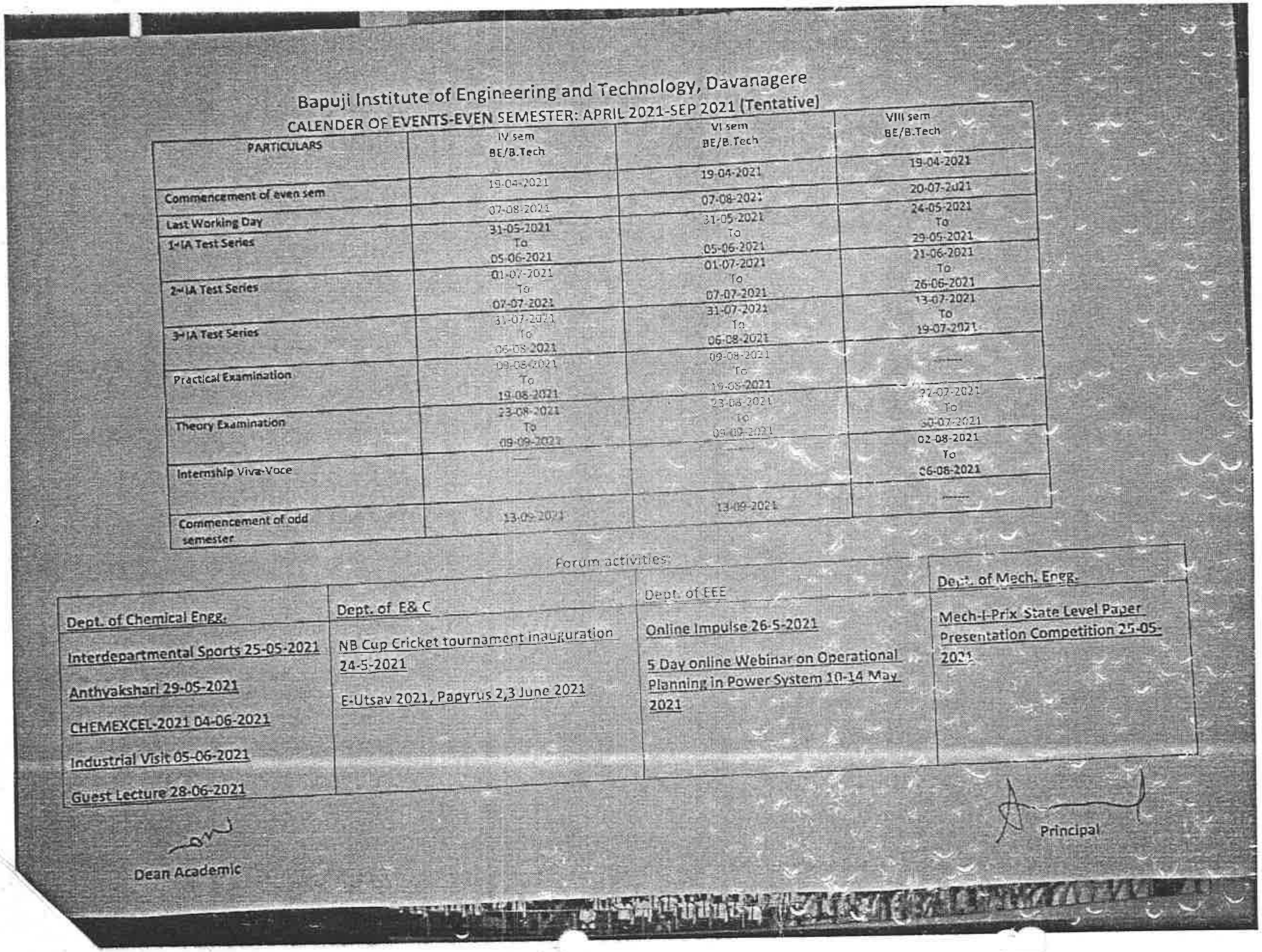


Bapuji Institute of Engineering and Technology, Davanagere

CALENDER OF EVENTS-EVEN SEMESTER: APRIL 2021-SEP 2021 (Tentative)

PARTICULARS	IV sem BE/B.Tech	VI sem BE/B.Tech	VIII sem BE/B.Tech
Commencement of even sem	19-04-2021	19-04-2021	19-04-2021
Last Working Day	07-08-2021	07-08-2021	20-07-2021
1st IA Test Series	31-05-2021 To 05-06-2021	31-05-2021 To 05-06-2021	24-05-2021 To 29-05-2021
2nd IA Test Series	01-07-2021 To 07-07-2021	01-07-2021 To 07-07-2021	21-06-2021 To 26-06-2021
3rd IA Test Series	31-07-2021 To 06-08-2021	31-07-2021 To 06-08-2021	13-07-2021 To 19-07-2021
Practical Examination	09-08-2021 To 19-08-2021	09-08-2021 To 19-08-2021	------
Theory Examination	23-08-2021 To 09-09-2021	23-08-2021 To 09-09-2021	22-07-2021 To 30-07-2021
Internship Viva-Voce	—	------	02-08-2021 To 06-08-2021
Commencement of odd semester	13-09-2021	13-09-2021	------

Forum activities:

Dept. of Chemical Engg.	Dept. of E& C	Dept. of EEE	Dept. of Mech. Engg.
Interdepartmental Sports 25-05-2021 Anthyakshari 29-05-2021 CHEMEXCEL-2021 04-06-2021 Industrial Visit 05-06-2021 Guest Lecture 28-06-2021	NB Cup Cricket tournament inauguration 24-5-2021 E-Utsav 2021, Papyrus 2,3 June 2021	Online Impulse 26-5-2021 5 Day online Webinar on Operational Planning in Power System 10-14 May 2021	Mech-I-Prix State Level Paper Presentation Competition 25-05-2021

Dean Academic

Principal

Revised-Academic Calendar of EVEN semesters of UG Programmes for 2020-2021

Semesters EVENTS	IV semester B.E./B.Tech.	IV semester B.Arch./ B.Plan.	VI semester B.E./B.Tech.	VI semester B.Plan./B.Arch	VIII semester B.E./B.Tech.	VIII semester B.Plan.	VIII semester B.Arch
Commencement of EVEN Semester	19.04.2021	19.04.2021	19.04.2021	19.04.2021	19.04.2021	19.04.2021	19.04.2021
Last Working day of EVEN Semester	07.08.2021	07.08.2021	07.08.2021	07.08.2021	#20.07.2021	#20.07.2021	07.08.2021
Practical Examinations	09.08.2021 To 19.08.2021	09.08.2021 To 19.08.2021	09.08.2021 To 19.08.2021	---	---	---	---
Theory Examinations	23.08.2021 To 09.09.2021	23.08.2021 To 09.09.2021	23.08.2021 To 09.09.2021	10.08.2021 To 31.08.2021	22.07.2021 To 30.07.2021	22.07.2021 To 30.07.2021	10.08.2021 To 17.08.2021
Internship	---	---	---	---	---	---	---
Internship Viva-Voce/ Project Viva-Voce	---	---	---	---	02.08.2021 To 06.08.2021	---	---
Professional training / Organization study	---	---	---	---	---	---	---
Commencement of ODD Semester	13.09.2021	13.09.2021	13.09.2021	13.09.2021	---	---	23.08.2021

- The classroom sessions for even the semester should commence from the dates mentioned above.
- The Institute needs to function for **six days** a week with additional hours (**Saturday is a full working day**). #if required the college can plan to have extra classes even on Sundays also.
- If any of the above dates are declared to be a holiday then the corresponding event will come into effect on the next working day.
- Notification regarding the Calendar of Events relating to the conduct of **University Examinations** will be issued by the Registrar (Evaluation) from time to time.
- The faculty/staff shall be available to undertake any work assigned by the university.
- Academic Calendar may be modified based on guidelines/directions issued in the future by MHRD/UGC/AICTE/State Government.
- Revised Academic Calendar is also applicable for **Autonomous Colleges.** In case if any changes are to be affected by Autonomous Colleges in the academic terms and examination schedule, they could do so with the approval of the University.

21.04.2021.

REGISTRAR

VISION OF THE DEPARTMENT

To train the students to become Civil Engineers with leadership qualities, having ability to take up professional assignments and research with a focus on innovative approaches to cater to the needs of the society.

MISSION OF THE DEPARTMENT

1. To provide quality education through updated curriculum and conducive teaching learning environment for the students to excel in higher studies, competitive examinations and professional career.
2. To impart soft skills, leadership qualities and professional ethics among the graduates to handle the projects independently with confidence.
3. To deal with the contemporary issues and to cater to the socio-economic needs.
4. To build industry-institute interaction and to establish good rapport with alumni.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO 1: Core Competence**:** Graduates will be able to plan, analyse, design and construct sustainable Civil Engineering Infrastructure.

PEO 2: Professional Skills**:** Graduates will be professional engineers with a sense of ethics, creativity, leadership, self-confidence and independent thinking to cater to the needs of the society.

PEO 3: Societal Needs**:** Graduates will be able to contribute effectively for the development of industry and professional bodies.

PEO 4: Cognitive Intelligence**:** Graduates will be able to take up competitive examinations, higher studies and involve in research and entrepreneurship activities.

PROGRAM SPECIFIC OUTCOMES (PSOs)

Students after the completion of the Program will be able to

1. Apply the fundamental concepts, software and codal provisions in the analysis, design and construction of sustainable civil engineering infrastructure.
2. Inculcate professional and leadership qualities, sense of ethics and confidence related to civil engineering.

Faculty will be able to

3. Contribute to the overall development of civil engineering community through the professional bodies and offer services to the society.

Vision of BIET

To be a center of excellence recognized nationally and internationally, in distinctive areas of engineering education and research, based on a culture of innovation and invention.

Mission of BIET

BIET contributes to the growth and development of its students by imparting a broad based engineering education and empowering them to be successful in their chosen field by inculcating in them positive approach, leadership qualities and ethical values

Title & Code	**Applied Geotechnical Engineering (18CV62)**
CO	**Statement**
18CV62.1	**Plan** and **execute** geotechnical site investigation program for civil engineering projects
18CV62.2	**Plot** stress distribution and resulting settlement beneath the loaded footings on sandy and clayey soils
18CV62.3	**Compute** the lateral earth pressure behind earth retaining structures
18CV62.4	**Estimate** the factor of safety against failure of slopes
18CV62.5	**Determine** the bearing capacity of soil and proportion the shallow isolated and combined footings for uniform bearing pressure
18CV62.6	**Determine** the load carrying capacity of single pile and group of piles

Course Title		**Applied Geotechnical Engineering**										
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
18CV62.1	2	2	1	1		1		1				2
18CV62.2	2	2	1	1		1		1				2
18CV62.3	2	2	1	1		1		1				2
18CV62.4	2	2	1	1		1		1				2
18CV62.5	2	2	1	1		1		1				2
18CV62.6	2	2	1	1		1		1				2
Average	2	2	1	1		1		1				2

CO	**PSO1**	**PSO2**
18CV62.1	2	2
18CV62.2	2	2
18CV62.3	2	2
18CV62.4	2	2
18CV62.5	2	2
18CV62.6	2	2
Average	2	2

TIME TABLE

Day ▼ / Time ▶	1 8.00 - 9.00	2 9.00 - 10.00	10.00 - 10.30	3 10.30 - 11.30	4 11.30 - 12.30	12.30 - 2.00	5 2.00 - 3.00	6 3.00 - 4.00	7 4.00 - 5.00
MONDAY		17CV64	**SHORT BREAK**	18CV62 -B		**LUNCH BREAK**			
TUESDAY	17CV64				18CV62 -B		← 18CVL47 - B_2 →		
WEDNESDAY	18CV62-B				17CV64		← 18CVL47 - A_1 →		
THURSDAY		18CV62-B							
FRIDAY				18CV62-B					
SATURDAY		17CV64							

Sign. of the Staff

Sign. of the HOD

Sign. of the Principal

B. E. CIVIL ENGINEERING
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER - VI

APPLIED GEOTECHNICAL ENGINEERING

Course Code	**18CV62**	CIE Marks	40
Teaching Hours/Week(L:T:P)	(3:2:0)	SEE Marks	60
Credits	04	Exam Hours	03

Course Learning Objectives: This course will enable students to

1. Appreciate basic concepts of soil mechanics as an integral part in the knowledge of Civil Engineering. Also to become familiar with foundation engineering terminology and understand how the principles of Geo-technology are applied in the design of foundations
2. Learn introductory concepts of Geotechnical investigations required for civil engineering projects emphasizing in situ investigations
3. Conceptually learn various theories related to bearing capacity of soil and their application in the design of shallow foundations and estimation of load carrying capacity of pile foundation
4. Estimate internal stresses in the soil mass and application of this knowledge in proportioning of shallow and deep foundation fulfilling settlement criteria
5. Study about assessing stability of slopes and earth pressure on rigid retaining structures

Module-1

Soil Exploration: Introduction, Objectives and Importance, Stages and Methods of exploration- Test pits, Borings, Geophysical methods, stabilization of boreholes, Sampling techniques, Undisturbed, disturbed and representative samples, Geophysical exploration and Bore hole log. Drainage and Dewatering methods, estimation of depth of GWT (Hvorslev's method).

Module-2

Stress in Soils: Introduction, Boussinesq's and Westergaard's theory concentrated load, circular and rectangular load, equivalent point load method, pressure distribution diagrams and contact pressure, Newmark's chart.

Foundation Settlement: Types of settlements and importance, Computation of immediate and consolidation settlement, permissible differential and total settlements (IS 8009 part 1).

Module-3

Lateral Earth Pressure: Active, Passive and earth pressure at rest, Rankine's theory for cohesionless and cohesive soils, Coulomb's theory, Rebhann's and Culmann's graphical construction.

Stability of Slopes : Assumptions, infinite and finite slopes, factor of safety, Swedish slip circle method for C and C-ø (Method of slices) soils, Fellineous method for critical slip circle, use of Taylor's stability charts.

Module-4

Bearing Capacity of Shallow Foundation: Types of foundations, Determination of bearing capacity by Terzaghi's and BIS method (IS: 6403), Modes of shear failure, Factors affecting Bearing capacity of soil. Effect of water table and/or eccentricity on bearing capacity of soil, field methods of determining bearing capacity of soil: SPT and plate load test.

Module-5

Pile Foundations: Types and classification of piles, single loaded pile capacity in cohesionless and cohesive soils by static and Dynamic formulas, efficiency of Pile group, group capacity of piles in cohesionless and cohesive soils, negative skin friction, pile load tests, Settlement of piles, under reamed piles (only introductory concepts – no derivation).

Course outcomes: On the completion of this course students are expected to attain the following outcomes;

1. Ability to plan and execute geotechnical site investigation program for different civil engineering projects
2. Understanding of stress distribution and resulting settlement beneath the loaded footings on sand and clayey soils
3. Ability to estimate factor of safety against failure of slopes and to compute lateral pressure distribution behind earth retaining structures
4. Ability to determine bearing capacity of soil and achieve proficiency in proportioning shallow isolated and combined footings for uniform bearing pressure
5. Capable of estimating load carrying capacity of single and group of piles

Question paper pattern:

Question paper pattern:

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Textbooks:

1. Murthy V.N.S., Principles of Soil Mechanics and Foundation Engineering, UBS Publishers and Distributors, New Delhi.
2. K.R. Arora, Soil Mechanics and Foundation Engineering, Standard Publisher Distributors, New Delhi.
3. P C Varghese, Foundation Engineering, PHI India Learning Private Limited, New Delhi.
4. Punmia B C, Soil Mechanics and Foundation Engineering-(2017), 16thEdition, Laxmi Publications co., New Delhi.

Reference Books:

1. T.W. Lambe and R.V. Whitman, Soil Mechanics-, John Wiley & Sons.
2. Donald P Coduto, Geotechnical Engineering- Phi Learning Private Limited, New Delhi.
3. Shashi K. Gulathi & Manoj Datta, Geotechnical Engineering-. , Tata McGraw Hill Publications.
4. Debashis Moitra, "Geotechnical Engineering", Universities Press.,
5. Malcolm D Bolton, "A Guide to soil mechanics", Universities Press.,
6. Bowles J E , Foundation analysis and design, McGraw- Hill Publications.
7. Bureau of Indian Standards: IS-1904, IS-6403, IS-8009, IS-2950, IS-2911 and all other relevant codes.

Subject : Applied Geotechnical Engineering Subject Code : 18CV62 Class : VIth - B

Period	Date	Topics Planned	Date	Topics Covered	Remarks
1	19/04/21	MODULE-01 Introduction	19/04/21	MODULE-01 Introduction	-
2	20/04/21	Objectives and Importance	20/04/21	objectives and Importance	
3	21/04/21	Stages and methods of Exploration	21/04/21	Stages and methods of exploration	
4	22/04/21	methods of Exploration	26/04/21	method of Exploration	
5	23/04/21	Test pits borings	27/04/21	Test pits Borings	
6	26/04/21	Geophysical method stabilization of boreholes	28/04/21	Geophysical method stabilization of boreholes	
7	27/04/21	Sampling techniques undisturbed, disturbed and representative sample	29/04/21	Sampling techniques undisturbed, disturbed and representative sample	
8	28/04/21	Geophysical Exploration and Bore hole log	30/04/21	Geophysical Exploration and Borehole log	
9	29/04/21	Drainage and Dewatering methods	03/05/21	Drainage and Dewater-ing methods	
10	30/04/21	estimation of depth of GWT (Hvorslev's method)	04/05/21	estimation of depth of GWT (Hvorslev's method)	
11	03/05/21	MODULE-02 Introduction Boussinesq's and Westergaard's theory	05/05/21	MODULE-02 Introduction Boussinesq's and Westergaard's theory	
12	04/05/21	Concentrated load Circular load	06/05/21	Concentrated load Circular load	
13	05/05/21	Rectangular load equivalent point load method	07/05/21	Rectangular load equivalent point load method	
14	06/05/21	pressure distribution diagram, contact pressure	10/05/21	pressure distribution diagram, contact pressure	
15	07/05/21	New mark's Chart	11/05/21	New mark's Chart	
16	10/05/21	foundation Settlement	12/05/21	foundation Settlement	
	11/05/21	approximate method		approximate method	

LESSON PLAN

Subject : Applied Geotechnical Engineering Subject Code : 18CV62 Class : VIth B

Period	Date	Topics Planned	Date	Topics Covered	Remarks
18	12/05/21	types of settlement and importance	17/05/21	types of settlement and importance	
19	13/05/21	Computation of immediate settle-ment	18/05/21	Computation of immediate settlement	
20	14/05/21	and consolidation settlement	19/05/21	and consolidation settlement	
21	17/05/21	MODULE-03, active passive and earth pressure at rest	28/06/21	MODULE-03, active passive and earth pressure at rest	
22	18/05/21	Rankine's theory for cohesionless soils	29/06/21	Rankine's theory for cohesionless soils	
23	19/05/21	and cohesive soils	30/06/21	and cohesive soils	
24	20/05/21	Coulomb's theory	08/07/21	Coulomb's theory	
25	21/05/21	Rebhann's and Culmann's graphical construction	09/07/21	Rebhann's and Culmann's graphical construction	
26	24/05/21	assumptions, infinite and finite slope	12/07/21	assumptions, infinite and finite slope	
27	25/05/21	factory safety	13/07/21	factory safety	
28	26/05/21	use of taylor's stability charts	14/07/21	use of taylor's stability charts	
29	27/05/21	Swedish slip circle method for C and C-φ (method of slices)	15/07/21	Swedish slip circle method for C and C-φ (method of slices)	
30	28/05/21	Fellenius method for critical slip circles	16/07/21	Fellenius method for critical slip circles	
31	31/05/21	MODULE-04 type of foundations	20/05/21	MODULE-04 type of foundations	
32	01/06/21	determination of bearing capacity by Terzaghi's	21/05/21	determination of bearing capacity by Terzaghi's	
33	02/06/21	BIS methods	24/05/21	BIS methods	
		Effect of water		Effect of water	

Subject : Applied Geotechnical Engineering Subject Code : 18CV62 Class : VI th B

Period	Date	Topics Planned	Date	Topics Covered	Remarks
35	04/06/24	Eccentricity	26/05/24	Eccentricity	
36	07/05/24	Field methods plate load test	27/05/24	Field methods plate load test	
37	08/05/24	SPT (standard penetration test)	28/05/24	SPT (standard) penetration test	
38	09/06/24	~~Proportioning of shallow foundation~~	31/05/24	Modes of shear failure	
39	10/06/24	Modes of shear failure	02/06/24	Modes of shear failure	
40	11/06/24	factors affecting Bearing capacity of soil	03/06/24	factors affecting Bearing capacity of soil	
41	12/06/24	MODULE-05: types and classification of piles	04/06/24	MODULE-05 types and classification of piles	
42	14/06/24	single loaded pile capacity in cohesionless	10/06/24	single loaded pile capacity in cohesionless	
43	15/06/24	and cohesive soils by static formula and dynamic formula	14/06/24	and cohesive soils by static formula and dynamic formula	
44	16/06/24	Efficiency of pile group	15/06/24	Efficiency of pile group	
45	17/06/24	group capacity of piles in cohesionless	16/06/24	group capacity of piles in cohesionless	
46	18/06/24	and cohesive soils	17/06/24	and cohesive soils	
47	21/06/24	negative skin friction	18/06/24	negative skin friction	
48	22/06/24	pile load tests	19/06/24	pile load tests	
49	23/06/24	Settlement of piles	22/06/24	Settlement of piles	
50	24/06/24	underreamed pile only introductory concepts no derivation	25/06/24	underreamed pile only introductory concepts no derivation	

Period	Date	Topics Planned	Date	Topics Covered	Remarks

Text Books :

1. Murthy V.N.S Principles of soil mechanics and foundation Engineering. UBS publishers and distributors new Delhi
2. K.R. Arora. Soil mechanics and foundation engineering. standard publisher. Distributors

Reference Books :

1. T.W. Lambe and R.V. Whitman. Soil mechanics John Wiley and sons
2. Donald P. Coduto. Geotechnical Engineering PHI learning private limited New Delhi
3. Shashi K Gulhati and Manoj Datta. Geotechnical Engineering. Tata MC Graw Hill publications
4. Debashis Moitra. Geotechnical Engineering universities press
5. Bowles J.E. foundation analysis and design Mcgraw-Hill publication

Class : VI B   Subject Code : 18CV62   Subject : Applied Geotechnical Engineering   Total No. of Classes : 56.

