

**ROY G. PERRY COLLEGE OF ENGINEERING
CIVIL & ENVIRONMENTAL ENGINEERING DEPARTMENT
PRAIRIE VIEW A&M UNIVERSITY**

ASSESSMENT REPORT COVER PAGE

**CVEG 4100 GEOTECHNICAL ENGINEERING
DESIGN LAB**

FALL 2021 SEMESTER

NAME OF INSTRUCTOR: Dr. Md Jobair Bin Alam

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Outcome-7: An ability to acquire and apply new knowledge as needed using appropriate learning strategies.

Detailed Course Syllabus
(Distributed to Students at the beginning of the Semester)
ABET Outcomes measured using course should be
explicitly listed in the syllabus

Course Description in ABET Format

CVEG 4100 Geotechnical Engineering Design Lab

1.	Course number and name:	CVEG 4100 Geotechnical Engineering Design Lab
2.	Credits and contact hours:	1 credit hours
3.	Instructor's or course coordinator's name:	Dr. Md Jobair Bin Alam
4.	Textbook: Title:	1. Principles of Foundation Engineering
	Author:	1. BM Das 2. N. Sivakugan
	Publisher, Year & Edition:	Cengage Learning
	a. Other Supplemental material	Handouts from US Army Core of Engineers, NAVFAC Manual
5.	Specific course information	
	a. Brief description of the content of the course (catalog description)	CVEG 4100. Geotechnical Engineering Lab. 1 Credit. Subsoil Exploration method and report, Borelog reading and interpretation, Design of Shallow foundation, Stress increase and distribution, Settlement analysis, Design of Deep foundation, Earth retaining structures design, Slope stability Analysis.
	b. Prerequisites or Co-requisites	CVEG 3300 – Geotechnical Engineering
	c. *Indicate whether a required, elective, or selected elective (as per definition provided) course in the program	*****Highly Required*****
6.	a. Specific goals for the course specific outcomes of instruction (e.g., The student will be able to explain the significance of current research about a particular topic.) <i>Students will be able to:</i>	b. Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course. <i>The specific goals for the course specific outcomes listed on the left column will address the following student learning outcomes:</i>
	1. Perform analysis of soil boring report and interpret the necessary information required to design geotechnical infrastructure	
	2. Understand and be able to apply the fundamental equations in soil mechanic to solve practical geotechnical engineering design	

	problems.	Outcome 7 An ability to acquire and apply new knowledge as needed using appropriate learning strategies.
	3. Be proficient in the methodology for solving soil mechanics problems and related geotechnical design using their knowledge in mathematics, science.	
	4. Perform in a team to solve mega projects, development of leadership skills, group work in project where critical thinking develops, new strategical approach develops for problem solving.	
7	Brief list of topics to be covered	Introduction, basic soil mechanics (2 hours) Soil exploration and bore log interpretation (4 hours) Shallow Foundation Design (6 hours) Settlement Analysis (4 hours) Deep foundation Design (4 Hours) Design of Earth Retaining Structures (3 hours) Slope Stability Analysis (3 hours)

CVEG 4100 Geotechnical Engineering Design Fall 2021

General Course Information

Information Item	Information
Instructor:	Md Jobair Bin Alam, Ph.D., P.E.
Section # and CRN:	P81 & 17736
Office Location:	SR Collins Building # 312
Office Phone:	936 261 1652
Email Address:	mdalam@pvamu.edu
Office Hours:	8.00 am to 10.00 am (T)
Mode of Instruction:	In Class
Course Location:	Wilson 109G
Class Days & Times:	10.00 am – 12.30 pm (Wednesday)
Catalog Description:	Credit 1 semester hours. Fundamental understanding subsoil exploration, shallow foundation design, stress increase, consolidation settlement, Flow net and Seepage of Earth Dam, deep foundation design, lateral earth pressure and retaining wall.
Prerequisites:	CVEG 3300
Co-requisites:	None
Required Text(s):	Principles of Foundation Engineering (8 th or 9 th Edition)-B.M. Das
Recommended Text(s):	Handouts

General Course Information Table

Upon successful completion of this course, students will be able to:

1. Ability to command basic and applied knowledge in geotechnical engineering.
2. Be able to read subsurface soil boring report and characterize soil strata.
3. Assign lab for specific soil from required layer and describe soil properties based on laboratory results.
4. Analyze and determine the foundation design parameters.
5. Analyze and recommend different design module for site specific foundation case.
6. Design shallow and deep foundation based on design parameters with maximum factor of safety.
7. Analyze lateral earth pressure and design earth retaining structure

Student Learning Outcomes Table

Civil Engineering Program Outcomes (Student Learning Outcomes)

ABET EAC Criterion 3 {[1] - [7] Student Outcomes (SOs)}

- 1) an ability to identify, formulate, and solve **complex** engineering problems by applying principles of engineering, science, and mathematics
- 2) an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
- 3) an ability to communicate effectively with a range of audiences
- 4) an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
- 5) an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
- 6) an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
- 7) an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

3 REPEAT RULE:

Any student in the College of Engineering, who has already taken the course at PVAMU threetimes (which is the maximum limit), will not be permitted to enroll that same course at PVAMU.

Civil Engineering Program Educational Objectives (PEOs)

Graduates from the Civil Engineering program will:

1. Have careers in civil engineering or related fields that lead to increasing levels of responsibility and leadership
2. Obtain professional licensure/certifications
3. Complete graduate studies in civil engineering or related fields
4. Engage in professional development and service

Mapping of Program Educational Objectives onto Student Outcomes

PEO	Program Educational Objectives	CE Student Outcomes						
	<i>Graduates from the Civil Engineering program will:</i>	[1]	[2]	[3]	[4]	[5]	[6]	[7]
PEO 1	Have careers in civil engineering or related fields that lead to increasing levels of responsibility and leadership	X	X	X	X	X	X	X
PEO 2	Obtain professional licensure/certifications	X	X					
PEO 3	Complete graduate studies in civil engineering or related fields	X	X	X	X		X	X
PEO 4	Engage in professional development and service	X	X	X	X		X	X

- 1) an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
- 2) an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
- 3) an ability to communicate effectively with a range of audiences
- 4) an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
- 5) an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
- 6) an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
- 7) an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

Table: Outcome Measures

Course	CVEG Objectives				ABET Criterion 3						
	1	2	3	4	1	2	3	4	5	6	7
CVEG 4100	x	x	x	x							x

x are the outcomes measured for this course

Mapping of CVEG Courses onto PEOs and Program Outcomes [Beginning Fall 2019] Updated Fall 2021

Previous Course No.	New Course No.	Course Title	CE Student Outcomes/SOs						
			[1]	[2]	[3]	[4]	[5]	[6]	[7]
CVEG 1011	CVEG 1101	Introduction to Engineering							
CVEG 1021	CVEG 1102	Introduction to Civil Engineering Lab							I
CVEG 2043	CVEG 2301	Engineering Mechanics I							I
CVEG 2061	CVEG 2101	Materials & Dynamics Lab						I	
CVEG 2063	CVEG 2332	Mechanics of Materials I		I					
CVEG 2073	CVEG 2304	Global Development Issues {CORE}			I	√	I		R
CVEG 2081	CVEG 2102	Surveying & Geospatial Concepts			R			I	
CVEG 3023	CVEG 3300	Geotechnical Engineering		I					
CVEG 3031	CVEG 3100	Concrete & Steel Lab						√	
CVEG 3043	CVEG 3301	Environmental Engineering			R			√	
CVEG 3051	CVEG 3102	Professional Engineering I				√			
CVEG 3053	CVEG 3302	Transportation Engineering			R		√		
CVEG 3063	CVEG 3303	Hydraulics			√		R	√	
CVEG 3073	CVEG 3304	Structural Analysis I	I						√
CVEG 3083	CVEG 3305	Steel Design	√	√	R				
CVEG 4013	CVEG 4300	Reinforced Concrete	R	√					
CVEG 4021	CVEG 4100	Geotech Engineering Design Lab		R					√
CVEG 4043	CVEG 4301	Environmental Engineering Design	√	√	R				
CVEG 4053	CVEG 4302	Transportation Engineering Design	√				√		
CVEG 4063	CVEG 4303	Water Resources Engineering	√	√					I
CVEG 4093	CVEG 4304	Systems Engineering		√					√
CVEG 4472	CVEG 4200	Sr. Design & Professionalism I		√	√	√	√		√
CVEG 4482	CVEG 4201	Sr. Design & Professionalism II	√	√	√	√			

I – means the described outcome is introduced (not measured) but could be monitored.

√ - means that the skills described in the program outcome are covered and **measured** in the course.

R – means the described outcome is reinforce in the course (not measured) but could be monitored.

Additionally, evidence are to collected to satisfy **CE Program Criteria** covering basic concepts in **Management** (CVEG 3302, 4302, 4200, 4201, 4304), **Business** (CVEG 4304, 4200, 4201), **Public Policy** (CVEG 2304, 4200, 4201), **Professional Ethics** (CVEG 1102, 2304, 3102), **Leadership** (CVEG 4200, 4201), **Consideration of Sustainability** (CVEG 4301, 4302, 4303), **Importance of Professional Licensure** (CVEG 3102, 4200, 4201).

Note: Courses with a mixture of students from other Programs are intentionally excluded when possible.

The Assessment Process

Student Learning outcomes are measured using both **direct** and **indirect** measurements. Direct measurement is derived from either designated homework, tests, lab reports project reports or other assignments. Indirect measurement is drawn from end- of-semester Student Opinion Surveys (SOS) and any surveys completed by graduating Seniors. The above listed Student Learning Outcomes (Program Outcomes) are measured and evaluated in specified cycles and an Assessment Report is prepared annually for the purposes of continuously improving the Program's learning outcomes.

Major Course Requirements

TOPICS COVERED

1. Sub-soil Investigation
2. Boring Logs
3. Shallow Foundation
4. Consolidation
5. Settlement Analysis
6. Mat and Combined Footing
7. Seepage and Flow net
8. Deep Foundation
9. Lateral Earth Pressure
10. Slope Stability Analysis

Detailed Description of Major Assignments:

Assignment Title or Grade Requirement	Description
1. Tests/Exams	Written tests designed to measure knowledge of presented course material
2. Homework Assignments	Periodic written assignments designed to supplement and reinforce course material
3. Final Exam	Comprehensive closed book examination.

Course Grade Requirement	Value	Total
1) Assignments	5%	5
2) Attendance	5%	5
3) 2 Tests @ 15% Each	30%	30
4) 2 Projects @ % 20% Each	40%	40
5) Final Exam	20%	20
Total:	100%	100

Course Grade Requirement Table

Grading Criteria and Conversion:

A = 90-100
B = 80-90
C = 70-80
D = 60-70
F = 0-59

Course Procedures

Submission of Assignments:

Assignment Submission

Dates to submit assignments will be provided to you at the time the assignment is handed out. **LATE ASSIGNMENTS WLL NOT BE ACCEPTED!!** Use the following format for all of your homework:

1. Your homework should be complete, neat, and professionally presented.
2. Use **only engineering paper (no graph paper)** for submitting your homework

3. Your homework should have the following on top of the first sheet
 - a. Your name and Roster Number
 - b. Course prefix, number, section, and title
 - c. Homework number
 - d. Date Given
 - e. Date Due
4. Five (5) points will be deducted for improper cover pages.
5. Drawing of free body diagram is must for the questions which need Free body Diagram.
6. Show all steps for arriving to the final answer clearly. Include all appropriate sketches.
7. Reference all figures, tables, constant values, equations, and conversions used to complete the problem.
8. Include all the appropriate units throughout the solution. Points will be deducted for answers presented without the appropriate units.
9. Start a new page for every new problem. Problems should be in the order assigned.

Exam Policy:

Exams should be taken as scheduled. No makeup examinations will be allowed except under documented emergencies (See Student Handbook).

CEE POLICY TO ERADICATE CHEATING (PROTECT INTEGRITY OF EXAMS)

Cheating is unprofessional, unethical and is antithetical to our core value of "Excellence in Civil Engineering Education," and WILL NOT BE TOLERATED at any level. To combat this serious problem, the Civil & Environmental Engineering (CEE) Department has adopted the following rules to eradicate cheating.

- If a student cheats on a test/assignment, the student shall receive an automatic zero for the test/assignment.
- A student who has been determined to have cheated in a course will IMMEDIATELY relinquish his/her leadership position in any of the department's professional organizations.
- If a student cheats multiple times in a course, the student will receive a grade of "F" for the course.
- The calculators allowed for use in exams may be restricted to the latest FE-approved calculators. For the latest NCEES FE approved calculators visit ncees.org or <https://ncees.org/exams/calculator/>

[This NCEES policy protects the integrity of NCEES exams and has been adopted to do likewise for department's exams.]

Exam Guidelines

- All cellphones/smartwatches MUST be placed in a book bags during exams and turned off. Book bags MUST be placed in front of the classroom and away from students. Students without a book bag must place cellphone/smartwatch (turned off) on Instructor's desk – no exceptions
- Any student possessing a cellphone/smartwatch or any other unauthorized device WILL receive an automatic zero for the test/assignment. This is cheating.
- Calculator covers are DISALLOWED during tests and must be placed in students' book bags during exams.
- There shall be NO SHARING of resources during the exam

Restroom Visit: if you need to use the restroom, do so before opening the exam. Once the exam begins, you must submit your work to the instructor if you leave the classroom to visit the rest room (your exam terminates).

16 WEEK CALENDAR

Week 1: Topic(s)	Basic Soil Mechanics Review and Subsoil Investigation
Chapter(s):	Chapters 1 and 2
Assignment(s):	None
Week 2: Topic	Subsoil Investigation and Shallow Foundation Design
Chapter(s):	Chapter 6
Assignment(s):	None
Week 3: Topic(s)	Shallow Foundation Design
Chapter(s):	Chapter 6
Assignment(s):	None
Week 4: Topic(s)	Stress Increase Determination
Chapter(s):	Handouts and Chapter 8
Assignment(s):	Homework # 1: Select Problems are Assigned
Week 5: Topic(s)	Stress Increase Determination and Consolidation Settlement
Chapter(s):	Chapter 8
Assignment(s):	None
Week 6: Topic(s)	Primary Consolidation Settlement
Chapter(s):	Chapter 9
Assignment(s):	Project # 1: Report Submission
Week 7: Topic(s)	Primary and Secondary Consolidation Settlement
Chapter(s):	Chapter 9
Assignment(s):	Exam # 1
Week 8: Topic(s)	Mat Foundation and Combined Footing
Chapter(s):	Chapter 10
Assignment(s):	Homework # 2: Select Problems are Assigned
Week 9: Topic(s)	Flow Net and Seepage Analysis of Earth Dam
Chapter(s):	Handouts
Assignment(s):	None
Week 10: Topic(s)	Deep Foundation Design
Chapter(s):	Chapters 9 and 10
Assignment(s):	None
Week 11: Topic(s)	Deep Foundation Design
Chapter(s):	Chapters 12
Assignment(s):	Homework # 3: Select Problems are Assigned
Week 12: Topic(s)	Lateral Earth Pressure
Chapter(s):	Chapters 16
Assignment(s):	Exam # 2
Week 13: Topic(s)	Lateral Earth Pressure and Retaining Structure
Chapter(s):	Chapters 16
Assignment(s):	Homework #4: Select Problems are Assigned
Week 14: Topic(s)	Slope Stability
Chapter(s):	Handouts
Assignment(s):	None, Thanksgiving Holiday (November 25-27, 2021)
Week 15: Topic	Slope Stability
Chapter(s):	Handouts
Assignment(s):	Project # 2 Report Submission and Presentation
Week 16: Topic(s)	Last Class Day; Course Evaluation; Course Review for Final Examination
Assignment(s):	Comprehensive Final Exam Period – December 2-8, 2021

Important Semester Dates

- Week 3 – Labor Day Holiday on Monday, September 6, 2021
- Week 3 – Last Day to Withdraw from Course(s) without academic record, Tuesday, Sept. 7, 2021
- Week 3 – Withdrawal from course(s) with academic record ("W") Begins on Wednesday, Sept. 8, 2021
- Week 8 – Mid-Semester Examination Period, Thursday – Saturday, October 14-16, 2021
- Week 9 – Mid-Semester Grades Due on Wednesday, October 20, 2021
- Week 11 – Withdrawal from course(s) with academic record ("W") Ends on Monday, Nov. 1, 2021
- Week 12 - Priority Registration Period for Spring 2022 Begins on Nov. 8, 2021

- Week 14 – Thanksgiving Break, Thursday - Saturday, Nov. 25-27, 2021
- Week 15 – Last Class Day for Fall Semester, Wednesday, Dec. 1, 2021

Student Support and Success

John B. Coleman Library

The John B. Coleman Library's mission is to enhance the scholarly pursuit of knowledge, to foster intellectual curiosity, and to promote life-long learning and research through our innovative services, resources, and cultural programs, which support the Prairie View A&M University's global mission of teaching, service, and research. It maintains library collections and access both on campus, online, and through local agreements to further the educational goals of students and faculty. Website: <https://www.pvamu.edu/library/>; Phone: 936-261-1500

Academic Advising Services

Academic Advising Services offers students a variety of services that contributes to student success and leads towards graduation. We assist students with understanding university policies and procedures that affect academic progress. We support the early alert program to help students get connected to success early in the semester. We help refer students to the appropriate academic support services when they are unsure of the best resource for their needs. Faculty advisors support some students in their respective colleges. Your faculty advisor can be identified in PantherTracks. Advisors with Academic Advising Services are available to all students. We are located across campus. Find your advisor's location by academic major at www.pvamu.edu/advising. Phone: 936-261-5911

The University Tutoring Center

The University Tutoring Center (UTC) offers free tutoring and academic support to all registered PVAMU students. The mission of the UTC is to help provide a solid academic foundation that enables students to become confident, capable, independent learners. Competent and caring staff and peer tutors guide students in identifying, acquiring, and enhancing the knowledge, skills, and attitudes needed to reach their desired goals. Tutoring and academic support are offered face-to-face in the UTC, in virtual face-to-face sessions (<https://www.pvamu.edu/student-success/sass/university-tutoring-center/>), and through online sessions (<https://www.pvamu.edu/pvplace/>). Other support services available for students include Supplemental Instruction, Study Break, Academic Success Workshops, and Algebra Study Jam. Location: J. B. Coleman Library, Rm. 307; Phone: 936-261-1561; Email: pv tutoring@pvamu.edu; Website: <https://www.pvamu.edu/student-success/sass/university-tutoring-center/>

Writing Center

The Writing Center provides well-trained peer tutors to assist students with writing assignments at any stage of the writing process. Tutors help students with various writing tasks from understanding assignments, brainstorming, drafting, revising, editing, researching, and integrating sources. Students have free access to Grammarly online writing assistance. Grammarly is an automated proofreading and plagiarism detection tool. Students must register for Grammarly by using their student email address. In addition, students have access to face-to-face and virtual tutoring services either asynchronously via email or synchronously via Zoom. Location: J. B. Coleman Library, Rm. 209; Phone: 936-261-3724; Website: <https://www.pvamu.edu/student-success/writing-center/>; Grammarly Registration: <https://www.grammarly.com/enterprise/signup>

Academic Early Alert

Academic Early Alert is a proactive system of communication and collaboration between faculty, academic advisors, and PVAMU students that is designed to support student success by promptly identifying issues and allowing for intervention. Academic Early Alerts help students by providing a central location to schedule advising appointments, view advisor contact information, and request assistance. Students who recognize that they have a problem that is negatively affecting their academic performance or ability to continue school may self-refer an Academic Early Alert. To do so, students will log in to PV Place and click on Academic Early Alert on the left sidebar. Phone: 936-261-5902; Website: <https://www.pvamu.edu/student-success/early-alert/>

Student Counseling Services

The Student Counseling Services unit offers a range of services and programs to assist students in maximizing their potential for success: short-term individual, couples, and group counseling, as well as crisis intervention, outreach, consultation, and referral services. The staff is licensed by the State of Texas and assists students who are dealing with academic skills concerns, situational crises, adjustment problems, and emotional difficulties. Information shared with the staff is treated confidentially and in accordance with Texas State Law. Location: Hobart Taylor, 2nd floor; Phone: 936-261-3564; Website: <https://www.pvamu.edu/healthservices/student-counseling-services/>

Office of Testing Services

Testing Services serves to create opportunities by offering a suite of exams that aid in the students' academic and professional success. Currently, we administer entrance (HESI A2), college readiness (TSI assessment), Prior Learning (CLEP, DSST), and proctored exams. Location: Wilhelmina Delco, 3rd Floor, Rm. 305; Phone: 936-261-3627; Email: aetesting@pvamu.edu; Website: www.pvamu.edu/testing

Office of Diagnostic Testing and Disability Services

The Americans with Disabilities Act (ADA) is a federal anti-discrimination statute that provides comprehensive civil rights protection for persons with disabilities. Among other things, this legislation requires that all students with disabilities be guaranteed a learning environment that provides for reasonable accommodation of their disabilities. If you believe you have a disability requiring an accommodation, contact the Office of Disability Services. As a federally-mandated educational support unit, the Office of Disability Services serves as the repository for confidential disability files for faculty, staff, and students. For persons with a disability, the Office develops individualized ADA letters of request for accommodations. Other services include learning style inventories, awareness workshops, accessibility pathways, webinars, computer laboratory with adapted hard and software, adapted furniture, proctoring non-standardized test administrations, ASL interpreters, ALDs, digital recorders, Livescribe, and a comprehensive referral network across campus and the broader community. Location: Hobart Taylor, Rm. 1D128; Phone: 936-261-3583; Website: <https://www.pvamu.edu/disabilityservices/>

Center for Instructional Innovation and Technology Services (CIITS)

Distance Learning, also referred to as Distance Education, is the employment of alternative instructional delivery methods to extend programs and services to persons unable to attend college in the traditional manner. The Center for Instructional Innovation and Technology Services (CIITS) supports student learning through online, hybrid, web-assist, and 2-way video course delivery. For more details and contact information, visit: <https://www.pvamu.edu/dlearning/distance-learning-2-2/students-2/>; Phone: 936-261-3283

Veteran Affairs

Veterans Services works with student veterans, current military and military dependents to support their transition to the college environment and continued persistence to graduation. The Office coordinates and certifies benefits for both the G.I. Bill and the Texas Hazlewood Act. Location: Evans Hall, Rm. 102; Phone: 936-261-3563; Website: <https://www.pvamu.edu/sa/departments/veteranaffairs/>

Office for Student Engagement

The Office for Student Engagement delivers comprehensive programs and services designed to meet the co-curricular needs of students. The Office implements inclusive and accessible programs and services that enhance student development through exposure to and participation in diverse and relevant social, cultural, intellectual, recreational, community service, leadership development, and campus governance. Location: Memorial Student Center, Rm. 221; Phone: 936-261-1340; Website: <https://www.pvamu.edu/studentengagement/>

Career Services

Career Services supports students through professional development, career readiness, and placement and employment assistance. The Office provides one-on-one career coaching, interview preparation, resume and letter writing, and career exploration workshops and seminars. Services are provided for students at the Northwest Houston Center and College of Nursing in the Medical Center twice a month or on a requested basis. Distance Learning students are encouraged to visit the Career Services website for information regarding services provided. Location: Anderson Hall, 2nd floor; Phone: 936-261-3570; Website: <https://www.pvamu.edu/careerservices/>

University Rules and Procedures

Academic Misconduct

Academic dishonesty is defined as any form of cheating or dishonesty that has the effect or intent of interfering with any academic exercise or fair evaluation of a student's performance. The college faculty can provide additional information, particularly related to a specific course, laboratory, or assignment.

