POSTAL Book Package 2021

CIVIL ENGINEERING

Soil Mechanics and Foundation Engineering

Objective Practice Sets

Contents

MADE EASY Publications

10 CHAPTER
Stability of Earth Slopes

Q.1 Taylor's stability number curves are used for the analysis of stability of slopes. The angle of shearing resistance used in the chart is the
(a) effective angle (b) apparent angle
(c) mobilized angle (d) weighted angle

Q.2 For an infinite slope in cohesionless soil mass, factor of safety
(a) increases with depth
(b) decreases with depth
(c) remains same
(d) None of these

Q.3 In the slope stability analysis by friction circle method, the radius of friction circle is
(a) $R\cos\phi$ (b) $R\sin\phi$
(c) $R\tan\phi$ (d) $R\sec\phi$

Q.4 The factor of safety of an infinite slope in a sand deposit is found to be 1.732. The angle of shearing resistance of the sand is 30°. The average slope of the sand deposit is
(a) $\sin^{-1}(0.333)$ (b) $\cos^{-1}(0.252)$
(c) $\tan^{-1}(0.333)$ (d) $\cot^{-1}(0.621)$

Q.5 Given that the effective angle of internal friction of a soil is 10°, the angle between the failure plane and the major principle plane will be:
(a) 17.5° (b) 27.5°
(c) 40° (d) 50°

Q.6 For base failure of a slope, the depth factor D is
(a) zero (b) 1
(c) $0 < D < 1$ (d) $D > 1$

Q.7 The following refer to the stability analysis of an earth dam under different conditions:
1. Stability of downstream slope during steady seepage
2. Stability of upstream slope during sudden drawdown
3. Stability of upstream and downstream slopes during construction

Which of these statements are correct?
(a) 1 and 2 (b) 1 and 3
(c) 2 and 3 (d) 1, 2 and 3

Q.8 Which of the following statements are CORRECT?
I. In case of finite slope, the sliding is rotational whereas in infinite slope, the sliding is translational.
II. Variation in c value is generally more as compared to ϕ, hence larger factor of safety can be used for angle of internal friction.
III. With respect to a c-ϕ soil in an infinite slope, the factor of safety of the slope does not depend on the height of soil on the slope.
(a) I and II (b) II and III
(c) I and III (d) All of these

Q.9 An excavation was made in saturated soft clay ($\phi_u = 0$) with its sides vertical. When the depth of excavation reached 6 m, the sides caved in. The value of cohesion of the clay, if unit weight of clay is 20 kN/m^3 will be
(a) 15 kN/m^2 (b) 20 kN/m^2
(c) 30 kN/m^2 (d) 40 kN/m^2

Q.10 **Statement (I):** The factor of safety obtained in the Fellenius method of slices is conservative.
Statement (II): In the Fellenius method, the effect of horizontal forces acting on the sides of slices are neglected, but the effect of shearing forces acting on the sides of slices are included.
(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

Q.11 **List-I** given below gives the possible types of failure for a finite soil slope and **List-II** gives the reasons for these different types of failure. Match the items in **List-I** with the items in **List-II** and select the correct answer from the codes given below the lists:

List-I
A. Base failure
B. Face failure
C. Toe failure

List-II
1. Soils above and below the toe have same strength
2. Soil above the toe is relatively weaker
3. Soil above the toe is relatively stronger

Codes:

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

Q.12 For a soil, cohesion is 15 kN/m^3 unit weight is 20 kN/m^3 and the factor of safety is 1.5 along with stability number of 0.05. The safe maximum height of slope is
(a) 5.0 m (b) 8.0 m
(c) 10.0 m (d) 12.0 m

Q.13 Factor of safety against sliding of a slope, is the ratio of
(a) actual cohesion to that required to maintain stability of slope
(b) shear strength to shear stress along the surface
(c) neither (a) nor (b)
(d) both (a) and (b)

Q.14 An excavation was made at a slope angle of 54° in homogenous clay. When the depth of excavation reached 8 m, a slip occurred. The slip surface was likely to have passed
(a) Above for the slope
(b) Below the toe
(c) Through the toe
(d) Near the mid-point of the slope.