Sl No.	USN	NAME / DATE	19/04/21	20/04/21	21/04/21	26/04/21	27/04/21	28/04/21	29/04/21	30/04/21	03/05/21	04/05/21	05/05/21	06/05/21	07/05/21	10/05/21	11/05/21	12/05/21	13/05/21	17/05/21	18/05/21	19/05/21	20/05/21	21/05/21	24/05/21	25/05/21	26/05/21	23/07/21	26/07/21	27/07/21	No. of Days Present (56)	%	Test Marks I (30)	Test Marks II (30)	Test Marks III (30)	CIE (30) Average	CIE + Assg. Remarks (30+10)
1	4BD16CV022	Bharath kumar L K M	A	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	A	49	50	50	89	30	30	29	30	(30+10) =40
2	4BD17CV044	Mahesh Talawar	A	1	2	3	A	4	5	6	7	A	8	9	10	11	12	A	13	14	15	16	17	A	18	19	20	45	46	47	47	85	27	27	27	27	(27+10) =37
3	4BD17CV080	S H Punith	A	1	2	3	A	A	4	5	6	7	8	9	10	A	11	12	13	14	15	16	17	18	19	A	20	46	47	48	48	86	27	27	27	27	(27+10) =37
4	4BD17CV116	Vishwas S Kurnalli	A	A	1	2	3	4	5	6	7	8	A	9	10	11	12	13	A	14	15	A	16	17	18	19	20	45	46	47	47	85	27	27	24	26	(26+10) =36
5	4BD18CV002	Akhil Reddy M	1	2	3	A	4	5	6	7	8	9	A	10	12	12	13	14	15	A	16	17	18	19	20	21	22	49	50	51	51	91	30	30	29	30	(30+10) =40
6	4BD18CV003	Ambika Ningappa	A	A	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	A	16	17	18	19	20	21	22	49	50	51	51	91	30	30	30	30	(30+10) =40
7	4BD18CV004	Anmol L	A	1	2	3	4	5	6	7	8	A	9	10	11	12	A	13	14	15	16	17	18	19	20	A	21	46	47	48	48	86	30	30	28	29	(29+10) =39
8	4BD18CV006	Archana. M.A	A	1	2	3	4	5	6	A	7	8	9	10	11	12	13	14	A	15	16	17	18	19	20	21	22	50	51	52	52	93	30	30	30	30	(30+10) =40
9	4BD18CV008	Arya N Jadhav	A	1	2	3	4	5	6	A	7	8	9	A	10	11	12	13	14	15	A	16	17	18	19	20	A	44	45	46	46	85	28	28	28	28	(28+10) =38
10	4BD18CV009	Ashwini Ningappa	A	1	2	3	4	5	6	7	A	8	A	9	10	11	12	13	14	A	15	16	17	18	19	20	21	50	51	52	52	93	29	29	29	29	(29+10) =39
11	4BD18CV010	Banashree Pujar	A	1	2	3	A	4	5	6	7	8	A	9	10	11	12	13	14	15	16	17	18	19	20	21	22	49	50	51	51	91	29	29	29	29	(29+10) =39
12	4BD18CV012	Basavaraja K	A	1	2	3	4	5	A	6	7	8	A	9	10	11	12	13	14	15	16	17	18	19	20	21	22	50	51	52	52	93	30	30	30	30	(30+10) =40
13	4BD18CV014	Bhavana. K.M	A	1	2	3	A	4	5	6	7	8	9	10	11	12	A	13	14	15	16	17	18	19	20	21	22	49	50	51	51	91	30	30	29	30	(30+10) =40
14	4BD18CV016	Chethan R	A	1	2	3	4	5	6	A	7	8	9	10	11	12	13	A	14	15	16	A	17	18	19	20	21	45	46	46	46	85	30	30	29	30	(30+10) =40
15	4BD18CV018	Darshanlekh B.M	A	1	2	3	A	4	5	6	7	8	9	10	A	11	12	13	14	A	15	16	17	18	19	20	21	47	48	49	49	87	30	30	28	29	(29+10) =39
16	4BD18CV020	Deepa. T.S	A	1	2	3	A	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	50	51	52	52	93	30	30	28	29	(29+10) =39
17	4BD18CV022	Dineshyadav V	A	1	2	3	A	4	5	6	7	8	9	10	A	11	12	13	14	15	16	17	18	19	20	21	22	48	49	50	50	89	30	30	30	30	(30+10) =40
18	4BD18CV026	H.K Varun	A	1	2	3	4	5	A	6	7	8	9	A	10	11	12	13	14	15	16	A	17	18	19	20	A	44	45	46	46	85	28	28	29	28	(28+10) =38
19	4BD18CV030	Hruthik S.M	1	2	A	3	A	4	5	6	7	8	A	9	10	11	12	13	14	15	A	16	17	18	19	20	21	48	49	50	50	89	28	28	29	28	(28+10) =38
20	4BD18CV032	Kiran B.K	1	2	3	4	A	5	6	7	8	9	A	10	A	11	12	13	14	15	A	16	17	18	19	20	A	44	45	46	46	85	27	27	22	25	(25+10) =35
21	4BD18CV034	Krishnasagara D.H	A	1	2	3	4	5	6	A	7	8	A	9	10	11	12	A	13	14	15	A	16	17	18	19	20	45	46	47	47	85	30	30	29	30	(30+10) =40
22	4BD18CV036	Likith G.S	A	1	2	3	A	4	5	6	7	A	8	9	10	11	12	13	14	15	A	16	17	18	19	20	21	47	48	49	49	87	30	30	29	30	(30+10) =40
23	4BD18CV038	Rakshitha. M.K	A	1	2	3	A	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	49	50	51	51	91	30	30	30	30	(30+10) =40
24	4BD18CV040	Manjunath V	1	2	3	A	A	4	5	6	7	8	9	A	10	11	12	13	14	15	16	17	18	19	20	21	A	44	45	46	46	85	27	27	27	27	(27+10) =37
25	4BD18CV042	Manoj T	1	2	A	A	3	4	5	6	7	A	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	48	49	50	50	89	30	30	30	30	(30+10) =40
26	4BD18CV044	Meghana. H.P	A	1	2	3	A	4	5	6	A	7	8	A	9	10	11	12	13	A	14	15	16	17	18	19	20	48	49	50	50	89	30	30	29	30	(30+10) =40
27	4BD18CV048	Mohaseena D.N	A	1	2	3	4	A	5	6	7	8	A	9	10	11	12	13	14	15	A	16	17	18	19	20	21	A	49	A	49	87	30	30	28	29	(29+10) =39
28	4BD18CV050	Nagaraj S Bakraji	A	1	2	3	4	5	6	7	8	9	A	10	11	12	13	14	15	16	17	18	19	20	21	22	23	A	49	50	50	89	30	30	23	28	(28+10) =38
29	4BD18CV052	Naveen Kumar G.S	A	A	1	2	3	4	5	6	7	A	8	9	10	11	12	13	14	15	A	16	17	18	19	20	A	A	47	48	48	86	30	30	27	29	(29+10) =39
30	4BD18CV054	Nikhil D Vernekar	A	A	A	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	A	17	18	19	20	21	47	48	49	49	87	30	30	28	29	(29+10) =39
		Initials of Teacher																																			
		Initials of H O D																																			

Class : VI B Subject Code : 18CV62 Subject : Applied Geotechnical Engineering Total No. of Classes : 56

Sl No.	USN	NAME / DATE	19/04/21	20/04/21	21/04/21	26/04/21	27/04/21	28/04/21	29/04/21	30/04/21	03/05/21	04/05/21	05/05/21	06/05/21	07/05/21	10/05/21	11/05/21	12/05/21	13/05/21	17/05/21	18/05/21	19/05/21	20/05/21	21/05/21	19/07/21	20/07/21	22/07/21	23/07/21	26/07/21	27/07/21	No. of Days Present 56	%	Test Marks I (30)	Test Marks II (30)	Test Marks III (30)	CIE Average (30)	CIE+ASS Remarks (30+10)
31	4BD18CV056	Pooja	A	1	2	3	4	A	5	6	7	8	9	A	10	11	12	13	14	A	15	16	17	18	46	47	48	49	50	51	51	91	30	30	29	30	(30+10) =40
32	4BD18CV058	Pradeep G.K	A	A	1	2	3	4	5	6	A	7	8	9	10	11	12	13	14	15	16	A	17	18	45	A	46	47	48	49	49	87	30	30	28	29	(29+10) =39
33	4BD18CV060	Priya. H. P	A	1	2	3	4	5	6	A	7	8	9	10	A	11	12	13	14	15	A	16	17	18	45	46	47	48	49	50	50	89	30	30	28	29	(29+10) =39
34	4BD18CV062	Rachana M	A	1	2	3	4	5	A	6	7	8	9	10	A	11	12	A	13	14	15	16	17	18	46	47	48	49	50	51	51	91	30	23	28	27	(27+10) =37
35	4BD18CV064	Ranjitha Y.B	1	2	3	4	A	5	6	7	A	8	9	10	A	11	12	A	13	14	15	16	A	17	42	43	44	45	46	47	47	85	30	30	29	30	(30+10) =40
36	4BD18CV066	Ruthu S	A	A	1	2	3	4	5	6	7	8	A	9	10	11	12	13	14	15	16	A	17	18	44	45	46	47	48	49	49	87	30	30	25	28	(28+10) =38
37	4BD18CV068	Sagar N Betageri	A	1	2	3	4	A	5	6	7	8	A	9	10	11	12	A	13	14	15	16	17	18	45	46	47	48	49	50	50	89	30	30	30	30	(30+10) =40
38	4BD18CV070	Sai kumar H	A	1	2	3	4	5	6	7	8	9	10	A	11	12	13	14	15	16	17	18	19	20	49	50	51	~~52~~	53	54	54	97	30	30	30	30	(30+10) =40
39	4BD18CV072	Sanjaykumar M.M	A	A	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	A	16	17	18	19	45	A	46	47	48	49	49	87	30	28	23	27	(27+10) =37
40	4BD18CV074	Sathvik H.M	A	A	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	A	16	17	18	19	44	45	46	47	48	49	49	87	30	30	23	28	(28+10) =38
41	4BD18CV080	Simran A	A	1	2	3	4	5	A	6	7	8	9	10	11	12	13	14	A	15	16	A	17	18	45	46	47	48	49	50	50	89	30	30	30	30	(30+10) =40
42	4BD18CV084	Sumanth K.R	A	1	2	3	4	5	A	6	7	8	A	9	10	11	12	13	14	A	15	16	17	18	43	44	45	46	47	48	48	86	30	30	27	29	(29+10) =39
43	4BD18CV086	Sunil M Daragad	A	1	2	3	4	A	5	6	A	7	8	9	10	11	12	13	14	15	16	17	18	A	44	A	45	46	47	48	48	86	30	30	29	30	(30+10) =40
44	4BD18CV088	Tarun G.V	A	1	2	3	A	4	5	6	A	7	8	A	9	10	11	12	13	14	A	15	16	17	44	45	46	47	48	A	48	86	30	30	21	27	(27+10) =37
45	4BD18CV094	Vageesh K.R	A	A	1	2	3	4	5	6	7	8	A	9	10	11	12	13	14	15	16	17	18	19	47	A	48	49	50	51	51	91	30	30	22	27	(27+10) =37
46	4BD18CV096	Vidya Kiran M	1	2	A	3	4	5	6	A	7	8	A	9	10	11	12	13	14	15	16	17	18	19	44	A	45	46	47	48	48	86	30	30	24	28	(28+10) =38
47	4BD18CV098	Vinay C R	1	2	3	A	4	5	A	6	7	8	9	A	10	11	12	13	14	15	16	A	17	18	45	A	46	47	48	49	49	86	30	30	21	27	(27+10) =37
48	4BD18CV100	Vinayaka M A	1	2	3	A	4	5	6	A	7	8	9	10	A	11	12	13	14	15	16	17	A	18	45	46	A	47	48	49	49	86	30	30	21	27	(27+10) =37
49	4BD18CV102	Vishwanag R.T	A	A	1	2	3	4	5	6	7	8	A	9	10	11	12	13	14	15	16	17	A	18	46	47	48	49	50	51	51	91	30	30	24	28	(28+10) =38
50	4BD18CV104	Yathin G	1	2	A	A	3	4	5	6	7	8	9	10	A	11	12	13	14	15	A	16	17	18	41	42	43	44	45	46	46	85	30	30	17	26	(26+10) =36
51	4BD18CV109	Jyothika. N.B	A	A	1	2	3	4	5	6	7	8	9	10	11	12	13	A	14	15	16	17	18	19	45	A	46	47	48	49	49	86	30	30	27	29	(29+10) =39
52	4BD18CV110	Dheeraj. R	A	1	2	3	4	5	A	6	7	8	9	10	11	12	13	14	15	16	A	17	18	19	45	A	46	47	48	49	49	86	22	22	24	26	(26+10) =36
53	4BD19CV401	Amoghavarsha KSK	A	1	2	3	4	5	6	A	7	8	A	9	10	12	13	A	14	15	16	17	18	19	42	43	44	45	46	47	47	85	24	24	29	26	(26+10) =36
54	4BD19CV404	Gajendra M	A	1	2	3	4	5	6	7	A	8	9	10	11	A	12	13	14	15	16	17	18	19	45	46	47	48	49	50	50	89	30	30	24	28	(28+10) =38
55	4BD19CV406	H.T Mathad	A	1	2	3	4	5	6	7	8	9	10	A	A	11	A	12	13	14	15	A	16	17	41	42	43	44	45	46	46	85	30	30	27	29	(29+10) =39
56	4BD19CV408	Hemanth kumar. M	A	1	2	3	4	5	6	A	7	8	A	9	10	11	12	13	14	15	16	17	18	19	47	48	49	50	51	52	52	93	30	30	29	30	(30+10) =40
57	4BD19CV409	K.B. Vishak	1	2	3	4	A	5	6	7	8	9	A	10	11	12	13	14	15	16	17	18	19	A	47	48	49	A	50	51	51	91	30	30	29	30	(30+10) =40
58	4BD19CV414	Mohammed Siddiq Hussain	1	2	A	A	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	45	46	A	47	48	49	49	86	30	30	22	27	(27+10) =37
59	4BD19CV415	Mruthyunjayaswamy	A	A	1	2	3	4	5	6	7	8	9	A	10	11	12	13	14	15	16	A	17	18	45	A	46	47	48	49	49	86	30	30	28	29	(29+10) =39
60	4BD19CV418	Nikhil S.P	A	1	2	3	4	A	5	6	7	A	A	8	9	10	11	12	13	A	14	15	A	16	39	40	41	42	43	44	44	85	30	30	29	30	(30+10) =40
		Initials of Teacher																																					
		Initials of H.O.D																																					

Class : 'VI B'　Subject Code : 18CV62　Subject : Applied Geotechnical Engineering　Total No. of Classes : 56.

Sl No.	USN	NAME	19/04/21	20/04/21	21/04/21	26/04/21	27/04/21	28/04/21	29/04/21	30/04/21	03/05/21	04/05/21	05/05/21	06/05/21	07/05/21	10/05/21	11/05/21	12/05/21	13/05/21	17/05/21	18/05/21	19/05/21	20/05/21	21/05/21	24/05/21	25/05/21	26/05/21	27/05/21	28/05/21	31/05/21	No. of Days Present	%	Test Marks I (30)	Test Marks II (30)	Test Marks III (30)	CIE Average 30	CIE + Assignment 40
61	4BD19CV419	Nithin H.S	A	1	2	3	4	5	A	6	7	8	A	9	10	11	12	13	14	15	16	A	17	18	19	20	21	22	23	24			30	30	29	30	(30+10) =40
62	4BD19CV423	T. M. Rushik	A	A	1	2	3	4	5	6	7	A	8	9	10	11	A	12	13	14	15	16	17	18	19	20	21	22	23	A			30	30	28	29	(29+10) =39
63	4BD19CV424	Santhosh B	A	1	2	3	4	A	A	5	6	7	8	9	10	A	11	12	13	14	15	A	16	17	18	A	A	19	20	21			30	30	18	26	(26+10) =36
64	4BD19CV425	Santhosh M	A	1	2	3	4	5	6	7	8	9	A	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26			30	30	29	30	(30+10) =40
65	4BD19CV426	Sattar Khan	A	A	1	2	3	4	5	6	7	8	9	10	A	11	12	13	A	14	15	A	A	16	17	18	19	20	A	21			27	27	22	26	(26+10) =36
66	4BD19CV428	Shashank Kolivad	A	1	2	3	4	5	6	A	7	8	9	A	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25			29	29	29	29	(29+10) =39
67	4BD19CV429	Shreyas C D	A	1	2	A	3	4	5	6	7	8	9	10	11	12	13	14	15	16	A	17	18	19	20	21	22	23	24	25			30	30	26	29	(29+10) =39
68	4BD19CV432	Vinay Karthik H.M	1	2	A	3	4	5	6	7	8	9	A	10	12	12	A	13	14	15	16	17	18	19	20	21	22	A	23	24			30	30	29	30	(30+10) =40
69	4BD19CV433	Vinutha. T	A	1	2	3	4	5	6	7	8	A	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26			29	29	29	29	(29+10) =39
70	4BD19CV434	Yuvaraja. N.T	A	1	2	3	4	5	6	7	8	9	A	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26			30	30	23	28	(28+10) =38

Initials of Teacher

Initials of H.O.D.

5th sem [A and B] Divisions

Title of the course :- Applied Geotechnical Engineering.

Course :- 17CV53.

MODULE - 01

Soil Exploration

Shankramma H H
Assistant professor
BIET Davangere

MODULE - 01

SOIL EXPLORATION

⇒ Introduction

The field and laboratory investigations required to obtain the necessary data for the soil for proper design and successful construction of any structure at the site are collectively called soil Exploration

The choice of the foundation and its depth the bearing capacity. settlement analysis depend very much upon the various engineering properties of the foundation soils.

⇒ objectives of soil Exploration

1) Determination of the nature of the deposits of soil
2) Determination of the depth and thickness of the various soil strata and their extent in horizontal direction
3) The location of ground water and fluctuations in ground water table
4) obtaining soil and rock samples from the various strata
5) The determination of the engineering properties of the soil and rocks strata that affect the performance of the structure.
6) Determination of the in-situ properties by performing field tests
7) To select the type and depth of foundation and to determine the bearing capacity of the selected foundation
8) To ensure the safety of surrounding existing structures.

Prof. & Head of Civil Engg. Dep
B. I. E. T. Davangere - 4

⇒ stages in soil Exploration

1) Reconnaissance
2) preliminary exploration
3) detailed exploration
4) laboratory testing

1) stage 1 : Reconnaissance

1) photographs of the site and its neighborhood
2) access to the site for workers and equipment
3) sketches of all fences, utility posts, driveways walkways, drainage systems, and so on
4) ~~utt~~ utility services that available, such as water and electricity
5) sketches of topography including all existing structures, cuts, fills, ground depression, ponds etc

2) stage 2 : prelimary Exploration

1) boring are made or test pit is opened to establish in general manner the stratification.
2) type of soil to be expected and possibly the location of the ground water table
3) The initial borings indicate the upper soil is loose or highly compressible.
4) site data and sample recovery to approximately establish the foundation design and identify the construction procedures
5) index properties such as liquid limit, plasticity index, and penetration data, together with unconfined compression tests on samples

3) Stage 3:- detailed exploration

1) If the soil is relatively uniform in stratification
2) To determine the geological structure which should include the thickness, sequence and extent of the soil strata
3) To determine the groundwater conditions
4) To obtain disturbed and undisturbed samples for laboratory tests
5) To conduct in situ tests

4) Stage 4:- laboratory testing

1) To classify the soils
2) To determine soil strength, failure stresses and strains, stress, strain response, permeability, compactability, and settlement parameters

* methods of explorations

1) Direct method
2) Semi Direct method
3) Indirect method

1) Direct method

⇒ Trial pits

Applicable to all types of soils provide for visual examination in their natural condition disturbed and undisturbed soil samples can be conveniently obtained ~~fo~~ at different depths depth of investigation is limited to 3 to 3.5m

Advantages

1) cost effective
2) provide detailed information of stratigraphy
3) large quantities of disturbed soils are

available for testing

4) large blocks of undisturbed samples can be carved out from the pits

5) field tests can be conducted at the bottom of the pits

Disadvantages

1) Depth limited to about 6m

2) Deep ~~is~~ pits uneconomical

3) Excavation below groundwater and into rock difficult and costly

4) Too many pits may scar site and require back fill soils

Limitations

1) undisturbed sampling is difficult

2) collapse in granular soils or below ground water table

* Semi direct method

⇒ Boring techniques

making or drilling bore holes into the ground with a view to obtaining soil or rock samples from specified or known depths is called boring

The common methods of advancing bore holes are

1) Auger boring

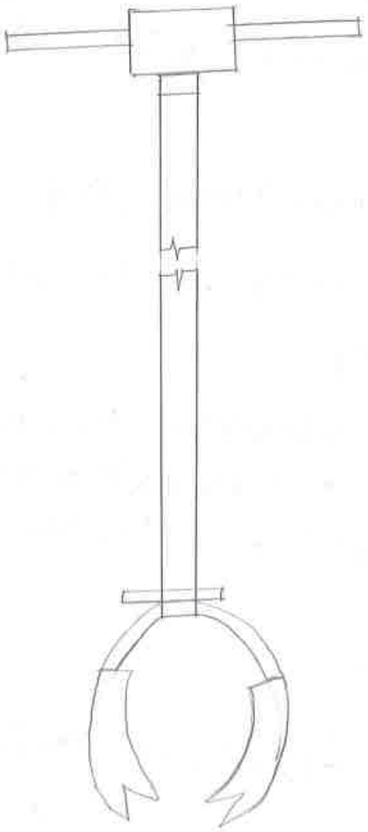
2) Auger and Shell boring

3) wash boring

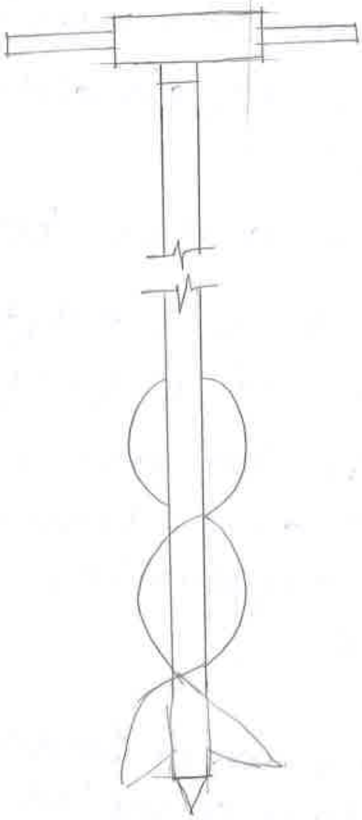
4) percussion boring

5) Rotary drilling

1) Auger boring



(a) post hole auger



(b) Helical auger

1) auger is carried out by holding it vertically and pressing it down while the auger is rotated

2) The turning action cuts the soil which fills the annular space

3) one the annular space is filled the auger is withdrawn and cleaned

4) the cleaned auger is again inserted in the hole and the process repeated

⇒ hand operated augers are of two types

a) post hole auger

b) Helical auger

1) Hand operated augers may be used for boring holes to a depth 6m in soft soils

2) side of the hole are likely to cave in casing pipe may be used to prevent the collapse of the sides of bore holes

3) power driven augers are used for greater boring depths and where hard or stiff soil strata are encountered

4) auger boring is convenient in the case of partially saturated sands, silt silts, and medium to stiff cohesive soils

5) as possible. auger borings are kept dry

6) augers are severely disturbed soil It is useful for identification purpose only

7) augers boring are used for shallow foundations highways and barrow pits where the required depth of exploration is relatively small

advantages

1) quick
2) used in uncased holes
3) undisturbed samples can be obtained quite easily
4) Drilling mud not used
5) groundwater location can easily be identified

Disadvantages

1) Depth limited to about 1.5m at greater depth drilling becomes difficult and expensive
2) site must be accessible to motorized vehicle

8) auger boring or shell boring

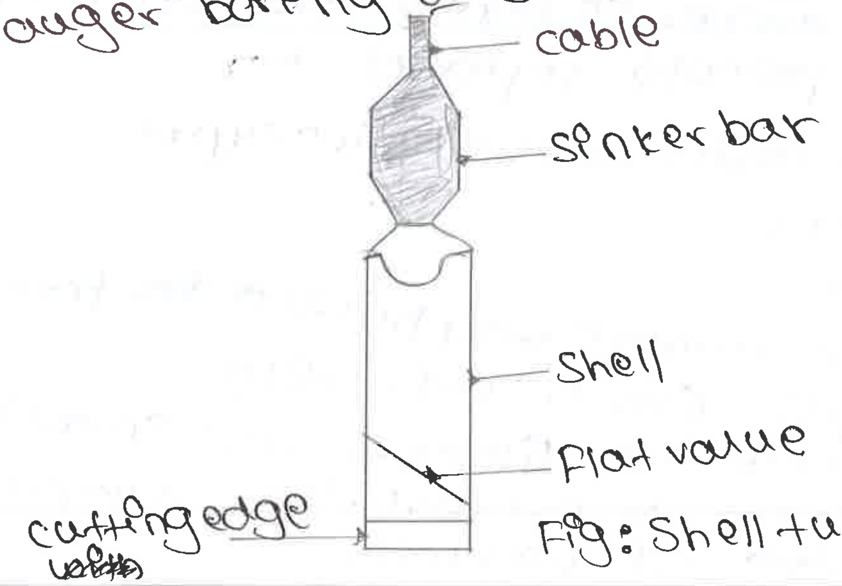


Fig: Shell tube or auger boring

1) It is widely used in India. a shell also called a sand bailer

2) It is Heavy duty pipe with a cutting edge

3) different lengths and weights are used according to requirements

4) sinker bars are sometimes used to add weight to the bailer

5) The shell is raised and let fall in a hole

6) after that soil that is cut, enters the tube which is emptied when full

7) when shell is used augering becomes difficult.