You are expected to practice academic honesty in every aspect of this course and all other courses. Make sure you are familiar with the *University Administrative Guidelines on Academic Integrity*, which can be found on the [Academic Integrity webpage](#). Students who engage in academic misconduct are subject to university disciplinary procedures. As listed in the *University Administrative Guidelines on Academic Integrity*, the University Online Catalog, and the Student Code of Conduct, the following are examples of prohibited conduct. This list is not designed to be all-inclusive or exhaustive. In addition to academic sanctions, any student found to have committed academic misconduct that is also a violation of criminal law may also be subject to disciplinary review and action by the Office of Student Conduct (as outlined in the Student Code of Conduct).

Forms of Academic Dishonesty:

1. Cheating: Deception in which a student misrepresents that he/she has mastered information on an academic exercise that he/she has not learned, giving or receiving aid unauthorized by the instructor on assignments or examinations. Examples: unauthorized use of notes for a test; using a "cheat sheet" on a quiz or exam; any alteration made on a graded test or exam which is then resubmitted to the teacher;
2. Plagiarism: Careless or deliberate use of the work or the ideas of another; representation of another's work, words, ideas, or data as your own without permission or appropriate acknowledgment. Examples: copying another's paper or answers, failure to identify information or essays from the internet and submitting or representing it as your own; submitting an assignment which has been partially or wholly done by another and claiming it as yours; not properly acknowledging a source which has been summarized or paraphrased in your work; failure to acknowledge the use of another's words with quotation marks;
3. Collusion: When more than one student or person contributes to a piece of work that is submitted as the work of an individual;
4. Conspiracy: Agreeing with one or more persons to commit an act of academic/scholastic dishonesty; and
5. Multiple Submission: Submission of work from one course to satisfy a requirement in another course without explicit permission. Example: using a paper prepared and graded for credit in one course to fulfill a requirement and receive credit in a different course.

Nonacademic Misconduct

The university respects the rights of instructors to teach and students to learn. Maintenance of these rights requires campus conditions that do not impede their exercise. Campus behavior that interferes with either (1) the instructor's ability to conduct the class, (2) the inability of other students to profit from the instructional program, or (3) campus behavior that interferes with the rights of others will not be tolerated. An individual engaging in such disruptive behavior may be subject to disciplinary action. The Office of Student Conduct will adjudicate such incidents under nonacademic procedures.

Sexual Misconduct

Sexual harassment of students and employees at Prairie View A&M University is unacceptable and will not be tolerated. Any member of the university community violating the university's sexual harassment policy will be subject to disciplinary action. In accordance with the Texas A&M University System guidelines, your instructor is obligated to report to the Office of Title IX Compliance (titleixteam@pvamu.edu) any instance of sexual misconduct involving a student, which includes sexual assault, stalking, dating violence, domestic violence, and sexual harassment, about which the instructor becomes aware during this course through writing, discussion, or personal disclosure. The faculty and staff of PVAMU actively strive to provide a learning, working, and living environment that promotes respect that is free from sexual misconduct, discrimination, and all forms of violence. If students, faculty, or staff would like assistance or have questions, they may contact the Title IX Coordinator at 936-261-2144 or titleixteam@pvamu.edu. More information can be found at www.pvamu.edu/titleix, including confidential resources available on campus.

Pregnancy, Pregnancy-related, and Parenting Accommodations

Title IX of the Education Amendments of 1972 prohibits sex discrimination, which includes discrimination based on pregnancy, marital status, or parental status. Students seeking accommodations related to pregnancy, pregnancy-related conditions, or parenting (reasonably immediate postpartum period) are encouraged to contact Student Disability Services or the Dean of Students' Office for additional information and to request accommodations.

Non-Discrimination Statement

Prairie View A&M University does not discriminate on the basis of race, color, sex, religion, national origin, age, disability, genetic information, veteran status, sexual orientation, or gender identity in its programs and activities. The University is committed to supporting students and complying with The Texas A&M University System non-discrimination policy. It seeks to establish an environment that is free of bias, discrimination, and harassment. If you experience an incident of discrimination or harassment, we encourage you to report it. If you would like to speak with someone who may be able to afford you privacy or confidentiality, there are individuals who can meet with you. The Director of Equal Opportunity & Diversity has been designated to handle inquiries regarding the non-discrimination policies and can be reached at Harrington Science Building, Suite 109 or by phone at 936-261-1744 or 1792.

Class Attendance Policy (See the University Online Catalog for Full Attendance Policy)

Prairie View A&M University requires regular class attendance. Attending all classes supports the full academic development of each learner, whether classes are taught with the instructor physically present or via distance learning technologies such as interactive video and/or the internet. Excessive absenteeism, whether excused or unexcused, may result in a student's course grade being reduced or in the assignment of a grade of "F." Absences are accumulated beginning with the first day of class during regular semesters and summer terms. Each faculty member will include the University's attendance policy in each course syllabus.

Student Academic Appeals Process

Authority and responsibility for assigning grades to students rest with the faculty. However, in those instances where students believe that miscommunication, errors, or unfairness of any kind may have adversely affected the instructor's assessment of their academic performance, the student has a right to appeal by the procedure listed in the University Online Catalog and by doing so within thirty days of receiving the grade or experiencing any other problematic academic event that prompted the complaint.

Technical Considerations

Minimum Recommended Hardware and Software:

- Intel PC or Laptop with Windows 10 or later version; Mac with OS High Sierra*
- Smartphone or iPad/Tablet with Wi-Fi*
- High-speed Internet access
- 8 GB Memory
- Hard drive with 320 GB storage space
- 15" monitor, 800x600, color or 16 bit
- Sound card w/speakers
- Microphone and recording software
- Keyboard & mouse
- Most current version of Google Chrome, Safari, or Firefox

Note: Be sure to enable Java & pop-ups in the Web browser preferences

* Smartphones, Google Chrome books, and Android tablets may not be supported. iPads are the only tablets supported.

Participants should have a basic proficiency of the following computer skills:

- Sending and receiving email
- A working knowledge of the Internet
- Microsoft Word (or a program convertible to Word)
- Acrobat PDF Reader
- Windows or Mac OS
- Video conferencing software

Netiquette (online etiquette)

Students are expected to participate in all discussions and virtual classroom chats as directed. Students are to be respectful and courteous to others on discussion boards. Foul or abusive language will not be tolerated. Do not use ALL CAPS for communicating to others AS IT CAN BE INTERPRETED AS YELLING. Avoid slang terms such as

"wassup?" and texting abbreviations such as "u" instead of "you." Limit and possibly avoid the use of emoticons. Be cautious when using humor or sarcasm as tone is sometimes lost in an email or discussion post, and the message might be taken seriously or sound offensive.

Video Conferencing Etiquette

When using Zoom, WebEx, or other video conferencing tools, confirm the visible area is tidy, clear of background clutter, inappropriate or offensive posters, and other distractions. Ensure you dress appropriately and avoid using high traffic or noisy areas. Stay muted when you are not speaking and avoid eating/drinking during the session. Before the class session begins, test audio, video, and lighting to alleviate technology issues.

Technical Support

Students should go to <https://mypassword.pvamu.edu/> if they have password issues. The page will provide instructions for resetting passwords and contact information if login issues persist. For other technical questions regarding eCourses, call the Center for Instructional Innovation and Technology Services at 936-261-3283 or email ciits@pvamu.edu.

Communication Expectations and Standards

Emails or discussion postings will receive a response from the instructor, usually in less than 48 hours. Urgent emails should be marked as such. Check regularly for responses.

Discussion Requirement

Online courses often require minimal to no face-to-face meetings. However, conversations about the readings, lectures, materials, and other aspects of the course can occur in a seminar fashion. The use of the discussion board will accomplish this. The instructor will determine the exact use of discussion boards.

It is strongly suggested that students type their discussion postings in a word processing application such as Word and save it to their PC or a removable drive before posting to the discussion board. This is important for two reasons: 1) If for some reason your discussion responses are lost in your online course, you will have another copy; 2) Grammatical errors can be greatly minimized by the use of the spell-and-grammar check functions in word processing applications. Once the post(s) have been typed and corrected in the word processing application, copy and paste to the discussion board.

COVID-19 Campus Safety Measures

To promote public safety and protect students, faculty, and staff during the coronavirus pandemic, PVAMU has adopted policies and practices to limit virus transmission.

- **Self-monitoring** - Students should follow CDC recommendations for self-monitoring. Students who have a fever or exhibit symptoms of COVID-19 should participate in class remotely and should not participate in face-to-face instruction.
- **Face Coverings** - Face coverings (cloth face covering, surgical mask, etc.) are recommended in classrooms, teaching laboratories, common spaces such as lobbies and hallways, public study spaces, libraries, academic resource, and support offices, and outdoor spaces where 6 feet of physical distancing is challenging to maintain reliably.
- **Physical Distancing** - Physical distancing should be maintained between students, instructors, and others in course and course-related activities where possible.
- **Personal Illness and Quarantine** - Students required to quarantine are to participate in courses and course-related activities remotely and must not attend face-to-face course activities. Students should notify their instructors of the quarantine requirement. Students under quarantine are expected to participate in courses and complete graded work unless they have symptoms that are too severe to participate in course activities. Students experiencing personal injury or illness that is too severe for the student to attend class qualify for

an excused absence. To receive an excused absence, students must provide appropriate documentation to the Office for Student Conduct, studentconduct@pvamu.edu.

End of Semester Course Assessment Report

This summary contains the following Information

1. Performance Statistics

- Total number of students in class
- The class average performance (**stated as %**) in each course outcome assessed in this class and the **two previous times course was assessed**.
- The acceptable class average for the class in each outcome area as set by your Department. **You cannot use any number of your choice**
- Percentage of students who scored below the expected average in each outcome.

2. Implementation Summary

- Brief summary of plans implemented during the semester based on last assessment report

3. Perceived Problems

- Instructor's critical **evaluation** of perceived problems that affected students' performance. **Realistic problems should be identified throughout the semester and summarized in this section of the report.**

4. New Plans for Addressing Problems

- Instructor's plans for addressing the perceived problems the next time the class is taught. **These should be specific enough for another instructor to implement. Most of these should be things that, you, the instructor can implement to help students to improve. Be creative.**

5. Overall Trend over last three assessment periods

- Instructors summary of overall performance trend for each outcome measured over the last three periods.

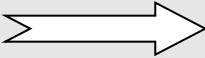
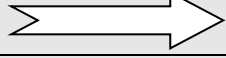
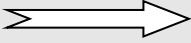
5. Were Expectations Met?

- Answer **YES** if the **class average was above the expected average** and the **stated percentage of students** scored at or above the expected average, else answer **NO**.

END OF SEMESTER COURSE OUTCOME ASSESSMENT REPORT
CVEG 4100 GEOTECHNICAL ENGINEERING DESIGN LAB
FALL 2021 SEMESTER

Report Prepared by: Dr. Md Jobair Bin Alam

Report Date: December 10, 2021

Semester	Analysis Type	Number of Students	Outcome 7 An ability to acquire and apply new knowledge as needed using appropriate learning strategies.			
			Expected Class Average/	Expected Percent of students at or above average	Class Average	% Students meeting Expected Average
Fall 2021	Direct	12	70	75	80	81
Fall 2020	Direct	22	70	75	82.36	75
Fall 2019	Direct	20	70	75	88.85	75
Implementation Summary	Items implemented from previous report or after meeting previous instructor		All the implementation summary for the sub-outcomes were implemented for this outcome.			
Perceived Problems	Perceived problems are directly related to the PC and the sub items under them 		Major problems were inability to produce a standard report. Students' technical ability to solve engineering problems by applying innovative idea improved.			
Plans for Addressing Problems	Plans for address specific measures to address PC and their sub areas 		Provide the students with sample professional technical engineering report to better present their technical work.			
Overall Trend over Periods	Ascertain if there were improvements over previous semesters 		Students' performance was above the expected average.			
Were Expectations Met?			YES			

**Grade Sheet Showing
Student and Class Performance in Outcomes
The computed semester average in each outcome
as stated in the Assessment report are
highlighted in boldface**

**Grade Sheet Showing Student and Class Performance in Course Outcomes
CVEG 4100 Geotechnical Engineering Design Lab, FALL 2021 Semester**

SL. No.	Project	Assignment
1	82	95
2	91	85
3	88	90
4	88	50
5	88	80
6	88	83
7	91	83
8	82	83
9	82	65
10	82	88
11	91	80
Average	86.63636364	80.18181818
Max	91	95
Min	82	50
SDEV	3.880018744	12.51253917
Expected Avg	75	75
%Student above expected avg	100	81

Outcome 7: An ability to acquire and apply new knowledge as needed using appropriate learning strategies

**OUTCOME SPECIFIC ASSIGNMENTS
USED TO ASSESS OUTCOMES**

ASSIGNMENTS FOR OUTCOME 7

An ability to acquire and apply new knowledge as needed using appropriate learning strategies

**DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING
OUTCOMES SPECIFIC ASSIGNMENT COVER SHEET
CVEG 4100 – Geotechnical Engineering Design Laboratory
FALL 2021**

Instructor: Md. Jobair Bin Alam, Ph.D., P.E.

Title of Assignment

Site Investigation Report and Design of Shallow Foundation

Outcome Measured Using this Assignment

Outcome 7

An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

Check the acquiring and applying engineering knowledge related to this assignment

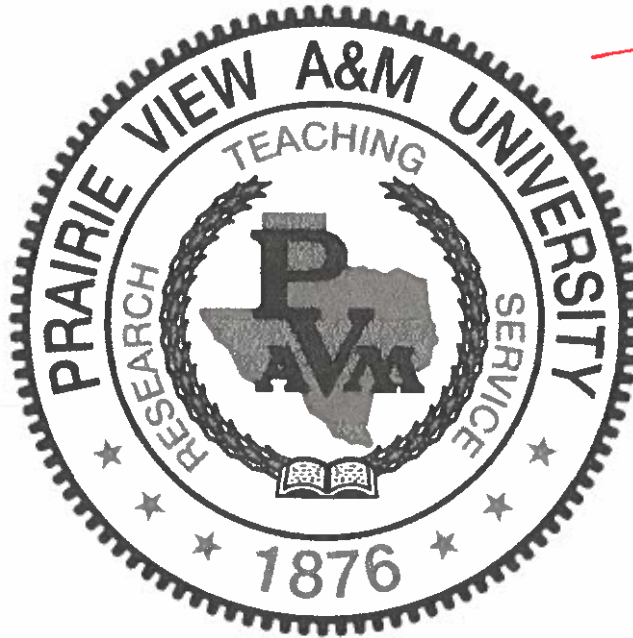
Assignment problem	
×	involves wide-ranging problem-solving issues
×	involves critical thinking in solving engineering and design problems
×	Involves real time design problems solution
×	involves identifying appropriate parameters for designing
×	Involves practicing application of engineering judgement
×	involves familiarizing with contemporary industry design and field investigation
Assignment problems will improve	
×	Ability to command basic and applied knowledge of mathematics, science, and engineering
×	Ability to identify, formulate, and solve geotechnical engineering problems by interpreting data and data analysis.
×	Ability to design a system, component, or process in geotechnical engineering to meet desired needs within realistic constraints such as economic, environmental, social, ethical, health and safety, manufacturability, and sustainability.
×	Ability to communicate effectively to understand the impact of geotechnical engineering solutions in a global, economic, environmental, and societal context.

Brief justification of the suitability of assignment for the outcome

The assignment will increase the students' ability to identify the appropriate method of field investigation to categorize the problems associated with geotechnical design calculation and recommendation. It will also increase the understanding of the contemporary industry practice of geotechnical design and new strategies

Sample of graded student's solution

Prairie View A&M University



CVEG 4021: Geotechnical Engineering Design Project **Shallow Foundation Design**

Autumn Carter

Shadaria Lynch

Perla Zaldivar

Submitted to:
Dr. J. B. Alam

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Letter of Transmittal

October 13, 2021

Dr. Jobair Bin Alam
Civil & Environmental Engineering
Prairie View A&M University

Dear Dr. Alam,

The attached technical report contains the detailed results of the proposed shallow foundation design for the new K-12 school. The report contains an analysis and recommendation for the building foundation best suited for a building located in Lubbock, Texas. This report consists of the introduction, site location, the soil profile of the site area with the inclusion of boring logs from B-1 to B-18 and the spread footing of the proposed parking areas. If you have any questions or concerns, please do not hesitate to contact us.

Sincerely,
Autumn Carter
Shadaria Lynch
Perla Zaldivar

Figures

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Introduction

The engineers that created this document were tasked with recommending a foundation type for a planned skyscraper in Lubbock, Texas. A steel frame is used to construct the structure. The facility's foundation must be constructed for bearing capacity as well as settling. The benefits and downsides of various types of foundations are grouped together, along with justifications for the foundation dimensions chosen.

City of Lubbock requires BGR Architects to conduct a geotechnical assessment and design a foundation system. Soil boring information, ground water table position, precise soil information, and design soil parameters are all part of the foundation system. A design for both bearing capacity and settling concerns, as well as a suggestion for the optimal shallow foundation system and a CAD drawing, will be included in the system. These design elements will offer the information that a shallow foundation system requires.

The project's goal is to investigate the subsurface conditions at a given location in order to aid foundation design for proposed constructions and then make general recommendations for the new existing structure. Drilling soil borings to depths of 0-20 feet below current grades within the planned development area, laboratory testing, and the creation of an engineering report were all part of the scope of services.

Chapter 1: Proposed K-12 School Petersburg ISD

1.1 Site Location

The proposed school for Petersburg ISD is located in Lubbock, TX. The site plan for the school is shown in Figure 1, also displaying the location of the borings. The school building will be built of a conventional steel frame. Of all the borings 12 are located under the proposed building at a minimum of 20 ft deep. There are 4 borings located on the proposed parking areas. The soil borings should be taken at a minimum of 5 feet deep. The maximum column load allowed is 50 kips. The foundation will consist of a continuous footing for the perimeter of the building while the steel columns will have a spread footing.

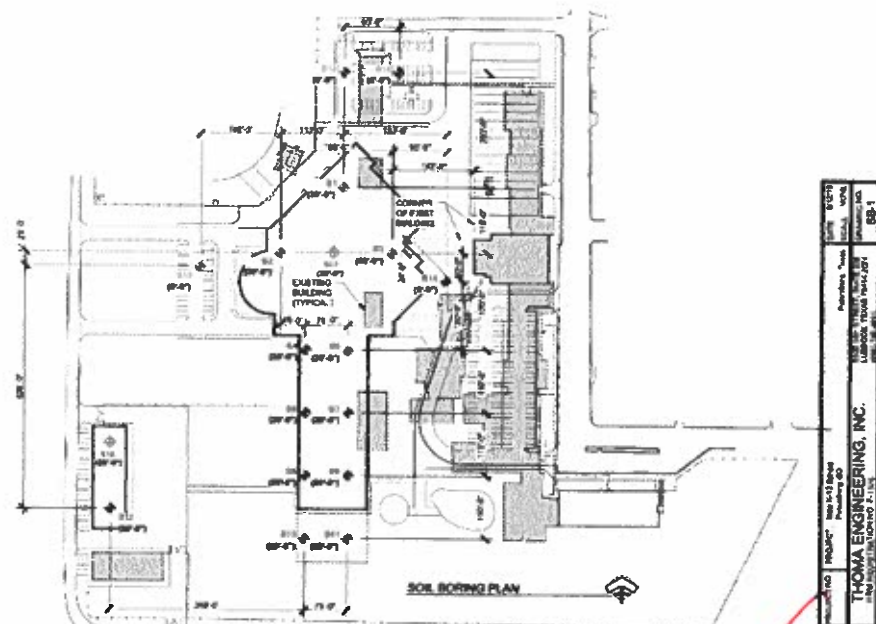


Figure 1. New K-12 School Petersburg ISD

1.2 Soil Profile from Boring Log

The boring log showed that the soil was dry and no ground water present. The boring log contains a detailed description for each boring sample taken. Figure 2 displays the boring log description found for test hole B-1, B-2 and B-3. For B-1 the soil was found to be lean clay with sand (CL) however it varied by color throughout the 20 ft. After 20 ft the soil was found to be sandy lean clay (SC). For B-2 the soil was found to be lean clay with soil to 7.5 ft and sandy lean clay (SC) for the rest of the boring. For B-3 the soil sample was found to be lean clay with sand (CL).