Q.15 Which one of the following parameters can be used to estimate the angle of internal friction of a sandy soil?
(a) Particle size
(b) Roughness of particle
(c) Particle size distribution
(d) Density index

Q.16 **Statement (I) :** Total stress analysis is adopted for long term stability problems.

Statement (II) : Total stresses and effective stresses are numerically the same after excess pore water pressure is dissipated.
(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

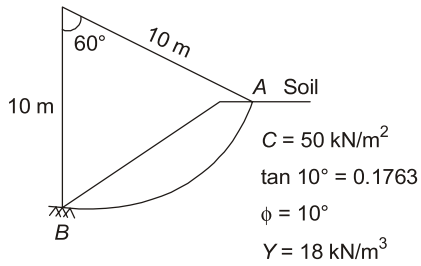
Q.17 Consider the following forces:
1. Weight of the sliding wedge of slope.
2. Resultant reaction '*R*' of the slip.
3. Total cohesive resistance developed along the slip circle.
4. Critical height of slope.

Which of these are taken into consideration in the friction circle method for the equilibrium of sliding sector in the stability analysis of slope?
(a) 1, 2 and 4 (b) 1, 3 and 4
(c) 1, 2 and 3 (d) 2, 3 and 4

Q.18 A canal 6 m deep runs through a soil having C_u = 18 kN/m^2, ϕ_u = 10°, e = 0.80 and G_s = 2.72. The angle of slope of bank is 45°. If sudden drawdown takes place upto the bed level of the canal, the factor of safety is
(For β = angle of slope of bank = 45°, ϕ_u = 10°, S_n = 0.108, ϕ_u = 4.88°, stability number = 0.137)

(a) 2.96 (b) 2.14
(c) 1.41 (d) 1.14

Common data question:
Consider a sliding surface *AB* in the figure below:



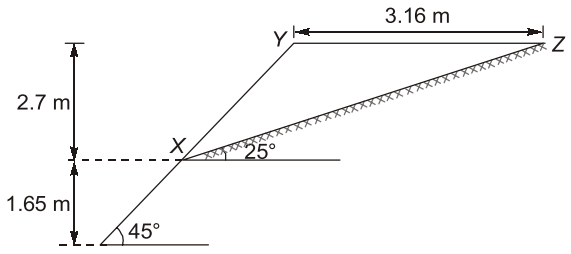
Normal effective pressure on sliding surface *AB* is 255 kN/m^2 downward tangential disturbing force along *AB* is 840 kN.

Q.19 The factor of safety with respect to shear strength criteria is
(a) 1.468 (b) 0.68
(c) 0.86 (d) 0.98

Q.20 The factor of safety with respect to height is
(a) 1.846 (b) 1.264
(c) 1.341 (d) 1.628

Q.21 A granular soil possesses saturated density of 18 kN/m^3. Its effective angle of friction is 40°. If the desired factor of safety is 1.8, then the safe angle of slope for the soil, when seepage occurs parallel to the slope surface will be _____ degrees.

Q.22 A soil mass is resting on an inclined clay layer as shown in figure. The sail has $c = 6$ kN/m^2, $\phi = 20°$, $\gamma = 17$ kN/m^3.



The FOS against wedge failure along the interface is _____.
(a) 2.03 (b) 2.12
(c) 1.09 (d) 0.78

Q.23 A granular soil has $G = 2.7$, $e = 0.5$ and $\phi = 35°$. A slope of 30° is made by this material. If seepage occurs parallel to the slope with the water table at a depth of 1.5 m, the factor of safety available on the slip plane parallel to the ground surface at a depth of 4 m is _____.

Q.24 Stability analysis of by the method of slices for 1 : 1 slope on the critical plane gave the following results:
Sum of tangential forces = 160 kN
Sum of normal forces = 330 kN
Sum of neutral forces = 60 kN
Length of failure surface = 20 m
Effective angle of shearing resistance = 15°
Effective cohesion = 20 kN/m^2
The factor of safety with respect to shear strength is
(a) 0.553 (b) 3.05
(c) 2.95 (d) 0.34

Q.25 For stability analysis of slopes of purely cohesive soils, the critical centre is taken to lie at the intersection of:
(a) The perpendicular bisector of the slope and the locus of the centre.
(b) The perpendicular drawn at one-third slope from the toe and the locus of the centre.
(c) The perpendicular drawn at two-third slope from the toe and the locus of the centre
(d) Directional angles

Q.26 Consider the following statements:
1. Method of slices overestimates the value of factor of safety.
2. Exact value of factor of safety is obtained in $\phi_T = 0$ analysis.
3. Reduction in shearing resistance in embankment is caused by tension crack at the top of it.
4. Plane surface of failure never occurs in saturated soils.