3) wash boring

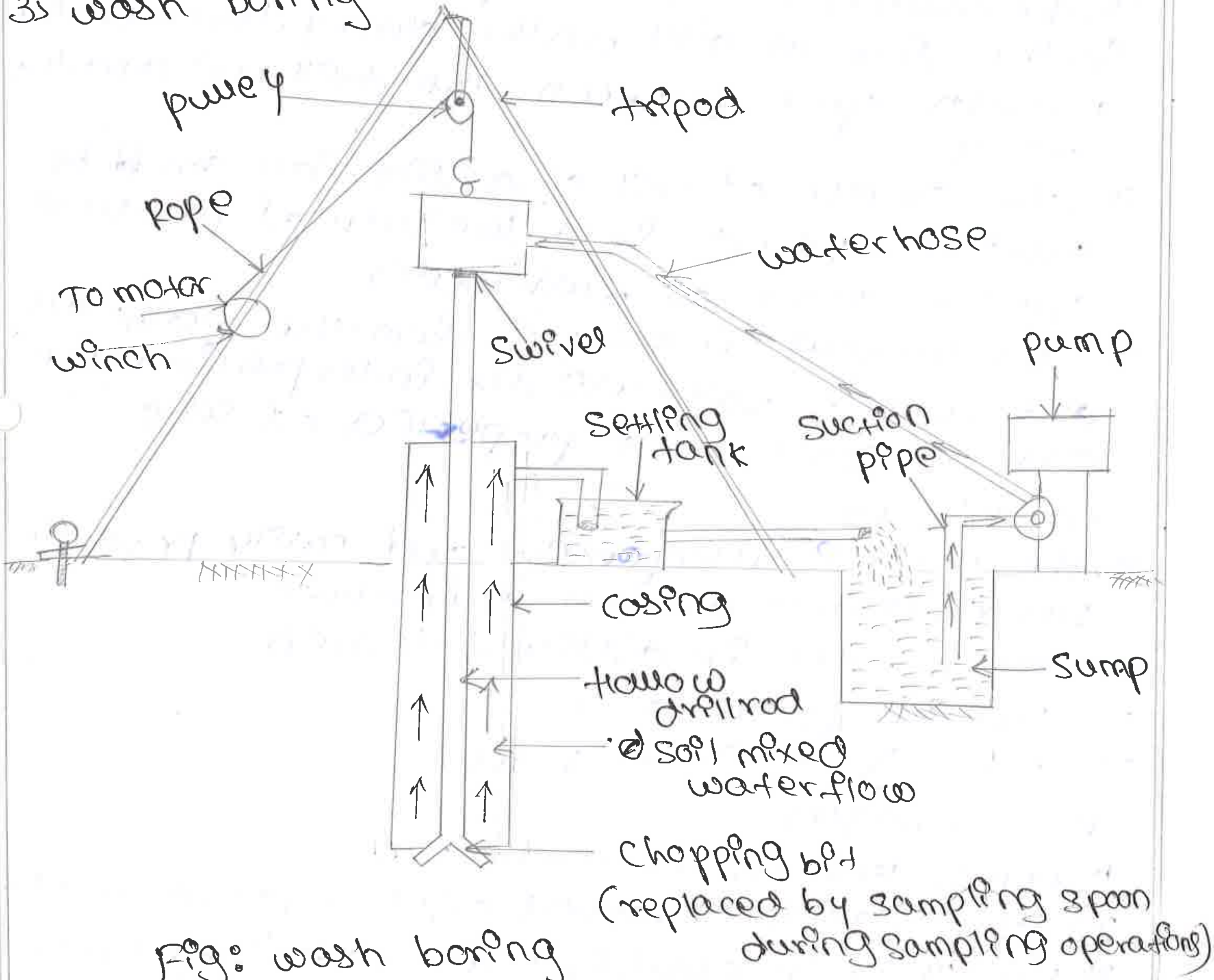


Fig: wash boring

1) wash boring is a fast and simple method for advancing holes in all types of soils

2) Boulders and rocks cannot be penetrated by this method

3) The method consists in first driving a casing through which a hallow drill rod with a sharp chisel ~~or~~ chopping bits at the lower end is inserted

4) water is forced under pressure through the drill rod which is alternatively raised and dropped and also rotated

5) The resulting chopping and jetting action of bit and water disintegrates the soil

6) The cutting are forced up to the ground surface in the form of soil water slurry through the annualar space between the drill rod and the casing

7) The change of soil stratification ~~could be~~ could be gussed from the rate of progress and the colour of wash water

8) the samples recovered from the washwater are almost valueless for interpreting the correct geotechnical properties of soils

Advantages

1) The use of inexpensive and easily portable handling and drilling equipments

2) can be used in difficult terrain

3) low equipment costs

4) used in uncased holes

Disadvantages

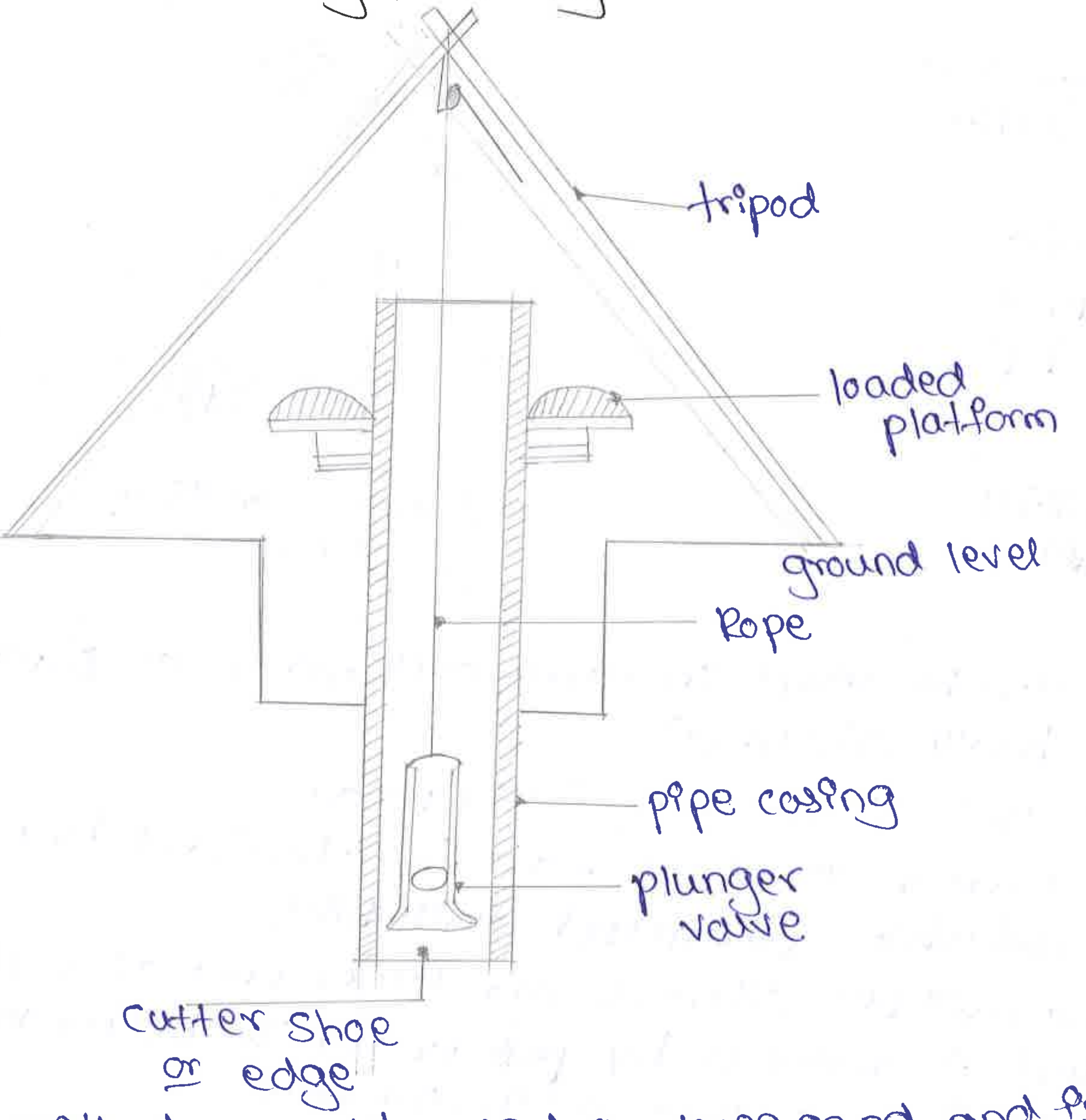
1) Depth limited to about 30m

2) slow drilling through stiff clays and gravels

3) Difficulty in obtaining accurate location of groundwater level

4) undisturbed soil samples cannot be obtained

4) percussion drilling or boring



1) The method cannot be used in loose sand and is slow in plastic clay

2) The formation gets badly disturbed by impact

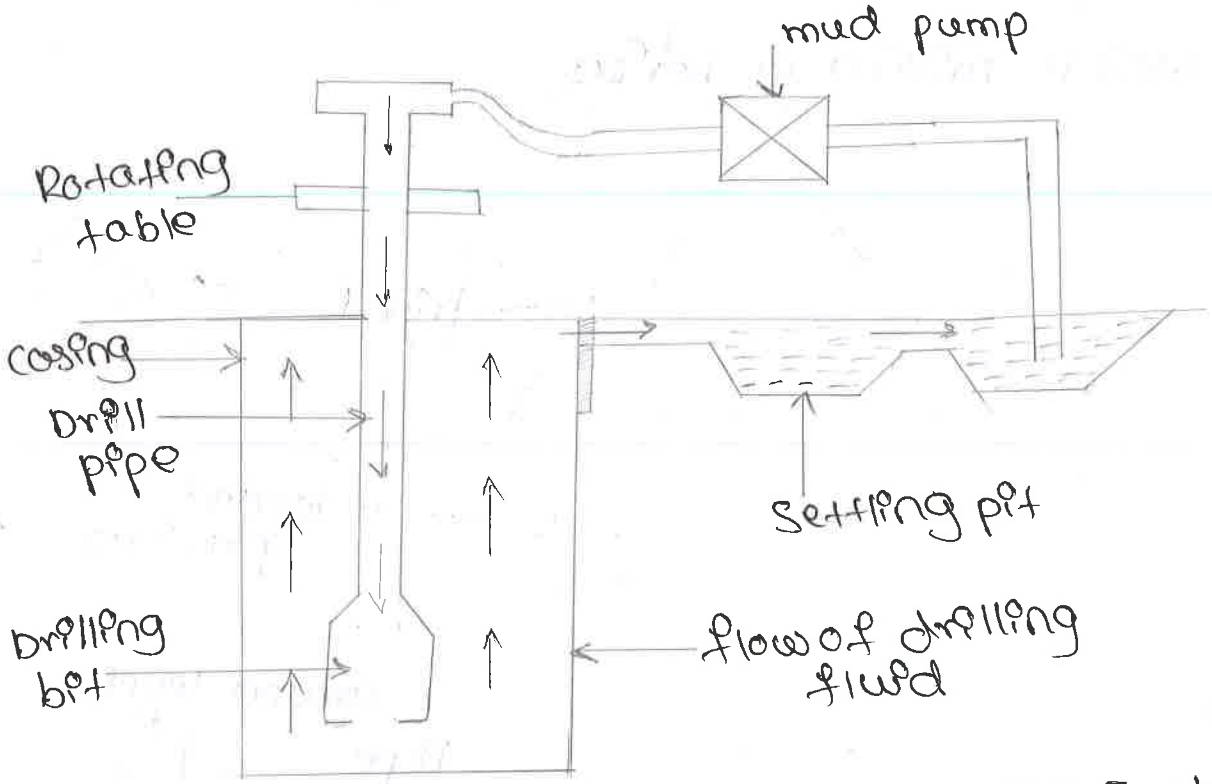
3) a heavy drill bit is suspended from a drill rod or a cable and is driven by repeated blows

4) water is added to facilitate the breaking of stiff soil or rock

5) The slurry of the pulverised materials is bailed out at intervals

6) This method only suitable for drilling boreholes in bouldery and gravelly strata

5> Rotary Boring



1> can be used in sand. clay and rocks (unless badly fissured)

2> This is a very fast method

3> even rock cores may be obtained by using suitable diamond drill bits

4> a drill bit fixed to the lower end of a drill rod is rotated by power while being kept in firm contact with the hole

5> Drilling fluid or bentonite slurry is forced under pressure through the drilling rod and it comes up bringing the cuttings to the surface

6> when soil samples are required the drilling rod raised and drilling bit is replaced by a sampler

Advantages

1> quick

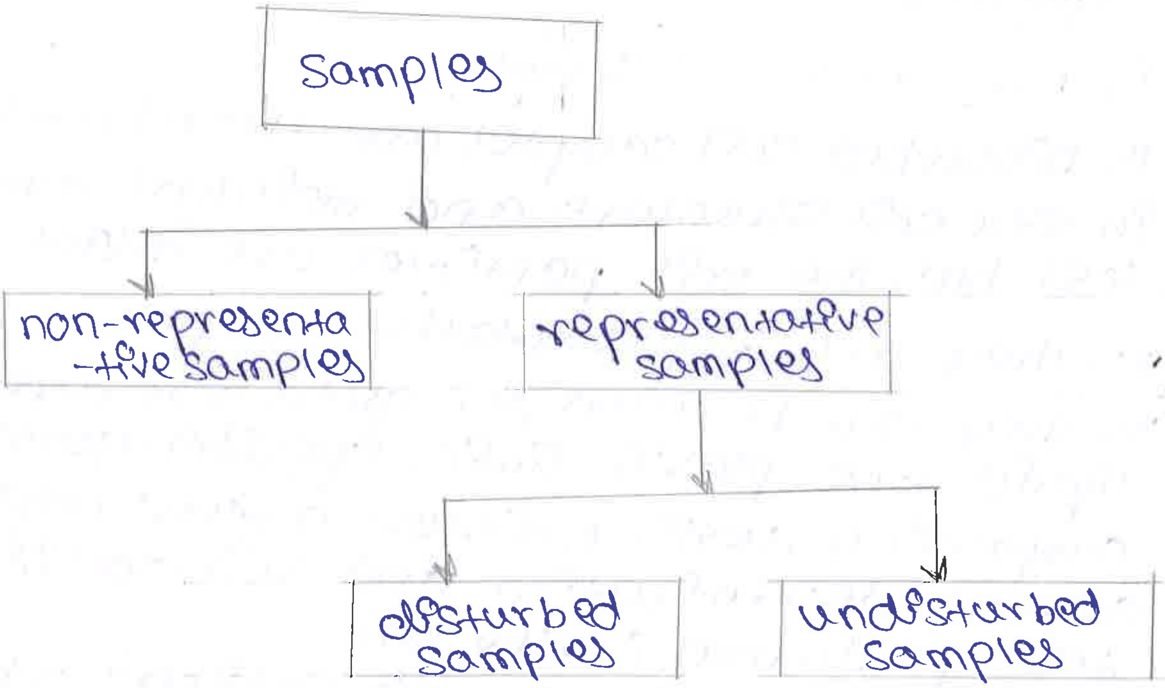
2> can drill through any type of soil or rock

3> undisturbed samples can easily be recovered

Disadvantages

1) Expensive equipment
2) Terrain must be accessible to motorized vehicle
3) Difficulty in obtaining location of groundwater level
4) additional time required for setup and cleanup.

* samples



⇒ non representative samples

1) mixture of materials from various soil or rock strata or are samples from which some mineral constituents have been lost or got mixed up soil samples
2) auger borings or wash borings are non-representative samples
3) they are not representative
4) These are suitable only for providing qualitative information such as major changes in subsurface strata

⇒ Representative samples

1> soil structure get modified or destroyed during the sampling operation

2> The water content may also have changed

3> structure of the soil may be significantly disturbed

4> They are suitable for identification and for the determination of certain physical properties such as atterberg limits and grain specific gravity.

(i) Disturbed soil samples

1> Disturbed soil samples are those in which the in-situ soil structure and moisture content are lost. but the soil particles are intact

2> They are representative samples

3> They can be used for grain size analysis. liquid and plastic limit, specific gravity, compaction tests, moisture content organic content determination and soil classification test performed in the lab

Examples :- obtain through cuttings while augering, grab, split spoon (SPT), etc

(ii) undisturbed soil samples

undisturbed soil samples are those in which the in-situ soil structure and moisture content are preserved

1> They are representative and also intact

2> These are used for consolidation, permeability or shear strengths etc [engineering properties]

3> more complex jobs or where clay exist.

4> Insand is very Difficult to obtain undisturbed sample

MODULE - 02

Stress in soils

Module - 02
Stress in Soils

①

Introduction

Stresses are induced in a soil mass due to self weight of soil and due to structural loads applied at or below the ground surface

The vertical stress at depth z below ground surface due to self weight of soil is given by

$$\sigma_z = \gamma z$$

where σ_z = vertical stress
z = depth below ground surface
γ = unit weight of soil

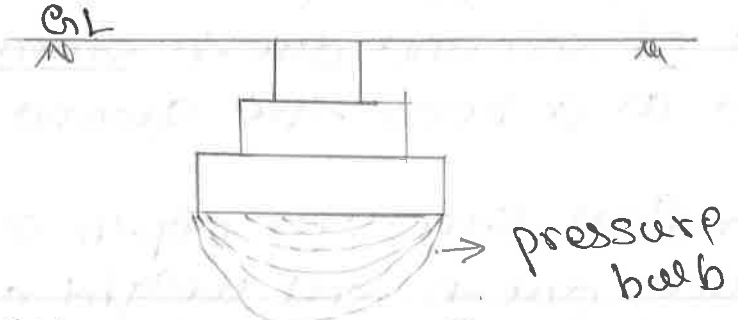
The estimation of vertical stresses at any point in a soil mass due to external loading is essential to the prediction of settlements of buildings, bridges, and pressure

Is stress and settlements within a soil mass are caused by both external and internal loading

a) External loading
External loading includes vertical loads applied on the ground surface or near the ground surface

b) Internal loading
Internal loading is applied inside the soil mass away from the ground surface
Ex: piles

2> foundation pressure transmitted to soil strata at various elevations below footings



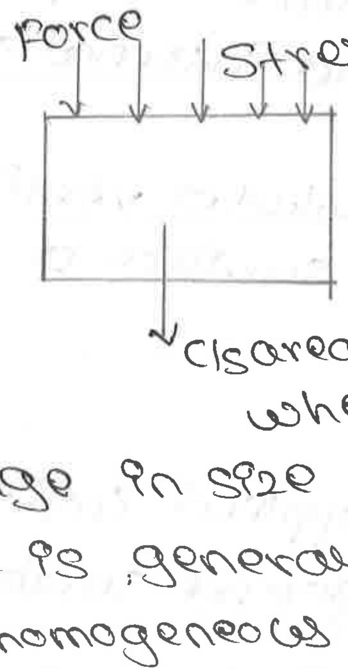
3> beam, columns. transmitted in all downward and lateral directions

Stress

The ratio of external or internal restoring force by a per unit area

External = Internal

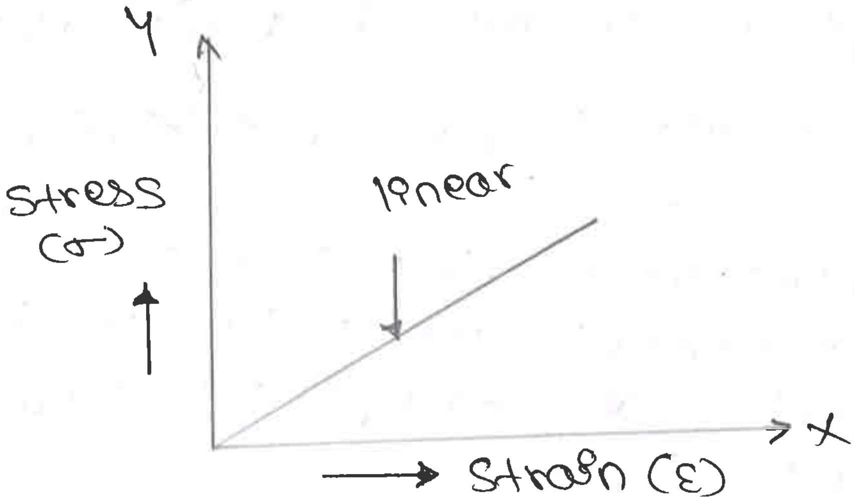
$$\text{Stress} \underset{\text{ratio of}}{=} \frac{\text{External restoring force}}{\text{c/s area}}$$



$$\text{Stress} = \frac{F}{A} = \text{N/m2}$$

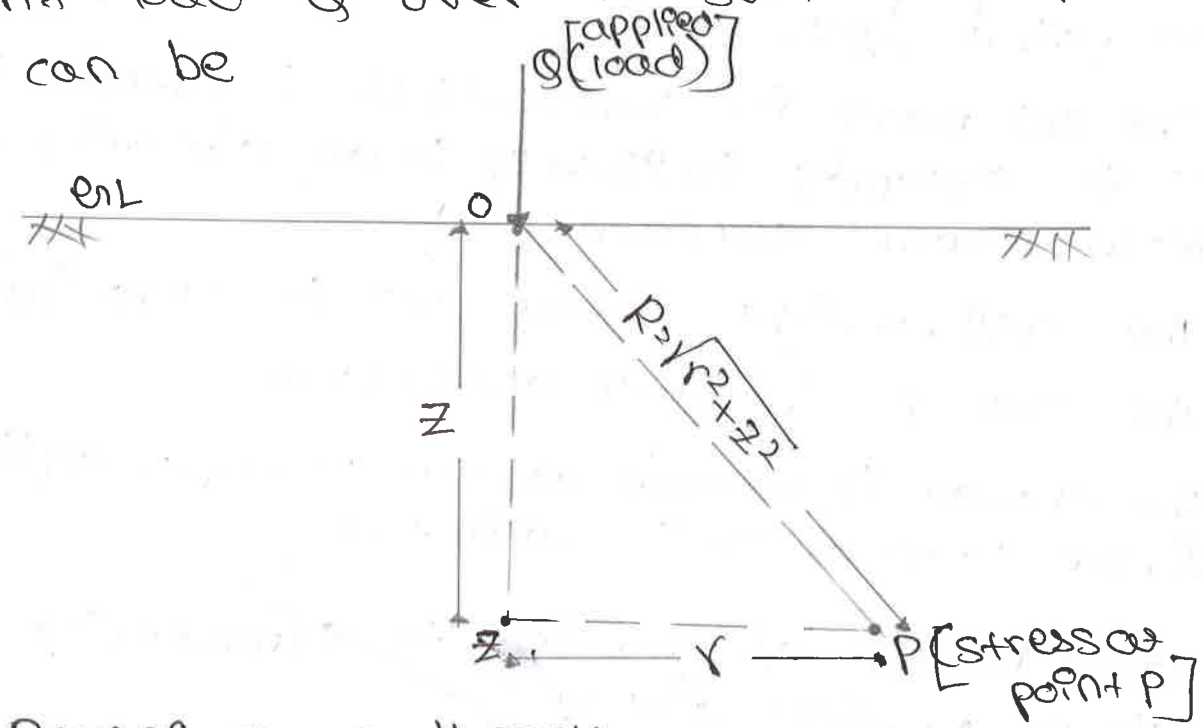
when applied force on body the change in size and shape of the body

* It is generally assumed that the soil mass is homogeneous and ~~istor~~ isotropic the stress strain relationship is assumed to be linear



⇒ Stress distribution

* Stress at any point 'P' in soil mass due to point load 'Q' over the surface at point 'O' can be



a) Boussinesq's theory
b) Westergaards theory

a) Boussinesq's theory

Boussinesq's theory is 1885 has given solution the stress caused by the application of point load at the surface of homogeneous, elastic and Isotropic medium

=> following assumptions are made by Boussinesqs

1> The soil mass in an elastic medium for which elasticity E is constant

2> The soil mass is homogeneous, that is all its constituent parts or elements are similar and it has identical properties at every point in it in identical directions

3> The soil mass is isotropic, that is it has identical properties in all directions through any point of it

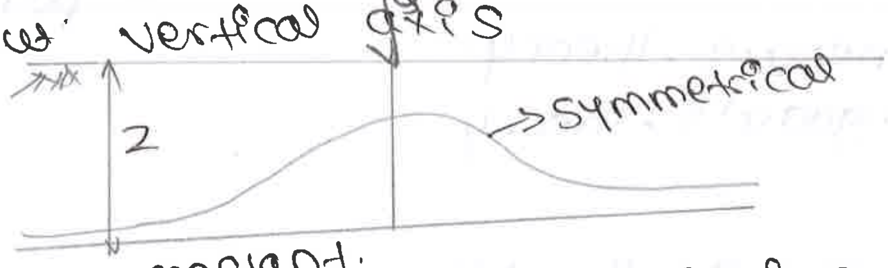
4> The soil mass is semi-infinite in extent, that is it extends infinitely in all directions below a level surface

5> The self-weight of the soil is ~~igore~~ ignored

6> The soil is initially unstressed

7> the change in volume of the soil upon application of the load on it is neglected

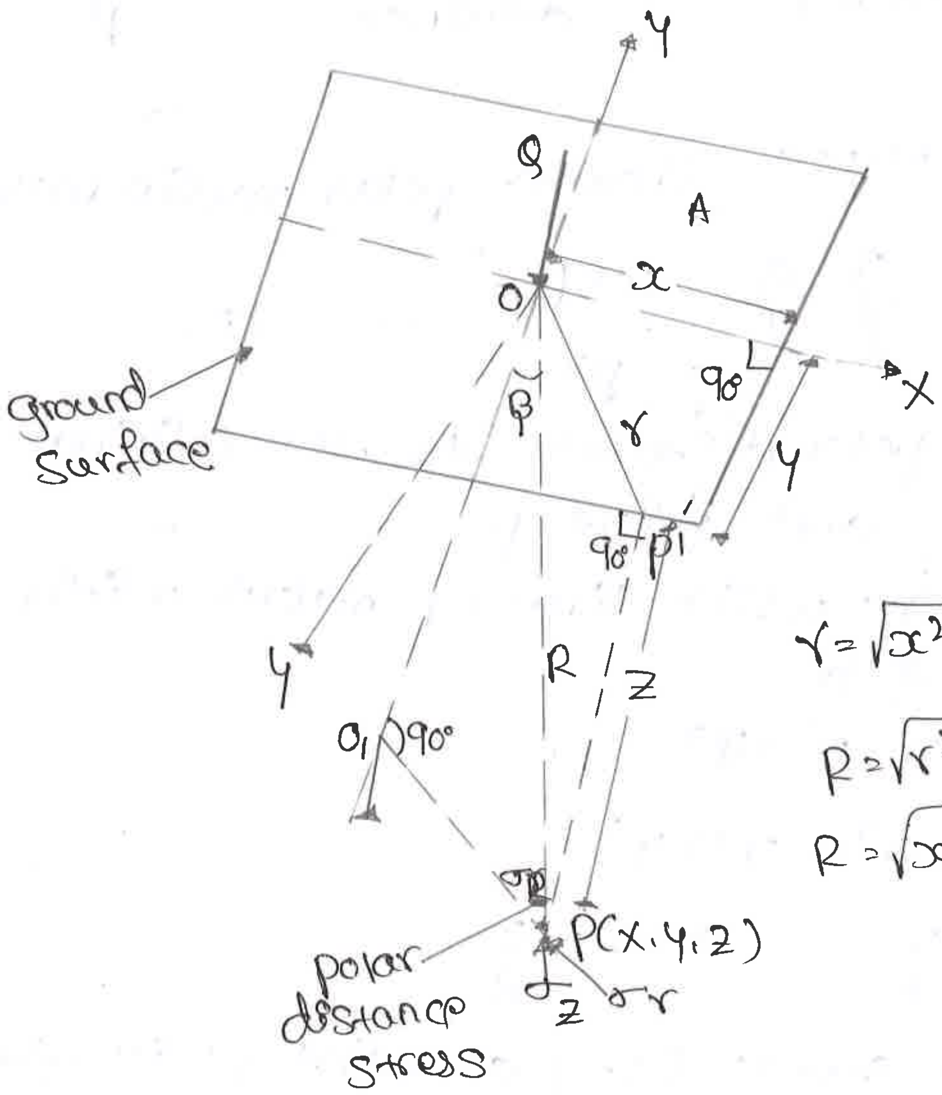
8> distribution of stresses is symmetrical about vertical axis



9> The top surface of soil is free from shear stress and is subjected to normal stress

10> continuity of stress is maintained in the medium

Let a point load Q (vertical load) act at the ground surface. at a point O which may be taken as the origen of the x, y and z-axes as shown let us find the stress components at a point 'P' in the soil mass. having coordinates x, y and z or having a radial horizontal distance 'r' and vertical distance Z from the point 'O'

