Assignments for

Soil Mechanics
(Program Elective)
(2940605)

BE Civil PDDC (Part Time)
Semester IV

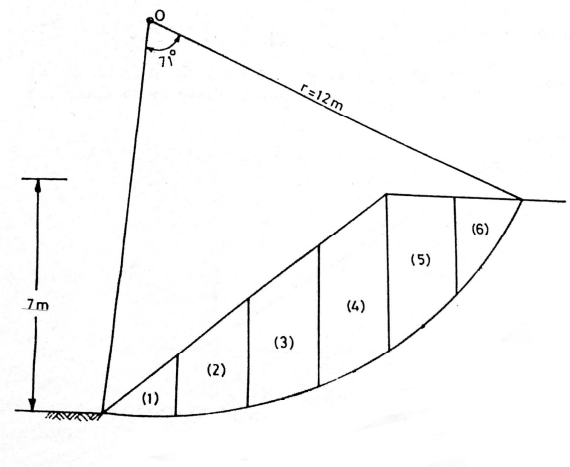
Directorate of Technical Education
Gandhinagar, Gujarat

APPLIED MECHANICS DEPARTMENT

Shantilal Shah Engineering College, Bhavnagar

Even Semester. Term Dates: 01/02/2024 to 25/05/2024

Tutorial- I
Slope Stability

	Answer the following	Mapped With
1	Differentiate between finite and infinite slopes.	CO1
2	Explain different types of slope failure.	CO1
3	Differentiate different types of the factor of safety used in the stability analysis of slopes.	CO1 & CO2
4	A deep cut of 9 m has to be made in a clay with unit weight of 18 kN/m^3 and a cohesion of 27 kN/m^2. A hard stratum exists at a depth 18 m below the ground surface. Determine from Taylor's chart if a 30° slope is safe. If a factor of safety of 1.5 is desired, what is a safe angle of slope?	CO2 & CO3
5	A slope is to be laid at angle of 30° with horizontal. Find the safe height of the slope for a factor of safety of 1.5 if the soil properties are C = 15 kN/m^2, Ø = 22°, ϒ = 18 kN/m^3.	CO2 & CO3
6	A new canal is excavated to a depth of 5 m below ground level, through a soil having the following characteristics: C=20 kN/m^2, Ø=10°, e = 0.8 and G = 2.80. The slope of banks is 1:1. Calculate the factor of safety with respect to cohesion when the canal runs full. If it is suddenly and completely emptied, what will be the factor of safety? Taylor's stability number for this condition is 0.137	CO3 & CO4
7	Calculate the factor of safety using Swedish circle method for a trial slip shown in following figure. The slip circle has radius 12 m and central angle 71°. The soil properties are: Ø= 30°, C = 20 kN/m^2, ϒ = 20 kN/m^3. 	CO3, CO4 & CO5

Tutorial- II Stress Distribution of Soils		
	Answer the following	**Mapped With**
1	Give the comparison of Boussinesq and Westergaard analysis	CO1
2	Explain the concept of pressure bulb. Plot the isobar of intensity 0.1Q	CO2
3	Draw contact pressure diagram for flexible and rigid footing in saturated clay and sand.	CO3 & CO4
4	A concentrated load 10 kN acts on the surface of a soil mass. Using Boussinesq analysis find the vertical stress at points. (i) 3 m below the surface on the axis of loading and (ii) At radial distance of 2 m from axis of loading but at same depth of 3 m.	CO1 & CO2
5	Two railway wagon lines in a harbour yard are located 6 m centre to centre. The average load per meter run in the lines are 100 kN/m and 80 kN/m. Find the vertical stress induce by the loading at a depth of 2 m beneath each loading and half way between them.	CO4 & CO5
6	Calculate the stress in a soil mass below the centre of a uniformly loaded circular area of radius 1.5 m with a pressure of 60 kN/m^2 and obtain the exact depth at which the stress reduces to 10% of the applied stress.	CO4 & CO5
7	An overhead water tank with a weight of 2800 kN is supported at a depth of 3 m on a tower by four isolated square footing of sides 2 m each placed in a square pattern with a centre to centre spacing of 8 m. Compute the vertical stress at foundation level, (i) at the centre of the structure (ii) at the centre of each footing	CO4 & CO5