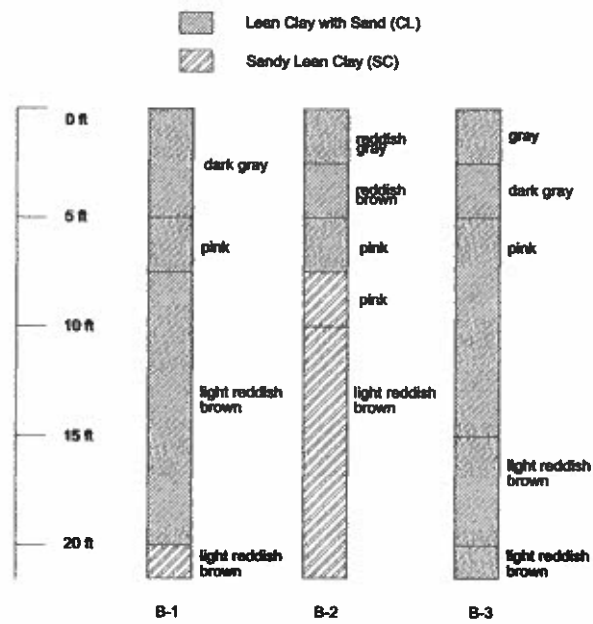


Figure 2. Boring Profile for B-1 to B-3

Figure 3 displays the boring log description found for test hole B-4, B-5 and B-6. All three boring soil samples were found to be a lean clay soil with different variations of colors.

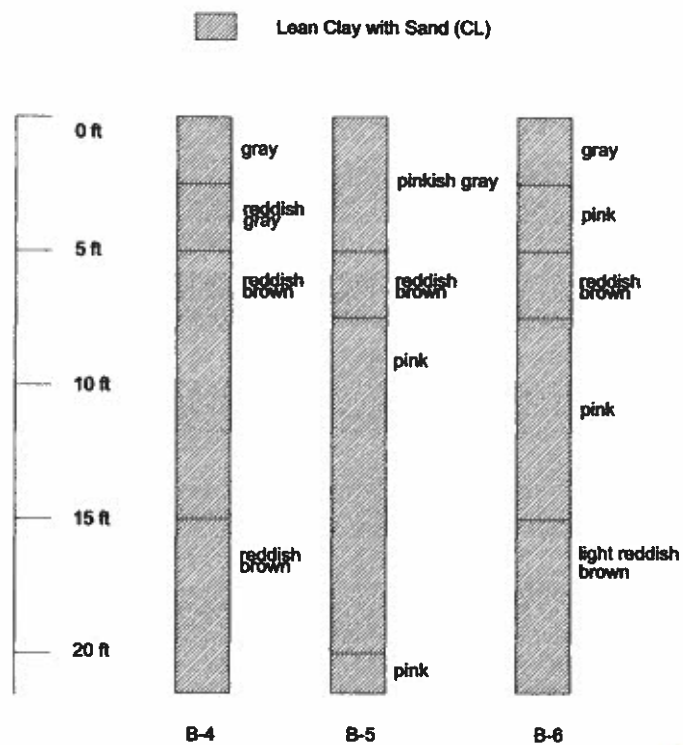


Figure 3. Boring Profile for B-4 to B-6

Figure 4 displays the boring log description found for test hole B-7, B-8 and B-9. Boring 7 and 8 is composed of lean clay with sand. While boring 9 contains lean clay with sand and fat clay with sand

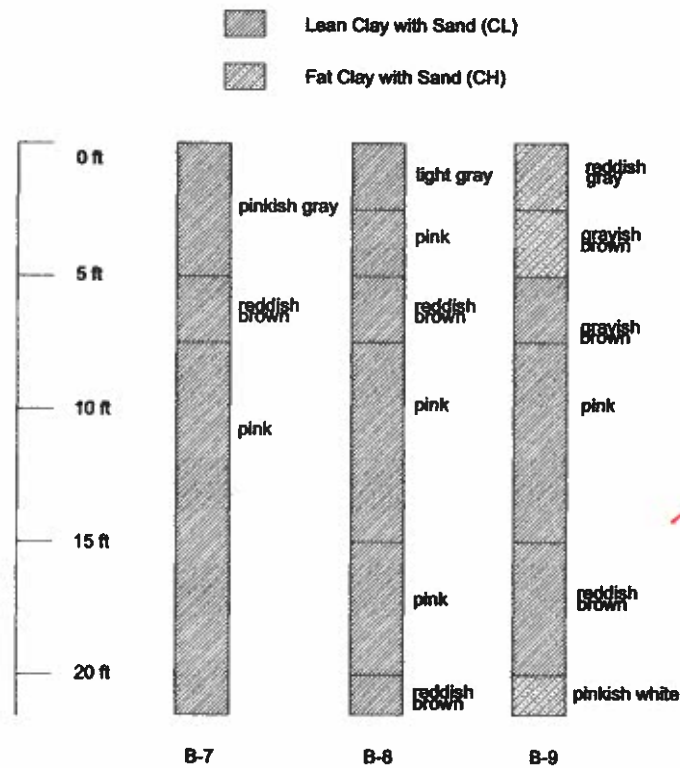


Figure 4. Boring Profile for B-7 to B-9

Figure 5 displays the boring log description found for test hole B-10, B-11 and B-12. All three borings are composed of lean clay with sand with different variations of color.

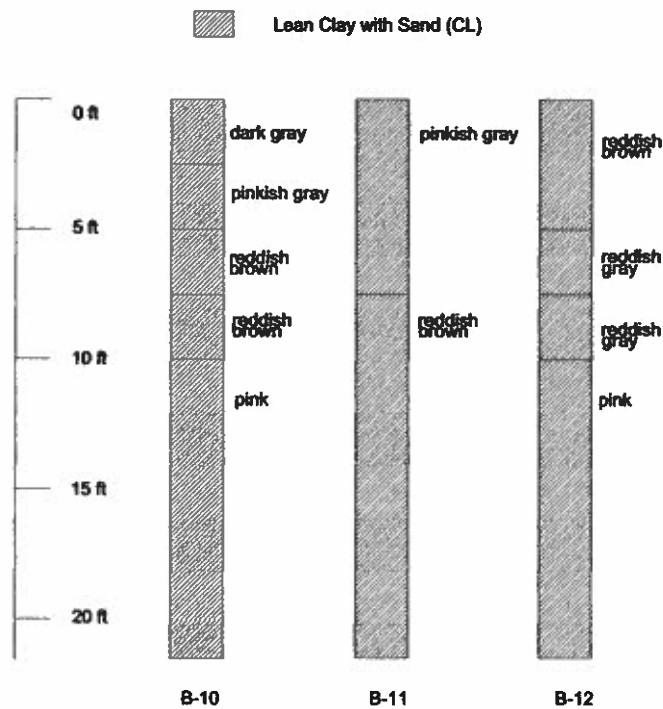


Figure 5. Boring Profile for B-10 to B-12

Figure 6 displays the boring log description found for test hole B-13, B-14 and B-15. Boring 13 is composed of lean clay with sand and clayey sand. While boring 14 contains lean clay with sand. Boring 15 is composed of lean clay with sand and fat clay with sand.

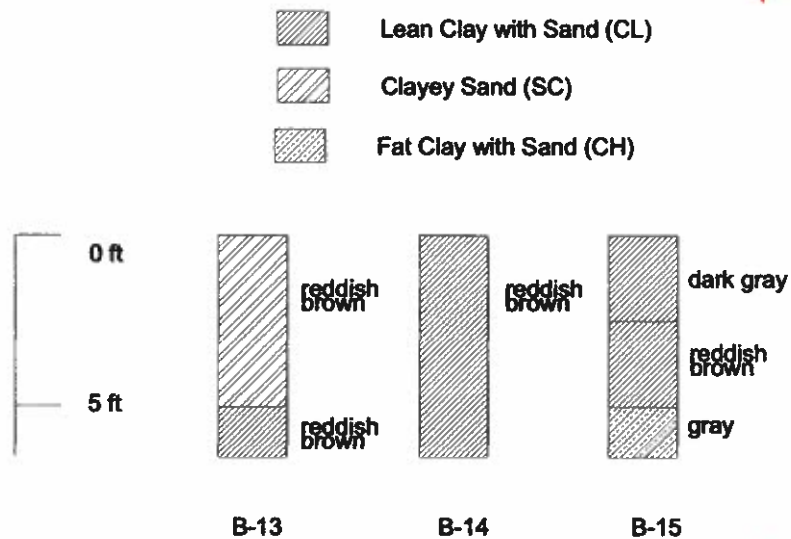


Figure 6. Boring Profile for B-13 to B-15

Figure 6 displays the boring log description found for test hole B-16, B-17 and B-18. Boring 16 is composed of lean clay with sand. While boring 17 and 18 contains lean clay with sand and clayey sand.

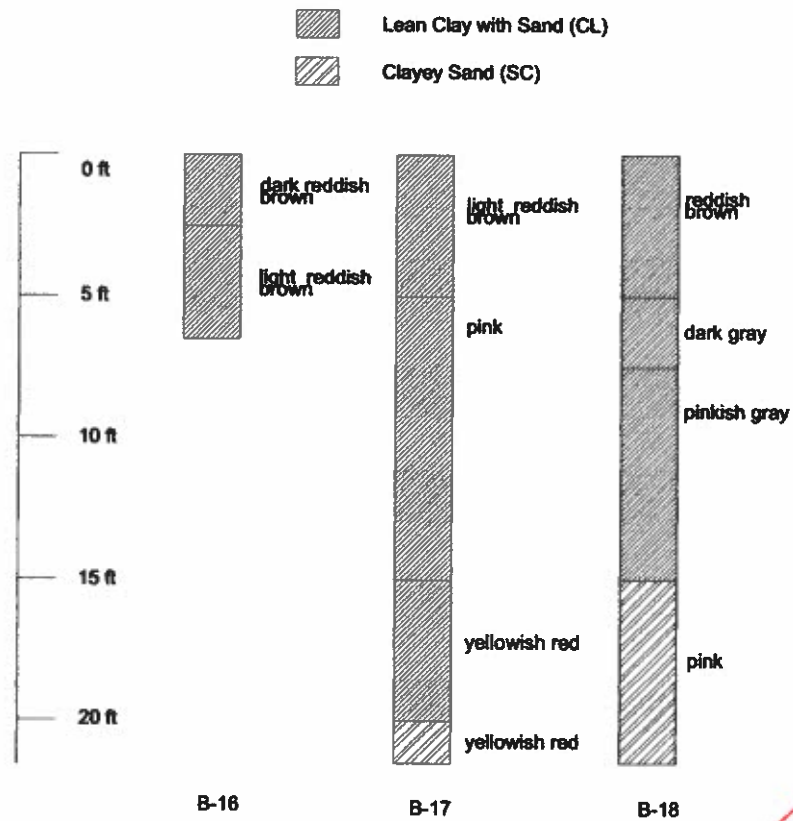


Figure 7. Boring Profile for B-16 to B-18

* you should provide the design parameter obtained from SPT in a tabular format for all borings!

Chapter 2: Foundation Design

2.1 Foundation Selection

The foundation type is chosen based on a number of variables. Majority of the selection process depends on the data that is collected from the boring analysis. Bearing capacity failure, settlement, soil quality, appropriate depth and strength, adverse soil changes, and seismic stresses are only a few of the issues. These elements work together to define the requirements for a long-term foundation design. To avoid frost damage, the foundation must first be deep enough. The foundation design must also meet all regulations to ensure that the foundation is safe from any potential failures. The structure should also be supported in the event of an earthquake or other natural calamity.

2.2 Soil Analysis

Based on all the boring logs the allowable bearing capacity was calculated based on boring log B-12. The standard penetration was found to be 33, with that value the dry unit weight was determined. The unit weight was calculated to be 134.86 lb/ft³. Using that value the effective stress was found as well as the blow count corrected to 60% of the theoretical free-fall hammer energy. From Table 24 for shear strength for cohesive soils, the cohesion (c') was determined to be 2000 psf. The friction angle (φ) was taken to be zero. No water table was found on any boring log therefore no consolidation settlement will occur.

2.3 Ultimate Bearing Capacity

Foundations must satisfy the bearing capacity with no failure in the surrounding soil. In addition, the settlement must be within tolerable limits. The Terzaghi's Bearing Capacity Theory for strip footing:

$$q_u = cN_c + qN_q + \left(\frac{1}{2}\right)BN_r \quad (1)$$

Where,

q_u = Ultimate Bearing Capacity

c = Cohesion of Soil

N_c, N_q, N_r = Terzaghi's Bearing Capacity Factors

B = Width of Square Footing

Ultimate bearing capacity of square foundations:

$$q_u = 1.3cN_c + qN_q + 0.4BN \quad (2)$$

In the Terzaghi's Bearing Capacity Theory equation, cohesion, friction and density are properties that are very important.

2.4 Allowable Bearing Capacity

The allowable bearing capacity is the load per unit area the foundation applies on the underlying soil.

$$q_{all} = q_u / FS \quad (3)$$

The Factor of Safety for shallow foundation ranges from the values 3 to 4. Allowable loading-bearing capacity of shallow foundations requires applying a factor of safety to the gross ultimate bearing capacity. The allowable bearing capacity for the spread footing was found to be 5906.5 lb/ft² for a 3ft by 3ft square. The continuous footing around the perimeter was found to be 4766.5 lb/ft². The allowable bearing capacity for the proposed parking lots was determined to be 5232.2 lb/ft².

did you check - structural load
50 ksf is okay with your design

$$Q_{design} > Q_{imposed} (50 ksf)$$

$$\uparrow$$

$$\boxed{Q_{all} = q_{all} \times A} \Rightarrow \underline{\underline{did it}}$$

(ok)

Chapter 3: Conclusion & Recommendation

3.1 Conclusion

Calculations were done using Terzaghi's bearing capacity factors, the unit weight and cohesiveness of the soil, and the depth of the soil to estimate the dimensions of the footing. Since boring logs were taken at separate points on the site and at varying depths at each location, the angle of friction found was influenced, which influenced Terzaghi's bearing capacity factors. This had an impact on the soil's unit weight. The cohesiveness of the soil was altered since the type of soil varied at each place where a boring log was collected, as well as at each depth. The ultimate bearing capacity would vary across the site as a result of these changing circumstances and the unknown dimensions of the square footing, affecting the permissible bearing capacity as well. As a result, having uniformly sized footings is the ideal option. Estimates were needed to estimate the dimensions of the footing that would be effective across the site. To begin, calculations were done for each depth of each boring log to calculate the eventual bearing capacity when a strip foundation was considered. As a result, the allowable bearing capacity for spread footing, continuous footing and parking lot. The square footing dimensions were determined to be 3ft by 3ft.



Calculations

Soil Analysis:

Based on B-12; $N = 33$

From Table 21: 30-50 SPT

$$\gamma_d = 18 \text{ kN/m}^3$$

$$\gamma_d = \frac{\gamma}{1+w}$$

$$18 = \frac{\gamma}{1 + 0.177}$$

$$\gamma = 21.186 \frac{\text{kN}}{\text{m}^3} = 134.86 \frac{\text{lb}}{\text{ft}^3}$$

$$\sigma = \gamma h = \left(134.86 \frac{\text{lb}}{\text{ft}^3} \right) (21.5 \text{ ft}) = 2899.5 \frac{\text{lb}}{\text{ft}^2}$$

$$C_N = \sqrt{\frac{2000}{2899.5}} = 0.83$$

$$N_{60} = N \times C_N = 33(0.83) = 27.4$$

Allowable Bearing Capacity:

Given:

$$c' = 2000 \text{ psf}$$

$$\theta = 0^\circ$$

$$N_c = 5.70$$

$$N_q = 1.0$$

$$N_y = 0$$

$$\gamma = 134.86 \text{ lb/ft}^3$$

$$q = \gamma \cdot D_f$$

$$q = (134.86 \text{ lb/ft}^3)(21.5 \text{ ft}) = 2899.49 \text{ lb/ft}^2$$

Spread Footing (Square)

$$q_u = 1.3c'N_c + qN_q + 0.4\gamma B N_y$$

$$q_u = (1.3)(2000 \text{ psf})(5.70) + (2899.49 \text{ psf})(1) + 0.4(134.86)(B)(0) = 17719.49 \text{ psf}$$

$$q_{all} = q_u / FS$$

$$q_{all} = 17719.49 / 3 = 5906.5 \text{ lb/ft}^2$$

$$q_{all} = Q / A$$

$$A = Q / q_{all}$$

$$B^2 = 50 \text{ kips} \cdot 1000 / 5906.5$$

$$B^2 = 8.465$$

$$B = 3 \text{ ft} \times 3 \text{ ft}$$

Continuous Footing

$$q_u = c'N_c + qN_q + 0.5\gamma BN_\gamma$$

$$q_u = (2000\text{psf})(5.70) + (2899.49\text{psf})(1)$$

$$q_u = 14299.49\text{psf}$$

$$q_{all} = q_u / FS$$

$$q_{all} = 14299.49 / 3 = 4766.5 \text{ psf}$$

Parking

$$q = \gamma \cdot D_f$$

$$q = (134.86 \text{ lb/ft}^2)(6.5 \text{ ft})$$

$$q = 876.59 \text{ lb/ft}^2$$

$$q_u = 1.3c'N_c + qN_q + 0.4\gamma BN_\gamma$$

$$q_u = (1.3)(2000\text{psf})(5.70) + (876.59\text{psf})(1)$$

$$q_u = 15696.6 \text{ psf}$$

$$q_{all} = q_u / FS$$

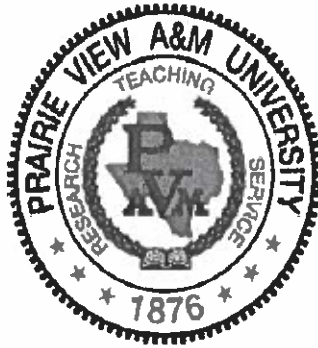
$$q_{all} = 15696.6 / 3 = 5232.2 \text{ psf}$$


Reference:

?

Geotechnical Foundation Design Project
Lubbock, TX
Project outline

88



CVEG 4100: Geotechnical Engineering Design
Fall 2021

Submitted by:
Paige Hines
Sydney Jones
Michael LeBlanc
Johnathon Chevalier

Submitted to:
Dr. Jobair Bin Alam

Prairie View A&M University
Roy G. Perry College of Engineering
Civil & Environmental Engineering Department



CVEG 4100: Geotechnical Engineering Design

Section: P81

Title: Geotech Project 1 Report

Submitted By: M.A.R.S Engineering

Abram Augustine, Alex Martinez, Caleb Ross, Nathaniel Smith

Submitted To: Dr. Alam, Md Jobair Bin Ph.D., P.E.

Due Date: October 13, 2021 NLT 10:00 A.M.

Fall 2019

ABET Criteria 3(c) and 3(i)

?

Letter of Transmittal

October 12, 2021

Dr. Jobair Bin Alam

Civil Engineering Department

Prairie View A&M University

Dear Dr. Alam,

This report describes a design for a project done by M.A.R.S. Engineering. The report contains the detailed analysis and recommendations for the building foundation and parking cross-section for the project "New K-12 School Petersburg ISD". The report contains a shallow foundation design best suited for the proposed building in Petersburg, Texas. All the information in the report was gathered from EIT's and engineers involved in the project. This report also consists of different sections that will analyze some differently significant parts of the project. Please feel free to contact our project manager if you have any questions or concerns regarding the report (857-342-0981).



Thank you,

M.A.R.S. Engineering

Abstract

The engineers of this project were tasked with providing a foundation type that best fit the proposed building in Lubbock, Texas. The buildings will be constructed with a conventional steel-framed building structural system. The building is anticipated to have a foundation that will consist of continuous footing around the building and spread footing under the isolated steel columns. The foundation of the project must be designed for bearing capacity and settlement. Comparing the different types of foundations will help decide if the selection and dimensions are both good fits for the project's structure.

Table of contents?

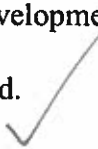
Introduction

The test that we will be conducting is the Standard Penetration Test (SPT). The Standard Penetration Test is a testing method that is used to determine the geotechnical properties of subsurface soils. The test compared to others is inexpensive and can estimate the density and shear strength parameters of soil accurately. The test uses a thick-walled sample tube, with an outside diameter of 50.8 mm and an inside diameter of 35 mm, and a length of around 650 mm. This is driven into the ground at the bottom of a borehole by blows from a slide hammer with a mass of 63.5 kg (140 lb) falling through a distance of 760 mm (30 in). The sample tube is driven 150 mm into the ground and then the number of blows needed for the tube to penetrate each 150 mm (6 in) up to a depth of 450 mm (18 in) is recorded. The sum of the number of blows required for the second and third 6 inches of penetration is termed the "standard penetration resistance" or the "N-value". In cases where 50 blows are insufficient to advance it through a 150 mm (6 in) interval the penetration after 50 blows are recorded. The blow count provides an indication of the density of the ground, and it is used in many empirical geotechnical engineering formulae. In regard to the N-value, it provides an indication of the density of subsurface soil. Using this, the approximate shear strength properties of the soils can be estimated for the project.

show figure, project location
site area.

Objective

The objective of this project was to prepare a comprehensive geotechnical investigation and to prepare a written report of the analysis and recommend a foundation that would best suit the building design for the proposed structure near Lubbock, Texas. The things that need to be done will be drilling soil borings at a depth of a minimum of 0 to 20 feet below the existing grades within the proposed development area and laboratory testing and preparation of an engineering report will be conducted.



Geotechnical Engineering

Criteria

The contents within this report presents-

- Soil boring information and sub-surface soil conditions
- Detail soil information and design soil parameters
- Design of foundation for both bearing capacity and settlement consideration.
- Recommendation of best shallow foundation system providing all details, calculations, and reasons for decision.
- Detail of foundation in CAD Drawing

New K-12 School Petersburg Description

The project contains samples of 18 soil borings, B-1 through B-18, with depths around 21.5 ft and 6.5 ft below the ground surface. The boreholes were drilled by a CME 75 Hollow stem auger following the ASTM procedures. The samples from the project site were taken to a lab and the samples that were selected were tested to analyze material properties

Texas Cone Penetration tests (TxDOT Designation Tex-132-E) were performed in accordance with TxDOT geotechnical manual 2016, in the borings at approximately 5-foot intervals.