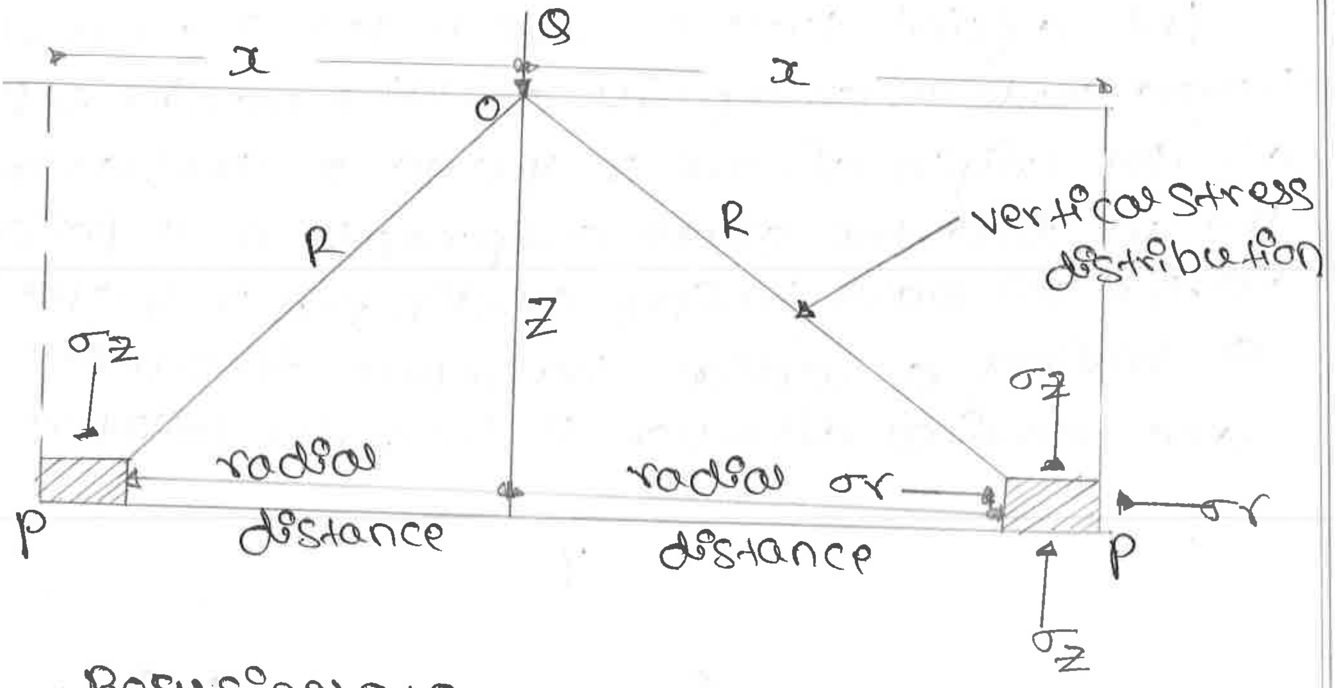


$Q/A \neq \sigma$

$$r = \sqrt{x^2 + y^2}$$

$$R = \sqrt{r^2 + Z^2}$$

$$R = \sqrt{x^2 + y^2 + Z^2}$$



Bosussinesq's showed polar radial may be

$$\sigma R = \frac{3}{2}\frac{Q}{\pi} \quad \frac{\cos\beta}{R^2} \text{ --- } ①$$

where R = polar distance b/w the original 'o' and point 'p'

β = angle which line op makes with the vertical

$$R = \sqrt{r^2+z^2}$$

where $r^2 = x^2+y^2$

$\sin\beta = \frac{r}{R}$ $\quad\cos\beta = \frac{Z}{R}$

Vertical stress (σ_Z) at point 'p' is given

$$\sigma_Z = \sigma R \cos^2\beta \text{ --- } (2)$$

$$= \frac{3}{2\pi}\left(\frac{Q\cos\beta}{R^2}\right) \times \cos^2\beta$$

$$= \frac{3Q}{2\pi}\left[\frac{\cos^3\beta}{R^2}\right]$$

$$= \frac{3Q}{2\pi}\left[\frac{\left(\frac{Z}{R}\right)^3}{R^2}\right] \qquad \because \cos\beta = \frac{Z}{R}$$

$$\sigma_Z = \frac{3Q}{2\pi}\left[\frac{Z^3}{R^5}\right] \text{ —— } ③$$

dividing and multiplying Z^2

$$= \frac{3Q}{2\pi}\left[\frac{Z^2}{Z^2}\times\frac{Z^3}{R^5}\right]$$

$$= \frac{3Q}{2\pi}\left[\frac{Z^5}{Z^2R^5}\right]$$

$$= \frac{3Q}{2\pi}\times\frac{1}{Z^2}\left[\frac{Z^5}{R^5}\right] \qquad \because R = \sqrt{r^2+Z^2}$$

$$R = (r^2+Z^2)^{1/2}$$

$$= \frac{3Q}{2\pi}\times\frac{1}{Z^2}\left[\frac{Z^5}{(r^2+Z^2)^{5/2}}\right]$$

dividing by Z^5

$$= \frac{3Q}{2\pi}\times\frac{1}{Z^2}\left[\frac{Z^5}{(r^2+Z^2)^{5/2}}\right]\times\frac{1}{Z^5}$$

$$= \frac{3Q}{2\pi}\times\frac{1}{Z^2}\left[\frac{Z^5/Z^5}{\left[\frac{r^2}{Z^5}+\frac{Z^2}{Z^5}\right]^{5/2}}\right]$$

$$= \frac{3Q}{2\pi}\times\frac{1}{Z^2}\left[\frac{1}{\left[\frac{r^2}{Z^5}+\frac{Z^2}{Z^5}\right]^{5/2}}\right]$$

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multiplying by z^3

$$= \frac{3Q}{2\pi} \times \frac{1}{z^2} \left[\frac{1}{\left[\frac{r^2}{\cancel{z^3}} \times \cancel{z^3} + \frac{1}{\cancel{z^3}} \times \cancel{z^3} \right]^{5/2}} \right]$$

$$= \frac{3Q}{2\pi} \times \frac{1}{z^2} \left[\frac{1}{\left[\frac{r^2}{z^2} + 1 \right]^{5/2}} \right]$$

$$= \frac{3Q}{2\pi} \times \frac{1}{z^2} \left[\frac{1}{\left[1 + \frac{r^2}{z^2} \right]^{5/2}} \right]$$

$$\sigma_z = \frac{3Q}{2\pi} \times \frac{1}{z^2} \left[\frac{1}{\left[1 + \left(\frac{r}{z} \right)^2 \right]^{5/2}} \right]$$

$$\boxed{\sigma_z = \frac{3}{2\pi} \frac{Q}{z^2} \left[\frac{1}{\left[1 + \left(\frac{r}{z} \right)^2 \right]^{5/2}} \right]}$$

$\uparrow$

Boussinesq equation

$$I_B = \frac{3}{2\pi} \left[\frac{1}{\left[1 + \left(\frac{r}{z} \right)^2 \right]^{5/2}} \right]$$

I_B = Boussinesq influence factor

$$\sigma_z = I_B \frac{Q}{z^2}$$

* limitations

1> The solution was derived assuming the soil as an elastic medium. but the soil doesnot behave as an elastic material

2> when the stress decrease occurs in soil the relation between the stress and the strain is not linear as assumed. therefore. the solution is not strictly applicable

3> In deep sand deposits. the modulus of elasticity increases with an increase in depth and therefore the Boussinesq's solution will not give satisfactory results

4> the point loads applied below ground surface causes somewhat smaller stresses than are caused by surface loads. and therefore. the solution is not strictly applicable.

b> westergaard's solution

1> actual sedimentary deposits are generally anisotropic

2> thin layers of sand embedded in homogeneous clay strata

3> westergaard's solution assumes that there are thin sheets of rigid materials sandwiched in a homogeneous soil mass.

4> thin sheets are closely spaced and are of infinite rigidity and prevent the medium from undergoing lateral strain

according to westergaard the vertical normal stress σ_z at a point 'P' at a depth z below the point load 'Q'

$$\sigma_z = \frac{C/2\pi}{\left[C^2 + \frac{r^2}{z}\right]^{3/2}} \frac{Q}{z^2}$$

where c depends upon the poisson ratio (μ)

$$C = \sqrt{\frac{(1-2\mu)}{(2-2\mu)}}$$

For elastic material the value of μ varies between 0 to 0.5

$\mu = 0$ and $C = 1/\sqrt{2}$

is assumed that there is lateral restrained

$$\sigma_z = \frac{1}{\pi\left[1+2\left(\frac{r^2}{z}\right)\right]^{3/2}} \frac{Q}{z^2}$$

$$\sigma_z = \frac{1}{\pi\left[1+2\left(\frac{r}{z}\right)^2\right]^{3/2}} \frac{Q}{z^2}$$

$$\sigma_z = I_w \frac{Q}{z^2}$$

where $I_w = \frac{1}{\pi\left[1+2\left(\frac{r}{z}\right)^2\right]^{3/2}}$ is known as westergaard's influence factor.

* comparison between Boussinesq's and westergaard's solutions

(1) I_w are considerably smaller than the Boussinesq influence factor (I_B)

(2) the westergaard influence factor is about 2/3 of the Boussinesq value for small values

5th sem [A and B] Divisions

course tittle :- Applied Geotechnical Engineering

subject code :- 17CV53

MODULE - 03

Lateral Earth pressure and stability of slopes

module-03

Lateral earth pressure

Introduction

This important property influences the design of retaining walls abutments, bulkheads, sheet pile walls, basement walls and underground conduits which retain or support soil, and as such is of very great significance, The soil mass retained or supported by the retaining structures is called backfill which may have its top surface horizontal or inclined. The portion of the backfill lying above a horizontal plane at the level of the top of the retaining structures is called surcharge and its inclination to the horizontal is called surcharge angle β, Retaining walls are constructed in various fields of civil Engineering such as hydraulics, and irrigation structures, highways, railways, tunnels, mining and military engineering

⇒ Different type of lateral earth pressure

1> co-efficent of earth pressure at rest (k_o)

2> co-efficient of active earth pressure (k_a)

3> co-efficent of passive earth pressure (k_p)

1> earth pressure at rest

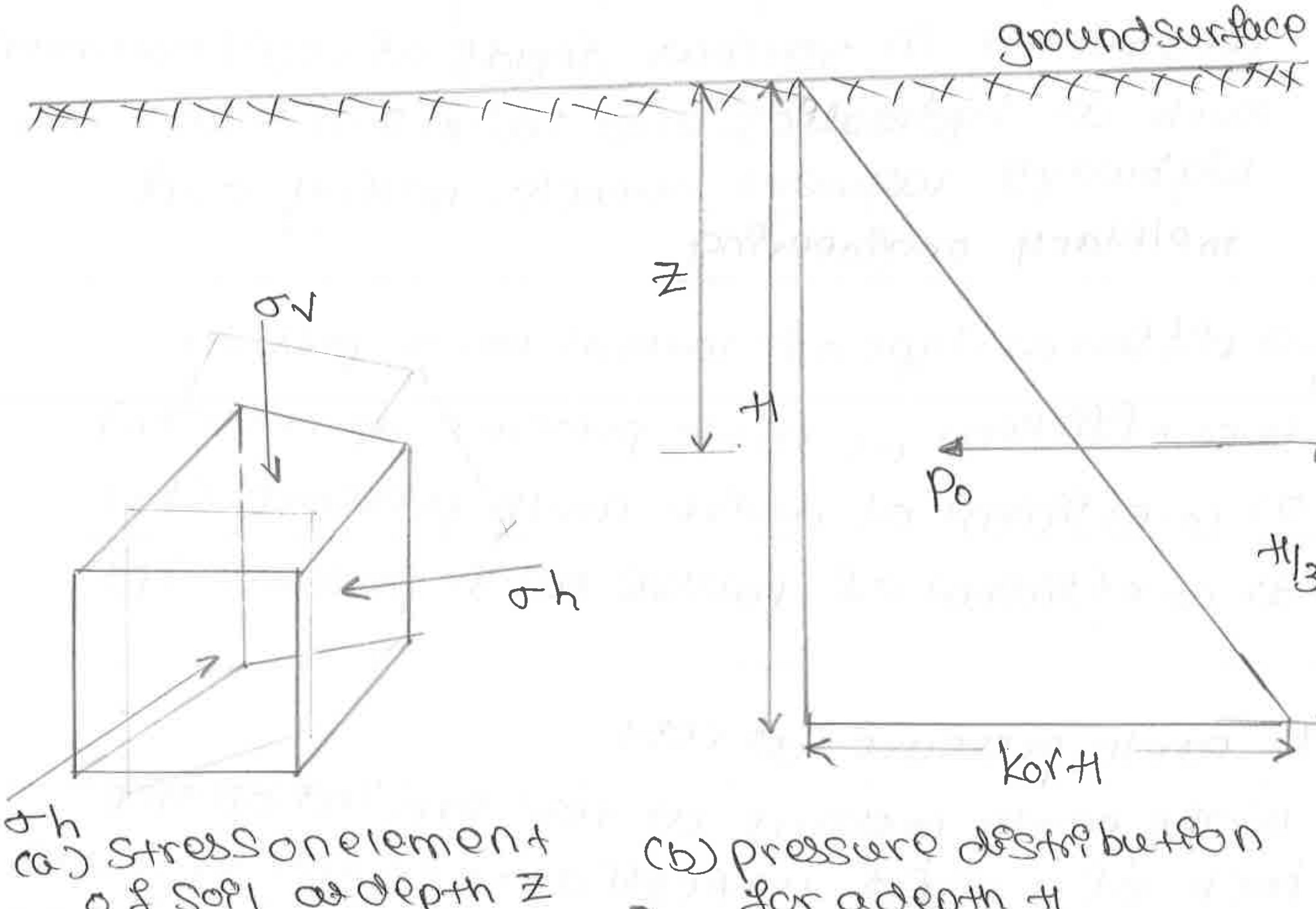
1> The earth pressure at rest exerted on the back of a rigid, unyielding retaining structure.

2> determined by using the theory of elasticity assuming the soil to the semi-infinite, homogeneous elastic and isotropic.

Consider an element of soil at a depth 'z' being acted upon by vertical stress σv and horizontal stress σh as shown in figure, there will be no shear stress. and hence σv and σh are the principal stresses.

Let E and μ be the modulus of elasticity and poisson's ratio of the soil respectively. the lateral strain εh in the horizontal direction

$$\varepsilon h = \frac{1}{E}\left[\sigma h - \mu\left[\sigma v + \sigma h\right]\right]$$



(a) Stress on element of soil at depth Z

(b) pressure distribution for a depth H

Fig:- Stress conditions relating to earth pressure at rest soil deforms vertically under its self weight but is prevented from deforming laterally because of an infinite extent in all lateral directions. the earth pressure at rest corresponds to the condition of zero lateral strain [$\varepsilon h = 0$]

$$\sigma h = \mu\,[\sigma v + \sigma h]$$

$$\frac{\sigma h}{\sigma v} = \frac{\mu}{1-\mu} = k_o$$

where k_o is coefficient of earth pressure at rest which is the ratio of the intensity of the earth pressure at rest to the vertical stress at a ~~de~~ specified depth

lateral pressure (σh) at rest by P_o and substituting $\sigma v = \gamma z$ where γ is the appropriate unit weight of the soil depending on its condition

$$P_o = k_o \gamma z.$$

The distribution of the earth pressure at rest with depth is thus linear (or of hydrostatic nature) for constant soil properties such as E, μ and γ

Structure such as a retaining wall of height H' the pressure distribution diagram is thus trianguar with zero intensity at $z = 0$ and intensity of $k_o \gamma z$ at the base of the wall where $z = H$. the total earth pressure P_o per unit length of the wall

$$P_o = \int_0^H k_o \gamma z \, dz = \tfrac{1}{2} k_o \gamma H^2$$

$$\boxed{P_o = \frac{1}{2} K_o \gamma H^2}$$

Considered to act at (1/3)H above the base of the wall

$$\boxed{K_o = (1 - \sin\phi)}$$

The at rest condition does not involve failure of the soil, but represents a state of elastic equilibrium

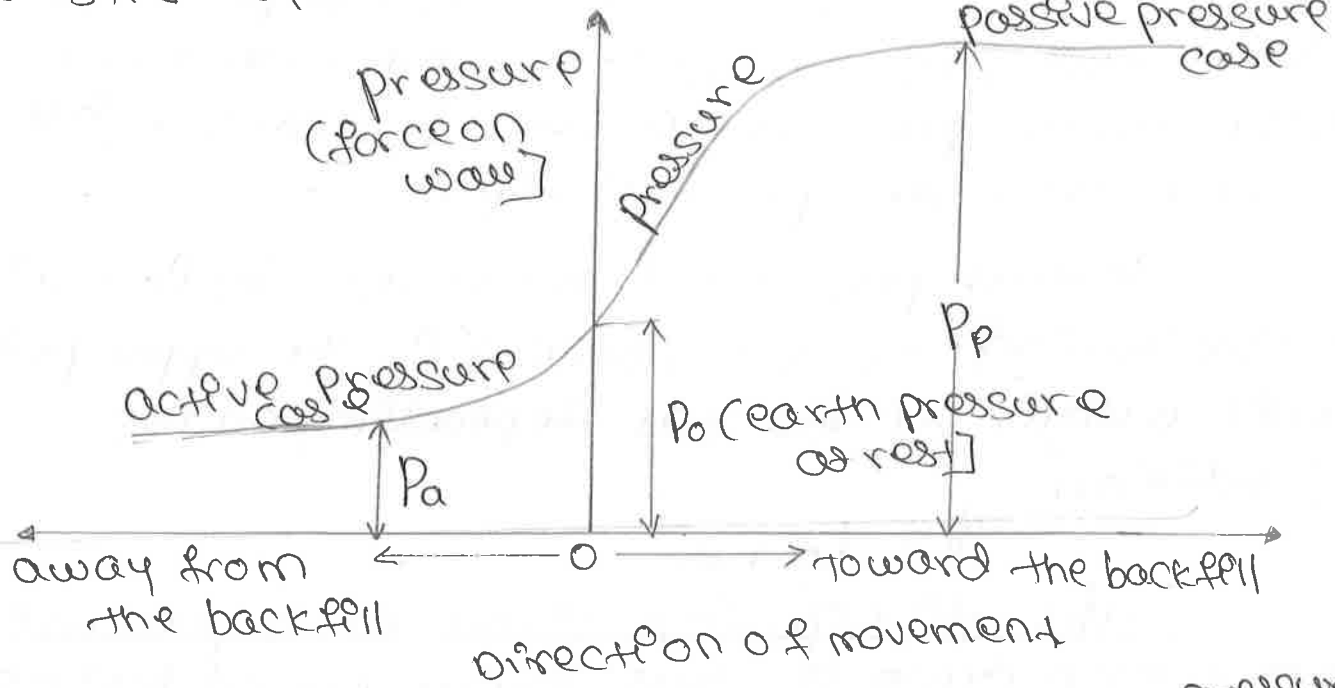


Fig: Relation between lateral earth pressure and movement of wall

a) active earth pressure

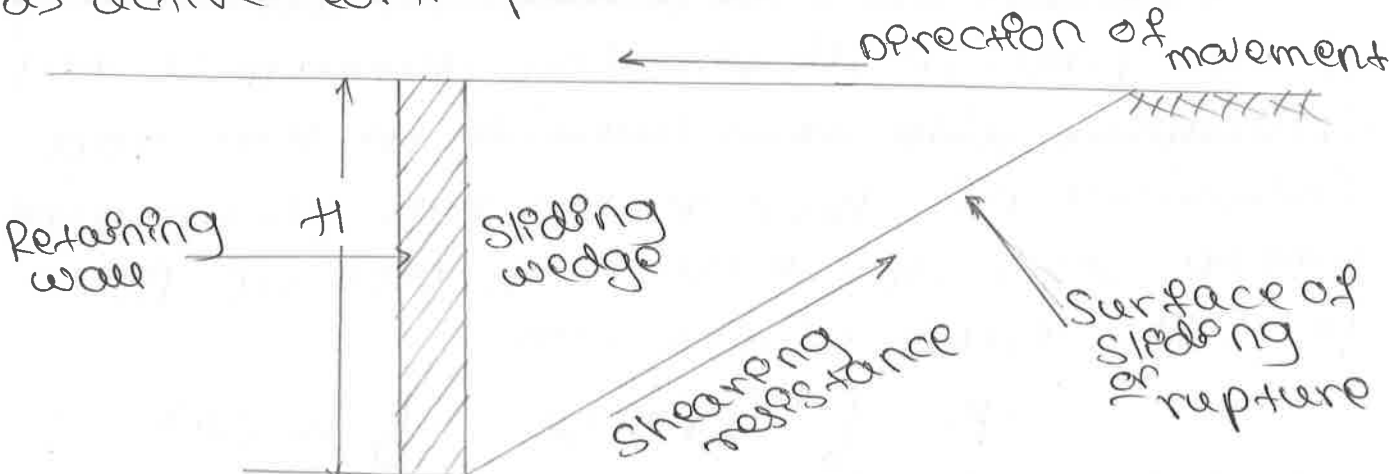


Fig:- conditions in the case of active earth pressure

1) earth pressure is said to be active if the structure tends to move away from the fill. and if the structure is removed the retained soil will move in the forward / downward direction

2) the soil mass behind the wall tends to fail and this mass will exert pressure on the wall.

3) The coefficient of the earth pressure corresponding to the minimum pressure on the wall is the coefficient of the active earth pressure.

4) the soil mass is active in exerting pressure on the wall and hence the term active earth pressure

5) active earth pressure co-efficient (ko) is the ratio between the lateral and vertical principal effective stresses at the limiting stress state when an earth retaining structure moves away (by a small amount) from the backfill (retained soil)

3) passive earth pressure

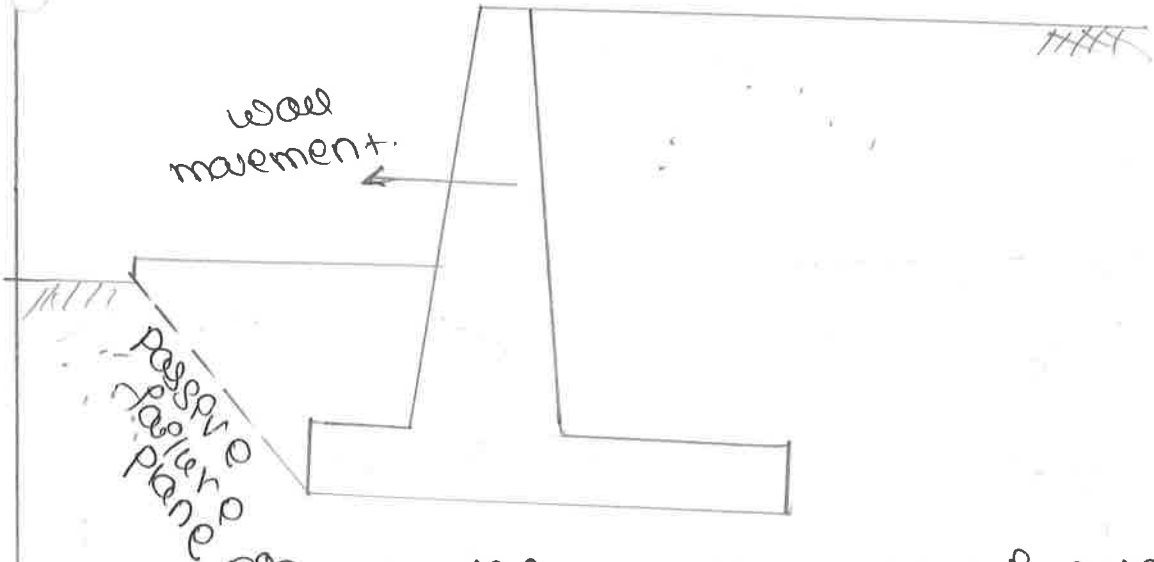


Fig:- conditions in the case of passive earth pressure

1> passive pressure means the structure tends to move towards the fill and the fill itself moves backword / upwards

2> press the wall into the soil mass as larger mass of earth than in the active state exerts resistance to the movement.

3> It is in a passive state and the earth has to be pushed up as failure.

4> The pressure required for a failure to happen is called passive earth pressure.

5> The passive pressure is used as the soil is in a passive state.

