Rewa Engineering College, Rewa

Rewa 486001

Department OF Civil Engineering

VIIITH SEMESTER
GEOTECHNICAL ENGG II
SESSION: 2017-18

Prepared by: **Approved by**

Anoop Kumar Tiwari **(HOD)**

OBJECTIVES

Design of Shallow Foundations discussing the different types of foundations, calculation of bearing capacity, stresses in soil, concept of contact pressure, calculation of settlements and codal provisions.
Design of Deep Foundations where the different concepts discussed are different types of foundations, design methodology for piles, calculation of pile capacity, stresses in pile, analysis of pile group, settlement of pile group, negative skin friction, piles subjected to lateral loads, pile load test and design and construction of well foundation, piers etc.
Soil Improvement Techniques: Soils those are highly susceptible to volume and strength changes can cause severe roughness and accelerate the deterioration of the pavement structure in the form of increased cracking and decreased ride quality when combined with truck traffic. Generally, the stiffness (in terms of resilient modulus) of some soils is highly dependent on moisture and stress state (see Section 5.4). In some cases, the subgrade soil can be treated with various materials to improve the strength and stiffness characteristics of the soil. Stabilization of soils is usually performed for three reasons:

1. As a construction platform to dry very wet soils and facilitate compaction of the upper layers-for this case, the stabilized soil is usually not considered as a structural layer in the pavement design process.
2. To strengthen a weak soil and restrict the volume change potential of a highly plastic or compressible soil-for this case, the modified soil is usually given some structural value or credit in the pavement design process.
3. To reduce moisture susceptibility of fine grain soils.

Soil Exploration and Geophysical Investigation which includes planning for subsurface exploration, methods of exploration, geophysical exploration followed by an overview on soil sampling and samplers, in-situ and common soil tests and finally the writing of a soil investigation report.
Design of Machine Foundations which discussed concepts like free and forced vibration, dynamically loaded foundations, dynamic soil properties, mass-spring-dashpot model and elastic half space theory.

OUTCOMES

At the end of this course, student will be able to:

1. Be able to comprehend and utilize the geotechnical literature to establish the framework for foundation design.
2. Be able to plan and implement a site investigation program including subsurface exploration to evaluate soil/structure behavior and to obtain the necessary design parameters.
3. Be able to carry out laboratory and field compaction tests for preparation of foundation surfaces and placement of engineered fill.
4. Be able to determine allowable bearing pressures and load carrying capabilities of different foundation systems.

UnitI
Shallow Foundations : Type of foundations shallow and deep. Bearing capacity of foundation on cohesion lessand cohesive soils. General and local shear failures. Factors effecting B.C.Theories of bearing capacity-Prandle, Terzaghi, Balla, Skempton, Meyerh of and Hansan. I.S.code on B.c. Determination of bearingcapacity. Limits of total and differential settlements. Plate load test.

Unit II
Deep Foundation : Pile foundation, Types of piles, estimation of individual and group capacity of piles in cohesion less and cohesive soils. Static and dynamic formulae.. Pile load test,Settlement of pile group,Negative skin friction, under reamed piles and their design. Piles under tension, inclined and lateral load Caissons. Well foundation. Equilibrium of wells. Analysis for stability tilts and shifts, remedial measures.

Unit III
Soil Improvement Techniques : Compaction. Field and laboratory methods, Proctor compaction tests, Factors affecting compaction. Properties of soil affected by compaction. Various equipment for field compaction and their suitability. Field compaction control. Lift thickness.
Soil stabilisation : Mechanical, Lime,Cement, Bitumen, Chemical, Thermal, Electrical -stabilisation and sabilisation by grouting. Geo synthetics, types, functions, materials and uses.

Unit IV
Soil Exploration and Foundations on Expansive and Collapsible soils : Methods of soil exploration. Planning of exploration programme for buildings, highways and earth dams.Disturbed and undisturbed samples andsamplers for collecting them.Characteristics of expansive and collapsible soils, their treatment, Construction techniques onexpansive and
collapsible soils. CNS layer.

Unit V
Sheet piles/Bulkheads and Machine foundation : Classification of sheet piles/bulkheads.Cantilever and anchored sheet piles, Cofferdams, materials, types and applications. Modes of vibration.Mass spring analogy, Natural frequency. Effect of vibration on soils.Vibration isolation. Criteria for design. Design of block foundation for impact type of machine.

LABORATORY WORK:
Laboratory work will be based on the course of Geotech. Engg. I & II as required for soil investigations of engineering projects and not covered in the lab. Work ofGeotech. Engg. I.