Laboratory testing was accomplished generally in accordance with ASTM procedures and performed on selected samples to evaluate the classification, strength and other engineering characteristics of the subsurface materials. The tests on the selected samples included:

- Moisture Content (ASTM D 2216)

- Unit Weight (ASTM D 2937)
- Atterberg Limits (ASTM D 4318)
- Percent Passing No. 200 Sieve (ASTM D 1140)
- Unconfined Compression (ASTM D 2166)
- Triaxial Shear Strength (ASTM D 2850)
- One Dimensional Consolidation (ASTM D 2435)



Table 3.1a – New K-12 School Petersburg Subsurface Profile for B-1 through B-18

table title should be on the page
where the tables are.

	Depth (ft.)	N	Stress (σ')	CN	N60	Soil Classification
Boring 1	0	18	0	-	-	Sandy Lean Clay
	2.5	18	287.5	2.637521894	47.47539408	Sandy Lean Clay
	5	35	575	1.865009616	65.27533658	Lean Clay with Sand, Pink
	7.5	13	862.5	1.522773975	19.79606168	Lean Clay with Sand, Light Reddish Brown
	10	34	1150	1.318760947	44.83787219	Lean Clay with Sand, Light Reddish Brown
	15	41	1725	1.076763804	44.14731597	Lean Clay with Sand, Light Reddish Brown
	20	53	2300	0.9325048082	49.42275484	Sandy Lean Clay (SC), Light Reddish Brown
Boring 2	0	13	0	-	-	Lean Clay with Sand (CL), reddish gray
	2.5	18	287.5	2.637521894	47.47539408	CL, reddish brown
	5	16	575	1.865009616	29.84015386	CL, pink
	7.5	18	862.5	1.522773975	27.40993155	Sandy Lean Clay (CL), pink
	10	39	1150	1.318760947	51.43167692	Sandy Lean Clay (CL), light reddish brown
	15	39	1725	1.076763804	41.99378836	Sandy Lean Clay (CL), light reddish brown
	20	60	2300	0.9325048082	55.95028849	Sandy Lean Clay (CL), light reddish brown
Boring 3	0	10	0	-	-	Sandy Lean Clay (CL), gray
	2.5	9	287.5	2.637521894	23.73769704	CL, very dark gray
	5	9	575	1.865009616	16.78508655	Lean Clay with Sand (CL), Pink
	7.5	13	862.5	1.522773975	19.79606168	Lean Clay with Sand (CL), Pink
	10	28	1150	1.318760947	36.92530651	Lean Clay with Sand (CL), Pink
	15	33	1725	1.076763804	35.53320554	CL, light reddish brown
	20	54	2300	0.9325048082	50.35525964	Sandy Lean Clay (CL), light reddish brown
Boring 4	0	10	0	-	-	Lean Clay with Sand (CL), gray
	2.5	15	287.5	2.637521894	39.5628284	CL, reddish gray
	5	14	575	1.865009616	26.11013463	CL, reddish brown
	7.5	10	862.5	1.522773975	15.22773975	CL, reddish brown
	10	15	1150	1.318760947	19.7814142	CL, reddish brown
	15	34	1725	1.076763804	36.60996934	Sandy Lean Clay
	20	36	2300	0.9325048082	33.5701731	Sandy Lean Clay
Boring 5	0	18	0	-	-	Lean Clay with Sand (CL), pinkish gray
	2.5	14	287.5	2.637521894	36.92530651	Lean Clay with Sand (CL), pinkish gray
	5	30	575	1.865009616	55.95028849	CL, reddish brown
	7.5	26	862.5	1.522773975	39.59212336	CL, pink
	10	20	1150	1.318760947	26.37521894	CL, pink
	15	56	1725	1.076763804	60.29877303	CL, pink
	20	21	2300	0.9325048082	19.58260097	Sandy Lean Clay
Boring 6	0	8	0	-	-	Sandy Lean Clay (CL), gray
	2.5	17	287.5	2.637521894	44.83787219	CL, pink
	5	13	575	1.865009616	24.24512501	CL, reddish brown
	7.5	8	862.5	1.522773975	12.1821918	Lean Clay with Sand (CL), pink
	10	13	1150	1.318760947	17.14389231	Lean Clay with Sand (CL), pink
	15	18	1725	1.076763804	19.38174847	Sandy Lean Clay
	20	39	2300	0.9325048082	36.36768752	Sandy Lean Clay

Boring 8	0	9	0	-	-	Sandy Lean Clay (CL), light gray
	2.5	16	287.5	2.637521894	42.2003503	CL, pink
	5	11	575	1.865009616	20.51510578	CL, reddish brown
	7.5	10	862.5	1.522773975	15.22773975	Lean Clay with Sand (CL), pink
	10	9	1150	1.318760947	11.86884852	Lean Clay with Sand (CL), pink
	15	27	1725	1.076763804	29.07262271	Sandy Lean Clay (CL), pink
	20	25	2300	0.9325048082	23.31262021	CL, reddish brown
Boring 9	0	12	0	-	-	Fat Clay with Sand (CH), reddish gray
	2.5	13	287.5	2.637521894	34.28778462	CH, grayish brown
	5	18	575	1.865009616	33.5701731	Lean Clay with Sand (CL), grayish brown
	7.5	29	862.5	1.522773975	44.16044528	CL, pink
	10	24	1150	1.318760947	31.65026272	CL, pink
	15	96	1725	1.076763804	103.3693252	CL, reddish brown
	20	53	2300	0.9325048082	49.42275484	Sandy Fat Clay (CH), pinkish white

	Depth (ft.)	N	Stress (σ')	CN	N60	Soil Classification
Boring 10	0	10	0	-	-	Lean Clay with Sand (CL), very dark gray
	2.5	7	287.5	2.637521894	18.46265326	CL, pinkish gray
	5	14	575	1.865009616	26.11013463	CL, reddish brown
	7.5	31	862.5	1.522773975	47.20599323	Sandy Lean Clay (CL), reddish brown
	10	28	1150	1.318760947	36.92530651	CL, pink
	15	54	1725	1.076763804	58.14524542	CL, pink
	20	69	2300	0.9325048082	64.34283177	CL, pink

Boring 11	0	14	0	-	-	Lean Clay with Sand (CL), pinkish gray
	2.5	13	287.5	2.637521894	34.28778462	Lean Clay with Sand (CL), pinkish gray
	5	18	575	1.865009616	33.5701731	Lean Clay with Sand (CL), pinkish gray
	7.5	35	862.5	1.522773975	53.29708913	CL, reddish brown
	10	40	1150	1.318760947	52.75043787	CL, reddish brown
	15	57	1725	1.076763804	61.37553683	CL, reddish brown
	20	59	2300	0.9325048082	55.01778369	CL, reddish brown

Boring 12	0	3	0	-	-	Lean Clay with Sand (CL), reddish brown
	2.5	9	287.5	2.637521894	23.73769704	Lean Clay with Sand (CL), reddish brown
	5	7	575	1.865009616	13.05506732	CL, reddish gray
	7.5	7	862.5	1.522773975	10.65941783	Sandy Lean Clay (CL), reddish gray
	10	25	1150	1.318760947	32.96902367	CL, pink
	15	29	1725	1.076763804	31.22615032	CL, pink
	20	33	2300	0.9325048082	30.77265867	CL, pink

Boring 13	0	11	0	-	-	Clayey Sand (SC), reddish brown
	2.5	14	287.5	2.637521894	36.92530651	Clayey Sand (SC), reddish brown
	5	25	575	1.865009616	46.62524041	Lean Clay with Sand (CL), reddish brown

Boring 14	0	8	0	-	-	Lean Clay with Sand (CL), reddish brown
	2.5	8	287.5	2.637521894	21.10017515	Lean Clay with Sand (CL), reddish brown
	5	25	575	1.865009616	46.62524041	Lean Clay with Sand (CL), reddish brown

Boring 15	0	13	0	-	-	Sandy Lean Clay (CL), very dark gray
	2.5	21	287.5	2.637521894	55.38795977	CL, reddish brown
	5	36	575	1.865009616	67.14034619	Fat Clay with Sand (CH), gray

Boring 16	0	14	0	-	-	Lean Clay with Sand (CL), dark reddish brown
	2.5	8	287.5	2.637521894	21.10017515	CL, light reddish brown
	5	19	575	1.865009616	35.43518271	CL, light reddish brown

Boring 17	0	10	0	-	-	Lean Clay with Sand (CL), light reddish brown
	2.5	5	287.5	2.637521894	13.18760947	Lean Clay with Sand (CL), light reddish brown
	5	13	575	1.865009616	24.24512501	CL, pink
	7.5	17	862.5	1.522773975	25.88715758	CL, pink
	10	23	1150	1.318760947	30.33150178	CL, pink
	15	30	1725	1.076763804	32.30291412	CL, yellowish red
	20	50	2300	0.9325048082	46.62524041	Sandy Lean Clay (CL), yellowish red

Boring 18	0	3	0	-	-	Sandy Lean Clay (CL), reddish brown
	2.5	8	287.5	2.637521894	21.10017515	Sandy Lean Clay (CL), reddish brown
	5	14	575	1.865009616	26.11013463	CL, dark gray
	7.5	13	862.5	1.522773975	19.79606168	CL, pinkish gray
	10	4	1150	1.318760947	5.275043787	CL, pinkish gray
	15	32	1725	1.076763804	34.45644173	Clayey Sand (SC), pink
	20	54	2300	0.9325048082	50.35525964	Clayey Sand (SC), pink

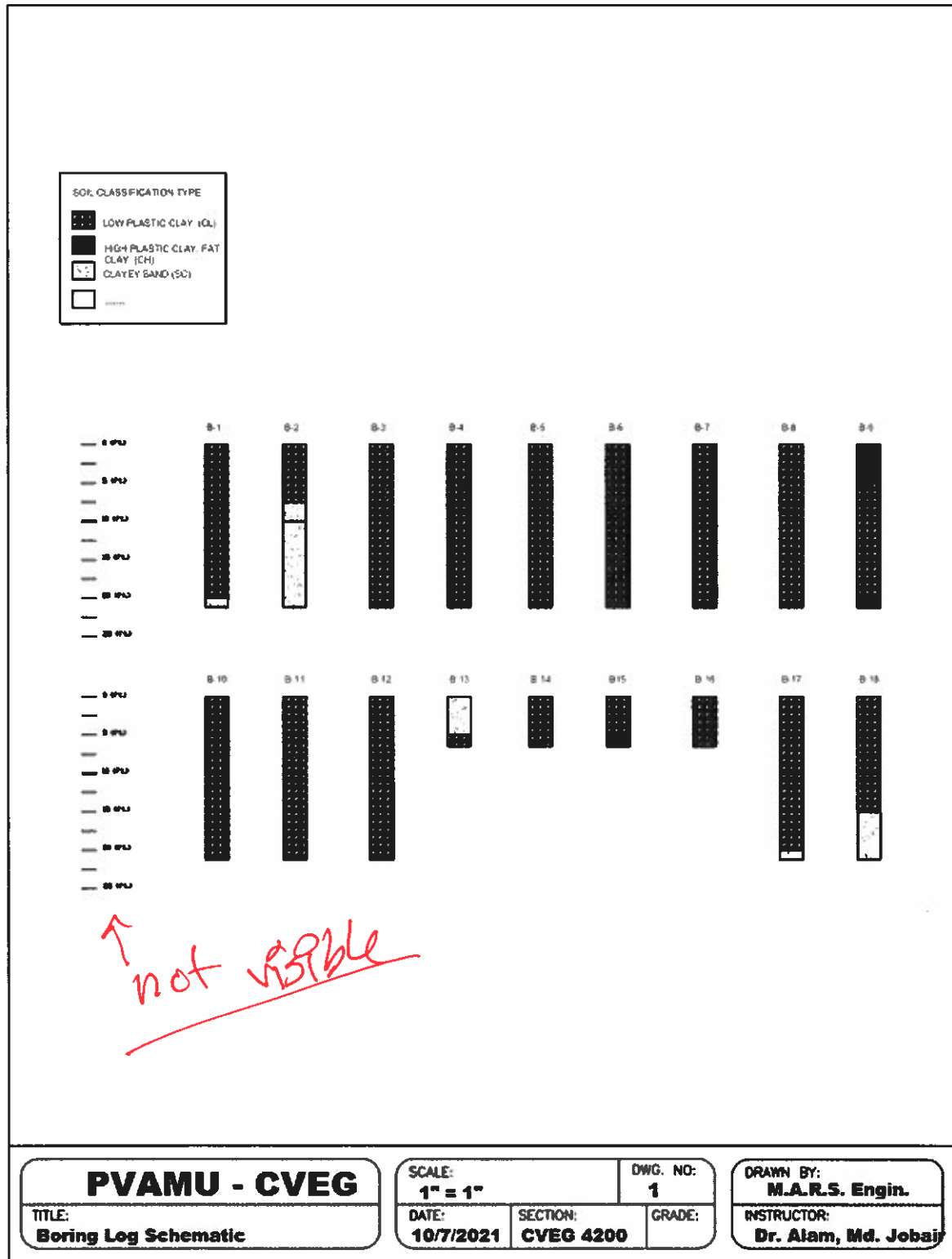


Figure 3.1c: Boring Log Schematic

3.1.4 Site and Subsurface Conditions

Site Location and Description

At the time of exploration activities, the site was existing and was generally level and exhibiting.

3.1.3 Groundwater Information

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↓ must be consistent

The level of the groundwater was not observed in the boring log process during the time when the drilling operations were. It can be inferred that the groundwater levels were supposed to be recorded during the time of the drilling and upon completion of the drilling. It can also be inferred that fluctuations in the groundwater level could be affected by natural variations such as rainfall, temperature, humidity, etc.. Also, perched water could be encountered in discontinuous zones within the overburden. The groundwater levels presented in this report, assuming that any are present, are the levels that were measured during the time of our field activities. One recommendation would be to determine the actual levels of groundwater at the location of the site during the time of the construction activities to determine the impact on the construction process.

Environmental Site Assessment

The Environmental Site Assessment or ESA is usually considered to be the first step in buying a piece of land. Before a piece of land can be purchased, the owner must assure himself/herself that the future development of the land would even be feasible given the present soil conditions. In order to move forward in development, geotechnical engineers would be hired to check and analyze the soil. They would do so through preliminary borings in order to make sure that the soil is able to withstand the development process. This is why many institutions often require a Phase I ESA to be conducted. Conducting an ESA lifts some of the responsibility off of the land buyer/owner when it comes to their land quality and provides them with a confirmation that their land is suitable or not.

Standards for Performing a Phase I Site Assessment have been created by the EPA. These standards include:

- Researching the history of the facility, the soil type, and ground and surface water
- Evaluating the storage, handling, treatment, and disposal of the materials and the waste
- Investigating the site for any evidence of underground storage tanks or spills

3.2.1. Foundation Design

1.) Selection of Foundation

The appropriate foundation is selected for each selected facility based on certain factors. It is important to recognize the foundation type based on adequate and meaningful data from subsurface exploration

Selection of Foundation Type

The selection of a specific type of foundation is based on the following factors below:

Adequate Depth: the foundation must have an adequate depth to prevent frost damage. For other foundations like bridge piers, the foundation depth must be adequate in order to prevent damage by scour.

Adequate Strength: The foundation must be designed with adequate strength so that it does not fracture or break apart due to the applied loads of the structure. The foundation must also be designed and constructed properly with the design specifications taken into account.

Adverse Soil Changes: The soil foundation must be able to resist long term adverse changes.

Bearing Capacity Failure: The soil foundation must be safe against a bearing capacity failure.

Seismic Forces: The soil foundation must be able to support the structure on top of it during the time of an earthquake without excessive lateral or settlement movement.

Settlement: The soil foundation must not settle to a point that it damages the structure.

Quality: The foundation must be of an adequate quality so that it is not subjected to deterioration.

Soil Bearing Capacity

Terzaghi theorized that the soil underneath the footing would generate a triangle of pressure. The bearing capacity of the soil is developed in a footing due to three properties of soil:

1. Cohesion

2. Friction ✓

3. Density ✓

The terms used in the Terzaghi bearing capacity equation are the ultimate bearing capacity, the cohesion term, the surcharge term, and the density term. The ultimate bearing capacity (q_{ult}) of a foundation is the load beyond which a foundation would fail and no longer be useful. Cohesion (c) is a chemical process. Clay particles tend to adhere to each other due to electrical charges present in clay particles. Unlike cohesion, friction is a physical process. The higher the friction between particles, the higher the capacity of the soil to carry footing loads. Usually, sands and silts inherit friction. For all practical purposes, clays are considered to be friction-free. The friction of a soil is represented by the friction angle $= 0$; where B is the width of the footing, and the angle of the soil pressure triangle is given by the **ultimate bearing capacity**.

Ultimate Bearing Capacity

The Ultimate Bearing Capacity is calculated by using the Terzaghi Bearing Capacity factors which depend on the internal angle of friction of the soil. Ultimate Bearing Capacity (q_{ult}) for a square footing with a width B is calculated as,

$$Q_{ult} = 1.3cN_c + Y_1 D_f N_q + 0.4 Y_2 B N_\gamma$$

↳ q_u

$q = \text{pressure}$
 $Q = \text{load}$

Where,

Q_{ult} = Ultimate bearing capacity ✓

C = cohesion of soil

N_c, N_q, N_γ = Terzaghi's bearing capacity factors ✓

γ_1 = effective unit weight of soil above soil of foundation

γ_2 = effective unit weight of soil below foundation

D_f = depth of footing, or distance from ground surface to base of footing

B = width of square footing

Given:

$$\gamma_1 = 125 \text{ lb/ft}^3$$

$$\gamma_2 = 125 \text{ lb/ft}^3$$

$$D = 21.5 \text{ ft}$$

$$C = 1000 \text{ lb/ft}^2 \text{ for clay. Friction angle} = 0$$

Ultimate bearing capacity is therefore,

$$Q_{ult} = 1.3cN_c + \gamma_1 D_f N_q + 0.4\gamma_2 B N_\gamma$$

$$\begin{aligned} C &= 1.3 (1000) (5.7) + 125 \text{ lb/ft}^3 (21.5) (1) \\ q &= 10,097.5 \text{ lb/ft}^2 \end{aligned}$$

Parking lot (shallow foundation)

$$Q_{ult} = 1.3cN_c + \gamma_1 D_f N_q + 0.4\gamma_2 B N_\gamma$$

$$\begin{aligned} C &= 1.3 (1000) (5.7) + 125 \text{ lb/ft}^3 (6.5) (1) \\ q &= 8222.5 \text{ lb/ft}^2 \end{aligned}$$

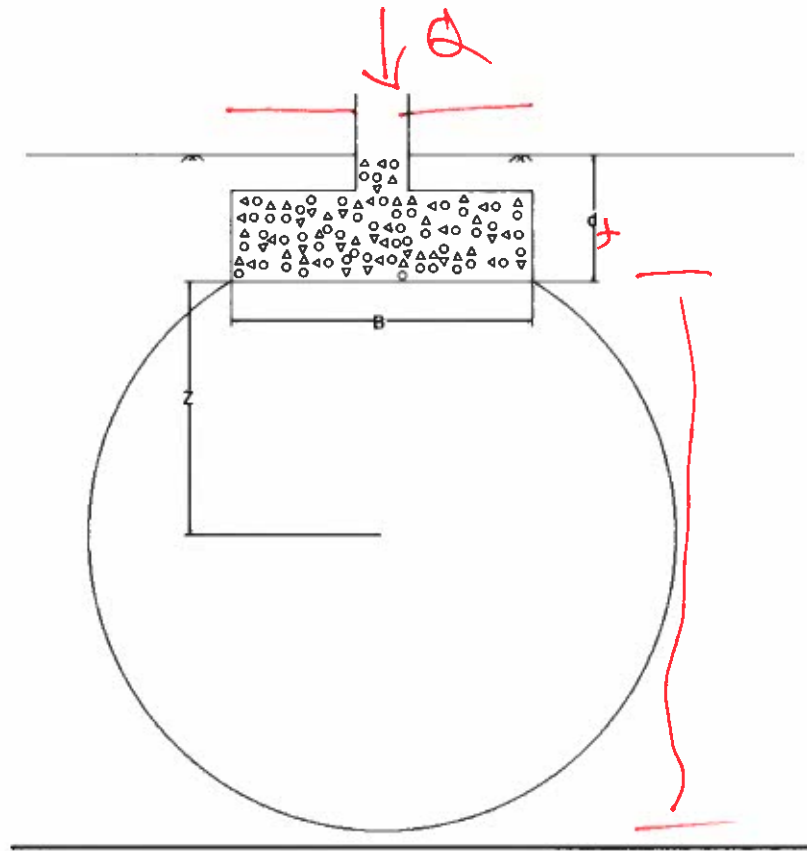


Figure 3.1d: Ultimate Bearing Capacity

Allowable Bearing Capacity

Allowable bearing capacity (q_a) refers to the loading per unit area that the soil is able to support without unsafe movement. It is also referred to as the design bearing capacity. A factor of safety of 2.5 to 3 is commonly applied to the value of q_{ult} . Care must be taken to ensure that a footing design is safe with regard to:

1. Foundation failure (collapse)
2. Excessive settlement

Allowable Bearing Capacity:

$$Q_a = q_{ult} / 3$$

$$Q_a = 3,365.83 \text{ lb./ft}^2$$

$$Q_a = 2740.83 \text{ lb/ft}^2$$

The allowable bearing capacity of the soil is determined to be 4.08 ksf for a 3.5ft by 3.5ft footing. This value will be used in ensuing foundation designs of compactness of the soils.

Primary Consolidation Settlement

Because there is no water, there is no consolidation settlement.

Results & Discussion

In order to determine the dimensions of the footing, the ultimate bearing capacity has to be calculated using the Terzaghi's bearing capacity factors, which depend on the internal angle of friction of the soil. To get the Ultimate Bearing Capacity the unit weight, cohesion of the soil, and the depth of the soil are needed to be known. When boring logs are taken at various locations on the site at different depths the angle of friction determined can be affected. If the angle of friction is affected, the Terzaghi's bearing capacity factors are affected too. When the type of soil is different at each point where a boring log was taken this also affects the unit weight of the soil and the cohesion of the soil. Since dimension of the footing and other things are not known, the

ultimate bearing capacity would not be consistent throughout the project. This would also change the allowable bearing capacity as well. Having footing with uniform dimensions would be more efficient and effective; but In order to determine the dimensions of the footing that would be effective across the site, calculations are needed to be done. Calculations were made for each depth of each boring log to determine the ultimate bearing capacity for a strip foundation. Based on this calculation, the lowest ultimate bearing capacity was taken to overestimate our ultimate bearing capacity. Based on this, the dimensions of a foundation is determined.