6> the corresponding coefficent of earth pressure is called the passive pressure coefficent

7> passive earth pressure coefficent (kp) is the ratio between the lateral and vertical principal effective stresses as the limiting stress state when an earth retaining structure is forced against a soil mass

8> The active pressure is the minimum likely pressure on a retaining structure and the passive pressure is the maximum likely. the at rest pressure usually lies between these two extremes active and passive pressure may occur simultaneously on different parts of a structure

⇒ Difference between active and passive pressure

active ~~pressure~~ pressure	passive pressure
1> very little movement is required to mobilise the active pressure (about 0.5% horizontal strain)	1> much higher movement is required to mobilise the pressure (about 2% horizontal strain)

5th sem [A and B] Divisions

Course title :- Applied Geotechnical engineering

Subject code :- 17CV53

MODULE – 04

Bearing capacity of Shallow foundation

Module - 04

Bearing capacity of Shallow foundation

Introduction

Foundation

Foundation is the lowest part of a structure which provides a base for the superstructure. the term foundation includes the portion of the structure below the ground level as well as the artificial arrangement of concrete block, piles, raft, grillage, etc. provided to transmit the loads on the structure including the dead weight of the structure itself to the soil below

The function of the foundation is to transfer the load of the superstructure to the underlying soil formation without overstressing the soil. Hence a safe foundation design provides for a suitable factor against

(1) Shear failure of the soil

(2) Excessive settlement

⇒ purpose of foundation

1> To distribute the weight of the structure over larger area so as to avoid overloading of the soil beneath

2> to load the sub-stratum evenly and thus prevent unequal settlement

3> To provide a level surface for building operations

4> To increase the stability of the structure by taking it deep into the ground

⇒ type of foundation

1) Shallow foundations
2) Deep foundations

1) Shallow foundations
i) Spread footings
ii) Strap footing
iii) combined footings
iv) mat or raft foundation

i) spread footings

(1) ~~The base~~ spread footings or simply footing is used to transmit the load from a wall or a column over a sufficiently large area of foundation soil

2) This is most common type of shallow foundation

(a) isolated footings

(1) spread footing is provided to support an individual column it is called isolated footing

2) used for reinforced concrete buildings

3) isolated footing may be square. rectangular, or circular

4) the footing of a column is also called as pad foundation

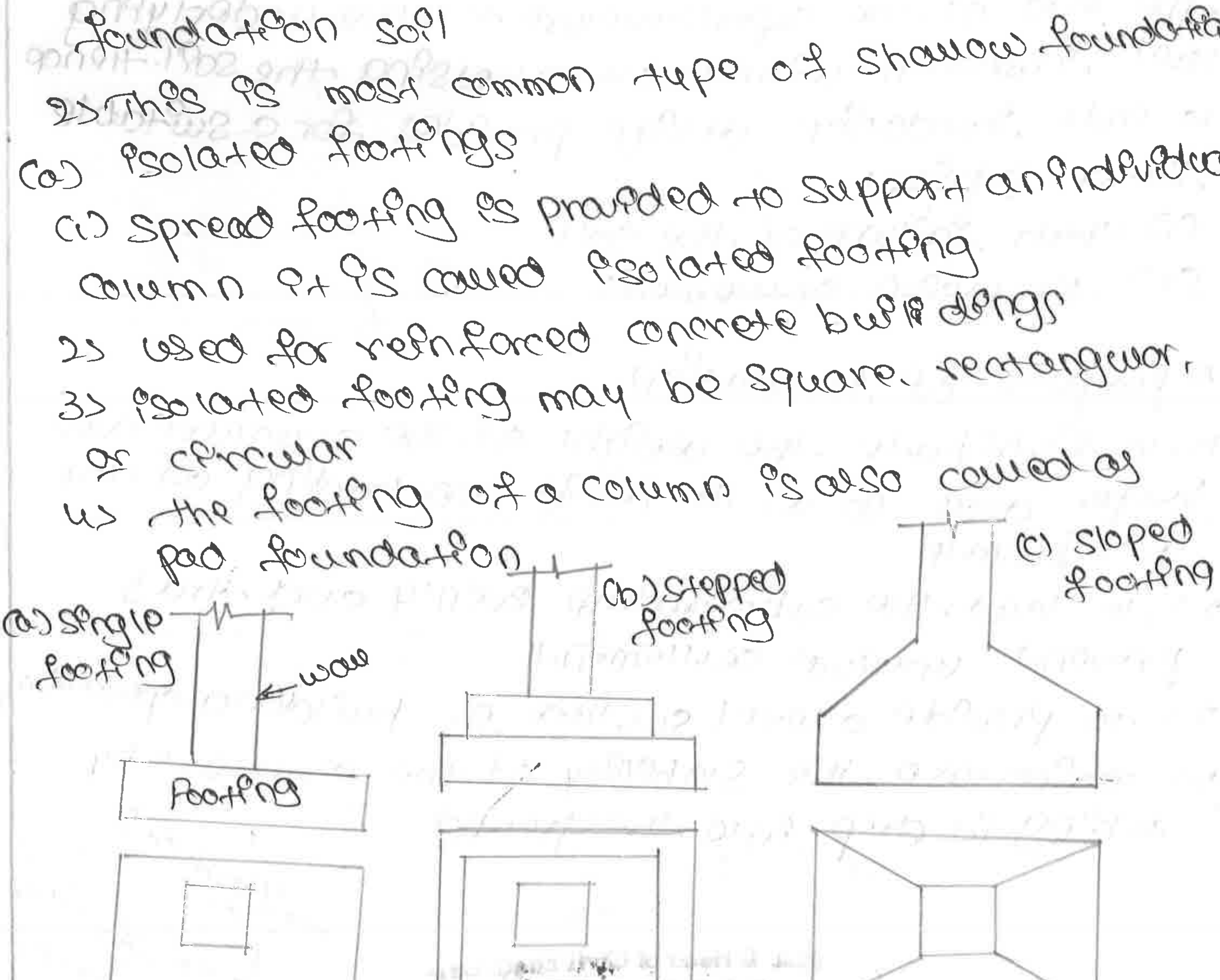


Fig : - Isolated footings

b) Strip / continuous footings

1) Strip footing is another type of spread footing which is provided for a load bearing wall

2) Strip footing than to provide a number of Spread footings in one line.

3) Strip footing is also known as continuous footing

4) Strip footings are usually used in the bearing wall type structure

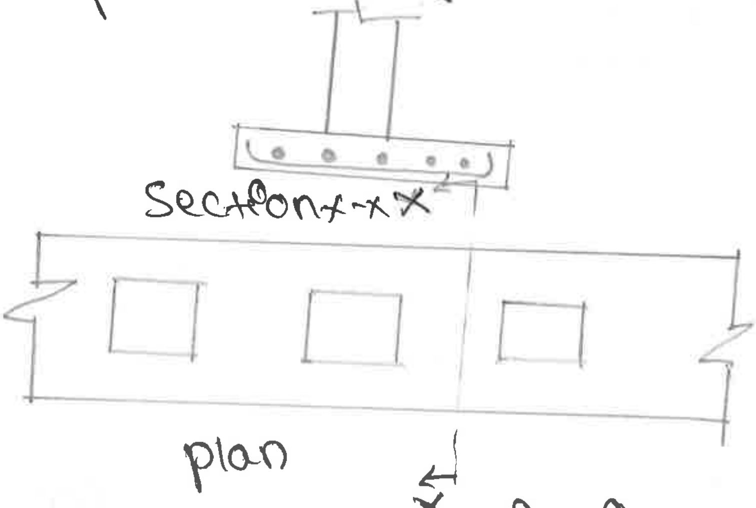


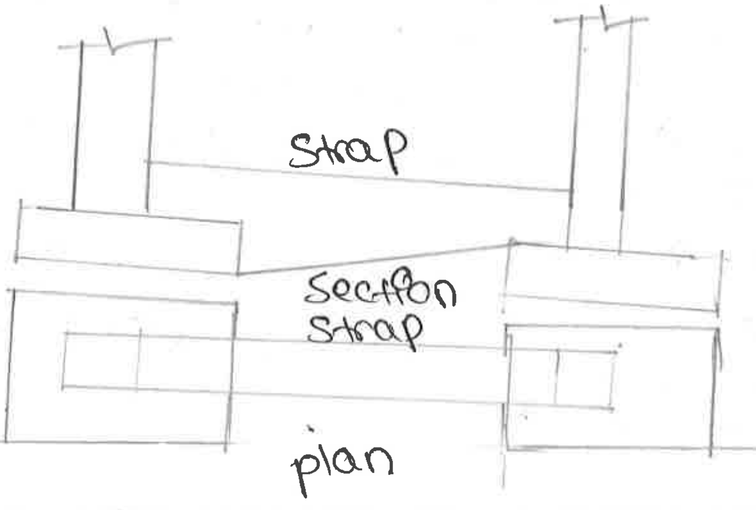
Fig: continuous footings

(ii) Strap footing

1) the two or more footings connected by a beam called Strap

2) It is also called as cantilever footing

3) transfer the column loads onto the soil beneath with equal and uniform soil pressure under both. spread footings

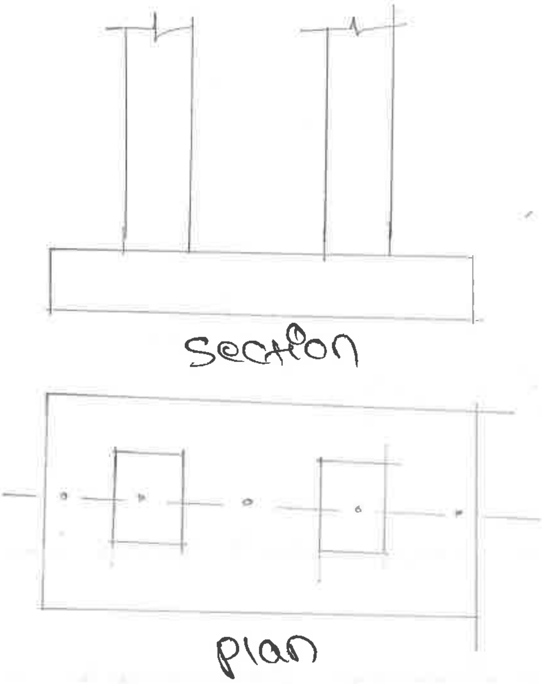


iii) combined footing

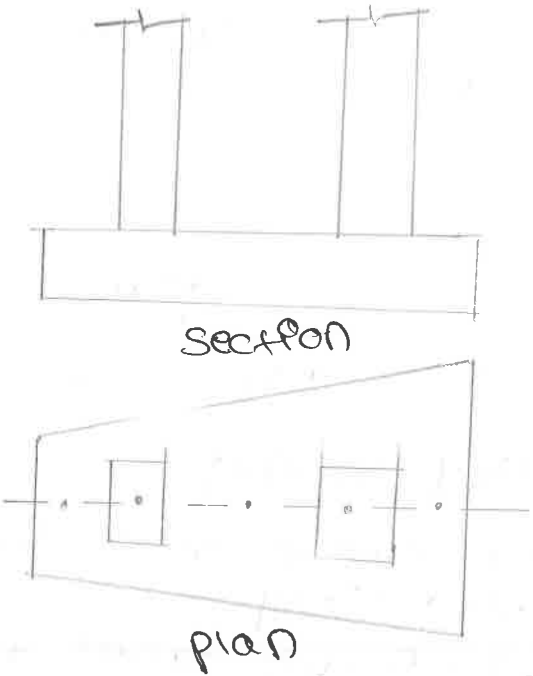
is a combined footing supports two or more columns in a row as

2) a combined footing is also provided in situations where there is limited space on one side owing to the existence of the boundary line of an adjoining ~~prom~~ private property

3) trapezoidal footing is provided when the load on one of the columns is larger than the other column load



(a) Rectangular combined footing



(b) trapezoidal combined footing

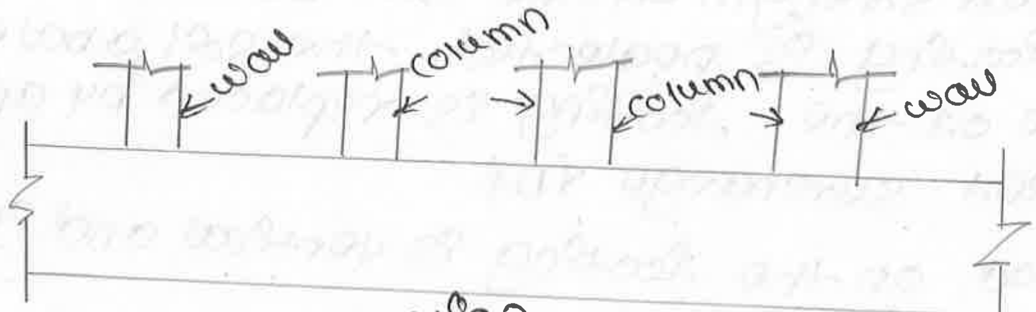
(iv) mat or raft foundation

1) a raft foundation or mat foundation is a large footing supporting walls as well as a number of columns in two or more rows

2) ~~when~~ this is adopted when the allowable soil pressure is low

3) Raft foundation is useful in reducing the differential settlement which may occur on non homogeneous soil

4> large variation in the loads on individual columns



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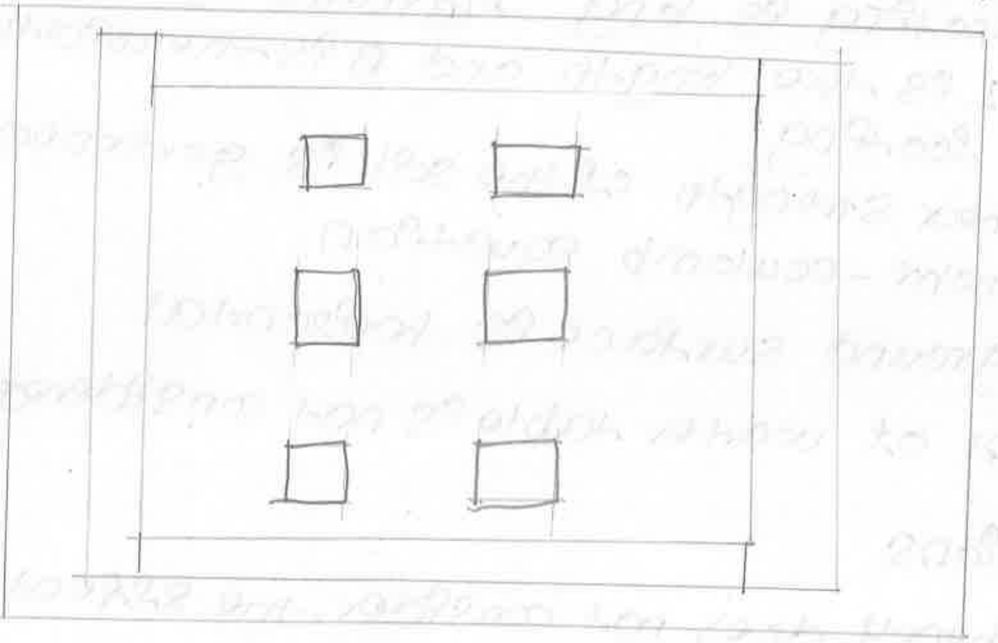


plan

Fig:- Raft or mat foundation

2> Deep foundation
(i) pile foundations
(ii) pier foundations
(iii) well foundations
(iv) caisson foundations

⇒ Imp Determination of bearing capacity by Terzaghi's

assumptions

1> The base of the footing is rough
2> the footing is located at a depth Df below the ground surface such that Df is less than or equal to the width B of the footing

Df ≤ B, or the foundation is shallow

3) the Shear strength of the soil above the base of the footing is neglected. the soil above the base of the footing is replaced by an equivalent surcharge γDf.

4) the load on the footing is vertical and is uniformly distributed

5) the footing is long L/B ratio is infinite where L is the length and B is the width of the footing

6) the Shear strength of the soil is governed by the mohr-coulomb equation

7) the ground surface is horizontal

8) effect of water table is not considered

limitations

1) This theory does not consider the effect of water table on bearing capacity

2) In this. theory, effect of depth of the foundation is not considered

3) This theory is applicable to only strip footing and not applicable for others like. rectangular square or circular foundation

4) In this theory, only vertical and symmetrical loading are considered

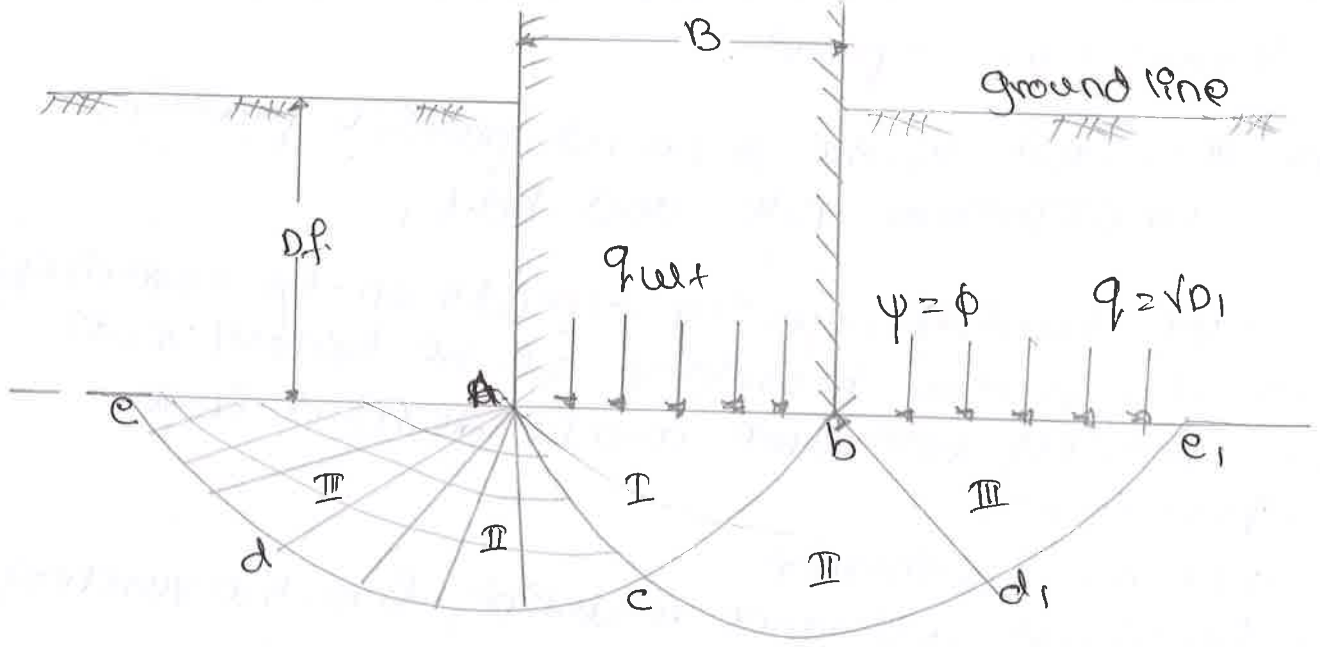


Fig :- Terzaghi's wedge

1> Terzaghi's assumed a strip footing with a rough base placed as the depth Df on a homogeneous and isotropic soil medium

2> the shearing resistance of the soil above the base of the footing is not considered. but the effect of soil -weight above the base is considered by superimposing an equivalent surcharge intensity. $q = \gamma Df$. the development of the failure surface in the soil is governed by the general shear failure

Zone I :- 1> The triangular zone Abc immediately below the foundation is an elastic zone and a a zone of active state.

2> It is assumed to move downwards with the footing and in the process produces lateral thrusts which when the soil fails,

3> overcome the passive resistance of the soil along both sides of the footing.

Zone II :- This is the zone of radial shear Adc and bcd, the curves dc and cd, are arcs of a logarithmic spiral

Zone - III :- This is the zone of passive plastic equilibrium Ade and bde,

The bearing capacity depends on the shearing resistance on the boundary. of the failure zones the shearing resistance can be divided into three parts

1> cohesive resistance
2> frictional resistance resulting from the surcharge q at the footing level
3> frictional resistance resulting from the weight. of soil within the failure zones

using equilibrium analysis. terzaghi, Expressed the ultimate bearing capacity in the

$$q_u = cN_c + \gamma D_f N_q + \frac{1}{2}\gamma B N_\gamma \text{ (for strip footing)}$$

where

c = unit cohesion
γ = Effective unit weight of soil
B = width of footing
D_f = depth of foundation

N_c, N_q and N_γ = the bearing ~~capa~~ fa capacity factors that are non dimensional (friction of the angle of friction ϕ)

when $\phi = 0$ $N_c = 5.7$ $N_q = 1.0$ and $N_\gamma = 0$

$\therefore q_u = 5.7c + \gamma D_f$.

or $q_u = 5.7c$ for a surface footing

Course Title: Applied Geotechnical Engineering

SUBJECT CODE - 17CV53

SEMESTER - Vth A and B

MODULE - 05

pile foundations

MODULE - 05

pile foundations

Introduction

pile perform the function of transferring load from the superstructure through weak compressible strata or through water onto stiffer or more compact and less compressible soils or onto rock

They may be required to carry uplift loads when used to support tall structures subjected to overturning forces from winds or waves. pile used in marine structures are subjected to lateral loads from the impact of berthing ships and from waves

combinations of vertical and horizontal loads are carried where piles are used to support retaining walls, bridge piers and abutments and machinery foundations

⇒ necessity of pile foundation

(1) when the upper soil layer is highly compressible and too weak to support the load transmitted by the superstructure

2) piles are used to transmit the load to underlying bedrock or a stronger soil layer

3) pile foundations are required for the transmission of structural loads through deep water to a firm stratum

4) pile foundations are used to resist horizontal forces. additional to support the vertical loads in earth retaining structures and tall structures

and tall structures that are subjected to Horizontal force due to high wind and earthquake

5> Expansive soils. such as black cotton soil. which Swell or Shrink as the water content changes. pile are used to transfer the load below the active zone

⇒ classification of piles

(a) Function or action

2) composition and materials

3> Installation

1> classification Based on function or action

a> end bearing pile

b> Friction piles

b> Tension or uplift piles

c> compaction piles

d> anchor piles

f> Fender piles

g> Sheet piles

h> Batter piles

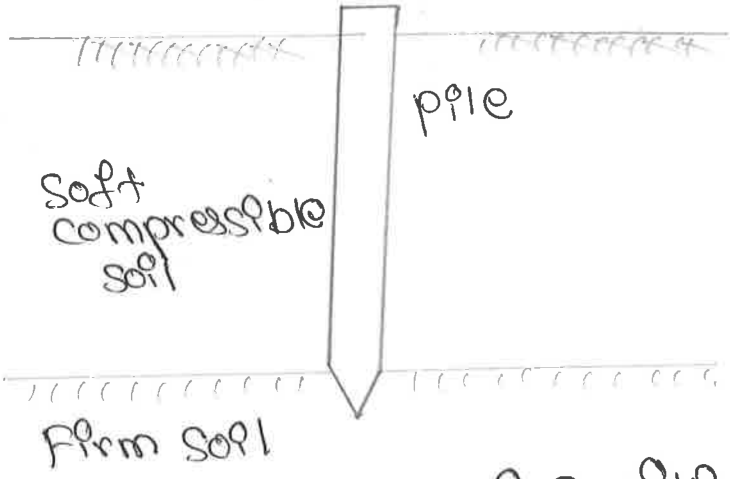
h> laterally loaded piles

a> ~~Friction piles~~ End bearing piles

1> Super-structure and transmitting the load down to the level at which it can be safely borne by the ground

2> The end bearing piles transmit the load of the structure to underlying hard soil

3> transfer load through the pile tip to a suitable stratum, passing soft soil or water



Fig(a):- End bearing pile

b) friction piles

1) when the piles are driven through a soft soil and developed their carrying capacity by friction on the sides of the piles, are called friction piles.

2) used to transfer loads to a depth in a frictional material by means of skin friction along the surface area of the pile

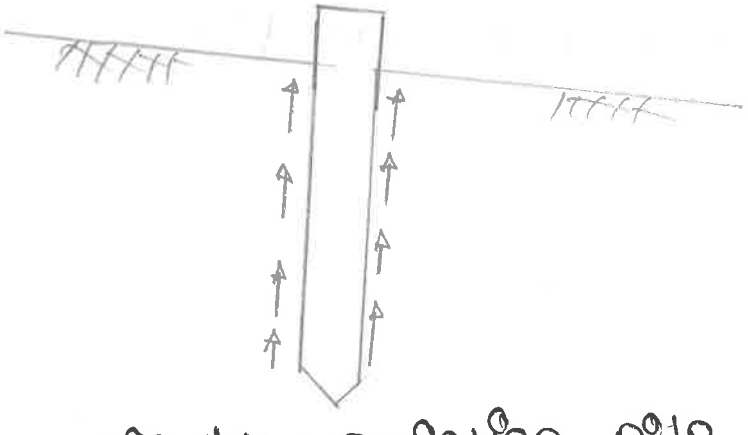


Fig (b) : Friction pile

c) Tension on uplift piles

1) The pile used to resist upward forces and in tension is known as tension pile

2) used to anchors structures subjected to

uplift due to hydrostatic pressure ~~or~~ to overturning moment due to horizontal forces

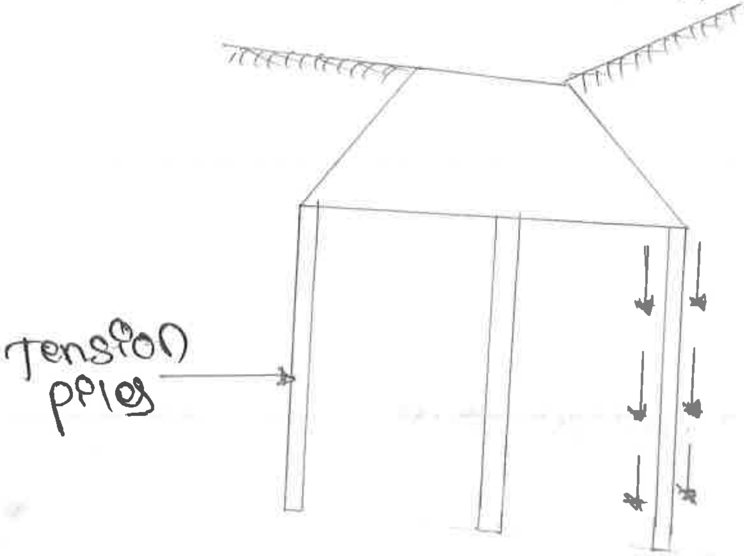


Fig (c) :- Tension piles

d> compaction piles

1> The piles driven in granular soils with the aim of increasing the bearing capacity of the soil are known as compaction piles

2> sand may be used to form the pile.