LIST OF EXPERIMENTS
1. Indian Standard Light Compaction Test/Std. Proctor Test
2. Indian Standard Heavy Compaction Test/Modified Proctor Test
3. Determination of field
density by Core Cutter Method
4. Determination of field density by Sand Replacement Method
5. Determination of field density by Water Displacement Method
6. The corifiled Compression Test
7. Triaxial compression test
8. Lab. Vane Shear test

Reference Books & Study Materials

1. Soil Mechanics & Foundation Engg. by Dr. K.R. Arora - Std. Publishers Delhi

2. Soil Mechanics & Foundation Engg. by B.C. Punmia - Laxmi Publiscations Delhi

3. Basic and Applied Soil Mechanics by Gopal Ranjan and A.S.R. Rao – New Age International Publishers

4. Modern Geotech. Engg. by Dr. Alam Singh-IBT Publishers Delhi.

5. Geotech. Engg. by C.Venkatramaiah-New AGe International Publishers, Delhi

6. Found. Engg. by GALeonards McGraw Hill Book Co. Inc.

7. Earthquake Resistant Design of Structures by Pankaj Agarwal & Manish Shrikhande - PHI Learning Pvt. Ltd.

8. Relevant IS Code

LECTURE PLAN

Department	Civil Engineering (VIII SEMESTER)	**Session :**	2017-18
Name of Teacher	Anoop Kumar Tiwari	**Semester**	VIII Sem.
Subject	**Geotechnical Engineering – II**	**Sub. Code**	CE-801
TIME SCHEDULE : Total expected periods: 44			

S. NO	Topic Covered	No. of Lectures Required	Reference
Unit I - Shallow Foundations			
1.	Type of foundations shallow and deep.		R1 (Page 636)
2.	Bearing capacity of foundation on cohesion less and cohesive soils.		R2 (Page 639)
3.	General and local shear failures.		R3 (Page 482)
4.	Factors effecting Bearing Capacity.		R3 (Page 499)
5.	Theories of bearing capacity - Prandle, Terzaghi, Balla,		R1 (Page 592), R3 (Page 483), R1 (Page 620)
6.	Theories of bearing capacity - Skempton, Meyerhoff and Hansan.		R3 (Page 489), R1 (Page 490), R3 (Page 493)
7.	I.S. code on bearing capacity. Determination of bearing capacity.		R3 (Page 495)
8.	Limits of total and differential settlements.		----
9.	Plate load test.		R1 (Page 621)
Unit II - Deep Foundations			
10.	Pile foundation, Types of piles.		R1 (Page 672)
11.	Estimation of individual and group capacity of piles in cohesion less and cohesive soils.		R2 (Page 737)
12.	Static and dynamic formulae		R3 (Page 556), R3 (Page 569)
13.	Pile load test		R1 (Page 688)
14.	Settlement of pile group		R1 (Page 692)
15.	Negative skin friction		R3 (Page 580)
16.	Under- reamed piles and their design		R2 (Page 750)
17.	Piles under tension, inclined and lateral load Caissons.		R1 (Page 694)
18.	Well foundation. Equilibrium of wells		R3 (Page 604)
19.	Analysis for stability tilts and shifts, remedial measures.		R1 (Page 742), R1 (Page 744)

Unit III - Soil Improvement Techniques			
20.	Compaction: Field and laboratory methods		R3 (Page 106), R3 (Page 117), R3 (Page 107)
21.	Proctor compaction tests		R2 (Page 407), R2 (Page 410)
22.	Factors affecting compaction		R3 (Page 109)
23.	Properties of soil affected by compaction		R3 (Page 113)
24.	Various equipment for field compaction and their suitability		R3 (Page 118)
25.	Field compaction control. Lift thickness.		R3 (Page 119)
26.	Soil stabilisation : Mechanical, Lime, Cement,		R1 (Page 376), R1 (Page 380)
27.	Soil stabilisation : Bitumen, Chemical, Thermal,		R1 (Page 377), R1 (Page 381)
28.	Soil stabilisation : Electrical-stabilisation and stabilisation by grouting.		R1 (Page 384)
29.	Geo-synthetics, types, functions, materials and uses.		R1 (Page 385)
Unit IV - Soil Exploration and Foundations on Expansive and Collapsible soils			
30.	Methods of soil exploration		R3 (Page 669)
31.	Planning of exploration programme for buildings and highways		R3 (Page 677)
32.	Planning of exploration programme for earth dams		R3 (Page 677)
33.	Disturbed and undisturbed samples		R3 (Page 672)
34.	Samplers for collecting disturbed and undisturbed samples		R3 (Page 674)
35.	Characteristics of expansive and collapsible soils, their treatment		R1 (Page 875), R1 (Page 880)
36.	Construction techniques on expansive and collapsible soils		R1 (Page 880)
37.	CNS layer.		R3 (Page 713), R3 (Page 714)
UNIT V - Sheet piles/Bulkheads and Machine foundation			
38.	Classification of sheet piles/bulkheads		R1 (Page 526)
39.	Cantilever and anchored sheet piles		R1 (Page 527), R1 (Page 532)
40.	Cofferdams, materials, types and applications		R1 (Page 556)
41.	Modes of vibration, Mass-spring analogy		R1 (Page 757), R2 (Page 797)
42.	Natural frequency, Effect of vibration on soils		R2 (Page 804)
43.	Vibration isolation, Criteria for design		R1 (Page 767), R1 (Page 757)