Tutorial- III Sub surface Investigation		
	Answer the following:	**Mapped With**
1	What do you understand by site investigation? What are the objectives of soil exploration program?	CO1 & CO2
2	What is a significant depth? How it can be determined?	CO1 & CO2
3	Differentiate between disturbed and un disturbed soil samples. How undisturbed samples are collected?	CO2 & CO3
4	Give brief description on area ratio, inside and outside clearance of a sample.	CO2 & CO3
5	Write the principles involved in geophysical methods and their limitations of soil investigation.	CO1 & CO4
6	What are the limitations of a plate load test?	CO2 & CO3
7	Describe salient features of a good sub soil investigation report. Write a short note on Bore log.	CO1 & CO2

Tutorial – IV Shear strength		
	Answer the following:	**Mapped With**
1	What is Mohr's strength theory for soil? Sketch the typical envelop for clean sand pure clay and C-ϕ soil.	CO1 & CO2
2	Explain various shear test based on different drainage conditions. Draw strength envelope for U-U, C-U and C-D test and comment on it.	CO1 & CO2
3	What do you understand by pore pressure? Explain pore pressure under isotropic consolidation and under deviator stress condition.	CO1 & CO2
4	What is a stress path? Sketch stress path for foundation loading and unloading conditions,	CO3
5	In a tri axial shear stress conducted on a soil sample having a cohesion of 12 kN/m^2. and angle of shearing resistance 36°.The cell pressure was 200 kN/m^2. Determine the value of deviator stress at failure. Solve the problem by analytical and graphical method.	CO1 & CO4
6	The stresses on a failure plane in a drained test on a cohesion less soil is as under: Normal stress (σ) = 100 kN/m^2 and Shear stress (τ) = 40 kN/m^2.Determine: (i) the angle of shearing resistance and the angle which the failure plane makes with the major principal plane. (ii) Find the major and minor principal stresses.	CO2 & CO3
7	The properties of soil in a 3 m high embankment are C = 50 kN/m^2, Ø = 20º and γ = 16 kN/m^3. Skempton's pare pressure parameters are found from tri axial test as A= 0.50 and B = 0.90. The height of embankment was raised from 3 m to 6 m. Assuming the dissipation of pore pressure during this period of construction is negligible and lateral pressure is half of vertical pressure, estimate the shear strength of soil at base of embankment just after increasing the height of construction.	CO3, CO4 & CO5

Tutorial – V Bearing Capacity of Shallow Foundation		
	Answer the following:	**Mapped With**
1	A 2 m wide strip footing is founded at a depth of 1.5m below the ground level in a homogeneous bed of dense sand, having the following properties. γ=18.5 kN/m^3, and Ø = 36°. Determine the ultimate, net ultimate, net safe bearing capacity of the footing. Assume a factor of safety of 3.0. For Ø = 36°, Nc = 60, Nq = 42, Nr = 47. Use Terzaghi's theory.	CO1& CO3
2	A square footing of size 2.2 m x 2.2 m is placed over loose sand at a depth of 1.6 m. with soil properties γ=16.5 kN/m^3, C = 11 kN/m^3 and Ø = 20°. Determine the safe load that can be carried by the footing.	CO2 & CO3
3	A footing of size 2m x 2m has to carry an axial load of 600 kN with M_x = 180 kN.m. Thesoil properties are: γ=20 kN/m^3, C = 150 kN/m^2, Ø = 25°. Calculate the net ultimate bearing capacity, if the water table is assumed to rise up to foundation level. Use I.S. method together with shape and depth factors.	CO2& CO3
4	A purely cohesive soil has a unit weight of 20 kN/m^3 and C = 150 kN/m^2 Determine thesafe bearing capacity for a rectangular footing 3m x 2m at a depth of 2m. Take F.S. = 3. Use appropriate method.	CO2& CO3
5	A square footing is required to carry a net load of 1000 kN. Determine the size of the footing if the depth of foundation is 1.5m and tolerable settlement is 40 mm. The watertable is at a great depth, The soil is sandy and average observed N value is 15.Take F.S. = 3. Use Teng's equation.	CO3& CO5
	Answer the following:	
1	Ultimate bearing capacity of a strip footing on cohesive soils will : (i) Increases with width of footing (ii) Decreases with increases of width of footing. (iii) Remains constant with increase of width of footing. (iv) Cannot be said.	CO1
2	Terzaghi's bearing capacity factors depends on (i) cohesion of soil (ii) angle of friction of soil (iii) permeability of soil (iv) all the above	CO1
3	The reduction factor due to water table at a depth equal to half the width of footing below footing is (i) 0.5 (ii) 0.75 (iii) 1.0 (iv) 0.25	CO1
4	A standard penetration test is conducted at a certain depth in a saturated fine sand stratum. The observed N value is 25. The equivalent resistance value is _____ .	CO1