Which of the statements given above are correct?
(a) 1 and 4 only (b) 2 and 3 only
(c) 3 and 4 only (d) 1 and 2 only

Q.27 A canal is to be excavated through a soil with $C = 15$ kN/m^2, $\phi = 20°$, $e = 0.9$ and $G = 2.67$. The side slope is 1 in 1. The depth of canal is 6 m. The factor of safety with respect to cohesion when canal runs full is _____. [Taylor's stability number, $S_n = 0.06$].

■■■■

Answers Stability of Earth Slopes

1. (d)	2. (c)	3. (b)	4. (c)	5. (d)	6. (d)	7. (d)	8. (a)	9. (c)	10. (c)
11. (d)	12. (c)	13. (d)	14. (c)	15. (d)	16. (a)	17. (c)	18. (d)	19. (b)	20. (a)
21. 11.97	22. (a)	23. 0.835	24. (c)	25. (d)	26. (c)	27. 4.84			

Explanations Stability of Earth Slopes

1. (d)

Taylor's stability number curves are used for analysis of stability of slopes. The angle of shearing resistance used in the change is weighted angle.

2. (c)

$$\text{FOS} = \frac{\tan\phi}{\tan i}$$

It does not depend on depth.

3. (b)

In friction circle method radium of friction circle is R sinϕ.

4. (c)

$$\text{FOS} = \frac{\sigma\tan\phi}{\sigma\tan\beta}$$

$$\Rightarrow \quad 1.732 = \frac{\tan\phi}{\tan\beta} = \frac{\tan 30^\circ}{\tan\beta}$$

$$\Rightarrow \quad \beta = \tan^{-1}(0.333)$$

5. (d)

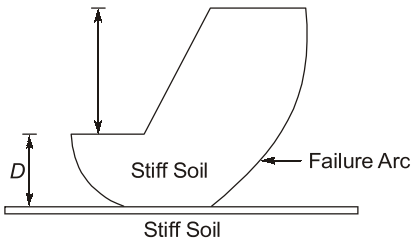
Angle from major principal plane

$$\theta = 45 + \frac{\phi}{2} = 45 + \frac{10}{2} = 50^\circ$$

Angle from minor principal plane

$$\theta = 45 - \frac{\phi}{2} = 45 - \frac{10}{2} = 40^\circ$$

6. (d)



$$\text{Depth} = \frac{H+D}{H} > 1$$

$(H + D)$ = Total Depth; (H) = Depth

8. (a)

In a c-f soil, factor of safety depends on height of the soil on the slope.

$$\text{FOS} = \frac{c + \gamma z\cos^2\beta\tan\phi}{\gamma z\cos\beta\sin\beta}$$

There is dependency on z.

9. (c)

Critical height of an unsupported cut in a c-ϕ soil is $2z_0 = 6$ m

$$\Rightarrow \quad z_0 = 3 \text{ m}$$

where $z_0 = \dfrac{2c}{\gamma\cdot\sqrt{k_A}}$

$$\Rightarrow \quad 3 = \frac{2\times c}{20\times\sqrt{\frac{1-\sin 0^\circ}{1+\sin 0^\circ}}}$$

$$\Rightarrow \quad c = 30 \text{ kN/m}^2$$

10. (c)

In fellenius method, the effect of horizontal forces as well as effect of shearing forces acting on the sides of slices are neglected.

11. (d)

Face failure or slope failure can occur when the slope angle β is very high and the soil close to the toe is quite strong or the soil in the upper part of slope is relatively weak.

Base failure can occur when the soil below the toe is relatively weak and soft and the slope is flat.

Toe failure occurs in steep slopes when the soil mass above the base and below the base is homogeneous.

12. (c)

$$S_n = \frac{C}{\gamma H_C}$$

$$\Rightarrow \quad S_n = \frac{C}{\gamma\,\text{FOS}\times H}$$