3> The pile tube driven to compact the soil is gradually taken out and sand is filled in its place thus forming a ~~sta~~ sand pile

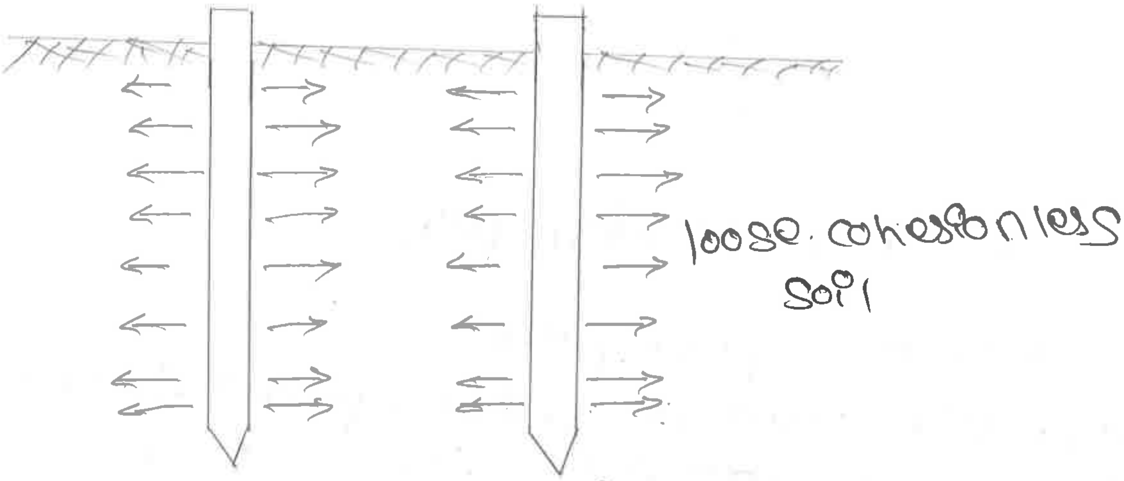


Fig (d) :- compaction pile

e> Anchor piles

1> The piles used for providing anchorage against horizontall pull from sheet piling walls or other pulling forces are known as anchor piles

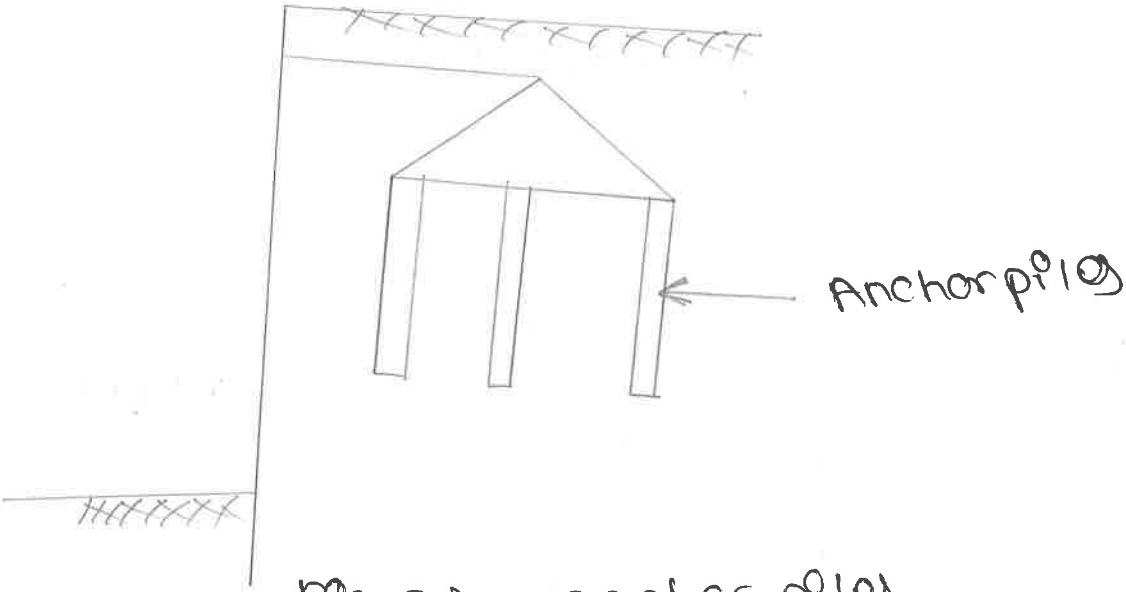


Fig (e) :- anchor piles

f> Render piles

1> The piles used to protect concrete deck on other water Frond structure from impact. may be caused ships or other floating objects is called Fender piles

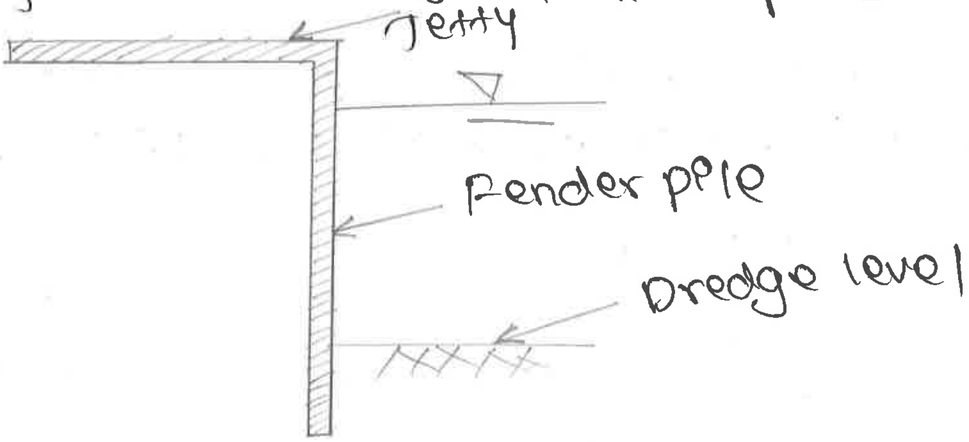


Fig f> :- Fender piles

g> Sheet piles

1> used to retain soil that do escape laterally when subjected to pressure to enclose

the area required for same foundation and protect. it ~~form~~ the action of running water
from

2> commonly used bulkheads, or cut-offs to reduce seepage and uplift in Hydraulic structures

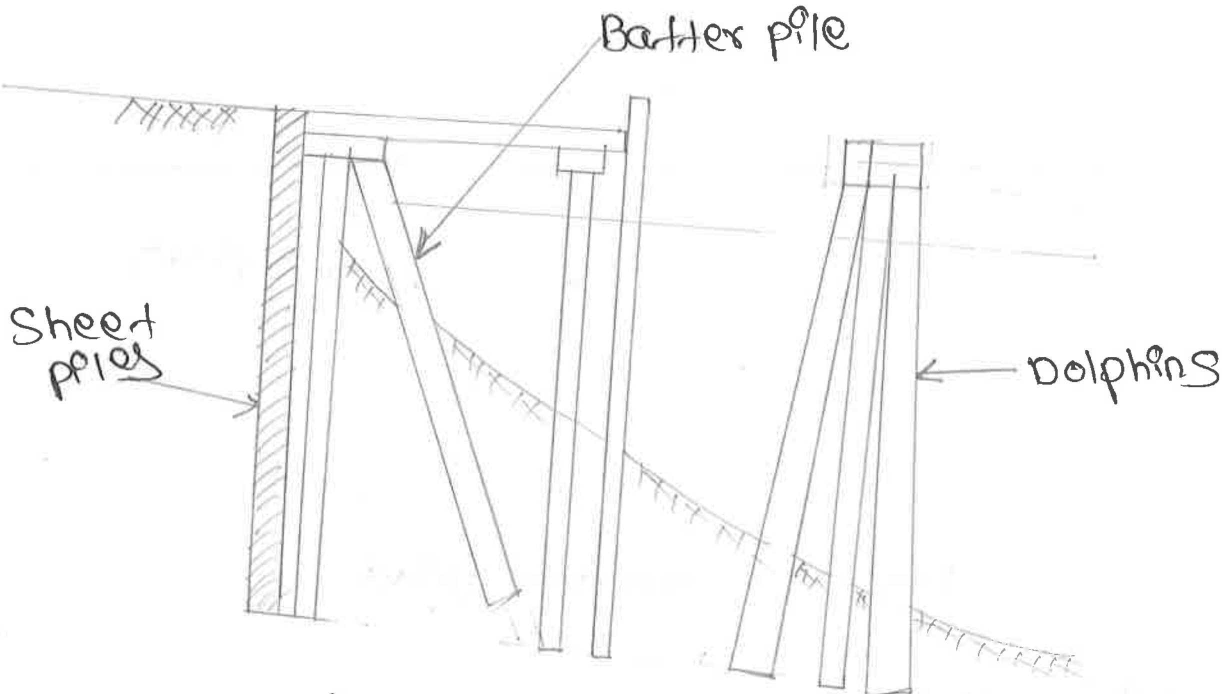


Fig 9:- Sheet piles

h> Batter piles

1> The piles driven at an inclination and have been found to resist the large the horizontal or inclined forces are known as batter piles

2> used to resist horizontal and inclined forces. especially in water front structures

i> laterally-loaded piles

used to support retaining walls, bridges, dams, and wharves and as fenders for harbor construction.

2> classification Based on material and composition

a> Timber piles
b> Steel piles
c> Concrete piles
d> composite piles
e> plastic piles

a> Timber piles

These are made of timber of sound quality. length may be up to about 5 m. Splicing is adopted for greater lengths. Diameter may be from 30 to 40 cm.

1> Timber piles perform well either in fully dry condition or submerged condition.

2> alternate wet and dry conditions reduce the life of a timber pile.

3> this adopted. maximum design load is about 250 kN.

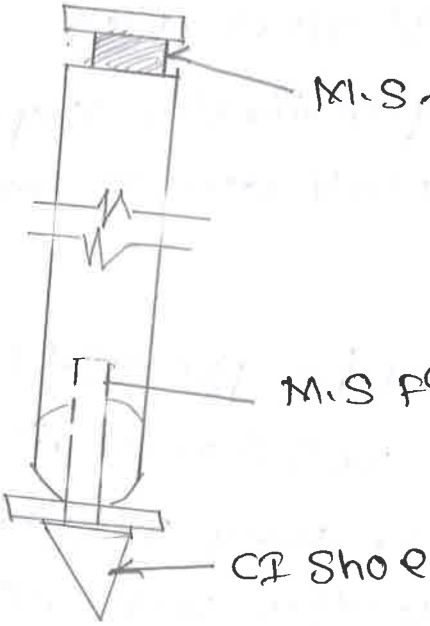


Fig (a): timber piles with M.S Hoop and CI Shoe b> Steel piles

1> Steel piles have been used for supporting heavy loads

2> It is used only in bearing

3> Steel piles require heavy hammers for driving

4> used to withstand large impact stresses and where disturbance from driving is desired

5> also used in open excavations and to provide seepage barrier

6> steel piles are likely to be affected by corrosive action and so will require painting

7> usually H-piles, pipe piles, ~~or~~ sheet piles

⇒ advantages of steel piles

(i) piles can bear heavy loads

2> piles can be used for very long lengths

3> piles can be driven through hard layers

4> piles are easy to handle and can easily be cut to desire length

⇒ disadvantages of steel piles

1> piles are comparatively expensive

2> piles may decay due to corrosion

c> concrete piles

These may be precast or cast in-situ

precast piles are reinforced to withstand handling stress, they require space for casting and storage more time to cure and heavy equipment for handling and driving

CBCS SCHEME

USN | | | | | | | | | | | 15CV53

Fifth Semester B.E. Degree Examination, June/July 2019
Applied Geotechnical Engineering

Time: 3 hrs.   Max. Marks: 80

Note: 1. ***Answer any FIVE full questions, choosing ONE full question from each module.***
2. ***Use of IS : 6403 is permitted.***

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

Module-1

1 a. Enumerate the objectives of subsurface exploration. **(04 Marks)**

b. Explain with reference to soil surplus : Area ratio , Inside clearance , Outside clearance and Recovery ratio. **(04 Marks)**

c. Estimate the position of ground water table from the following data :
Depth upto which water is boiled out is 32m. Water raise in the first day : 2.4m , Second day : 2.0m and Third day : 1.6m. **(08 Marks)**

OR

2 a. Distinguish between undisturbed , disturbed and representative soil samples. What are the tests conducted on these samples in the laboratory? **(05 Marks)**

b. Explain 'Seismic refraction method' of soil exploration, with a neat sketch on its mechanism. **(06 Marks)**

c. What is a Bore hole log? List the information recorded in it. **(05 Marks)**

Module-2

3 a. What do you understand by 'Pressure bulb'? Illustrate with a sketch. **(05 Marks)**

b. A circular area 6m is diameter , carries a uniformly distributed load of $10kN/m^2$. Plot the variation of vertical stress at depths 2m , 4m and 8m. **(06 Marks)**

c. Explain the principle of 'New – marks chart'. **(05 Marks)**

OR

4 a. What are different types of settlements of footings? Explain. **(04 Marks)**

b. Estimate the immediate settlement of a footing of size 2m × 3m resting at a depth of 1.5m in sandy soil whose compression modulus is $10N/mm^2$. Footing is expected to transmit a unit pressure of $200kN/m^2$. Poisson's ratio of soil is 0.3 and influence factor for footing is 1.06. **(04 Marks)**

c. A saturated clay 8m thick underlies a proposed new building. The existing overburden pressure at the centre of clay layer is $300kN/m^2$ and load due to new building increases the pressure by $200kN/m^2$. The liquid limit of soil is 75% with field water content = 50% and $G_S = 2.7$. Estimate consolidation settlement. **(08 Marks)**

Module-3

5 a. Explain step by step procedure of Culmann's graphical construction for determination of Active pressure. **(04 Marks)**

b. A 4.5m high retaining wall retains a cohesive soil with $C = 10kN/m^2$, $\phi = 20^0$ and $\gamma = 16kN/m^3$. Calculate the depth of tension cracks and critical depth. **(04 Marks)**

c. A retaining wall 6.6m high retains a cohesionless soil whose properties are $\phi = 25^0$, G = 2.6 and e = 0.6. The water table is at n depth of 2.1m below GL. Draw the earth pressure diagram and calculate magnitude and position of active earth pressure above the base of the wall. **(08 Marks)**

OR

6 a. What are the causes of slope failure? List and enumerate the types of failures in finite slopes. **(03 Marks)**

b. List and enumerate the types of failures in finite slopes. **(03 Marks)**

c. An embankment 6m high has a slope of 1V : 2H. The soil properties are $C = 5kN/m^2$, $\phi = 30^0$ and $\gamma = 19\ kN/m^3$. A trial slip circle of radius 8.8m and passing thro' the toe has its centre at the same level as the top of embankment. Find the factor of safety by the 'method of slices'. **(10 Marks)**

Module-4

7 a. Define Ultimate bearing capacity, Safe bearing capacity and Allowable bearing pressure. **(03 Marks)**

b. List the assumption made in Terzagh's b.c theory. **(03 Marks)**

c. Determine the safe bearing capacity of a square footing of side 1.8m, located at a depth of 1.5m below GL in a soil having $\gamma = 16.2\ kN/m^3$, $C = 15kN/m^2$ and $\phi = 35^0$. Take $N_c = 57.8$, $N_q = 41.1$ and $N_r = 42.4$ with FS = 3. Assume water tank at great depth, what will be the SBC if WT rises to the base of footing. **(10 Marks)**

OR

8 a. Explain the three modes of shear failure below the footing, with neat sketches. **(04 Marks)**

b. Discuss the effect of size and shape on the bearing capacity of footing on :
i) Sand ii) Clay. **(04 Marks)**

c. Proportion a square footing to carry a load of 900kN from a column 400 × 400mm in section and located at a depth of 1.5m below GL. The soil has $C = 0$, $\phi = 36^0$, $\gamma = 17.5kN/m^3$ above water table and $\gamma_{sat} = 20kN/cm^3$ below water table(WT). The WT is at the base of the footing. Permissible settlement is 25mm, Corrected N – Value = 30. Use a FS = 2.
[Use of IS : 6403 is permitted]. No structural design required. **(08 Marks)**

Module-5

9 a. Classify the pile foundations according to material and function, with neat figures. **(04 Marks)**

b. Explain in detail, the principle associated with determination of pile load capacity using static formula. **(04 Marks)**

c. A 12m long, 30mm dia. pile is driven in uniform deposit of sand with $\phi = 40^0$. The W.T is at great depth. The average dry unit weight of sand is $18kN/m^3$. Using Nq = 137, calculate the safe lad capacity of single pile with a FS = 2.5 and angle of wall friction $(\delta) = 30^0$. **(08 Marks)**

OR

10 a. What is meant by efficiency of pile groups? Discuss Feld's rule for its determination. **(04 Marks)**

b. What is Negative friction? Under what situation negative skin friction occurs. **(04 Marks)**

c. Calculate the safe load carrying capacity of a 16 pile group arranged in a square pattern with each pile is of 400mm diameter, 9m length and with a spacing of 1.2m c/c. The soil is 14m deep clay with unconfined strength of $100kN/m^2$, $r = 16kN/m^3$ and $r^1 = 9kN/m^3$ with adhesion factor $(\alpha) = 0.7$. W.T is 1m below GL. Use a FS = 2.5. **(08 Marks)**

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CBCS SCHEME

USN ☐☐☐☐☐☐☐☐☐☐ **15CV53**

Fifth Semester B.E. Degree Examination, June/July 2018
Applied Geotechnical Engineering

Time: 3 hrs. Max. Marks: 80

Note: Answer any FIVE full questions, choosing one full question from each module.

Module-1

1 a. What is subsurface exploration? What are objectives of soil exploration? **(08 Marks)**

b. What are Geophysical methods? Explain seismic refraction method with neat sketch. **(08 Marks)**

OR

2 a. List and explain different types of samplers used in soil sampling. **(08 Marks)**

b. What are the methods available for dewatering? Explain dewatering by well point system. **(08 Marks)**

Module-2

3 a. Derive the expressions for vertical stress and shear by using Boussinesq's theory. Also write expression for Westerguard's theory. **(08 Marks)**

b. What is Newmark's influence chart and also describe construction procedure for Newmarks's influence chart. **(08 Marks)**

OR

4 a. What are the types of settlement? Explain them with equations. **(08 Marks)**

b. A soft, normally consolidated clay layer 18 m thick. The natural water content, saturated unit weights specific gravity and liquid limit are 45%, 18 kN/m^3, 2.70 and 63% respectively. The vertical stress increment at centre of the layer due to the foundation load is 9 kN/m^2. The ground water level is at the surface of the clay layer. Determine the settlement of the foundation. **(08 Marks)**

Module-3

5 a. Define with neat sketch At rest, Active and Passive earth pressure. **(06 Marks)**

b. A retaining wall, 8 m high with a smooth vertical back, retains a clay backfill with $C' = 15$ kN/m^2, $\phi' = 15°$ and $\gamma = 18$ kN/m^3. Calculate the total active thrust on the wall assuming that tension cracks may develop to the full theoretical depth. **(10 Marks)**

OR

6 a. Explain the causes for slope failure and also list the type of slope failures. **(08 Marks)**

b. A 7m deep canal has side slope of 1:1. The properties of soil are $C_u = 20$ kN/m^2, $\phi_u = 15°$. $e = 0.9$ and $G = 2.75$. If Taylor's stability number is 0.108, determine the factor of safety with respect to cohesion when canal runs full. Also find the factor of safety in case of sudden draw down, if the Taylor's stability number for this condition is 0.137. **(08 Marks)**

Module-4

7 a. Write a note on standard penetration test and its corrections. **(08 Marks)**

b. Define safe bearing capacity, safe bearing pressure and allowable bearing pressure and also write expressions for the same. **(08 Marks)**

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

15CV53

CBCS SCHEME

USN ☐☐☐☐☐☐☐☐☐☐

15CV53

Fifth Semester B.E. Degree Examination, June/July 2018

Applied Geotechnical Engineering

Time: 3 hrs. Max. Marks: 80

Note: Answer any FIVE full questions, choosing one full question from each module.

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

Module-1

1 a. What is subsurface exploration? What are objectives of soil exploration? **(08 Marks)**

b. What are Geophysical methods? Explain seismic refraction method with neat sketch. **(08 Marks)**

OR

2 a. List and explain different types of samplers used in soil sampling. **(08 Marks)**

b. What are the methods available for dewatering? Explain dewatering by well point system. **(08 Marks)**

Module-2

3 a. Derive the expressions for vertical stress and shear by using Boussinesq's theory. Also write expression for Westerguard's theory. **(08 Marks)**

b. What is Newmark's influence chart and also describe construction procedure for Newmarks's influence chart. **(08 Marks)**

OR

4 a. What are the types of settlement? Explain them with equations. **(08 Marks)**

b. A soft, normally consolidated clay layer 18 m thick. The natural water content, saturated unit weights specific gravity and liquid limit are 45%, 18 kN/m^3, 2.70 and 63% respectively. The vertical stress increment at centre of the layer due to the foundation load is 9 kN/m^2. The ground water level is at the surface of the clay layer. Determine the settlement of the foundation. **(08 Marks)**

Module-3

5 a. Define with neat sketch At rest, Active and Passive earth pressure. **(06 Marks)**

b. A retaining wall, 8 m high with a smooth vertical back, retains a clay backfill with $C' = 15$ kN/m^2, $\phi' = 15°$ and $\gamma = 18$ kN/m^3. Calculate the total active thrust on the wall assuming that tension cracks may develop to the full theoretical depth. **(10 Marks)**

OR

6 a. Explain the causes for slope failure and also list the type of slope failures. **(08 Marks)**

b. A 7m deep canal has side slope of 1:1. The properties of soil are $C_u = 20$ kN/m^2, $\phi_u = 15°$, $e = 0.9$ and $G = 2.75$. If Taylor's stability number is 0.108, determine the factor of safety with respect to cohesion when canal runs full. Also find the factor of safety in case of sudden draw down, if the Taylor's stability number for this condition is 0.137. **(08 Marks)**

Module-4

7 a. Write a note on standard penetration test and its corrections. **(08 Marks)**

b. Define safe bearing capacity, safe bearing pressure and allowable bearing pressure and also write expressions for the same. **(08 Marks)**

USN ☐☐☐☐☐☐☐☐☐☐ **10CV64**

Sixth Semester B.E. Degree Examination, June/July 2019
Geotechnical Engineering - II

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions, selecting atleast TWO questions from each part.***

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

PART - A

1 a. Discuss the objectives of dewatering. List the different methods of dewatering and explain any one of them with neat sketch. (10 Marks)

b. By conducting a Seismic refraction study the following readings were obtained :

Time (sec)	0.1	0.2	0.3	0.4	0.45	0.50	0.55
Distance (M)	40	80	120	160	200	240	280

Geophones are placed at a spacing of 40m in a straight line and the time taken for the last wave to be received at each geophone is given , what is the velocities of wave in soil layers? What is the thickness of the top stratum? (10 Marks)

2 a. Explain the concept , procedure of construction and advantages of Newmark chart. (10 Marks)

b. A rectangular footing 2.4m × 2.0 carries a uniformly distributed load of 320 kN/m^2. Find the intensity of vertical pressure at a depth of 4.2m below the centre of the footing using Boussinesq equivalent point load method (10 Marks)

3 a. Explain with neat sketch a method of locating the phreatic line in a homogeneous earth dam with horizontal filter. (08 Marks)

b. A concrete dam fig. Q3(b) 17.5m base retains water to a level of 11.0m on the upstream. The water level on the downstream is 2.0m. The impervious stratum is 10.0m below the dam. The coefficient of permeability K = 1 × 10^{-6}m/sec. If dam is 50m long compute total quantity of seepage flow per day below the dam. Also compute seepage pressure at point P, 5m below the center of the dam. (12 Marks)

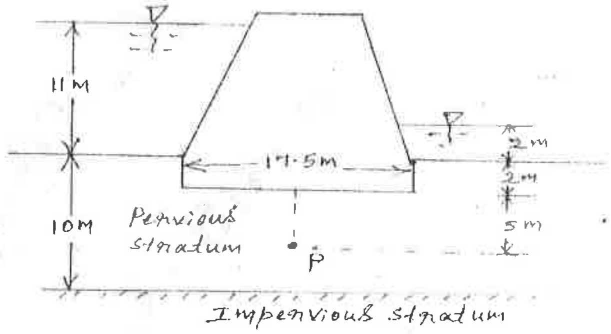

Fig.Q3(b)

4 a. Explain Rebhann's graphical method for determining active earth pressure on the basis of Coulomb's theory. (08 Marks)

b. A retaining wall of height 10m supports cohesionless soil with following properties :
G = 2.65 ; e = 0.65 and $\phi = 30^0$. The water table lies at 3m depth. The surface of back fill is horizontal and carries uniform surcharge of intensity 14kN/m^2. Determine total active earth pressure and its point of application. Also draw lateral active earth pressure distribution diagram. (12 Marks)

PART - B

5 a. Discuss the stability of finite slope by Swedish method of slices for a cohesive frictional soil. **(06 Marks)**

b. Explain the Fellineous method for stability analysis of slopes. **(06 Marks)**

c. An embankment is to be constructed with a soil having C = 20kN/m^2 ; ϕ = 10^0 and γ = 19kN/m^3. The desired factor of safety with respect to cohesion as well as friction is 1.5. Determine

i) Safe height of the desired slope if slope is 2H to 1V.

ii) Safe angle of slope if the desired height is 15. For ϕ = 10^0 stability numbers are as follows : **(08 Marks)**

Stability No.	0.04	0.08
Slope angle	20^0	30^0

6 a. List the factors influencing bearing capacity of soil. **(04 Marks)**

b. Explain standard penetration test and its corrections. **(08 Marks)**

c. A strip footing 2m wide carries a load intensity of 400 KPa at a depth of 1.2m in sand. The saturated unit weight of sand is 19.5 kN/m^3 and unit weight above water table is 16.8kN/m^3. If C = 0 and ϕ = 35^0 , determine the factor of safety with respect to shear failure for the following locations of water table.

i) Water table is 4m below ground level.

ii) Water table is 1.2m below ground level. **(08 Marks)**

7 a. Write a note on settlement of footings. **(10 Marks)**

b. A saturated clay 8m thick underlies a proposed new building. The existing overburden pressure at the centre of clay length is 300KPa and load due to a new building increases the pressure by 200 KPa. The liquid limit of the soil is 75%. Water content of soil is 50% and the specific gravity of soil is 2.7. Estimate consolidation settlement. **(10 Marks)**

8 a. Explain the factors affecting the choice of foundation. **(06 Marks)**

b. Discuss the proportioning of isolated footing. **(06 Marks)**

c. Explain determination of the pile load capacity. **(08 Marks)**

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USN ☐☐☐☐☐☐☐☐☐☐ **10CV64**

Sixth Semester B.E. Degree Examination, Dec.2018/Jan.2019
Geotechnical Engineering - II

Time: 3 hrs. Max. Marks:100

Note: 1. ***Answer any FIVE full questions, selecting atleast TWO questions from each part.***
2. ***Assume missing data suitably.***

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

PART – A

1 a. State the objectives of Soil exploration programme. **(06 Marks)**

b. List the methods used for controlling ground water during excavation and explain the Electro – Osmosis method. **(06 Marks)**

c. A Seismic refraction study of an area has given the following data. Determine the seismic velocity for the surface layer and under laying layer. Also determine the thickness of upper layer. **(08 Marks)**