44.	Design of block foundation for impact type of machine		R2 (Page 819)

Assignment Problems

S. No.	Assignment Problems	Date on which given	Remark
	Unit-I Shallow Foundations		
1.	Determine the ultimate bearing capacity of i) a strip footing, 1.2 m wide, ii) a square footing 1.2m x 1.2m and iii) a circular footing of dia 1.2 m. The base of the footing is at a depth of 1m resting on a dry sand stratum. Take γ_d = 17 kN/m^3, Φ' = 38° and c' = 0. (Use Terzaghi's theory).		
2.	In first question, determine the ultimate bearing capacity of the footing using the bearing capacity factors recommended by Meyerhoff, Hansen, Prandtle and Skempton.		
3.	In first question, determine the ultimate bearing capacity of the footing (strip footing only) if the ground water table is located at a depth of i) 0.5 m below ground surface, ii) 0.5 m below the base of the footing. γ_{sat} = 20 kN/m^3. (Use Terzaghi's theory).		
4.	What are the three principal modes of soil failure? Also state the assumptions made by Terzaghi for derivation of ultimate bearing capacity.		
	Unit-II Deep Foundations		
1.	A 450 mm wide, square in section concrete pile, 15 m long, is driven in a deep deposit of uniform clay. Unconfined compression test on undisturbed samples indicate an average q_u value of 75 kN/m^2. Calculate the ultimate load capacity of the pile.		
2.	200 mm diameter, 8 m long piles are used as foundations for a column in a uniform deposit of medium clay (qu = 100 kN/m2). The spacing between the piles is 500 mm. There are 9 piles in the ground arranged in a square pattern. Calculate the ultimate pile load capacity of the group. Assume adhesion factor = 0.9.		
3.	What are the uses of piles?		
4.	What are the different classifications of piles? Explain each in short.		
	Unit-III Soil Improvement Techniques		
1.	What are two types of compaction tests and derive the total energy imparted to soil in both type of proctor compaction tests.		
2.	Name different equipments for field compaction and their suitability.		
3.	What are different soil stabilization techniques? Explain them in brief.		
	What are Geo-synthetics? Name their types, functions, materials and		

4.	uses.		
	Unit-IV Soil Exploration and Foundations on Expansive and Collapsible Soils		
1.	What is soil exploration? Explain it's purpose, procedure and planning for a dam site.		
2.	List out various tests that can be performed on the following: i) Disturbed soil sample. ii) Undisturbed soil sample.		
3.	Discuss various construction techniques in the expansive soils.		
4.	Explain the following i) CNS layer ii) Undisturbed soil sample		
	Unit-V Sheet Piles/Bulkhead and Machine Foundation.		
1.	Discuss the use of single degree freedom system in the analysis of machine foundation. What are its limitations?		
2.	Explain the following: i) Resonance ii) Natural frequency of machine foundation. iii) Mass spring analogy.		

List of Experiments

Subject : CE-801, GeoTechnical Engineering-II

S.No.	Name of Experiment	Date of Performance	Remark
1.	Indian Standard Light Compaction Test/Std. Proctor Test		
2.	Indian Standard Heavy Compaction Test/Modified Proctor Test		
3.	Determination of field density by Core Cutter Method		
4.	Determination of field density by Sand Replacement Method		
5.	Determination of field density by Water Displacement Method		
6.	The corifiled Compression Test		
7.	Triaxial compression test		
8.	Lab. Vane Shear test		
9.	CBR Test		
10.	Demonstration of Plate Load Test SPT & DCPT		