Tutorial – VI
Pile Foundation

	Answer the following:	Mapped With
1	A 18 m long, 300 mm diameter pile is driven in a uniform deposit of soft clay having an unconfined compressive strength of 35 kN/m^2. The water table is at a great depth. The average dry unit weight of the clay is 18 kN/m^3. Calculate the safe load capacity of a pile with a factor of safety of 3.0.	CO2 & CO3
2	Estimate the pile length required to carry 600 kN axial load. The 500 mm pile is to be filled with concrete after driving. Layer I : Soft clay of 6m depth, C = 30 kN/m^2, γ = 18.5 kN/m^3 Layer II : Medium stiff clay of depth L, C = 55 kN/m^2, γ = 19.8 kN/m^3	CO2 & CO3
3	A pile load test is made on a 350 mm dia. test pile & following data are obtained. Load (kN) : 0 300 600 900 1200 1500 1800 Settlement (mm) : 0.00 1.25 3.75 7.50 13.75 23.75 36.75 Determine the design load on pile considering the settlement criteria. F.S.=2.0	CO2 & CO3
4	A square group of 9 piles, 9 m long was driven into soft clay. The piles used were 30 cm diameter,9 m length with center to center spacing of 0.9 m. The sub soil consists of clay with unconfined compressive strength of 90 kN/m^2. What is the capacity of pile group?. Take α = 0.8 and FOS = 2.5.	CO4 & CO5
5	Design square pile group to carry a load of 400 kN including the weight of pile cap at a site where the soil is uniform clay to a depth of 20 m underlain by rock. The piles are 6 m long and 300 mm in diameter. Average unconfined compressive strength of clay is 60 kN/m^2.Adhesion factor may be assumed 0.6.	CO5
6	Comment on the following statements: 1. Higher the cohesion value, lower is the adhesion factor. 2. Settlement of a group of vertical piles is usually more than that of a single pile under equal axial load. 3. The principal effect of negative skin friction is to reduce factor of safety.	CO1 & CO2

Tutorial – VII Introduction to Geosynthetics		
	Answer the following:	**Mapped With**
1	What are the different types of Geosynthetic materials?	CO1 & CO4
2	Enlist physical, mechanical and hydraulic properties of Geosynthetic materials.	CO1 & CO4
3	What are the various functions that Geosynthetics fulfill in road construction?	CO1 & CO5
4	Explain application of Geosynthetic material in soil erosion control.	CO1 & CO5

Pick up the most appropriate answer:

1 If angle of friction Ø, is greater than angle of slope *i*, the slope is always

A Stable B Unstable

C No relation between Ø and *i* D Cannot be said

2 The stability of slope of an earth dam is investigated for

A Steady seepage condition B Sudden draw down condition

C During construction condition D All of the above

3 Newmark's influence chart can be used for the determination of vertical stress under

A Circular loaded area only B Rectangular loaded area only

C Strip load only D Any shape of loaded area

4 The Westergaard analysis is used for

A Homogeneous soil B Cohesive soil

C Sandy soil D Stratified soil

5 The contact pressure distribution under a rigid footing on a cohesion less soil is

A Less at the edges B Uniform throughout

C More at the edges D Cannot be said

6 For an undisturbed sample the area ratio of the samples should be

A Zero B 10% or less

C 10 to 25% D More than 25%

7 Undisturbed samples are obtained by

A Direct excavation B Augurs

C Thin wall sampler D Thick wall sampler

8 A plate load test is useful to determine

A Settlement of foundation B Bearing capacity of foundation

C Both (A) and (B) D Shear strength

9 Elastic shock waves have different velocities in different material is the principle involved in

A Electrical resistivity method B Seismic refraction method

C Both (A) and (B) D Pressure meter method

10 The tendency of dense sand to expand on application of shearing load is known as

A Thixotropy B Dilatancy

C Activity D Sensitivity

11 Pore water parameter B is a function of

A Over consolidation ratio B Degree of saturation

C Under consolidation ratio D None of the above

12 The ratio of pore water pressure developed to the applied normal stress is called

A A factor B C factor

C B factor D Over consolidation ratio

13 The foundation whose length is considerably greater than its width, is called

A Strip footing B Isolated footing

C Strap footing D Combined footing

14 According to IS code, permissible value of total settlement for raft foundation in sand is

A 25 mm B 40 mm to 65 mm

C 75 mm D 65 mm to 100mm

15 A combined footing is is generally used when

A All columns are spaced apart B Columns are spaced close to each other

C There is only one column D Two columns and they are spaced far apart

16 In static cone penetration test, the cross-sectional area of the cone is

A 10 cm^2 B 20 cm^2

C 35 cm^2 D 50 cm^2

17 A shallow foundation is defined as a foundation which has

A Depth less than 0.6m B Depth less than its width

C Depth less than 1 m D Depth is more than the width

18 Following assumption is not made in the Terzaghi's bearing capacity theory

A Footing is at shallow depth B Base of footing is smooth

C L/B ratio is infinite D Load is truly vertical

19 A heave on the sides of foundation is always observed in

A Punching shear failure B Local shear failure

C General shear failure D Rotational failure

20 For a cohesion less soil , general shear failure is likely to occur if angle of friction is

A Greater than 36° B Between 28° and 36°

C Less than 20° D 0°

21 According to Terzaghi' equation, the bearing capacity of strip footing resting on cohesive soil (C= 10 kN/m^2) per unit depth and unit width (assume Nc = 5.7) is

A 47 kN/m^2 B 15.7 kN/m^2

C 57 kN/m^2 D 67 kN/m^2

22 The pit size made in plate load test is generally

A 5 times the width of plate B 2.5 times the width of plate

C 1.5 times the width of plate D equal to the width of plate

23 Permissible settlement is maximum in the case of

A Isolated footing on clay B Isolated footing on sand

C Raft on clay D Raft on sand

24 The immediate settlement of a rigid footing is about_____ times the maximum settlement of an equal flexible footing.

A 0.9 B 0.8

C 0.7 D 0.5

25 Which IS code gives a chart for the calculation of settlement per unit pressure as a function of width of footing and standard penetration number?

A IS-6403 B IS-456

C IS-1904 D IS-8009

26 Which soil property is not used to calculate the elastic settlement of footing on saturated clay?

A Poisson's ratio Elastic modulus of soil

C Width of the loaded area Coefficient Subgrade modulus

27 Under reamed piles are generally

A Driven piles B Bored piles

C Precast piles D Pre stressed piles

28 Negative skin friction on a pile is due to

A Downward movement of soil B Downward movement of pile

C Relative settlement of soil D Relative settlement of pile

29 The minimum centre to centre distance of a friction pile should be

A 1.5 times diameter of pile
B 2 to 3 times diameter of pile
C 3 to 4 times diameter of pile
D 4 to 5 times diameter of pile

30 Following is a function of Geosynthetic material

A Reinforcement
B Filtration
C Moisture barrier
D All of above

References:

- Soil Mechanics and Foundation Engineering; **Dr. K.R. Arora;** Standard Publishers Distributors, New Delhi, Year 2010
- Soil Mechanics and Foundation Engineering; **B.C. Punamia**; Laxmi Publication Pvt. Ltd., New Delhi, Year 2010
- Basic and applied soil mechanics; **Gopal Ranjan, Rao** A.S.R.; New age int. (p) ltd
- Soil Mechanics and Foundation Engineering, **S.K.Garg,** Khanna Publishers, New Delhi, Year-2005
- Soil Mechanics and Foundation Engineering**, P. Purushothama Raj,** Pearson India Education Services Pvt. Ltd., Noida, Year-2013
- Relevant IS Codes

Note: Last Date of Submission of Tutorials

Tutorial No.	Tutorial Name	Last Date of Submission
Tutorial I	Slope Stability	**19/02/2024**
Tutorial II	Stress Distribution of Soils	**04/03/2024**
Tutorial III	Sub surface Investigation	**18/03/2024**
Tutorial IV	Shear strength	**01/04/2024**
Tutorial V	Bearing Capacity of Shallow Foundation	**15/04/2024**
Tutorial VI	Pile Foundation	**29/04/2024**
Tutorial VII	Introduction to Geosynthetics & MCQ Questions	**13/05/2024**

Note: Attach the print of respective tutorials while submitting the tutorials.

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