Conclusion

In conclusion, this group was able to learn various processes in the field of geotechnical engineering. The objective of the Geotechnical Group was to explore the subsurface conditions at this site to facilitate foundation design for the proposed structures and then provide general recommendations for the new existing building for Lubbock, Texas. scope of services included drilling soil borings to depths of 0 to 20 feet below the existing grades within the proposed development area, laboratory testing and preparation of an engineering report. All in all, this group was able to successfully apply geotechnical engineering practices to this project.

Reference!

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Letter of Transmittal

October 13, 2021

Dr. Jobair Bin Alam, P.E.
Civil Engineering Department
Prairie View A&M University

Dear Dr. Alam,

The "New K-12 School Petersburg" findings are documented in the accompanying technical report. The study includes a structural layout that is best suited for a structure in Lubbock, Texas. The report's data was compiled from each and every engineer in the company. The theoretical, hypothesis, venture rundown, and supplement are all included in this report. If you have any questions or issues about the report, please don't hesitate to contact our task director Paige Hines at 808-471-2659 or hines_paige@yahoo.com.

Sincerely,
Paige Hines

Abstract

The engineers on this technical paper were charged with recommending a foundation type for a planned building in Lubbock, Texas. Steel frames are used to construct the structure and the facility's foundation must be built for bearing capacity as well as settling. The information was gathered and briefly examined to determine the benefits and drawbacks of various types of foundations and to justify their choice. ✓

table of content?

Introduction

The Standard Penetration Test (SPT) is a testing method for determining subsurface soil geotechnical characteristics. This test is cheap and can correctly determine the density and shear strength characteristics of soil. A conventional, thick-walled sample tube is driven into the earth at the bottom of a borehole to conduct this test. This is accomplished by strikes from a slide hammer mechanism with a specific weight and fall distance. The example tube is pushed 150 mm (6 in.) into the ground for this circumstance, after which the number of blows necessary for the cylinder to enter the soil each 150 mm up to a depth of 18 in (450 mm). Following this, the total number of blows required for the second and third 6 crawls of penetration is recorded as the SPT blow count. The standard penetration obstruction, often known as the N-value, is what this is referred to as. In terms of the N-value, it indicates the density of subsurface soil. The soils' estimated shear strength characteristics may be evaluated using this method.

Objective

The Geotechnical Group's goal was to examine the subsurface characteristics at this location in order to promote foundation plans for the planned buildings and then provide general recommendations for the new existing construction in Lubbock, Texas. Penetrating soil boring to depths of 0 to 20 feet under present assessments inside the projected advancement zone, lab testing, and the creation of an engineer designing report were among the services provided.

3.2.1. Geotechnical Engineering

Criteria

This report briefly presents available project information, outlines the testing procedures, describes the site and subsurface conditions, and presents the following:

1. Description of subsurface conditions and groundwater information
2. Boring logs and laboratory test results
3. Discussion of grading for the site and calculation of cut and fill
4. Site preparation recommendations including structural fill placement and compaction
5. Lateral earth pressure parameters
6. Recommendations for foundations and estimated settlement
7. Discussions of the factors impacting construction and performance of the proposed construction

3.1 New K-12 School Petersburg Description

Eighteen 2 soil borings, B-01 through B-18, were tested to depths of roughly 21.5 feet and 6.5 feet (B-13-B-16) below the existing ground surface during the field research. The borings were drilled with a track-mounted CME 75 boring rig and a Hollow stem drill, all in accordance with ASTM standards. Texas Cone Penetration Tests (TxDOT Designation Tex-132-E) were carried out in the borings at 5-foot intervals, as per the TxDOT geotechnical handbook 2016. The soil samples collected during the field inquiry were transported to the research center, where they were tested to determine material characteristics for evaluation.

Laboratory testing was carried out on chosen samples in line with ASTM standards to assess the subsurface materials' classification, strength, and other engineering properties. The following tests were carried out on the chosen samples:

- Moisture Content (ASTM D 2216)
- Unit Weight (ASTM D 2937)
- Atterberg Limits (ASTM D 4318)
- Percent Passing No. 200 Sieve (ASTM D 1140)
- Unconfined Compression (ASTM D 2166)
- Triaxial Shear Strength (ASTM D 2850)
- One Dimensional Consolidation (ASTM D 2435)

3.1 New K-12 School Petersburg Table Description

Table 3.1a – New K-12 School Petersburg Subsurface Profile for B-1

Test Hole #1 Soil Classification									
Depth (ft)	Liquid Limit	Plastic Limit	Plastic Index	Sieve Analysis (#200)	Coarse Fraction	Water Content	Group Name	Classification	
0 - 5	38	15	23	66.7%	33%	11.0%	CL	Sandy lean Clay (Dark Gary)	
5 - 7.5	35	14	21	74.1%	26%	13.8%	CL	Lean Clay with Sand (Pink)	
7.5 - 20	41	13	28	77.1%	23%	15.5%	CL	Lean Clay with Sand (Light reddish brown)	
20 - 21.5	34	13	21	60.6%	39%	17.5%	CH	Sandy lean Clay (Light reddish brown)	

Table 3.1b – New K-12 School Petersburg Subsurface Profile for B-2

Test Hole #2 Soil Classification									
Depth (ft)	Liquid Limit	Plastic Limit	Plastic Index	Sieve Analysis (#200)	Coarse Fraction	Water Content	Group Name	Classification	
0 - 7.5	41	12	29	75.4%	25%	15.9%	CL	Lean Clay with Sand (Reddish gray)	
7.5 - 10	34	15	19	67.7%	32%	14.5%	SC	Sandy lean Clay (Pink)	
10 - 21.5	41	17	24	64.5%	36%	17.0%	SC	Sandy lean Clay (Light Reddish Brown)	

Table 3.1c -- New K-12 School Petersburg Subsurface Profile for B-3

Test Hole #3 Soil Classification									
Depth (ft)	Liquid Limit	Plastic Limit	Plastic Index	Sieve Analysis (#200)	Coarse Fraction	Water Content	Group Name	Classification	
0 - 5	45	16	29	62.7%	37%	17.8%	CL	Sandy lean Clay (Gray)	
(5 - 15)	42	17	25	73.4%	27%	15.6%	CL	Lean Clay with Sand (Pink)	
20 - 21.5	35	16	19	56.7%	43%	15.8%	CL	Sandy lean Clay (Light Reddish Brown)	

Table 3.1d-- New K-12 School Petersburg Subsurface Profile for B-4

Test Hole #4 Soil Classification									
Depth (ft)	Liquid Limit	Plastic Limit	Plastic Index	Sieve Analysis (#200)	Coarse Fraction	Water Content	Group Name	Classification	
0 - 5	37	15	22	75%	25%	14%	CL	Lean clay with Sand (Gray)	
(5 - 15)	33	12	21	71%	29%	16%	CL	Lean clay with Sand (Reddish Brown)	
15 - 21.5	37	14	23	59%	42%	16%	CL	Sandy Lean Clay (Reddish Brown)	

Table 3.1e- New K-12 School Petersburg Subsurface Profile for B-5

Test Hole #5 Soil Classification										
Depth (ft)	Liquid Limit	Plastic Limit	Plastic Index	Sieve Analysis (#200)	Coarse Fraction	Water Content	Group Name	Classification		
0 - 7.5	36	13	23	70%	30%	13%	CL	Lean Clay with Sand		
7.5 - 20	38	15	23	81%	19%	12%	CL	Sandy lean Clay		
20 - 21.5	33	15	18	70%	30%	15%	CL	Sandy lean Clay		

Table 3.1f- New K-12 School Petersburg Subsurface Profile for B-6

Test Hole #6 Soil Classification										
Depth (ft)	Liquid Limit	Plastic Limit	Plastic Index	Sieve Analysis (#200)	Coarse Fraction	Water Content	Group Name	Classification		
0 - 7.5	37	14	23	66%	34%	18%	CL	Sandy Lean Clay (Pink)		
7.5 - 15	32	14	18	76%	24%	17%	CL	Lean Clay with Sand (Pink)		
15 - 21.5	39	15	24	68%	32%	20%	CL	Sandy Lean Clay (light reddish brown)		

Table 3.1g – New K-12 School Petersburg Subsurface Profile for B-7

Test Hole #7 Soil Classification									
Depth (ft)	Liquid Limit	Plastic Limit	Plastic Index	Sieve Analysis (#200)	Coarse Fraction	Water Content	Group Name	Classification	
0 - 7.5	36	16	20	69%	32%	12%	CL	Sandy lean Clay	
7.5 - 21.5	39	13	26	59%	41%	15%	CL	Sandy lean Clay	

Table 3.1h– New K-12 School Petersburg Subsurface Profile for B-8

Test Hole #8 Soil Classification									
Depth (ft)	Liquid Limit	Plastic Limit	Plastic Index	Sieve Analysis (#200)	Coarse Fraction	Water Content	Group Name	Classification	
0 - 7.5	35	15	20	66%	34%	18%	CL	Sandy Lean Clay	
7.5 - 15	29	16	13	79%	21%	20%	CL	Sandy Lean Clay	
15 - 21.5	47	14	33	59%	41%	14%	CL	Sandy Lean Clay	

Table 3.1i– New K-12 School Petersburg Subsurface Profile for B-9

<u>Test Hole #9 Soil Classification</u>									
<u>Depth</u> <u>(ft)</u>	<u>Liquid</u> <u>Limit</u>	<u>Plastic</u> <u>Limit</u>	<u>Plastic</u> <u>Index</u>	<u>Sieve</u> <u>Analysis</u> <u>(#200)</u>	<u>Coarse</u> <u>Fraction</u>	<u>Water</u> <u>Content</u>	<u>Group</u> <u>Name</u>	<u>Classification</u>	
<u>0 - 5</u>	<u>51</u>	<u>17</u>	<u>34</u>	<u>73%</u>	<u>27%</u>	<u>11%</u>	<u>CH</u>	<u>Fat Clay with</u> <u>Sand</u>	
<u>5 - 7.5</u>	<u>45</u>	<u>14</u>	<u>31</u>	<u>73%</u>	<u>27%</u>	<u>12%</u>	<u>CL</u>	<u>Lean Clay with</u> <u>Sand</u>	
<u>7.5 -</u> <u>20</u>	<u>38</u>	<u>12</u>	<u>26</u>	<u>74%</u>	<u>26%</u>	<u>11%</u>	<u>CL</u>	<u>Lean Clay with</u> <u>Sand</u>	
<u>20 -</u> <u>21.5</u>	<u>55</u>	<u>15</u>	<u>40</u>	<u>70%</u>	<u>30%</u>	<u>17%</u>	<u>CH</u>	<u>Sandy Fat Clay</u>	

Table 3.1j – New K-12 School Petersburg Subsurface Profile for B-10

<u>Test Hole #10 Soil Classification</u>									
<u>Depth</u>	<u>Liquid Limit</u>	<u>Plastic Limit</u>	<u>Plastic Index</u>	<u>Sieve Analysis (#200)</u>	<u>Coarse Fraction</u>	<u>Water Content</u>	<u>Group Name</u>	<u>Classification</u>	
0 - 7.5	43	16	27	71%	29%	13%	CL	Lean Clay with Sand	
7.5 - 1.5	39	14	25	67%	33%	12%	CL	Sandy Lean Clay	

Table 3.1k – New K-12 School Petersburg Subsurface Profile for B-11

<u>Test Hole #11 Soil Classification</u>									
<u>Depth (ft)</u>	<u>Liquid Limit</u>	<u>Plastic Limit</u>	<u>Plastic Index</u>	<u>Sieve Analysis (#200)</u>	<u>Coarse Fraction</u>	<u>Water Content</u>	<u>Group Name</u>	<u>Classification</u>	
0 - 7.5	31	12	19	69%	31%	13%	CL	Lean Clay with Sand	
7.5 - 20	43	13	30	71%	29%	10%	CL	Lean Clay with Sand	
20 - 21.5	52	21	31	77%	23%	21%	CH	Fat Clay	

Table 3.11– New K-12 School Petersburg Subsurface Profile for B-12

Test Hole #12 Soil Classification									
Depth (ft)	Liquid Limit	Plastic Limit	Plastic Index	Sieve Analysis (#200)	Coarse Fraction	Water Content	Group Name	Classification	
0 - 7.5	40	12	28	68%	32%	22%	CL	Lean Clay with Sand	
7.5 - 21.5	35	15	20	61%	39%	15%	CL	Sandy lean Clay	

Table 3.1m – New K-12 School Petersburg Subsurface Profile for B-13

<u>Test Hole #13 Soil Classification</u>									
<u>Depth</u> <u>(ft)</u>	<u>Liquid</u> <u>Limit</u>	<u>Plastic</u> <u>Limit</u>	<u>Plastic</u> <u>Index</u>	<u>Sieve</u> <u>Analysis</u> <u>(#200)</u>	<u>Coarse</u> <u>Fraction</u>	<u>Water</u> <u>Content</u>	<u>Group</u> <u>Name</u>	<u>Classification</u>	
<u>0 - 5</u>	<u>38</u>	<u>16</u>	<u>22</u>	<u>44%</u>	<u>56%</u>	<u>5%</u>	<u>SC</u>	<u>Clayey Sand</u>	
<u>5 - 6.5</u>	<u>45</u>	<u>14</u>	<u>31</u>	<u>74%</u>	<u>26%</u>	<u>15%</u>	<u>CL</u>	<u>Lean Clay with Sand</u>	

Table 3.1n – New K-12 School Petersburg Subsurface Profile for B-14

<u>Test Hole #14 Soil Classification</u>								
<u>Depth</u> <u>(ft)</u>	<u>Liquid</u> <u>Limit</u>	<u>Plastic</u> <u>Limit</u>	<u>Plastic</u> <u>Index</u>	<u>Sieve</u> <u>Analysis</u> <u>(#200)</u>	<u>Coarse</u> <u>Fraction</u>	<u>Water</u> <u>Content</u>	<u>Group</u> <u>Name</u>	<u>Classification</u>
<u>0 - 6.5</u>	<u>38</u>	<u>12</u>	<u>26</u>	<u>75%</u>	<u>25%</u>	<u>14%</u>	<u>CL</u>	<u>Lean Clay with Sand</u>

Table 3.1o – New K-12 School Petersburg Subsurface Profile for B-15

<u>Test Hole #15 Soil Classification</u>								
<u>Depth</u> <u>(ft)</u>	<u>Liquid</u> <u>Limit</u>	<u>Plastic</u> <u>Limit</u>	<u>Plastic</u> <u>Index</u>	<u>Sieve</u> <u>Analysis</u> <u>(#200)</u>	<u>Coarse</u> <u>Fraction</u>	<u>Water</u> <u>Content</u>	<u>Group</u> <u>Name</u>	<u>Classification</u>
<u>0 - 5</u>	<u>36</u>	<u>13</u>	<u>23</u>	<u>68%</u>	<u>32%</u>	<u>8%</u>	<u>CL</u>	<u>Sandy lean Clay</u>
<u>5 - 6.5</u>	<u>60</u>	<u>19</u>	<u>41</u>	<u>78%</u>	<u>22%</u>	<u>13%</u>	<u>CH</u>	<u>Fat Clay with Sand</u>

Table 3.1p – New K-12 School Petersburg Subsurface Profile for B-16

<u>Test Hole #16 Soil Classification</u>									
<u>Depth</u> <u>(ft)</u>	<u>Liquid</u> <u>Limit</u>	<u>Plastic</u> <u>Limit</u>	<u>Plastic</u> <u>Index</u>	<u>Sieve</u> <u>Analysis</u> <u>(#200)</u>	<u>Coarse</u> <u>Fraction</u>	<u>Water</u> <u>Content</u>	<u>Group</u> <u>Name</u>	<u>Classification</u>	
<u>0 - 6.5</u>	<u>41</u>	<u>18</u>	<u>23</u>	<u>73%</u>	<u>27%</u>	<u>16%</u>	<u>CL</u>	<u>Lean Clay with San</u>	

Table 3.1q – New K-12 School Petersburg Subsurface Profile for B-17

<u>Test Hole #17 Soil Classification</u>									
<u>Depth</u> <u>(ft)</u>	<u>Liquid</u> <u>Limit</u>	<u>Plastic</u> <u>Limit</u>	<u>Plastic</u> <u>Index</u>	<u>Sieve</u> <u>Analysis</u> <u>(#200)</u>	<u>Coarse</u> <u>Fraction</u>	<u>Water</u> <u>Content</u>	<u>Group</u> <u>Name</u>	<u>Classification</u>	
<u>0 - 5</u>	<u>41</u>	<u>17</u>	<u>24</u>	<u>71%</u>	<u>29%</u>	<u>14%</u>	<u>CL</u>	<u>Lean Clay with San</u>	
<u>7.5 -</u> <u>20</u>	<u>44</u>	<u>18</u>	<u>26</u>	<u>71%</u>	<u>29%</u>	<u>12%</u>	<u>CL</u>	<u>Lean Clay with San</u>	
<u>20 -</u> <u>21.5</u>	<u>38</u>	<u>18</u>	<u>20</u>	<u>51%</u>	<u>49%</u>	<u>17%</u>	<u>SC</u>	<u>Sandy Lean Clay</u>	

Table 3.1r – New K-12 School Petersburg Subsurface Profile for B-18

<u>Test Hole #18 Soil Classification</u>									
<u>Depth</u> <u>(ft)</u>	<u>Liquid</u> <u>Limit</u>	<u>Plastic</u> <u>Limit</u>	<u>Plastic</u> <u>Index</u>	<u>Sieve</u> <u>Analysis</u> <u>(#200)</u>	<u>Coarse</u> <u>Fraction</u>	<u>Water</u> <u>Content</u>	<u>Group</u> <u>Name</u>	<u>Classification</u>	
<u>0 - 5</u>	<u>43</u>	<u>16</u>	<u>27</u>	<u>71%</u>	<u>29%</u>	<u>19%</u>	<u>CL</u>	<u>Sandy Lean Cla</u>	
<u>(5 - 15)</u>	<u>38</u>	<u>14</u>	<u>24</u>	<u>64%</u>	<u>36%</u>	<u>18%</u>	<u>CL</u>	<u>Sandy lean Clay</u>	
<u>15 -</u> <u>21.5</u>	<u>35</u>	<u>14</u>	<u>21</u>	<u>49%</u>	<u>51%</u>	<u>13%</u>	<u>SC</u>	<u>Clayey Sand</u>	

3.1.2 New K-12 School Petersburg Subsurface Boring logs

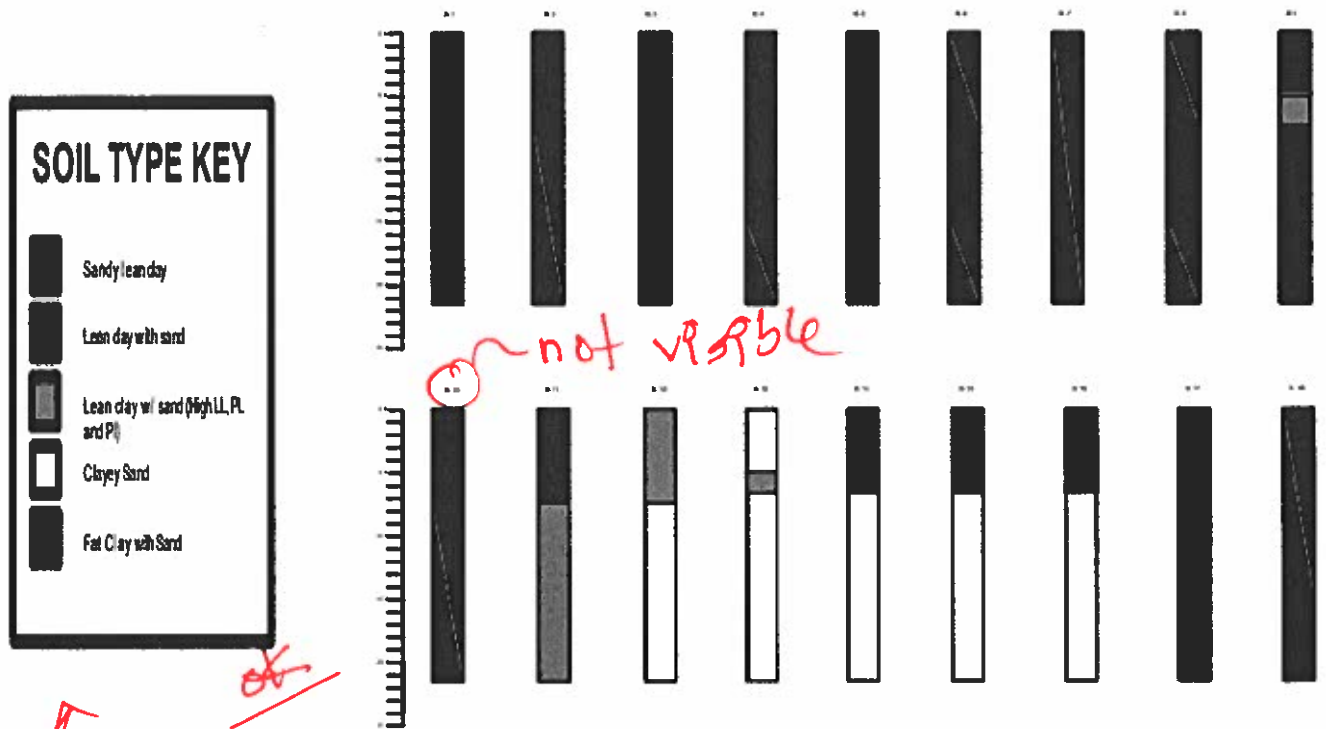


Figure 3.1.2a: Soil Boring Plan

3.2 Site and Subsurface Conditions

Site Location and Description

At the hour of investigation exercises, the site was existing and was commonly level and displaying.