Distance from Impact point to Geo phone (m)	15	30	60	90	120
Time to receive wave (sec)	0.025	0.05	0.10	0.11	0.12

2 a. Explain Equivalent point load method for determining vertical stress at any point within loaded area. **(06 Marks)**

b. Distinguish between Boussinesq's and Westergard's theories of stress distribution. **(06 Marks)**

c. Calculate the vertical stresses in the soil 3m below the foundation vertically below the 500kN load and 400kN load columns at 6m apart. **(08 Marks)**

3 a. State the assumptions made in the derivation of Laplace equation. **(06 Marks)**

b. What is Phreatic line. Explain the Casagrande's method to locate the phreatic line in a homogenous earth dam with a horizontal filter at toe. **(08 Marks)**

c. For a homogeneous earthen dam 52m heigh and 2m free board, a flow net constructed with four flow channels and number of potential drops are 25. The dam has a horizontal filter of 40m at its down stream end. Calculate discharge per meter length of dam if the coefficient of permeability of dam material is 3×10^{-3} cm/second. **(06 Marks)**

4 a. Distinguish between Coulomb's Earth Pressure theory and Rankine's Earth Pressure theory. **(05 Marks)**

b. Derive the equations for the earth pressure coefficient K_a and K_p by considering backfill with horizontal surface. Use Rankines theory. **(05 Marks)**

c. A retaining wall 4m high has a smooth vertical back. The back fill has a horizontal surface in level with top of the wall. The uniform surcharge load of 36kN/m^2 over the backfill unit weight of the backfill is 18kN/m^3 and angle of shearing resistance is 30^0 and cohesion is zero. Determine the magnitude and point of application of active pressure per meter length of the wall. **(10 Marks)**

PART – B

5 a. State and explain causes and types of failure of slopes. **(05 Marks)**

b. State and explain different types of slopes and list the assumptions made in slope stability analysis. **(05 Marks)**

c. Explain Stability of Finite slopes by method of slices. **(05 Marks)**

d. A 5m deep canal has side slopes of 1:1, the properties of soil are $C = 20 kN/m^2$, $\phi = 10^0$, $e = 0.08$ and $G = 2.8$. If Taylor's stability number is 0.108, determine the factor of safety with respect to cohesion when canal runs fall. **(05 Marks)**

6 a. State the factors influencing bearing capacity of soil. **(04 Marks)**

b. Distinguish between General shear failure and Local or Punching shear failure. **(04 Marks)**

c. Explain Plate load test for determining the ultimate bearing capacity of soil with neat sketch. **(06 Marks)**

d. A foundation 2.0m square is at 1.2m below ground level in sandy soil with a unit weight of $19.2 kN/m^3$ above water table and submerged unit weight of $10.1 kN/m^3$. If $C = 0$ and $\phi = 30^0$. Find ultimate bearing capacity when i) Water table is much below the base of foundation ii) Water table rises to the base of foundation iii) Water table rises to ground level. Take $N_q = 22$ and $N_r = 20$. **(06 Marks)**

7 a. Explain importance and concept of settlement analysis. **(06 Marks)**

b. State the factors influencing the settlement of foundation soil. **(04 Marks)**

c. Determine the consolidation settlement for saturated clay 8m thick underlies a proposed new building. The existing overburden pressure at the centre of clay layer is 300 KPa and load due to a new building increases the pressure by 200KPa. The liquid limit of soil is 75%, Water content of soil is 50% and $G_s = 2.7$. **(10 Marks)**

8 a. State and explain different types of classification of pile foundation. **(06 Marks)**

b. State the factors influencing the choice of foundation. **(04 Marks)**

c. Write short notes on Mat foundation. **(05 Marks)**

d. What is combined footing? Explain different types of combined footing. **(05 Marks)**

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Bapuji Educational Association ®
Bapuji Institute of Engineering and Technology, Davangere–577 004
Department of Civil Engineering

Assignment- 1

Course/Subject Title	**APPLIED GEOTECHNICAL ENGINEERING**	**Course/Subject Code**	**18CV62**
Semester	**VI th B**	**Scheme**	**CBCS – 18**
Starting Date	**13-07-2021**	**Assignment**	**I**
Last Date	**19-07-2021**	**Max. Marks**	**10**

Course Outcome Statements : After the successful completion of the course, the students will be able to

CO1	To plan & execute geotechnical site investigation program for different civil Engineering projects.
CO2	To plot stress distribution & resulting settlement beneath the loaded footings on sand & clayey soils.
CO3	To compute lateral earth pressure behind the earth retaining structures by different methods.
CO4	To estimate the factor of safety against failure of slopes by different methods.
CO5	To determine the bearing capacity of soil, modes of shear failures & Field methods of determining bearing capacity of soil (SPT & Plate load test).
CO6	To determine the load carrying capacity of single pile & group of piles for different soil conditions.

Q. No.	**Questions**	**Marks**	**CO**
1	Derive equations for the earth pressure coefficient Ka & Kp by considering back fill with horizontal surface use Rankines theory	**1.5**	**CO3**
2	A retaining Wall of height 10m supports cohesionless soil with the following properties G=2.65, e=0.65 & $\varphi=30^\circ$, water table lies at 3m depth surface of back fill is horizontal & carries Surcharge of intensity 14 kN/m^2. Draw lateral active earth pressure distribution diagram. Determine total active earth pressure & its point of application.	**1.5**	**CO3**
3	Differentiate between Active earth pressure & passive earth pressure on a retaining wall.	**1.5**	**CO3**
4	List the Assumptions made in Rankines theory to determine lateral earth pressure in soils	**1.5**	**CO3**
5	A gravity retaining wall retains 12m of a back fill $\gamma=17.7$kN/m^3, $\varphi=25^\circ$ with a uniform horizontal surface. Assume that wall interface to be vertical determine the magnitude & point of application of total active earth pressure. If the water table is at a height of 6m how do the magnitude & point of application of total active earth pressure change submerged unit weight of soil =10 kN/m^3.	**1.5**	**CO3**
6	Define with neat sketches at rest, active & passive earth pressure.	**1.5**	**CO3**
7	A retaining wall retains a cohesion less backfill with a height of 7.5m the top 3m of the back fill has unit weight of 18 kN/m^3 & $\varphi=30^\circ$. Lower 4.5m of the backfill has until weight of 24 kN/m^3 & $\varphi=20^\circ$. obtain pressure distribution diagram & determine the total active pressure & its point of application.	**1.5**	**CO3**
8	A retaining wall 8 m high with smooth vertical back fill retains a clay backfill with C'=15kN/m^2, $\varphi'=15^\circ$ & $\gamma=18$kN/m^3. Calculate the total active thrust on the wall assuming that tension cracks may develop to the full theoretical depth.	**1.5**	**CO3**
9	Explain step by step procedure of culmann's graphical construction for determination of active earth pressure.	**1.5**	**CO3**
10	A 4.5m high retaining wall retains a cohesive soil with C=10kN/m^2 $\varphi=20^\circ$ & $\gamma=16$kN/m^3. Calculate the depth of tension cracks & critical depth.	**1.5**	**CO3**
11	A retaining wall 6.6m high retains a cohesion less soil whose properties	**1.5**	**CO3**

	are φ=25°,G=2.6 & e=0.6. the water table is at n depth of 2.1m below GL. Draw the earth pressure diagram & calculate magnitude & position of active earth pressure above the base of the wall.		
12	Describe Rehbann's graphical method of determining the active earth pressure on a retaining wall.	**1.5**	**CO3**
13	A vertical smooth wall 6m high retains cohesionless soil φ=30°,G=2.65 & e=0.8 water table is at a depth of 2m from top . A uniform surcharge of 40kN/m² is applied on top of backfill surface. Assume soil above water table is dry. Draw active earth pressure diagram & obtain the magnitude & location of active earth pressure using Rankine's theory.	**1.5**	**CO3**

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Course/Subject Title	**APPLIED GEOTECHNICAL ENGINEERING**	**Course/Subject Code**	**18CV62**
Semester	**VIth B**	**Scheme**	**CBCS – 18**
Date	**07/06/2021**	**CIE Test**	**I**
Timing	**3.00 pm To 4.00 pm**	**Max. Marks**	**30**

Course Outcome Statements : After the successful completion of the course, the students will be able to

CO1	To plan & execute geotechnical site investigation program for different civil Engineering projects.
CO2	To plot stress distribution & resulting settlement beneath the loaded footings on sand & clayey soils.
CO3	To compute lateral earth pressure behind the earth retaining structures by different methods.
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CO5	To determine the bearing capacity of soil , modes of shear failures & Field methods of determining bearing capacity of soil (SPT & Plate load test).
CO6	To determine the load carrying capacity of single pile & group of piles for different soil conditions.

<table>
<tr><td colspan="5">Note: Answer One Full Question From Each Part</td></tr>
<tr><th>Q. No.</th><th>Questions</th><th>Marks</th><th>RBT Level</th><th>CO</th></tr>
<tr><td></td><td>Part -A</td><td></td><td></td><td></td></tr>
<tr><td>1 a)</td><td>What are Geophysical methods? Explain Seismic Refraction method with neat sketch.</td><td>7.5</td><td>L1,L2,L3</td><td>CO 1</td></tr>
<tr><td>1 b)</td><td>The following sizes of sampling tube are available in market.
<table>
<tr><th>Sample No</th><th>I</th><th>II</th><th>III</th></tr>
<tr><td>Outer diameter (mm)</td><td>75</td><td>110</td><td>50</td></tr>
<tr><td>Inner diameter (mm)</td><td>72</td><td>107</td><td>35</td></tr>
<tr><td>Length (mm)</td><td>600</td><td>600</td><td>600</td></tr>
</table>
Out of these which one would you select for obtaining undistributed soil sample from a base hole apply appropriate technique to get best undisturbed sample.</td><td>7.5</td><td>L1,L2,L3</td><td>CO 1</td></tr>
<tr><td></td><td>OR</td><td></td><td></td><td></td></tr>
<tr><td>2 a)</td><td>What is Dewatering? Explain the methods of Dewatering with neat sketch.</td><td>7.5</td><td>L1,L2,L3</td><td>CO1</td></tr>
<tr><td>2 b)</td><td>Predict the Ground water table given the following data : Depth upto which water is boiled out 18m, water rise in 1 day= 0.95m. II day =0.86m & III day=0.78m. use the hvorslev's method for predicting ground water table.</td><td>7.5</td><td>L1,L2,L3</td><td>CO 1</td></tr>
<tr><td></td><td>Part -B</td><td></td><td></td><td></td></tr>
<tr><td>3 a)</td><td>Compare Boussineq's theory with Westergaard's theory with logical graph analysis.</td><td>7.5</td><td>L1,L2,L3</td><td>CO2</td></tr>
<tr><td>3 b)</td><td>Explain the principle of New marks chart .</td><td>7.5</td><td>L1,L2,L3</td><td>CO2</td></tr>
<tr><td></td><td>OR</td><td></td><td></td><td></td></tr>
<tr><td>4 a)</td><td>What are different types of settlement? Explain
Estimate the immediate settlement of a footing of size 2m x3m resting at a depth of 1.5m in sandy soil whose compression modulus is 10 N/mm^2. Footing id expected to transmit a unit pressure of 200 kN/m^2. Poisson's ratio of soil is 0.3 & influence factor for footing is 1.06.</td><td>7.5</td><td>L1,L2,L3</td><td>CO2</td></tr>
<tr><td>4 b)</td><td>Saturated clay 8m thick underlies a proposed new building. The existing overburden pressure at the centre of clay layer is $300kN/m^2$ & load due to new building increases the pressure by $200kN/m^2$. The liquid limit of soil is 75% with field water content =50% & G_s= 2.7. Estimate consolidation settlement.</td><td>7.5</td><td>L1,L2,L3</td><td>CO2</td></tr>
</table>

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RBT (Revised Bloom's Taxonomy) Levels : Cognitive Domain		
L1 : Remembering	L2 : Understanding	L3 : Applying
L4 : Analysing	L5 : Evaluating	L6 : Creating

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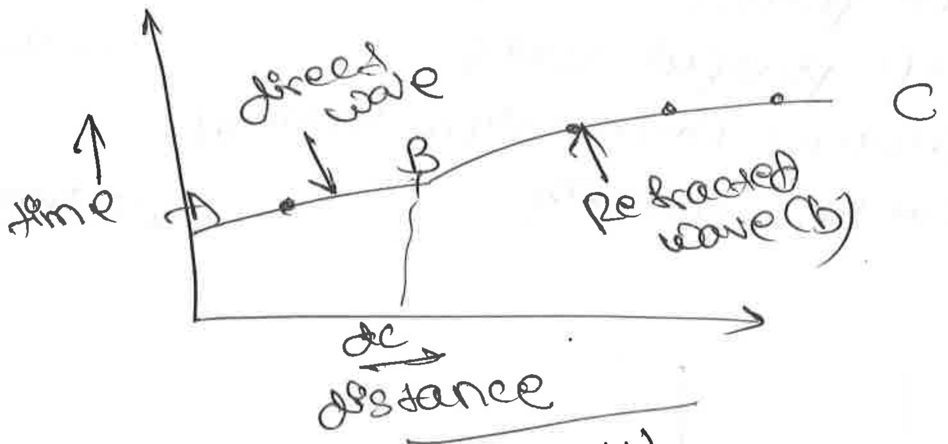
Semester	VIth B	**CIE No.**	I
Date	07/06/2021	**Max. Marks**	30

1(a) Geophysical methods

1) seismic Refraction method

2) electrical resistivity method — 3×1 = 3

1) Seismic Refraction method



— 4.5×1 = 4.5

$$D = \frac{d}{2}\sqrt{\frac{(V_2 - V_1)}{(V_2 + V_1)}}$$

total mark = 7.5

(b)

Sample no - I

Area ratio $A_r = \frac{D_2^2 - D_1^2}{D_1^2} \times 100$ — 2.5

Sample no - II

Area ratio $A_r = \frac{D_2^2 - D_1^2}{D_1} \times 100$ — 2.5

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Sample no-3

Area ratio $Ar = \frac{D_2^2 - D_1^2}{D_1^2} \times 100$ —— 3.5

Total marks = 7.5

2(a) Dewatering

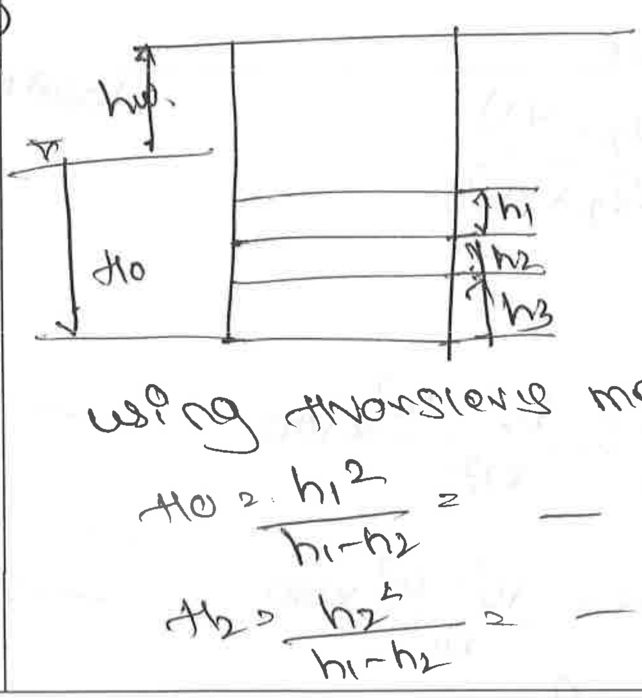
Subsurface drainage consists of collection and disposal of the ground water. It is also known as dewatering —— 2

Methods of dewatering

1) open ditches and sumps
2) well points
3) deep pumped wells —— 5.5
4) vacuum dewatering system
5) electro-osmosis

Total marks-7.5

2(b)



using Hvorslev's method

$H_0 = \frac{h_1^2}{h_1 - h_2} =$ —— m —— ①

$H_2 = \frac{h_2^2}{h_1 - h_2} =$ —— m —— 1

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Date	07/06/2021	**Max. Marks**	30

$H_3 = \frac{h_3^2}{h_2 - h_3} =$ ——— m ——— 1

$h_{w1} = H_w - H_0 =$ ——— m ——— 1

$h_{w2} = H_w - (h_1 + h_2) - H_2 =$ — m ——— 1

$h_{w3} = H_w - (h_1 + h_2 + h_3) - H_3 =$ m ——— 1

Depth of GWT $h_w = \frac{h_{w1} + h_{w2} + h_{w3}}{3}$ — 1.5

= ——— m

Total mark = 7.5

3(a) Compare Boussineq's theory and Westergaard's theory

- * Iw are considerably smaller than the Boussineq's influence factor (IB)
- * The effect of the load is negligibly small in both cases when r/z is greater than abo

$I = I_B =$ Boussineq's theory $\sigma_z = I\, Q/z^2$

$I = I_w$ in Westergaard's theory

$$= \frac{1/\pi}{\left(1 + 2\left(\frac{r}{z}\right)^2\right)^{3/2}}$$

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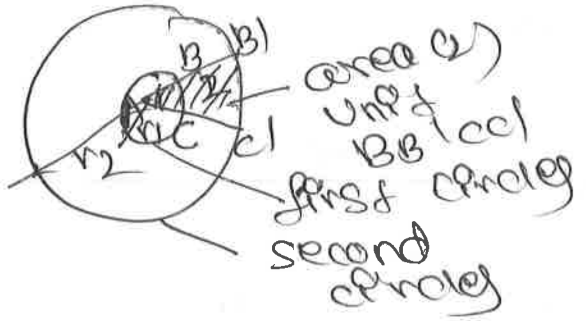
3(b) New marks charts



——— 3.5

$\sigma/q = (0.01, 0.2$ etc)

v/z If = 0.005 If = 1/200 = 0.005

vertical stress

$\sigma_z = q I_f N$.

q = uniformly distributed load ——— 4

If = influence value marked at bottom of chart

N = number of influence areas enclosed in the chart by loaded area

total mark
——— 7.5

4(a) types of settlement

1) Immediate settlements ——— 1

2) primary consolidation settlement ——— 1

3) secondary settlement ——— 1

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Course/Subject Title	Applied Geotechnical Engineering	**Course/Subject Code**	18CV82
Semester	VIth B	**CIE No.**	II
Date	07/06/2021	**Max. Marks**	30

sol 1)

area = 2m x 3m =

$Bs = 10\ kN/m^2$

$D = 1.5\ m$

$q = 200\ kN/m^2$

$\mu = 0.3 \quad I_w = 1.06$ — 4.5

Immediate settlement $S_i = qB\left(\frac{1-\mu^2}{Bs}\right)I_w$

q = intensity of contact pressure

$q = \frac{200}{3 \times 2} = \text{——}\ kN/m^2$

$S_i = \text{——}\ mm$

total mark = 7.5

4(b)

$H = 8\ m$

$\sigma_o = 300\ kN/m^2 \quad \Delta\sigma = 200\ kN/m^2$

$w_L = 75\% \quad w = 50\% \quad G_s = 2.7$

Initial void ratio $e_o = wG$

$= \text{——}$ — 1

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compression index $C_c = 0.009 (w_L - 10)$

$w_L = 75\%$ — 1

Consolidation settlement

$$S_c = \frac{C_c}{1+e_0} \times H \log_{10} \left[\frac{\sigma_0 + \Delta\sigma}{\sigma_0}\right]$$

$S_c =$ — mm — 5.5

total marks = 70.5

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Course/Subject Title	**APPLIED GEOTECHNICAL ENGINEERING**	**Course/Subject Code**	**18CV62**
Semester	**VI th B**	**Scheme**	**CBCS – 18**
Date	**05/07/2021**	**CIE Test**	**II**
Timing	**3.00 pm To 4.00 pm**	**Max. Marks**	**30**

Course Outcome Statements : After the successful completion of the course, the students will be able to

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Note: Answer One Full Question From Each Part

Q. No.	**Questions**	**Marks**	**RBT Level**	**CO**
	Part -A			
1 a)	With the help of sketches explain effects of water table & eccentric loading on bearing capacity of soil.	**7.5**	**L1,L2,L3**	**CO~~2~~5**
1 b)	Explain the field methods of determining bearing capacity of soil by SPT (Standard Penetration Test) & Plate load test.	**7.5**	**L1,L2,L3**	**CO ~~4~~5**
	OR			
2 a)	Distinguish between general shear failure & local shear failure.	**7.5**	**L1,L2,L3**	**CO~~4~~5**
2 b)	A foundation 2.0m square is installed 1.2m below ground level in sandy soil having unit weight of 19.2kN/m^2 above water table & submerged unit weight of 10.1kN/m^3. If c=0 & φ=30^0 find ultimate bearing capacity when i) water table is well below the base of the foundation ii) water table rises to foundation level iii) water table rises to ground level N_q=22 & N_γ=20	**7.5**	**L1,L2,L3**	**CO ~~4~~5**
	Part -B			
3 a)	Explain classification of piles based on function.	**7.5**	**L1,L2,L3**	**CO~~5~~6**
3 b)	What is negative skin friction? How it is estimated in different types of soils	**7.5**	**L1,L2,L3**	**CO~~5~~6**
	OR			
4 a)	Explain Efficiency of pile group & settlement of piles	**7**	**L1,L2,L3**	**CO~~5~~6**
4 b)	A 200mm diameter 8m long piles are used as foundation for a column in a uniform deposit of medium clay having unconfined compressive strength of 100 kN/m^2. The spacing between the piles is 500mm there are 9 piles in the ground arranged in a square pattern calculate the ultimate load capacity of the group assume adhesion factor =0.9 & N_c=9.	**8**	**L1,L2,L3**	**CO~~5~~6**

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Semester	VIth B	**CIE No.**	II
Date	05/07/2021	**Max. Marks**	30

1(a) (i) Effects of water table — 3.5

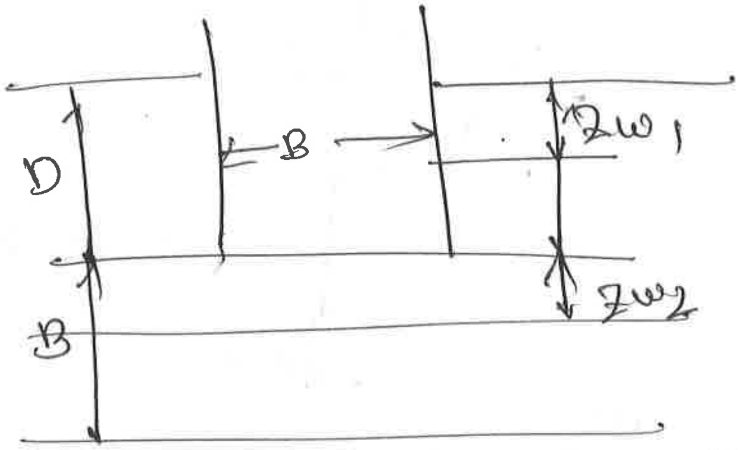

Fig:- location of water table

(i) $R_{w1} = 0.5\left(1 + \frac{Z_{w1}}{D_f}\right)$ $\frac{Z_{w1}}{D_f} < 1$

$\frac{Z_{w1}}{D_f} = 0$ $R_{w1} = 0.5$ $\frac{Z_{w2}}{D_f} = 1$

$R_{w2} = 1$

(ii) $\frac{Z_{w2}}{B} \le 1$ $R_{w2} = 0.5\left(1 + \frac{Z_{w2}}{B}\right)$

$\frac{Z_{w2}}{B} = 0$ $R_2 = 0.5$ $\frac{Z_{w2}}{B} = 1$

$R_{w2} = 1.0$

(iii) eccentric loading on bearing capacity of soil — 4

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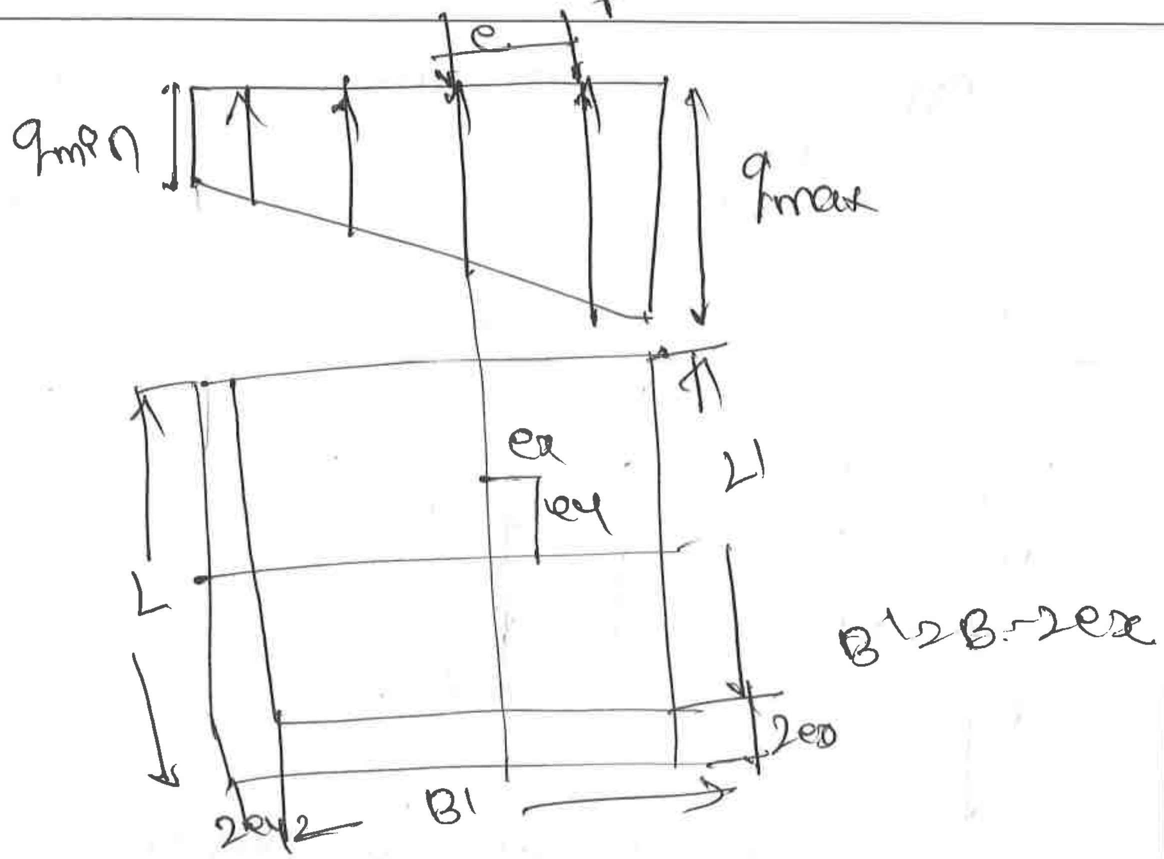

