Match **List-I** (Unit) with **List-II** (Purpose) and select the correct answer using the codes given below the lists:

List-I

A). Graded filter

B). Lime treatment

C). Impervious clay core

D). Curtain grouting

List-II

1). To reduce seepage of water through boby of earth dam

2). To reduce water seepage through foundation below dam

3). To stabilize black cotton soils

4). To drain water without losing fines form the soil

A. A-4, B-3, C-1, D-2 B. A-1, B-2, C-4, D-3

C. A-4, B-2, C-1, D-3 D. A-1, B-3, C-4, D-2

Ans. A

Sol. Lime treatment reduces liquid limit slightly and increase plastic limit immensely. so there is reduction in plasticity index.

22. A footing is resting on fully saturated clayey strata. For checking the initial stability, shear parameters are used from which one of the following

A. Consolidated non-drained tests

B. Unconsolidated drained tests

C. Unconsolidated non-drained tests

D. Unconsolidated non-drained tests with pore pressure measurement

Ans. D

Sol. **For checking initial stability, shear parameters aee used from Unconsolidated Undrained test with pore pressure measurement.**

23. Calculate net ultimate bearing capacity as per Skempton's method of a circular raft footing on a pure clayey soil when depth of the footing is 1 m below the ground level and radius of the footing is 80 cm cohesion value of the soil is 30 kN/m^2:

A. 168.75 kN/m^2 B. 202.50 kN/m^2

C. 303.75 kN/m^2 D. 292.50 kN/m^2

Ans. B

Sol. By skempton's method,

$q_{nv} = c \cdot N_c$

$N_c = 6\left(1 + 0.2\frac{D_f}{B}\right)$ when $0 \le \frac{D_f}{B} \le 2.5$

Here D_f = 1m, D/B = 1.6 m [$\because$ R = 80 cm, D = 160 cm = 1.6 m]

So, $N_c = 6 \times \left(1 + 0.2 \times \frac{1}{1.6}\right) = 6.75$

So, $q_{nv} = 30 \times 6.75 = 202.50$ kN/m^2

24. Which of following pile types is typically used in water front structures?

A. Compaction pile
B. Anchor pile
C. Fender pile
D. Tension pile

Ans. C

Sol. Compaction pile → for compaction of sand on side
Fender pile → used in water front structure.

25. The dimensions of dynamic viscosity are

A. $\frac{L^2}{T}$
B. $\frac{M}{LT}$
C. $\frac{MT}{L}$
D. $\frac{T}{L^2}$

Ans. B

Sol. $\tau = \mu \frac{dv}{dy}$

$$\frac{N}{m^2} = (\mu)\frac{m/s}{m}$$

$$\Rightarrow \mu = \frac{NS}{m^2} = \frac{kg}{m-s}$$

$$[\mu] = (ML^{-1}T^{-1})$$

26. The discharge of water through a rectangular channel of width 8 m is 15m^3/sec when the depth of flow of water is 1 .2 m. The specific energy of the flowing water is

A. 1.324 m
B. 2.824 m
C. 3.124 m
D. 4.123 m

Ans. A

Sol. Specific energy $= y + \frac{V^2}{2g}$

$$1.2 + \frac{\left(\frac{15}{8 \times 1.2}\right)^2}{2 \times 9.81} = 1.324 \text{ m}$$

27. Find the height of a mountain if pressure measured at its base and top are 74 cm and 60 cm of mercury respectively. Specific weight of air is 11.97 N/m^3 :

A. 1000 m
B. 1750 m
C. 2600 m
D. 1560 m

Ans. D

Sol. Difference in level of mercury= 74-60=14 cm

$$\Delta P = \rho g h$$

$$13.7 \text{x} 9.81 \times 10^3 N/m^3 \times 0.14m = H \times 11.97 N/m^3$$

$$H = 156374.24cm$$

$$H \approx 1560m$$

28. Which of the following pumps is suitable for small discharge and high head?

A. Centrifugal pump
B. Axial flow pump
C. Mixed flow pump
D. Reciprocating pump

Ans. D

Sol. Centrifugal and axial flow pump-large discharge and lower head.
Reciprocating pump-small discharge and high head.

29. Two throw reciprocating pumps mean:

A. Double acting pump
B. Double reciprocating pump
C. Duplex double acting pump
D. Double cylindrical pump

Ans. D

Sol. Two throw reciprocating pumps is same as double cylindrical pump.

30. The power channel that extends from the intake works to the power house is called:

A. Head race
B. Penstock
C. Diversion canal
D. None of these

Ans. A

Sol. The power channel that extends from the intake works to the power house is head race.