The figure beneath shows the structure site with comparing measurements of the boring examination.

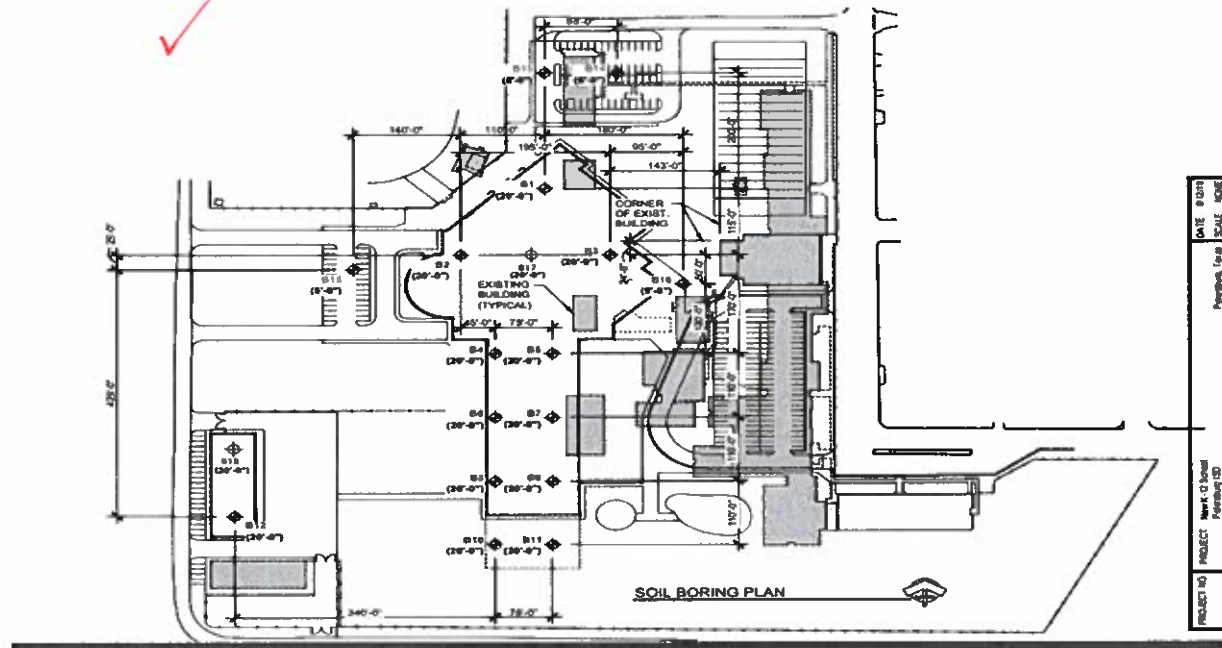


Figure 4: Soil Boring Plan

3.1.3 Groundwater Information

Groundwater level was not found in the borings during the hour of exhausting exercises. It should be perceived that the groundwater levels were wanted to be recorded during the entering and after exhausting fulfillment. It is possible that periodic assortments (temperature, precipitation, etc) will cause changes in the groundwater level. Also, perched water might be knowledgeable about sporadic zones inside the overburden. The groundwater levels presented in this report, expecting to be any, are the levels that were assessed at the hour of our field works out. It is recommended that the authoritative specialist choose the veritable groundwater levels at the site at the hour of the improvement activities to choose the impact, accepting any, on the advancement frameworks.

Environmental Site Assessment

The ESA is ordinarily seen as the underlying stage during the time spent normal due consistency. Before purchasing a land bundle, an owner should promise himself that the envisioned progression of the land is truly possible with its dirt conditions. This being expressed, the owner volunteers' geotechnical engineers to analyze the dirt through key borings to test the dirt and

guarantee that it is sensible. These are key motivations behind why associations and advancing foundations habitually require a Phase I ESA. Driving an ESA limits the obligation of the owner or advance trained professional and outfits them with a sensation of statement for the idea of their domain. Norms for Performing a Phase I Site Assessment have been made by the EPA. These norms include:

- Evaluating stockpiling, taking care of, treatment, and removal of materials and waste
- Investigating site for proof of underground stockpiling tanks or spills
- Researching history of the office, soil type, and ground and surface water

3.2.1. Foundation Design

1.) Selection of Foundation

The suitable establishment is chosen for each chose office dependent on specific components. Perceive the establishment type dependent on satisfactory and significant information from subsurface investigation

Determination of Foundation Type :

1. Quality: The establishment should be a satisfactory quality with the goal that it isn't exposed to disintegration, for example, from sulfate assault.
2. Satisfactory Strength: The establishment should be planned with adequate strength that is doesn't crack or fall to pieces under the applied superstructure loads. The establishment should likewise be appropriately built in conformance with the plan details
3. Unfavorable Soil Changes: The establishment should have the option to oppose long haul unfriendly soil changes.
4. Seismic Forces: The establishment should have the option to help the design during a tremor with-out exorbitant settlement or horizontal development.
5. Satisfactory Depth: Foundation should have a sufficient profundity to forestall ice harm. For Such establishments as scaffold wharfs, the profundity of the establishment should be adequate to forestall subverting by scour.
6. Bearing Capacity Failure: The Foundation should be protected against a direction limit disappointment.
7. Settlement: Foundation should not settle to such degree that it harms the construction.

Terzaghi hypothesized that the dirt under the balance would create a triangle of tension. The bearing limit of the dirt is created in a balance because of three properties of soil:

- i. Cohesion
- ii. Friction
- iii. Density

The terms utilized in the Terzaghi bearing cutoff condition are an authoritative bearing breaking point, the connection term, the additional charge term, and the thickness term. An authoritative bearing restriction of an establishment is the stack past which an establishment would miss the mark and not, now be significant. Attachment (c) is a substance cycle. Soil particles will overall stick to each other on account of electrical charges present in mud particles. As opposed to connection, contact is an actual cycle. The higher the scouring between particles, the higher the restriction of the dirt to pass on balance loads. Generally, sands and silt secure grinding. By and large, soils are seen as grating less. The pounding of a dirt is addressed by the grinding point = 0; where B is the width of the equilibrium, and the place of the dirt strain triangle is given by a conclusive bearing cutoff.

Calculations

Ultimate Bearing Capacity

The Ultimate Bearing Capacity is calculated by using the Terzaghi Bearing Capacity factors which depend on the internal angle of friction of the soil. Ultimate Bearing Capacity (Q_{ult}) for a square footing with a width B is calculated as,

$$Q_{ult} = 1.3cN_c + \gamma_1 D_f N_q + 0.4\gamma_2 B N_\gamma$$

Whereas,

$Q_{ultimate}$ = Ultimate bearing capacity
 C = cohesion of soil

N_c, N_q, N_γ = Terzaghi's bearing capacity factors

γ_1 = effective unit weight of soil above soil of foundation

γ_2 = effective unit weight of soil below foundation

D_f = depth of footing, or distance from ground surface to base of footing

B = width of square footing

Given:

$$\gamma_1 = 125 \frac{lb}{ft^3}$$

$$\gamma_2 = 125 \frac{lb}{ft^3}$$

$$D = 21.5 ft$$

$$C = 1000 \frac{lb}{ft^2} \text{ for clay.}$$

$$\text{Friction angle} = 0$$

q = bearing pressure
 Q = load.

Ultimate bearing capacity is therefore,

$$\begin{aligned} Q_{ultimate} &= 1.3cN_c + \gamma_1 D_f N_q + 0.4\gamma_2 B N_\gamma \\ &= 1.3 * (1000) * (5.7) + 125 \frac{lb}{ft^3} * (21.5) * (1) \\ &= 10,097.5 \frac{lb}{ft^2} \end{aligned}$$

Parking lot(shallow foundation)

$$\begin{aligned} \underline{Q_{ultimate}} &= 1.3cN_c + \gamma_1 D_f N_q + 0.4\gamma_2 B N_\gamma \\ &= 1.3 * (1000) * (5.7) + 125 \frac{lb}{ft^3} * (6.5) * (1) \\ &= 8222.5 \frac{lb}{ft^2} \end{aligned}$$

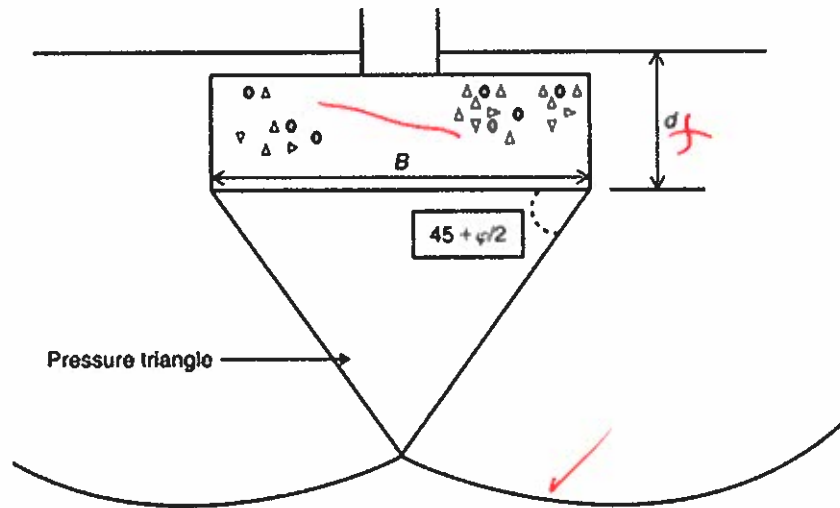


Figure 3.2.1a: Ultimate Bearing Capacity

Allowable Bearing Capacity

Allowable bearing capacity (Q_a) refers to the loading per unit area that the soil is able to support without unsafe movement. It is also referred to as the design bearing capacity. A factor of safety of 2.5 to 3 is commonly applied to the value of $q_{ultimate}$. Care must be taken to ensure that a footing design is safe with regard to:

1. Foundation failure (collapse)
2. Excessive settlement

Allowable Bearing Capacity:

$$\begin{aligned} Q_a &= \frac{Q_{ultimate}}{3} \\ Q_a &= 3,365.83 \text{ lb./ft}^2 \\ Q_a &= 2740.83 \text{ lb/ft}^2 \end{aligned}$$

The allowable bearing capacity of the soil is determined to be 4.08 ksf for a 3.5ft by 3.5ft footing. This value will be used in ensuing foundation designs of compactness of the soils.

Primary Consolidation Settlement

Because there is no water, there is no consolidation settlement.

Results & Discussion

To choose the elements of the equilibrium, counts were made using Terzaghi's bearing cutoff factors, the unit weight and attachment of the dirt, and the significance of the dirt. Since exhausting logs were taken at various regions on the site similarly as at different profundities at each space, this affected the resource chose, thusly impacting Terzaghi's bearing cutoff factors. This in like manner impacted the unit weight of the dirt. Since the sort of soil was different at each point where an exhausting log was taken similarly as at each significance, this impacted the union of the dirt. Considering these changing components and the dark elements of the square equilibrium, a conclusive bearing cutoff would move over the site, in this way changing the permissible bearing breaking point over the site as well. In any case, having different footings with various measurements isn't useful or monetarily incredible. Henceforth, having footings with uniform measurements is the most ideal decision. To choose the components of the equilibrium that would be practical over the site, appraisals ought to have been made. First thing, calculations were made for each significance of each exhausting log to choose a conclusive bearing breaking point concerning a strip foundation. Considering this, the most un-outrageous bearing breaking point was picked as a cautious advance not to misjudge our authoritative bearing cutoff. Considering this, the components in idea for the most decreased outrageous bearing cutoff regarding a strip foundation at that exact significance and exhausting log were used in figuring for a square foundation. From that point, the elements of 3.5ft by not set in stone.

Conclusion

Finally, this event provided an opportunity to learn about alternative geotechnical design cycles. The Geotechnical Group's mission was to examine the underlying characteristics at this location in order to promote the development of a design for the proposed structures and then make general recommendations for the new existing construction in Lubbock, Texas. Penetrating soil borings to depths of 0 to 20 feet beneath present assessments within the planned development area, lab testing, and the drafting of a designing report were all part of the scope of services. In the end, this group had the ability to apply geotechnical design methods to this project efficiently.

Test Hole #1 Soil Classification

Depth (ft)	Liquid Limit	Plastic Limit	Plastic Index	Sieve Analysis (#200)
0 - 5	38	15	23	66.7%
5 - 7.5	35	14	21	74.1%
7.5 - 20	41	13	28	77.1%
20 - 21.5	34	13	21	60.6%

Test Hole #2 Soil Classification

Depth (ft)	Liquid Limit	Plastic Limit	Plastic Index	Sieve Analysis (#200)
0 - 7.5	41	12	29	75.4%
7.5 - 10	34	15	19	67.7%
10 - 21.5	41	17	24	64.5%

Test Hole #3 Soil Classification

Depth (ft)	Liquid Limit	Plastic Limit	Plastic Index	Sieve Analysis (#200)
0 - 5	45	16	29	62.7%
(5 - 15)	42	17	25	73.4%
20 - 21.5	35	16	19	56.7%

Test Hole #4 Soil Classification

Depth (ft)	Liquid Limit	Plastic Limit	Plastic Index	Sieve Analysis (#200)
0 - 5	37	15	22	75%
(5 - 15)	33	12	21	71%
15 - 21.5	37	14	23	59%

Test Hole #5 Soil Classification

Depth (ft)	Liquid Limit	Plastic Limit	Plastic Index	Sieve Analysis (#200)
0 - 7.5	36	13	23	70%
7.5 - 20	38	15	23	81%
20 - 21.5	33	15	18	70%

Test Hole #6 Soil Classification

Depth (ft)	Liquid Limit	Plastic Limit	Plastic Index	Sieve Analysis (#200)
0 - 7.5	37	14	23	66%
7.5 - 15	32	14	18	76%
15 - 21.5	39	15	24	68%

Test Hole #7 Soil Classification

Depth (ft)	Liquid Limit	Plastic Limit	Plastic Index	Sieve Analysis (#200)
0 - 7.5	36	16	20	69%
7.5 - 21.5	39	13	26	59%

Test Hole #8 Soil Classification

Depth (ft)	Liquid Limit	Plastic Limit	Plastic Index	Sieve Analysis (#200)
0 - 7.5	35	15	20	66%
7.5 - 15	29	16	13	79%
15 - 21.5	47	14	33	59%

Test Hole #9 Soil Classification

Depth (ft)	Liquid Limit	Plastic Limit	Plastic Index	Sieve Analysis (#200)
0 - 5	51	17	34	73%
5 - 7.5	45	14	31	73%
7.5 - 20	38	12	26	74%
20 - 21.5	55	15	40	70%

Test Hole #10 Soil Classification

Depth (ft)	Liquid Limit	Plastic Limit	Plastic Index	Sieve Analysis (#200)
0 - 7.5	43	16	27	71%
7.5 - 21.5	39	14	25	67%

Test Hole #11 Soil Classification

Depth (ft)	Liquid Limit	Plastic Limit	Plastic Index	Sieve Analysis (#200)
0 - 7.5	31	12	19	69%
7.5 - 20	43	13	30	71%
20 - 21.5	52	21	31	77%

Test Hole #12 Soil Classification

Depth (ft)	Liquid Limit	Plastic Limit	Plastic Index	Sieve Analysis (#200)
0 - 7.5	40	12	28	68%
7.5 - 21.5	35	15	20	61%

Test Hole #13 Soil Classification

Depth (ft)	Liquid Limit	Plastic Limit	Plastic Index	Sieve Analysis (#200)
0 - 5	38	16	22	44%
5 - 6.5	45	14	31	74%

Test Hole #14 Soil Classification

Depth (ft)	Liquid Limit	Plastic Limit	Plastic Index	Sieve Analysis (#200)
0 - 6.5	38	12	26	75%

Test Hole #15 Soil Classification

Depth (ft)	Liquid Limit	Plastic Limit	Plastic Index	Sieve Analysis (#200)
0 - 5	36	13	23	68%
5 - 6.5	60	19	41	78%

Test Hole #16 Soil Classification

Depth (ft)	Liquid Limit	Plastic Limit	Plastic Index	Sieve Analysis (#200)
0 - 6.5	41	18	23	73%

Test Hole #17 Soil Classification

Depth (ft)	Liquid Limit	Plastic Limit	Plastic Index	Sieve Analysis (#200)
0 - 5	41	17	24	71%
7.5 - 20	44	18	26	71%
20 - 21.5	38	18	20	51%

Test Hole #18 Soil Classification

Depth (ft)	Liquid Limit	Plastic Limit	Plastic Index	Sieve Analysis (#200)
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0 - 5	43	16	27	71%
(5 - 15)	38	14	24	64%
15 - 21.5	35	14	21	49%

Coarse Fraction	Water Content	Group Name	Classification
33%	11.0%	CL	Sandy lean Clay (Dark Gary)
26%	13.8%	CL	Lean Clay with Sand (Pink)
23%	15.5%	CL	Lean Clay with Sand (Light reddish brown)
39%	17.5%	CH	Sandy lean Clay (Light reddish brown)

Coarse Fraction	Water Content	Group Name	Classification
25%	15.9%	CL	Lean Clay with Sand (Reddish gray)
32%	14.5%	SC	Sandy lean Clay (Pink)
36%	17.0%	SC	Sandy lean Clay (Light Reddish Brown)

Coarse Fraction	Water Content	Group Name	Classification
37%	17.8%	CL	Sandy lean Clay (Gray)
27%	15.6%	CL	Lean Clay with Sand (Pink)
43%	15.8%	CL	Sandy lean Clay (Light Reddish Brown)

Coarse Fraction	Water Content	Group Name	Classification
25%	14%	CL	Lean clay with Sand (Gray)
29%	16%	CL	Lean clay with Sand (Reddish Brown)
42%	16%	CL	Sandy Lean Clay (Reddish Brown)

Coarse Fraction	Water Content	Group Name	Classification
30%	13%	CL	Lean Clay with Sand
19%	12%	CL	Sandy lean Clay
30%	15%	CL	Sandy lean Clay

Coarse Fraction	Water Content	Group Name	Classification
34%	18%	CL	Sandy Lean Clay (Pink)
24%	17%	CL	Lean Clay with Sand (Pink)
32%	20%	CL	Sandy Lean Clay (light reddish brown)

Coarse Fraction	Water Content	Group Name	Classification
32%	12%	CL	Sandy lean Clay
41%	15%	CL	Sandy lean Clay

Coarse Fraction	Water Content	Group Name	Classification
34%	18%	CL	Sandy Lean Clay
21%	20%	CL	Sandy Lean Clay
41%	14%	CL	Sandy Lean Clay

Coarse Fraction	Water Content	Group Name	Classification
27%	11%	CH	Fat Clay with Sand
27%	12%	CL	Lean Clay with Sand
26%	11%	CL	Lean Clay with Sand
30%	17%	CH	Sandy Fat Clay

Coarse Fraction	Water Content	Group Name	Classification
29%	13%	CL	Lean Clay with Sand
33%	12%	CL	Sandy Lean Clay

Coarse Fraction	Water Content	Group Name	Classification
31%	13%	CL	Lean Clay with Sand
29%	10%	CL	Lean Clay with Sand
23%	21%	CH	Fat Clay

Coarse Fraction	Water Content	Group Name	Classification
32%	22%	CL	Lean Clay with Sand
39%	15%	CL	Sandy lean Clay

Coarse Fraction	Water Content	Group Name	Classification
56%	5%	SC	Clayey Sand
26%	15%	CL	Lean Clay with Sand

Coarse Fraction	Water Content	Group Name	Classification
25%	14%	CL	Lean Clay with Sand

Coarse Fraction	Water Content	Group Name	Classification
32%	8%	CL	Sandy lean Clay
22%	13%	CH	Fat Clay with Sand

Coarse Fraction	Water Content	Group Name	Classification
27%	16%	CL	Lean Clay with Sand

Coarse Fraction	Water Content	Group Name	Classification
29%	14%	CL	Lean Clay with Sand
29%	12%	CL	Lean Clay with Sand
49%	17%	SC	Sandy Lean Clay

Coarse Fraction	Water Content	Group Name	Classification
-----------------	---------------	------------	----------------

29%	19%	CL	Sandy Lean Clay
36%	18%	CL	Sandy lean Clay
51%	13%	SC	Clayey Sand

Reference:

?

**DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING
OUTCOMES SPECIFIC ASSIGNMENT COVER SHEET
CVEG 4100 – Geotechnical Engineering Design Laboratory
FALL 2021**

Instructor: Md. Jobair Bin Alam, Ph.D., P.E.

Title of Assignment

Stress Distribution and Consolidation Settlement

Outcome Measured Using this Assignment

Outcome 7

An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

Check the acquiring and applying engineering knowledge related to this assignment

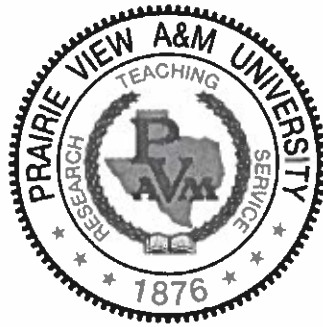
Assignment problem	
×	involves wide-ranging problem-solving issues
×	involves critical thinking in solving engineering and design problems
×	Involves real time design problems solution
×	involves identifying appropriate parameters for designing
×	Involves practicing application of engineering judgement
×	involves familiarizing with contemporary industry design and field investigation
Assignment problems will improve	
×	Ability to command basic and applied knowledge of mathematics, science, and engineering
×	Ability to identify, formulate, and solve geotechnical engineering problems by interpreting data and data analysis.
×	Ability to design a system, component, or process in geotechnical engineering to meet desired needs within realistic constraints such as economic, environmental, social, ethical, health and safety, manufacturability, and sustainability.
×	Ability to communicate effectively to understand the impact of geotechnical engineering solutions in a global, economic, environmental, and societal context.

Brief justification of the suitability of assignment for the outcome

This assignment will increase the students ability to determine the stress distribution into the soil due to structural loading and associated soil movement or settlement.