$B' = B - 2e_x$
$L' = L - 2e_y$
$A' = B' \times L'$

— total mark = 7.5

2(b) (i) standard penetration test (2131 - 1986)

correction to N value
1> dilatancy correction
2> overburden correction

(a) If $N' < 15$ or $N = 15$ $N' = N$

— 3.5

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Date	08/07/2021	**Max. Marks**	30

b) $N = 15 + (0.5 (N' - 15)]$

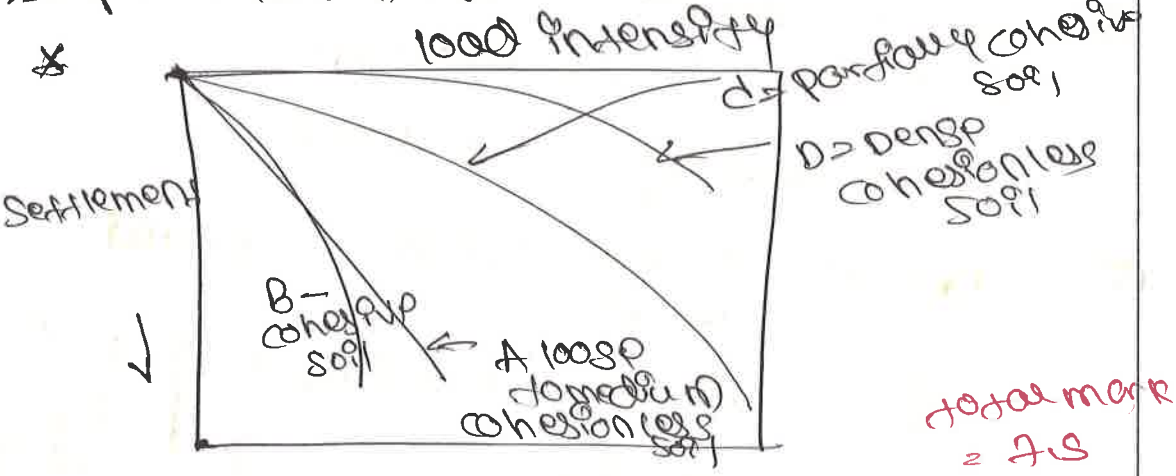
2) $\sigma_z = 280\ kN/m^2$

$$N = N' \left[\frac{350}{\sigma + 70}\right]$$

— 4

2) plate load test

*



total mark = 7.5

2(a) general shear failure

* It has well defined failure surface reaching upto ground surface
* there is considerable bulging of sheared mass of soil adjacent to the footing

— 3.5

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* failure is accompanied by tilting of the footing

Local shear failure

* failure pattern is clearly defined only immediately below the footing — 4

* slight bulging of soil around the footing

* failure is defined by large settlement

total marks =7.5

2(b) soln

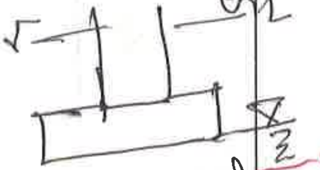
(i) water table is well below the base of the foundation

$$q_u = \gamma D_f N_q + 0.4 \gamma B N_\gamma$$ — 2.5

(ii) water table rises to ground level

$$q_u = \gamma D_f N_q + 0.4 \gamma' B N_\gamma$$ eq

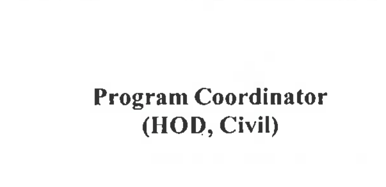
$$\gamma' = \gamma_{sat} - \gamma_w$$



— 2.5

(iii) water table rises to ground level

$$q = \gamma D_f N_q + 0.4 \gamma' B N_\gamma$$ eq



— 2.5

total marks =7.5

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3(a) classification of piles based on function

1) function or action
- end bearing piles
- frictional piles
- tension piles
- compaction piles
- Batter piles — 2.5

2) Based on materials
- Timber piles
- steel piles
- concrete piles — 2.5

3) Based on installation
- Driven piles
- cast-in-situ piles
- Driven and cast-in-situ piles — 2.5
- Bored and cast-in-place piles

total marks = 7.5

3(b) negative skin friction

The skinfriction is in the direction of the soil movement. pulling the pile downward it is necessary to subtract the skin friction force

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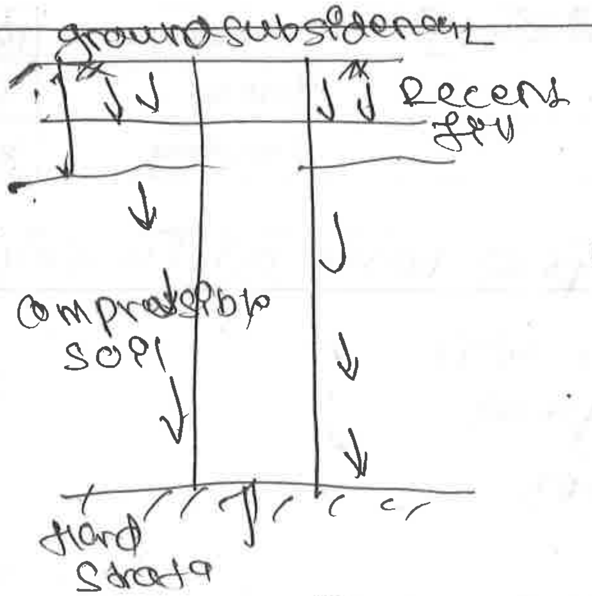
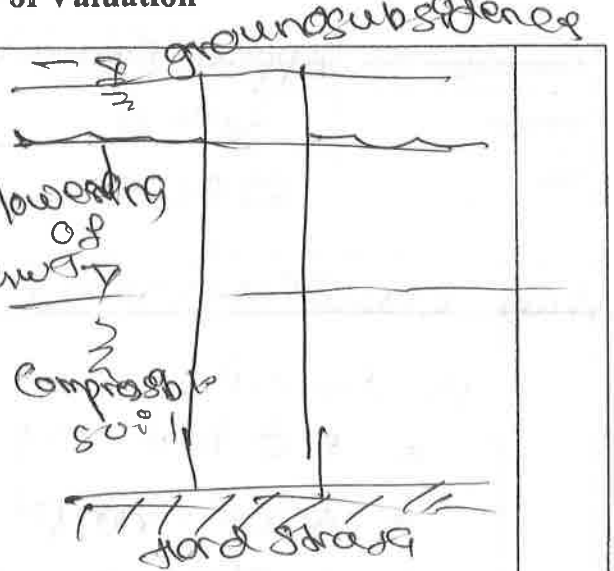


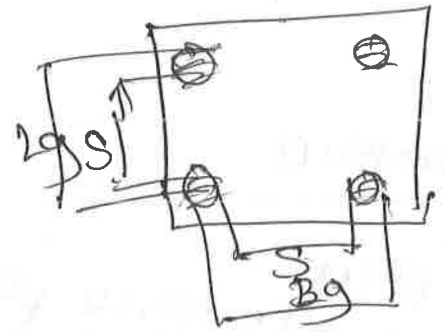
(a) Recent filling compressible soil



(b) lowering of ground water table

total mark = 7.5

4(a) Efficiency of pile group



$Lg = (m-1) \times S + d$ — 3.5

$Bg = (n-1) \times S + d$

$$\eta g = \frac{Qug}{np \times Qu}$$

settlement pile

$$Sc = \frac{H \times Cc}{1+e_0} \log_{10}\left[\frac{\sigma_0 + \Delta\sigma}{\sigma_0}\right]$$

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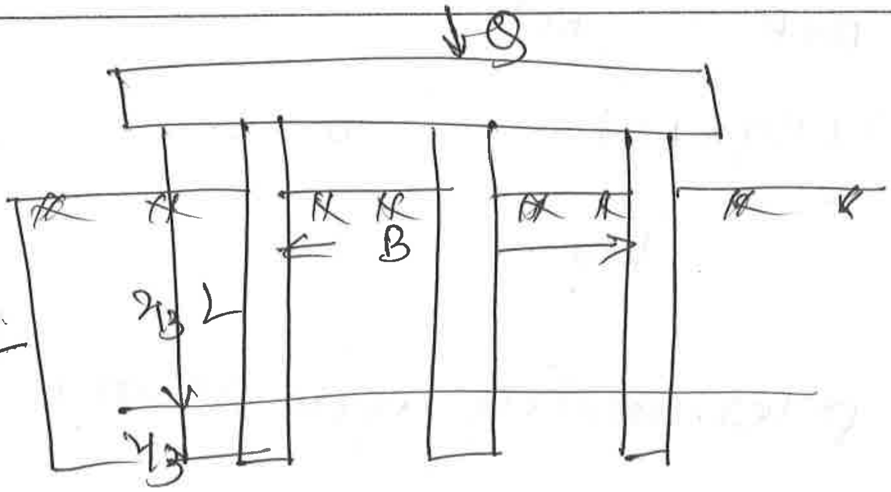
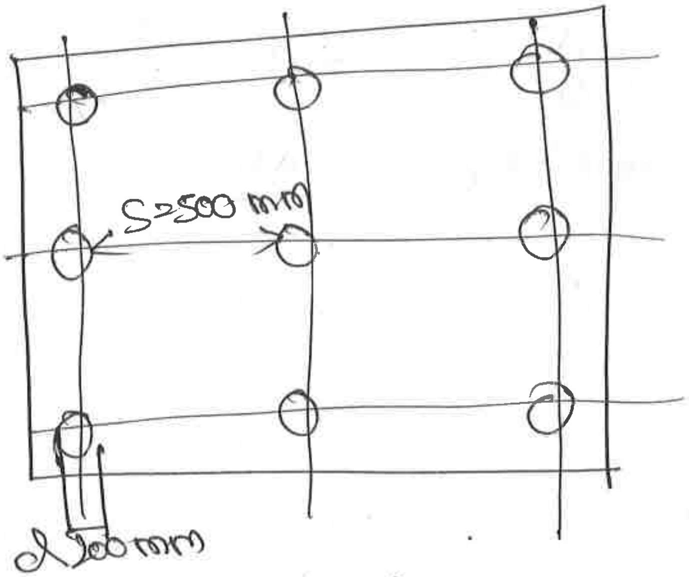


4.5

total marks 27.5

4(b)



$q_u = 100\ kN/m^2$ $n = 9$

$\alpha = 0.9$ $N_c = 9$

$B_g = (n-1) \times S + d$

$c_u = q_u/2 =$ kN/m2

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* Block failure

$Q_{ug} = c_u A_g N_c + c_u P_g L$

$A_g = B \times B = \quad m^2$

$P_g = 2(B_g + L_g) = \quad m$ — 3.5

$Q_u = \quad kN$

* for piles acting Individually

$Q_u = n c_u A_p N_c + n \alpha c_u A_s$

$A_p = \frac{\pi d^2}{4} = \quad m^2$ — 4

$A_s = \pi \times d \times L = \quad m^2$

Total marks 27.5

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Department of Civil Engineering

USN										

Course/Subject Title	**APPLIED GEOTECHNICAL ENGINEERING**	**Course/Subject Code**	**18CV62**
Semester	**VIth B**	**Scheme**	**CBCS – 18**
Date	**02/08/2021**	**CIE Test**	**III**
Timing	**3.45 pm To 4.45 pm**	**Max. Marks**	**30**

Course Outcome Statements : After the successful completion of the course, the students will be able to

CO1	To plan & execute geotechnical site investigation program for different civil Engineering projects.
CO2	To plot stress distribution & resulting settlement beneath the loaded footings on sand & clayey soils.
CO3	To compute lateral earth pressure behind the earth retaining structures by different methods.
CO4	To estimate the factor of safety against failure of slopes by different methods.
CO5	To determine the bearing capacity of soil , modes of shear failures & Field methods of determining bearing capacity of soil (SPT & Plate load test).
CO6	*To determine the load carrying capacity of single pile & group of piles for different soil conditions.*

Note: Answer One Full Question From Each Part

<table>
<tr><th>Q. No.</th><th>Questions</th><th>Marks</th><th>RBT Level</th><th>CO</th></tr>
<tr><td></td><td>Part -A</td><td></td><td></td><td></td></tr>
<tr><td>1 a)</td><td>Explain the causes for slope failure with sketches. Explain Swedish circle method of slices of stability analysis for slopes.</td><td>7.5</td><td>L1,L2,L3</td><td>CO4</td></tr>
<tr><td>1 b)</td><td>An embankment is inclined at an angle of 35^0 & height is 15 m. the angle of internal friction is 15^0& the cohesion is 200 kN/m². γ=18kN/m³. Find the factor of safety with respect to cohesion, if S_n=0.06</td><td>7.5</td><td>L1,L2,L3</td><td>CO4</td></tr>
<tr><td></td><td>OR</td><td></td><td></td><td></td></tr>
<tr><td>2 a)</td><td>Explain Fellinious method of obtaining centre of critical slip surface in the case of stability analysis of c-φ soil.</td><td>7.5</td><td>L1,L2,L3</td><td>CO4</td></tr>
<tr><td>2 b)</td><td>A 5m deep canal has side slopes of 1:1. The properties of soil are C_u=20kN/m²,φ_u=10^0. e=0.80 & G=2.8. if Taylor's stability number is 0.108, determine the factor of safety with respect to cohesion when the canal runs full. Also find the factor of safety in case of sudden draw down, if the taylor's stability number for this condition is 0.137.</td><td>7.5</td><td>L1,L2,L3</td><td>CO4</td></tr>
<tr><td></td><td>Part -B</td><td></td><td></td><td></td></tr>
<tr><td>3 a)</td><td>A canal is to be excavated through a soil with C=15 kN/m²,φ=20^0,e=0.9 & G=2.67. the side slopes is 1 in 1. The depth of canal is 6m. determine the FOS, with respect to cohesion when canal runs full. What will be the FOS, if the canal is rapidly emptied? Taylor's stability numbers are 0.06 & 0.114 respectively with respect to two cases.</td><td>7.5</td><td>L1,L2,L3</td><td>CO4</td></tr>
<tr><td>3 b)</td><td>A 7m deep canal has side slopes of 1:1. The properties of soil are C_u=20kN/m²,φ_u=15^0. e=0.9 & G=2.75. if Taylor's stability number is 0.108, determine the factor of safety with respect to cohesion when the canal runs full. Also find the factor of safety in case of sudden draw down, if the taylor's stability number for this condition is 0.137.</td><td>7.5</td><td>L1,L2,L3</td><td>CO4</td></tr>
<tr><td></td><td>OR</td><td></td><td></td><td></td></tr>
<tr><td>4 a)</td><td>An embankment is to be constructed with a soil having C=20kN/m², φ=10^0 & γ=19kN/m³. The desired factor of safety with respect to cohesion as well as friction as 1.5. determine i) safe height of the desired slope if slope is 2H to 1V. ii) safe angle of slope if the desired height is 15m. for φ=10^0: Taylor's stability numbers are as follows:
<table>
<tr><td>Stability No</td><td>0.04</td><td>0.08</td></tr>
<tr><td>Slope angle (i)</td><td>20</td><td>30</td></tr>
</table>
</td><td>7.5</td><td>L1,L2,L3</td><td>CO4</td></tr>
<tr><td>4 b)</td><td>List & enumerate the types of failure in finite slopes.</td><td>7.5</td><td>L1,L2,L3</td><td>CO4</td></tr>
</table>

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RBT (Revised Bloom's Taxonomy) Levels : Cognitive Domain		
L1 : Remembering	L2 : Understanding	L3 : Applying
L4 : Analysing	L5 : Evaluating	L6 : Creating

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B.I.E.T. Davangere.

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(SHANKRAMMA H)

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Scheme of Valuation

Course/Subject Title	Applied Geotechnical Engineering	**Course/Subject Code**	18CV62
Semester	VI th B	**CIE No.**	III
Date	02/08/2021	**Max. Marks**	30

1(a) Causes of slope failure

* Erosion – The wind and flowing water causes erosion of top surface of slope
* Steady seepage – seepage forces in the sloping direction add to gravity forces and make the slope susceptible to instability.
* Sudden Drawdown – in this case there is reversal in the direction flow and results in instability of side slope
* Rainfall – long periods of rainfall saturate, soften and erode soils. water
* earthquake – They induce dynamic shear forces
* external loading – additional loads placed on top of the slope increases
* construction activities at the top of slope, excavation at the bottom

— 3.5

Swedish circle method of slices of stability analysis for slopes

(i) purely cohesive soil

$$L = \frac{2\pi r\theta}{360^\circ}$$

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Scheme of Valuation

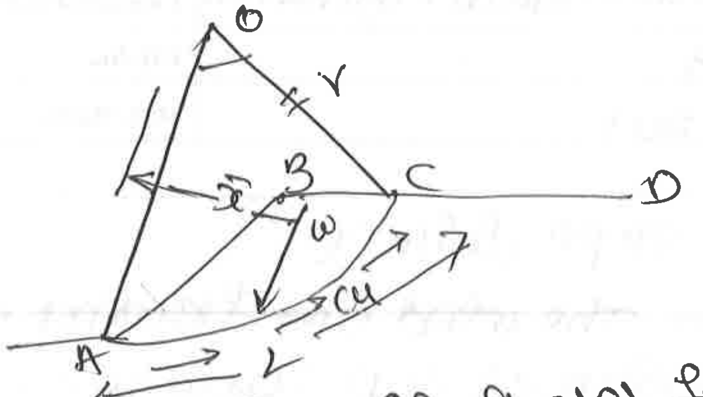


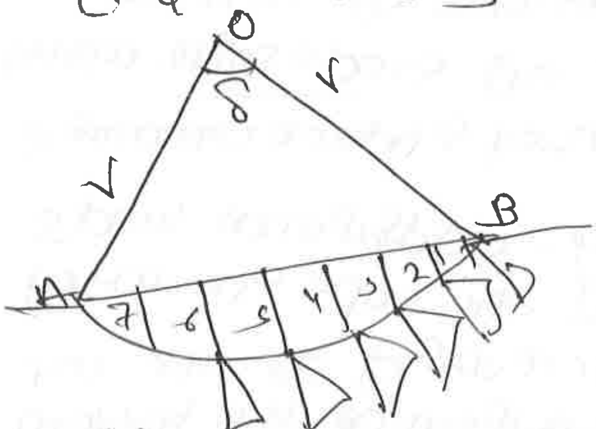
Fig:- trial slip circles for purely cohesive soil

$$P = \frac{CuLr}{W\bar{x}}$$

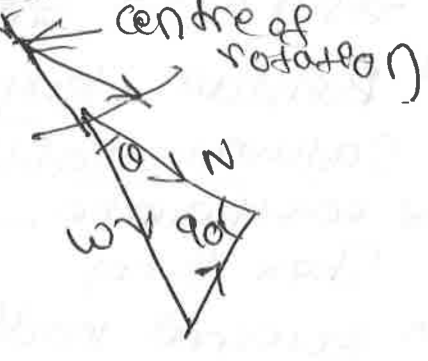
$$Cm = \frac{W\bar{x}}{Lr}$$

$$P = \frac{Cu}{Cm} = \frac{Cu}{\frac{W\bar{x}}{Lr}} = \frac{CuLr}{W\bar{x}}$$

C-φ analysis



(a)



(b)

— Be 800

$$\Sigma\Delta L = L = \frac{2\pi r\delta}{360°} = \text{length AB of slip circle}$$

$$F = \frac{MR}{MD} = \frac{CL + \tan\phi\,\Sigma N}{\Sigma T}$$

total mark -> 7.5

1(b) soln

$\beta = 38^\circ$ $H = 18m$ $\phi = 18^\circ$

$C = 200 \, kN/m^2$ $\gamma = 18 \, kN/m^3$

$S_n = 0.06$

Taylors stability number

$$S_n = \frac{C_m}{\gamma H}$$

mobilised cohesion $C_m = S_n \gamma H$

$= 0.06 \times 18 \times 15$

$= 16.2 \, kN/m^2$ — 3.5

Factor of safety with respect to cohesion

$$F_c = \frac{C}{C_m} = \frac{200}{16.2} = 12.34$$ — 2

or

$$F_c = \frac{C}{\gamma H S_n} = \frac{200}{18 \times 15 \times 0.06} = 12.34$$ — 2

total marks = 7.5

2(a) Fellinious method

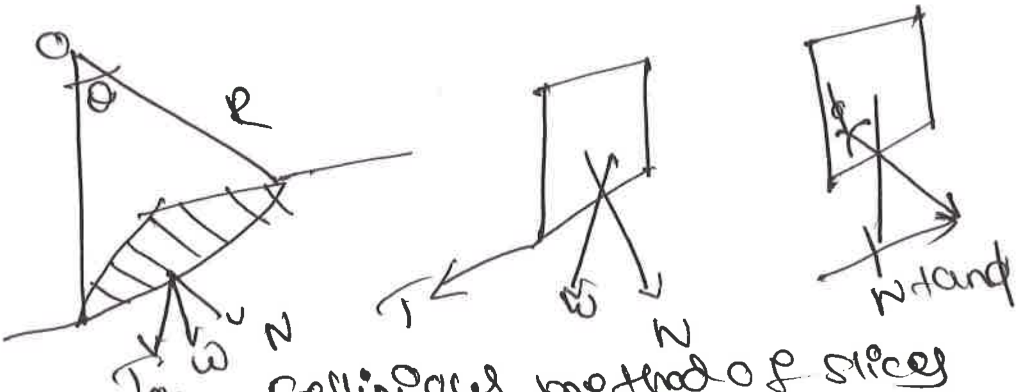


Fig: Fellinious method of slices

factor of safety $= \frac{\Sigma R\theta + \Sigma N \tan\phi}{\Sigma T}$

——— total mark 7.5

where

C = cohesion of soil

ϕ = soil friction

R = radius of trial slip circle

θ = central angle

N = component of wt normal to arc

T = component of weight, tangential ~~to~~ arc

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2(b) Sol/

$H = 5m$ $C_u = 20\ kN/m^2$ $\phi_u = 10^0$

$e = 0.80$ $G = 2.8$

$S_n = 0.108$ → canal runs full

$S_n = 0.137$ → sudden draw down

$\gamma_{sat} = \left[\frac{G+e}{1+e}\right]\gamma_w = .$ kN/m3 — 1.5

$\gamma' = \gamma_{sat} - \gamma_w =$ kN/m3 — 2

(i) when the canal runs full (submerged)

$S_n = 0.108$

factor of safety $F_c = \frac{c}{\gamma' H S_n} =$ — 2

(ii) sudden drawn $S_n = 0.137$

$F_c = \frac{c}{\gamma_{sat} H S_n} =$ — 2

total marks = 7.5

3(a) Sol/

$C = 18\ kN/m^2$. $\phi = 20^0$, $e = 0.9$ $G = 2.67$

$H = 6m$

$S_n = 0.06$ → canal runs full

$S_n = 0.114$ → canal is rapidly emptied

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$$\gamma_{sat} = \frac{(G+e)\gamma_w}{1+e}$$

$$\gamma_{sat} = \_\_\_\_ \text{ kN/m}^3$$

factor of safety $F_c = \frac{c}{\gamma_{sat} H S_n}$

or

$$F_c = \frac{C}{\gamma H S_n} =$$

total marks 2.5

3(b) Sol:

$H = 7\text{m}$ $C_u = 20 \text{ kN/m}^2$, $\phi_u = 15^\circ$

$e = 0.9$ and $G = 2.7$ $S_n = 0.108$, → canal runs fully

$S_n = 0.137$. sudden draw down

$$\gamma_{sat} = \frac{(G+e)\gamma_w}{1+e}$$

$$\gamma_{sat} = \_\_\_\_ \text{ kN/m}^3$$

factor of safety $F_c = \frac{C}{\gamma_{sat} H S_n}$

or

$$F_c = \frac{C}{\gamma H S_n}$$

total marks 2.5

4(a)

$C = 20 \text{ kN/m}^2$, $\phi = 10^\circ$ $\gamma = 19 \text{ kN/m}^3$

$F.S = 1.5$ $H = 18\text{m}$

$S_n = 0.04$ $\phi = 20^\circ$

$S_n = 0.08$ $\phi = 30^\circ$

Scheme of Valuation

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$$S_n = \frac{c}{F H \gamma_c} = \frac{20}{19 \times 18 \times 1.5}$$

$$= 0.046$$

$S_n = 0.04 = i = 20^\circ$

$S_n = 0.046 = i = ?$

$S_n = 0.08 = i = 80^\circ$

$$= \frac{\overset{45-30}{(\cancel{150}-45)}}{(0.08-0.04)} \times \overset{0.0833-0.04}{(\cancel{0.044}-\cancel{0.0833})}$$

safe slope = 16.28°

total marks = 7.5

4(b) types of failure in finite slopes

1) face (slope) failure
2) Toe failure
3) Base failure

1) face (slope) failure → This type of failure occurs when the slope

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angle is large and when the soil ~~at the toe~~ portion is strong

2) Toe failure – In this case the failure surface passes through the toe this occurs when the slope is steep and homogeneous

3) Base failure –

In this case the failure surface passes below the toe this generally occurs when the soil below the toe is relatively weak and soft.

total marks
=7.5