31. Ordinate of IUH are as shown below

Time	0	1	2	3
$Q(m^2/s)$	0	6	16	20

What is the ordinate of 1-h UH at t = 2h

A. 8 m^3/s
B. 11 m^3/s
C. 10 m^3/s
D. 17.5 m^3/s

Ans. B

Sol. Ordinate of 1h UH at time t is given by

$$(D_1 \text{ hour UH})_t = \frac{1}{2}\left[(IUH)_t + (IUH)_{t-D_1}\right]$$

$$= \frac{1}{2} \times [16+6] = 11\ m^3/s$$

32. Statement (I): shape of the recession limb of the hydrograph is independent of the storm characteristics.
Statement (II): Depletion of storage from the catchment takes place after the cessation of rainfall.

A. a
B. b
C. c
D. d

Ans. A

Sol. Since the depletion of storage takes place after cessation of rainfall, hence shape of falling limb of the hydrograph depends only upon the basin characteristics and independent of the storm characteristics.

Hence both statements are correct and statement (II) is the correct explanation of the statement (I).

33. A regime canal carries silt of size 0.25 mm. If the velocity of 0.44 m/sec then hydraulic mean depth will be

A. 0.55 m B. 0.97 m

C. 1.03 m D. 1.25 m

Ans. A

Sol.

$f = 1.76\sqrt{0.25} = 0.88$

$R = 2.5\frac{V^2}{f} = 2.5 \times \frac{0.44^2}{0.88} = 0.55$ m

34. Statement (I): Installation of water meters in the field will decrease the 'Duty' of water for that field.

Statement (II): Due to installation of water meter, the farmer will use water more economically.

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 explanation of statement (I).

C. Statement (I) is true; but statement (II) is false

D. Statement (I) is false; but statement (II) is true

Ans. D

Sol. Due to installation of water meter in the field, the farmer will use the water more economically, hence same area of field can be irrigated by lesser amount of water. Hence duty will be high.

35. Bump integrator equipment is used to

A. measure pavement surface condition B. find pavement deflection

C. fix chamber value D. Find design speed

Ans. A

Sol. Bump integrator also known as roughometer automatic road unevenness recorder gives quantitative integrated evaluation of surface irregularities on a digital counter/LCD screen. An unevenness index of less than 1500 mm/km is considered as good, a value less than 2500 mm/km is satisfactory up to speed of loo kmph and values greater than 3200 mm/km is considered as uncomfortable even for 55 kmph.

36. Determine the safe slopping flight distance for design speed of 14 m/s for two lane road assuming the coefficient of friction as 0.28 and a reaction time of 2 seconds.

A. 63.67 m
B. 61.47 m
C. 53.27 m
D. 73.57 m

Ans. A

Sol. $SSD = vt + \frac{v^2}{2gf}$

$= 14 \times 2 + \frac{(14)^2}{2 \times 9.81 \times 0.28}$

$= 63.67m$

37. Which of the following is considered to be the highest quality construction in the group of black top pavements

A. Bituminous carpet
B. Bituminous concrete
C. Mastic asphalt
D. Sheet asphalt

Ans. B

Sol. Bituminous concrete is considered to be of best quality in pavements since it has properties of both bitumen and concrete. It is strong, durable and water resistant.

38. Which of the following is used in a regular pavement maintenance activity?

A. Tack coat
B. Prime coat
C. Fog seal
D. None of these are correct

Ans. C

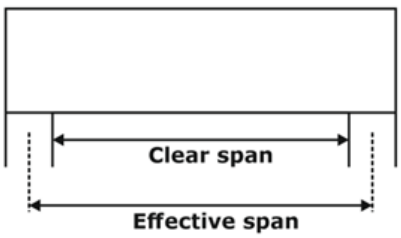
Sol. A fog seal is a light application of a diluted slow setting asphalt emulsion to the surface of an aged (oxidized) pavement surface. Fog seals are low cost and are used to restore flexibility to an existing pavement surface.

39. The centre – to centre distance between any two adjacent supports is called the _____ of a bridge.

A. Span
B. Clear span
C. Nominal span
D. Effective span

Ans. D

Sol.



40. The basic runways length should be increased at the rate of X percent per Y m rise in elevation above mean sea level, where

A. X = 6; Y = 200
B. X = 7; Y = 300
C. X = 7; Y = 200
D. X = 6; Y = 300

Ans. B

Sol. Elevation correction for basic runway length is applied as runway length be increased by 7% for every 300 m elevation from MSL.