Sample of graded student's solution

Prairie View A&M University
Roy G Perry College of Engineering
Civil & Environmental Engineering Department



CVEG 4100 P81 – Geotechnical Engineering
Design Lab

Fall 2021

Homework #2

Submitter: *Johnathon Chevalier*

Grader: *Dr. J. Alam, MD*

Roster #4

Date Assigned: 21 September 2021

Date submitted: 29 September 2021

Problem 1

Given

- Full tank
of water

@ 10 m

@ 20 m

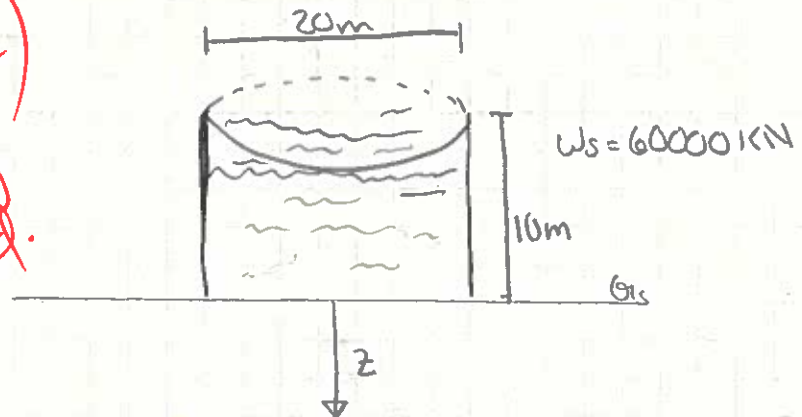
@ 30 m

$W_{self} = 60,000 \text{ kN}$

Question

Stress increase = ?

Solve



(+2)
very good.

①

$W_{water} = \gamma V$

$$L = (9.81 \times \pi/4) (20^2 \times 10)$$

$$L = 30819.02 \text{ kN}$$

$$q = \frac{60000 + 30819.02}{(\pi/4 \times 20^2)}$$

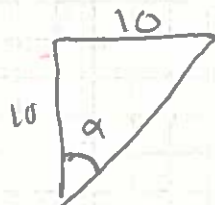
$$L = 289.1 \text{ kN/m}^2$$

②

@ $z = 10 \text{ m}$

$$\alpha = \tan^{-1}(\frac{10}{10}) =$$

$$L = 45^\circ$$



$$\sigma_z = (1 - \cos^2(45)) 289.1$$

$$L = 186.89 \text{ kN/m}^2$$

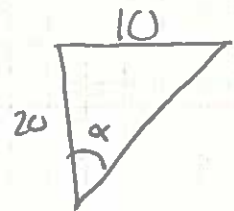
③ @ $z = 20 \text{ m}$

$$\alpha = \tan^{-1}(\frac{10}{20})$$

$$L = 26.56^\circ$$

$$\sigma_z = (1 - \cos^2(26.56)) 289.1$$

$$L = 82.237 \text{ kN/m}^2$$



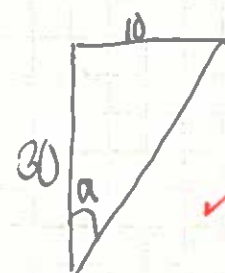
④ @ $z = 30 \text{ m}$

$$\alpha = \tan^{-1}(\frac{10}{30})$$

$$L = 18.43^\circ$$

$$\sigma_z = (1 - \cos^2(18.43)) 289.1$$

$$L = 42.262 \text{ kN/m}^2$$



Solution

@ $z = 10 \text{ m}$, 186.89 kN/m^2

@ $z = 20 \text{ m}$, 82.237 kN/m^2

@ $z = 30 \text{ m}$, 42.262 kN/m^2

Problem 2

Given

rectangle
10 ft x 15 ft
450 kips
40 ft, 8 ft
depth

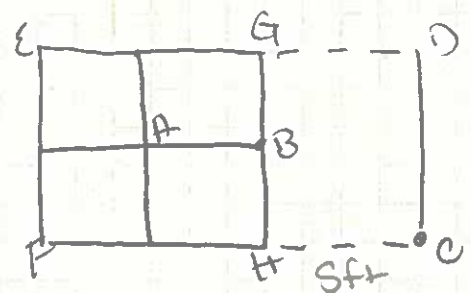
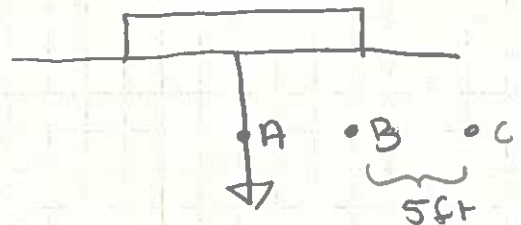
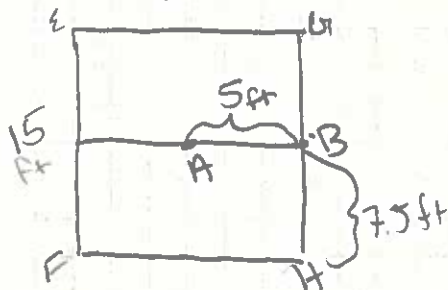
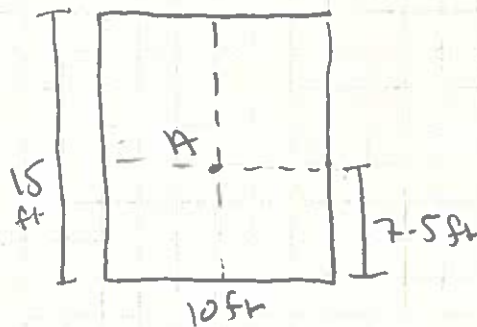
Solve

vertical stress

@ center, A,
B, C,

distribution plot

Solve



$$z = 10 \text{ ft}$$

$$Q = 450 \text{ kips}$$

$$q = \frac{Q}{z \cdot B}$$

$$q = \frac{450}{10 \times 15}$$

$$q = 3 \text{ kips/ft}^2$$

$$m = \frac{B}{2} = \frac{x}{z}$$

$$m = \frac{10}{2} = 5$$

$$n = \frac{z}{2} = \frac{y}{z}$$

$$n = \frac{15}{2} = 7.5$$

$$I = .105$$

$$\sigma = 4 \times q \times I$$

$$\sigma = 4 \times 3 \times .105$$

$$\sigma = 1.26 \text{ kips/ft}^2$$

$$m = \frac{x}{z}$$

$$m = 10/10 = 1$$

$$n = \frac{y}{z}$$

$$n = 7.5/10 = .75$$

$$I = .158$$

$$\sigma = 4 \times 3 \times .158$$

$$\sigma = .948 \text{ kips/ft}^2$$

$$m = \frac{x}{z}$$

$$m = 15/10 = 1.5$$

$$n = \frac{y}{z}$$

$$n = 15/10 = 1.5$$

$$I = .22$$

$$m = \frac{x}{z}$$

$$m = 5/10 = .5$$

$$n = \frac{y}{z}$$

$$n = 15/10 = 1.5$$

$$I = .13$$

$$\sigma = 3 \times (I_1 - I_2)$$

$$\sigma = 3 \times (.22 - .13)$$

$$\sigma = .27 \text{ kips/ft}^2$$

$$(4)$$

$$\sigma = \frac{qBL}{(B+z)(L+z)}$$

$$\sigma = \frac{3 \times 15 \times 10}{(15+10)(10+10)}$$

$$\sigma = .9 \text{ kips/ft}^2$$

$$(5)$$

$$z = 8$$

$$m = \frac{x}{z}$$

$$m = 5/8$$

$$n = \frac{y}{z}$$

$$n = 7.5/8$$

$$I = .1301$$

$$\sigma = 4 \times 3 \times .1301$$

$$\sigma = 1.632 \text{ kips/ft}^2$$

$$z = 16$$

$$m = .3125$$

$$n = .468$$

$$I = .045$$

$$\sigma = .54 \text{ kips/ft}^2$$

$$z = 24$$

$$m = .2$$

$$n = .31$$

$$I = .023$$

$$\sigma = .276 \text{ kips/ft}^2$$

$$z = 32$$

$$m = .15$$

$$n = .23$$

$$I = .008$$

$$\sigma = .11 \text{ kips/ft}^2$$

$$z = 40$$

$$m = .125$$

$$n = .187$$

$$I = 0$$

$$\sigma = 0$$

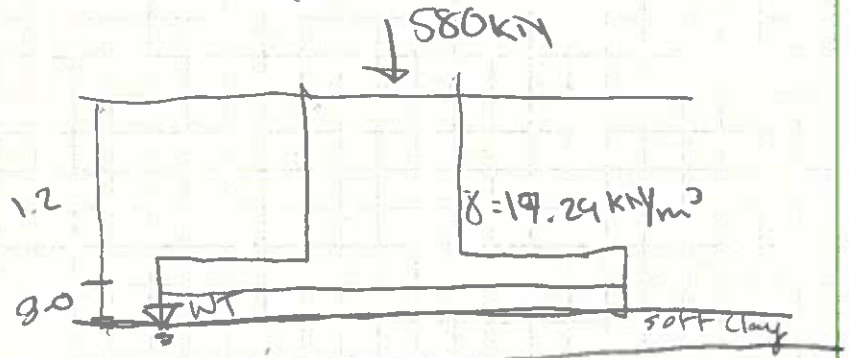
(-5)
Plot

Problem 3

Given

- CS ≥ 40 mm
- 580 kN
- WT - 4.2 m
- soft clay
- $\gamma = 18.86$ $\gamma_{sat} = 29.6\%$
- $w_L = 50\%$ $G_s = 2.65$

Solve



Solve

Proportional
Square
footing

$$P_0' = [3 + 12] [17.29] + \frac{1.5}{2} [18.86 - 9.807] = 93 \text{ kPa}$$

$$C_c = .009(w_L - 10)$$

$$L_c = .004(50 - 10) = .36$$

$$P_0 = w G_s = \frac{29.6}{100} (2.65)$$

$$L_D = .784$$

$$\Delta H = \frac{C_c H}{H L_c} \log \frac{P_0' + \Delta P}{P_0'}$$

$$L_D = \frac{.36(4.5)}{1.784} \log \frac{93 + \Delta P}{93}$$

$$L_D = .91 \log \frac{93 + \Delta P}{93}$$

B = 2.4:

$$\Delta P = \frac{1}{3} (15/3) \left(\frac{.25 + .06}{2} + .13 + .08 \right)$$

$$L_D = \frac{.36}{3} = .1215 \text{ m} \quad 2.4$$

B = 4.8

$$\Delta P = \frac{1}{3} \left[\frac{.6 + .17}{2} + .4 + .25 \right] = .3446$$

B = 7.2

$$\Delta P = \frac{1}{3} \left[\frac{.77 + .21}{2} + .6 + .4 \right] = .5178$$

$$\Delta H_{2.4} = .91 \log \left(\frac{93 + 12}{93} \right)$$

$$L_D = .048 \text{ m}, 48 \text{ mm}$$

$$\Delta H_{4.8} = .91 \log \left(\frac{93 + 3.8}{93} \right)$$

$$L_D = .036 \text{ m}, 36 \text{ mm}$$

$$\Delta H_{7.2} = .91 \log \left(\frac{93 + 5.8}{93} \right)$$

$$L_D = .024 \text{ m}, 24 \text{ mm}$$

	B=2.4	D=4.8	B=7.2	
Dim	P/3	q/4	P/3	q/4
3	1.25	.25	.62	.6
4.5	1.87	.13	.94	.4
6.0	2.5	.08	1.25	.25
7.5	3.12	.06	1.50	.17

2.4

$$q_{2.4} = .12 \times \frac{580}{2.42}$$

$$L_D = 2.87 \text{ kPa or } 12 \text{ kPa}$$

$$q_{4.8} = .35 \times \frac{580}{4.82}$$

$$L_D = 42.116 \text{ or } 8.8 \text{ kPa}$$

$$q_{7.2} = .52 \times \frac{580}{7.22} = 41.77 \text{ or } 5.8 \text{ kPa}$$

Solution

B = 4 m

B = 2.4 m

Problem 4

Given

-shallow foundation

$$Q = 1500 \text{ kips}$$

$$\gamma = 17 \text{ kN/m}^3$$

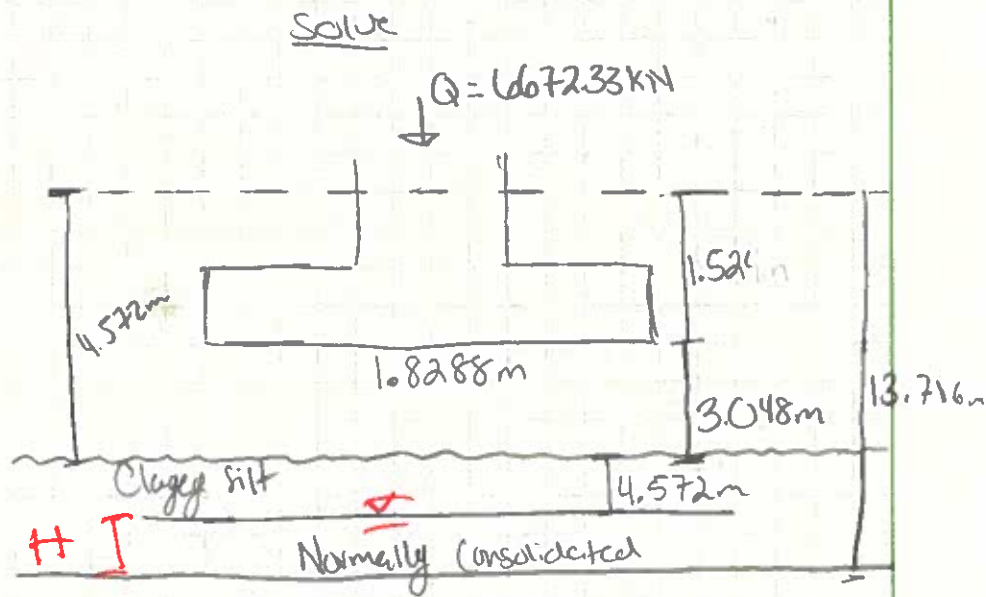
$$C_c = 0.25 \quad \gamma_{sat} = 16.85 \text{ kN/m}^3$$

$$e_0 = 0.9$$

$$\gamma_{water} = 15.8 \text{ kN/m}^3$$

Question

Consolidation Settlement = ?



$$z = (4.572 + 4.572) - 1.52$$

$$L = 7.62 \text{ m}$$

$$\sigma_0 H = (17 \times 4.572) + (15.8 \times 4.572)$$

$$L = 149.96 \text{ kN/m}^2$$

$$As = \frac{P}{A} = \frac{Q}{(z + 0)^2}$$

$$L = \frac{667233}{(0.18288 + 7.62)^2}$$

$$L = 24.73 \text{ kN/m}^2$$

$$AH = \frac{H_0}{H_0} C_c \log_{10} \left(\frac{\sigma_0 + As}{\sigma_0} \right)$$

$$L = \frac{4.572 \times 2}{1 + 0.9} \times 0.25 \times \log_{10} \left(\frac{149.96 + 24.73}{149.96} \right)$$

$$L = 0.211 \text{ m or } 211.88 \text{ mm}$$

Solution

$$AH = 0.211 \text{ m or } 211.88 \text{ mm}$$

(m,n) ⇒ method

(-5)

CIVIL ENGINEERING DEPARTMENT

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CVEG 4100- Geotechnical Engineering Design

Homework #2

Shadaria Lynch

Problem 1

load = 60,000 kN

pressure (q) = $\frac{\text{load}}{\text{area}} = \frac{60,000}{\pi/4 (20)^2} = \frac{60,000}{314.2} = 191 \text{ kN/m}^2$

Stress increase (σ_z) = $q \left[1 - \frac{1}{1 + (R/z)^2} \right]^{3/2}$

radius (R) = 20/2 = 10m

z = depth

@ 10m depth:

$\sigma_z = 191 \left[1 - \frac{1}{1 + (10/10)^2} \right]^{3/2}$

= 67.5 kN/m²

@ 20m depth:

$\sigma_z = 191 \left[1 - \frac{1}{1 + (10/20)^2} \right]^{3/2}$

= 17.1 kN/m²

@ 30m depth:

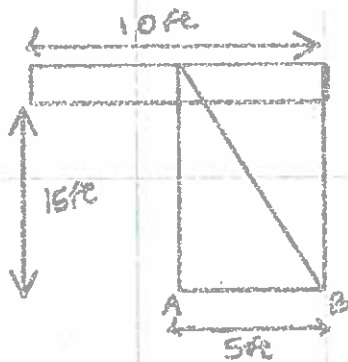
$\sigma_z = 191 \left[1 - \frac{1}{1 + (10/30)^2} \right]^{3/2}$

= 6.04 kN/m²

$q = \frac{60,000}{A} + \gamma_w h$

(5)

Problem 2



$$z = 10 \text{ ft}$$

$$Q = 450 \text{ kips}$$

a) vertical stress @ center of slab, point A

$$q = \frac{450}{10 \times 15} = 3 \text{ kips/ft}^2$$

$$m = \frac{b}{z} = \frac{5}{10} = 0.5 \quad n = \frac{L}{z} = \frac{7.5}{10} = 0.75$$

$$\text{vertical stress } \sigma_a = 4 \times q \times I_2$$

$$= 4 \times 3 \times 0.105 = 1.26 \text{ kips/ft}^2$$

b) at B

$$m = 10/10 = 1$$

$$n = 7.5/10 = 0.75$$

$$I_2 = 0.158$$

$$\sigma_b = 2 \times 3 \times 0.158 = 0.948 \text{ kips/ft}^2$$

c) at C

$$m = 15/10 = 1.5$$

$$n = 15/10 = 1.5$$

$$I_2 = 0.22 \text{ (CDEF)}$$

$$m = 5/10 = 0.5$$

$$n = 15/10 = 1.5$$

$$I_2 = 0.13 \text{ (CDGH)}$$

$$\sigma_c = 3 \times (0.22 - 0.13)$$

$$= 0.27 \text{ kips/ft}^2$$



d) Using approximate method

$$\sigma_c = \frac{qL}{(B+z)(L+z)} = \frac{3 \times 15 \times 10}{(15+10)(10+10)} = 0.9 \text{ kips/ft}^2$$

e) At $z = 8$

$$m = 9/8 = 0.625 \quad n = 7.5/8 = 0.975$$

$$\sigma_z = 4 \times 3 \times 0.1361 = 1.6332$$

At $z = 16$

$$m = 0.3125 \quad n = 0.468$$

$$\sigma_z = 4 \times 3 \times 0.045 = 0.54$$

At $z = 24$

$$m = 0.2 \quad n = 0.31$$

$$\sigma_z = 4 \times 3 \times 0.023 = 0.276$$

At $z = 32$

$$m = 0.15 \quad n = 0.23$$

$$\sigma_z = 0.10$$

At $z = 40$

$$m = 0.125 \quad n = 0.187$$

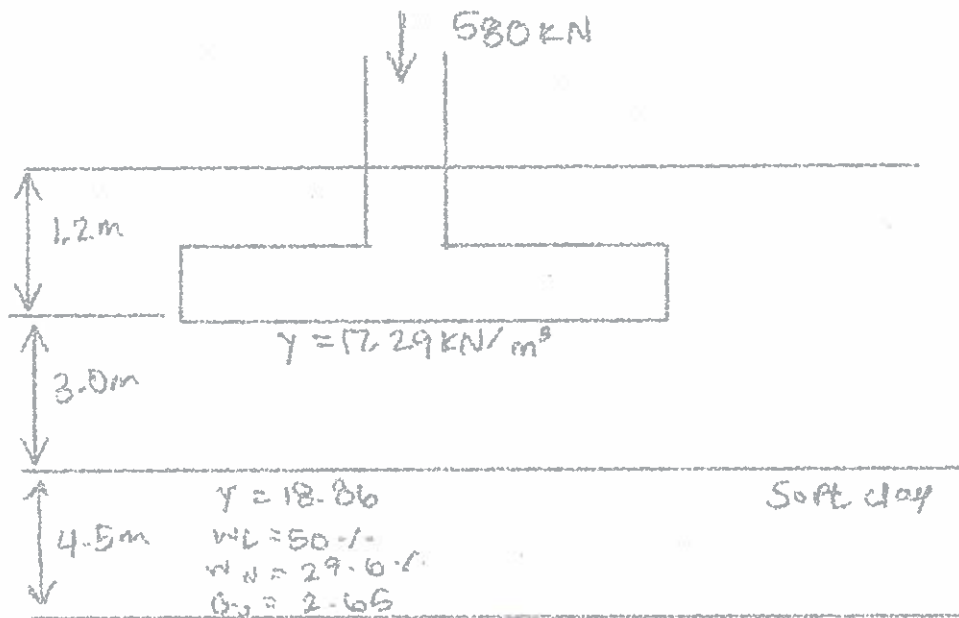
$$\sigma_z \approx 0$$

plot

46

(-5)