41. If the length of overland flow from the critical point to the mouth of drain is 13.58 Km and difference in level between the critical point and drain mouth is 10 m, the inlet time is

A. 2 hours
B. 4 hours
C. 6 hours
D. 8 hours

Ans. D

Sol. The inlet time can be calculated by:

$$Ti = \left(0.885\frac{L^3}{H}\right)^{0.385}$$

$$Given, L = 13.58$$

$$H = 10$$

$$Ti = \left(0.885\times\frac{13.58^3}{10}\right)^{0.385} = (221.6371)^{0.385} = 7.9997 = 8$$

42. A grit chamber of dimension 15 m x 2 m x 0.8 m liquid depth flow of 800 m^3/hr. Its detention time is

A. 0.6 minute
B. 1.2 minutes
C. 1.5 minutes
D. 1.8 minutes

Ans. D

Sol. Discharge, Q = 800 m^3/hr

Chamber dimension = 15 m x 2 m x 0.8 m

Volume of grit chamber, V = 15 x 2 x 0.8 = 24

Detention time, $T = \frac{V}{Q}x60 = \frac{24}{800}x60 = 1.8 \text{ minutes}$

43. What is the maximum permissible limit of fluoride in drinking water?

A. 1.2 mg/l
B. 1.5 mg/l
C. 3.0 mg/l
D. 0.5 mg/l

Ans. B

Sol. Maximum permissible limit of fluoride = 1.5 mg/l

Acceptable limit of fluoride= 1 mg/l

44. For a grit channel, if the recommended flow velocity is 0.25 m/s and the detention period is 1 minute, then length of the tank is:

A. 15 m
B. 25 m
C. 32.5 m
D. 40 m

Ans. A

Sol. Length = Flow velocity x Detention time

Length = 0.25 x 60

Length = 15 m

45. Effluent from wastewater treatment plant (flow rate = 6 m^3/s, Temperature = 25^0C) is discharged to a surface stream (Flow rate 1.2 m^3/s, Temperature = 15^0C). What is the temperature of the stream after mixing?

A. 10^0C
B. 15.77^0 C
C. 20^0C
D. 23.33^0C

Ans. D

Sol. Temperature of the mix = $T_{mix} = \frac{Q_1T_1+Q_2T_2}{Q_1+Q_2} = \frac{6\ x\ 25+1.2\ x\ 15}{6+1.2}$ = 23.33 ^{0}C

46. The branch of surveying where the curvature of the earth is considered is

A. Geodetic surveying
B. Plane surveying
C. Chain surveying
D. Reconnaissance surveying

Ans. A

Sol. Geodetic surveying is the branch of surveying which considers the true curvature of the earth. This type of surveying is carried out over a large extend of areas and is considered as more accurate than plane surveying where the curvature of earth is not considered.

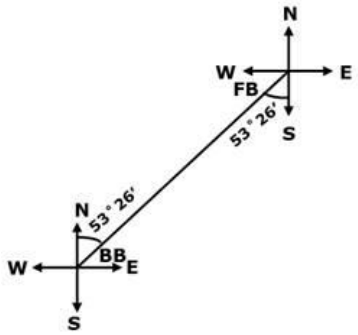
47. The fore bearing of a line is S 53°26′ W. If there is no local attraction, the back bearing of this line will be:

A. S 36°34′W
B. S 53°26′ E
C. N 36°34′ W
D. N 53°26′ E

Ans. D

Sol. Fore bearing = S 53°26′ W

Back bearing = N 53°26′ E



If the bearing is in quadrantal or reduced bearing system, in order to convert the fore bearing to back bearing it is only necessary to change the cardinal points by substituting N for S and E for W and vice versa. The numerical value of the bearing will remain the same.

48. The size of a theodolite is denoted by

A. the diameter of the upper plate
B. the diameter of the lower plate
C. the diameter of the vertical circle
D. least count of the instrument.

Ans. B

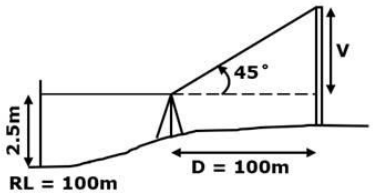
Sol. The size of a theodolite is denoted by the diameter of the scale plate or lower plate.
For example, an 80mm theodolite will have its diameter of lower plate as 80 mm.

49. The angle of elevation to the top of a tower is measured as 45°00′ using a theodolite placed at a distance of 100m from the tower. The staff reading held at a station of RL 100m was 2.5m, the telescope being horizontal. The reduced level of the top of the tower is

A. 100m
B. 200m
C. 202.5m
D. 102.5m

Ans. C

Sol.



$$V = D \times \tan\alpha = 100 \times \tan 45 = 100m$$

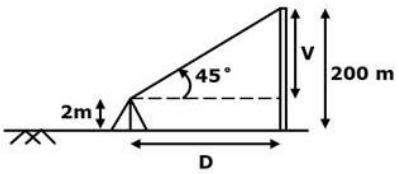
Reduced level of top of tower = 100+2.5+100 = 202.5 m

50. A theodolite is kept at a distance D from a tower of height 200 m. The base of tower and that of theodolite is at a same elevation from the bench mark. The height of the instrument from the ground level is 2 m. The angle of elevation measured to the top of tower is 45°. Find the distance D?

A. 198 m
B. 200 m
C. 280 m
D. 298 m

Ans. A

Sol.



V =200 -2 =198 m

$$V = D \times \tan\alpha$$

198 = D x tan45

D = 198 m.

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