Problem 3



$$\Delta H = \frac{C_c H \log \sigma_2 / \sigma_1}{1 + e_0}$$

$$C_c = 0.007(W_L - 10) = 0.28$$

$$H = 4.5 \text{ m}$$

$$e = \frac{G w_N}{S_d} = \frac{2.65 \times 0.296}{1} = 0.784$$

$$\sigma_1 = 17.29(3 + 1.2) + (18.86 - 9.81)(2.25) = 92.98 \text{ kN/m}^2$$

$$\sigma_2 = \sigma_1 + \Delta \sigma$$

$$\Delta \sigma = \frac{P}{(B + z)^2}$$

$$B = 2$$

$$z = 5.25 \text{ m}$$

$$C_c = 0.007(W_L - 10) = 0.28$$

$$\Delta H = \frac{0.28 \times 4.5 \log \sigma_2 / \sigma_1}{1 + 0.784} \Rightarrow \log \sigma_2 / \sigma_1 = 0.056$$

$$\frac{\sigma_2}{\sigma_1} = 1.13$$

$$\sigma_2 = 92.98 \times 1.13 = 105.1$$

$$\Delta \sigma = \sigma_2 - \sigma_1 = 105.1 - 92.98 = 12.12 \text{ kN/m}^2$$

$$12.12 = \frac{580}{(B + 5.25)^2} \Rightarrow (B + 5.25)^2 = 47.85$$

$$B + 5.25 = 6.9$$

$$B = 1.65 \text{ m}$$

(2)

$$B = 2.4 \text{ m}$$

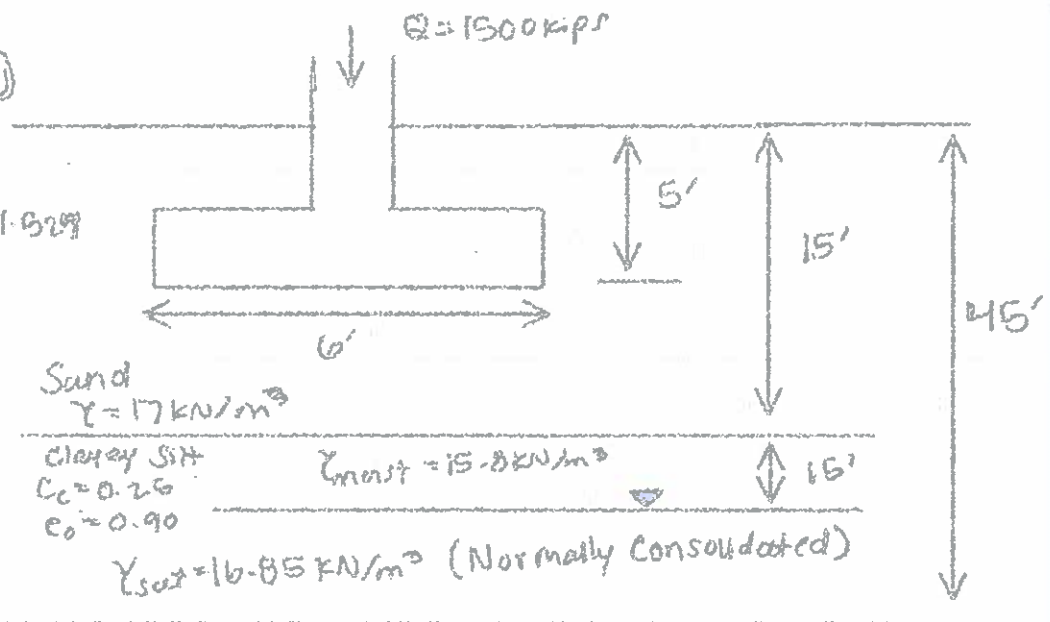
check

Problem 4

$$1 \text{ ft} = 0.3048 \text{ m}$$

$$B = 1.829 \text{ m}$$

$$Z = 2 \times 4.572 - 1.829 \\ = 7.62$$



$$Q = 1500 \text{ kips} \times \frac{4.448 \text{ kN}}{1 \text{ kips}} = 6672 \text{ kN}$$

$$\Delta H = \frac{H_0}{1 + e_0} C_c \log_{10} \left(\frac{\sigma_0 + \Delta \sigma}{\sigma_0} \right)$$

$$\sigma_0 = 17 \times 4.572 + 15.8 \times 4.572 = 149.96 \text{ kN/m}^2$$

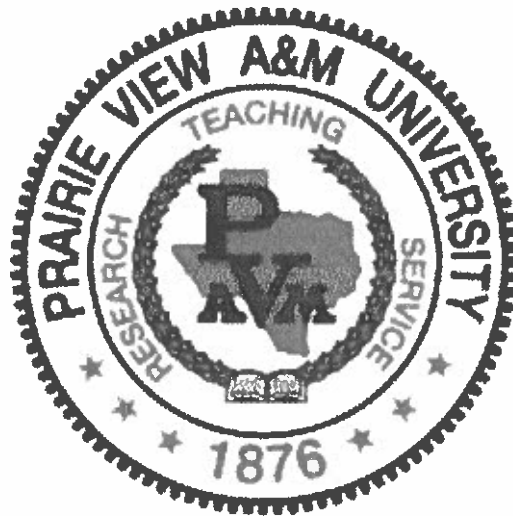
$$\Delta \sigma = \frac{Q}{(Z + B)^2} = \frac{6672}{(7.62 + 1.829)^2} = 74.73 \text{ kN/m}^2$$

$$\Delta H = \frac{4.572}{1 + 0.90} \times 0.25 \times \log \left(\frac{149.96 + 74.73}{149.96} \right)$$

$$= 0.211 \text{ m} = 211 \text{ mm}$$

(m, n) $\Rightarrow$ method

CIVIL ENGINEERING DEPARTMENT
PRAIRIE VIEW A&M UNIVERSITY



CVEG 4100 P81 GEOTECHNICAL ENGINEERING
DESIGN

Homework #2

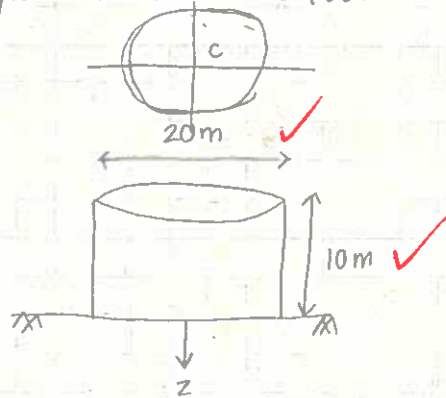
Perla Zaldivar (#10)

Given: September 22, 2021

Due: September 28, 2021

PROBLEM 1

Find the stress increase of the circular concrete water tank (when the tank is full of water) at 10m, 20m and 30m below the center of the tank. The self weight of the tank is 60,000 kN.



$$\text{pressure } (q_0) = \frac{\text{load}}{\text{area}} = \frac{60,000 \text{ kN}}{(\pi/4)(20\text{m})^2} = 191 \text{ kN/m}^2$$

$$\begin{aligned} \text{load} &= \frac{60,000}{\text{A}} + \gamma_w h \\ &= \frac{60,000}{\text{A}} + 9.81 \times 10 \\ &= \frac{60,000}{\text{A}} + 98.1 \text{ kN} \end{aligned}$$

$$\Delta \sigma = q_0 \left[1 - \frac{1}{1 + (R/z)^2} \right]^{3/2}$$

at 10m $R = 10\text{m}/2 = 10\text{m}$ $z = 10\text{m}$

$$\Delta \sigma = (191 \text{ kN/m}^2) \left[1 - \frac{1}{1 + \left(\frac{10}{10}\right)^2} \right]^{3/2} = 107.53 \text{ kN/m}^2$$

at 20m $R = 20\text{m}/2 = 10\text{m}$ $z = 20\text{m}$

$$\Delta \sigma = (191 \text{ kN/m}^2) \left[1 - \frac{1}{1 + \left(\frac{10}{20}\right)^2} \right]^{3/2} = 17.09 \text{ kN/m}^2$$

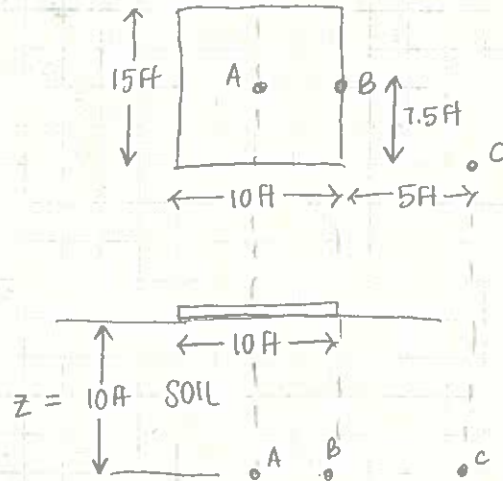
at 30m $R = 10\text{m}/2 = 10\text{m}$ $z = 30\text{m}$

$$\Delta \sigma = (191 \text{ kN/m}^2) \left[1 - \frac{1}{1 + \left(\frac{10}{30}\right)^2} \right]^{3/2} = 6.04 \text{ kN/m}^2$$

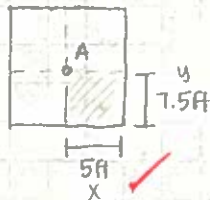
5

PROBLEM 2

- A rectangular concrete slab, 10 x 15 ft, rests on the surface of a soil mass. The load on the slab is 450 kips. Determine the vertical stress increase at a depth of 10 ft. (a) under the center of the slab at point A (b) under point B (c) at distance of 5 ft from corner point C (d) compare the results from 'a' with an estimate using the approximate method (e) plot the distribution of stress increase at point A with depth till 40 ft depth with a depth increment of 8 ft (using m & n method)



PART A



$$m = x/z = 5/10 = 0.5$$

$$n = y/z = 7.5/10 = 0.75$$

$$450 \text{ kip} -$$

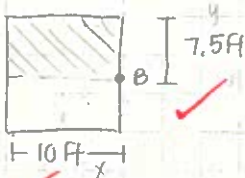
$$\Delta \sigma = 4Iq$$

$$q = \frac{Q}{A} = \frac{450 \text{ kip}}{(10 \text{ ft} \times 15 \text{ ft})} = 3 \text{ kip/ft}^2$$

$$I \text{ (from Fig 4)} = 0.107$$

$$\Delta \sigma = 4(0.107)(3 \text{ kip/ft}^2) = 1.284 \text{ kip/ft}^2$$

PART B



$$m = x/z = 10/10 = 1$$

$$n = y/z = 7.5/10 = 0.75$$

$$\Delta \sigma = 4Iq$$

$$q = \frac{Q}{A} = \frac{450 \text{ kip}}{(10 \text{ ft} \times 15 \text{ ft})} = 3 \text{ kip/ft}^2$$

$$I = 0.101$$

$$\Delta \sigma = 4(0.101)(3 \text{ kip/ft}^2) = 1.932 \text{ kip/ft}^2$$

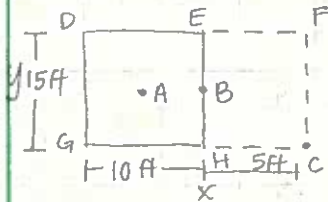
2

X

(-5)

PROBLEM 2 CONTINUE

PART C



for DFCG

$$m = x/z = 15/10 = 1.5$$

$$n = y/z = 15/10 = 1.5$$

$$I_1 = 0.218$$

$$I = (I_1 - I_2) \Delta q$$

$$I = (0.218 - 0.131)(3 \text{ kip/ft}^2)$$

$$0.261 \text{ kip/ft}^2$$

for EFCH

$$m = x/z = 5/10 = 0.5$$

$$n = y/z = 15/10 = 1.5$$

$$I_2 = 0.131$$

$$q = \frac{Q}{A} = \frac{450 \text{ kip}}{(10 \text{ ft} \times 15 \text{ ft})} = 3 \text{ kip/ft}^2$$

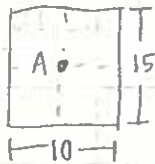
PART D

$$\Delta \sigma = \frac{q_0 B L}{(B+Z)(L+Z)} \quad (\text{eq 8.15})$$

$$q = \frac{Q}{A} = 3 \text{ kip/ft}^2$$

$$\Delta \sigma = \frac{(3 \text{ kip/ft}^2)(10 \text{ ft})(15 \text{ ft})}{(10 \text{ ft} + 10 \text{ ft})(15 \text{ ft} + 10 \text{ ft})} = 0.9 \text{ kip/ft}^2$$

PART E



$$q = \frac{Q}{A} = \frac{450 \text{ kips}}{10 \text{ ft} \times 15 \text{ ft}} = 3 \text{ kip/ft}^2$$

at $Z = 8 \text{ m}$

$$m = x/z = 5/8 = 0.625$$

$$n = y/z = 7.5/8 = 0.9375$$

$$I = 0.136$$

$$\Delta \sigma = 4 I q = 4(0.136)(3 \text{ kip/ft}^2) = 1.632 \text{ k/ft}^2$$

at $Z = 10 \text{ m}$

$$m = x/z = 5/10 = 0.5$$

$$n = y/z = 7.5/10 = 0.75$$

$$I = 0.055$$

$$\Delta \sigma = 4 I q = 4(0.055)(3 \text{ kip/ft}^2) = 0.66 \text{ k/ft}^2$$

Part E (continue)

at $z = 24 \text{ ft}$

$$m = x/z = 5/24 = 0.208$$

$$n = y/z = 7.5/24 = 0.3125$$

$$I = 0.028$$

$$\Delta\sigma = 4Iq = 4(0.028)(3 \text{ kip/ft}^2) = \boxed{0.336 \text{ kip/ft}^2}$$
 ✓

at $z = 32 \text{ ft}$

$$m = x/z = 5/32 = 0.156$$

$$n = y/z = 7.5/32 = 0.234$$

$$I = 0.011$$

$$\Delta\sigma = 4Iq = 4(0.011)(3 \text{ kip/ft}^2) = \boxed{0.132 \text{ kip/ft}^2}$$
 ✓

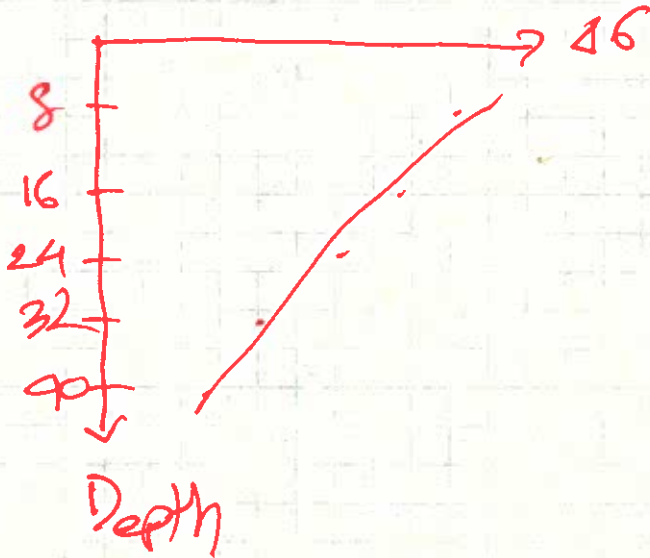
at $z = 40 \text{ ft}$

$$m = x/z = 5/40 = 0.125$$

$$n = y/z = 7.5/40 = 0.1875$$

$$I = 0.008$$

$$\Delta\sigma = 4Iq = 4(0.008)(3 \text{ kip/ft}^2) = \boxed{0.096 \text{ kip/ft}^2}$$
 ✓



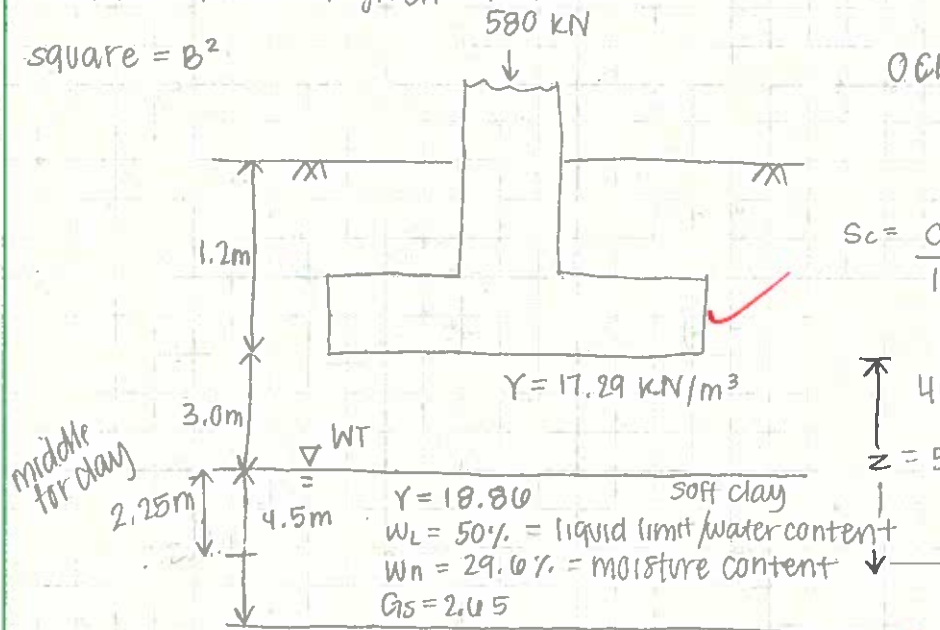
plot = ?

(-5)

PROBLEM 3

Proportion a square footing such that the consolidation settlement is not over 40mm for given conditions

square = B^2



$$OCR = \frac{\sigma'_b}{\sigma'_o}$$

$$S_c = \frac{C_c H}{1 + e_o} \log \left(\frac{\sigma'_o + \Delta \sigma'_o}{\sigma'_o} \right)$$

$$40 \text{ mm} \rightarrow 0.04 \text{ m}$$

$$z = 5.25$$

determine if its OC or NC

$$\sigma'_o = (1.2 + 3) \text{ m} (17.29 \text{ kN/m}^3) + (2.25 \text{ m}) (18.80 \text{ kN/m}^3 - 9.81 \text{ kN/m}^3)$$

$$\sigma'_o = 92.98 \text{ kPa} \approx 93 \text{ kPa}$$

$$e_o = W G_s = \frac{(29.6)(2.65)}{100} = 0.7844$$

$$(2.54) \quad CC = 0.009 (w_L - 10) = 0.009 (50 - 10) = 0.36$$

$$S_c = \frac{C_c H}{1 + e_o} \log \left(\frac{\sigma'_o + \Delta \sigma'_o}{\sigma'_o} \right) = \log \left(\frac{\sigma'_o}{\sigma'_o} \right) + \log \left(\frac{\Delta \sigma'_o}{\sigma'_o} \right)$$

$$0.04 = \frac{(0.36)(4.5)}{1 + 0.7844} \log \left(\frac{\Delta \sigma'_o}{93} \right)$$

$$0.04 = 0.907 \log \left(\frac{\Delta \sigma'_o}{93} \right)$$

$$10^{0.044} = \frac{\Delta \sigma'_o}{93}$$

$$1.106 = \frac{\Delta \sigma'_o}{93}$$

$$\Delta \sigma'_o = 102.93$$

$$\Delta \sigma'_o = \frac{q_o}{(B + z)^2}$$

$$102.93 = \frac{580 \text{ kN}}{(B + 5.25)^2}$$

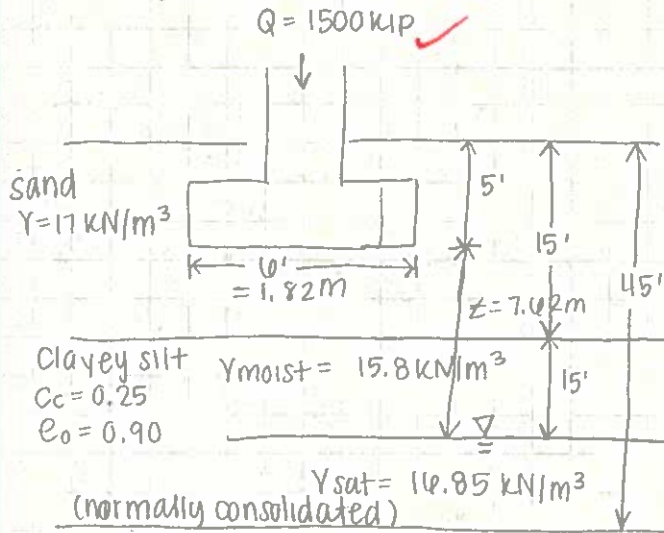
$$102.93 (B + 5.25)^2 = 580$$

$$\sqrt{(B + 5.25)^2} = \sqrt{5.63}$$

$$B + 5.25 = 2.37 \text{ m}$$

PROBLEM 4

A shallow foundation is to be constructed on a sandy soil layer underlain by clayey soil. Find the consolidation settlement for the footing.



$$\begin{aligned} 15' &= 4.5\text{m} \\ 5' &= 1.5\text{m} \\ 45' &= 13.7\text{m} \end{aligned}$$

$$NC \rightarrow S_c = \frac{C_c H}{1 + e_0} \log \left(\frac{\sigma'_0 + \Delta \sigma}{\sigma'_0} \right)$$

$$\begin{aligned} \text{kip} &\rightarrow \text{kN} \\ 6672.33 \text{ kN} \end{aligned}$$

mid point

$$+ 7.5 (16.85 - 9.81)$$

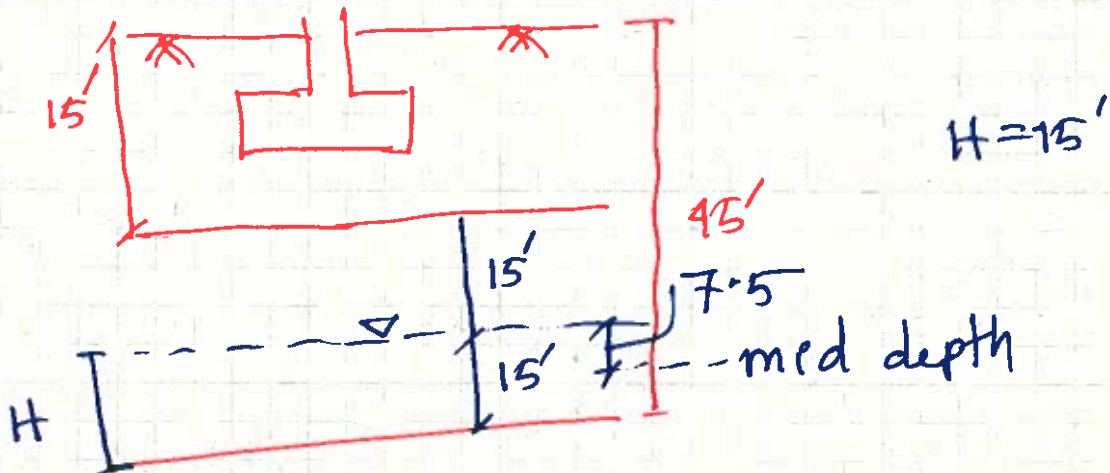
$$\sigma'_0 = (4.5\text{m})(17 \text{ kN/m}^3) + (4.5\text{m})(15.8 \text{ kN/m}^3) = 147.6 \text{ kN/m}^2$$

eq
(8.15a)

$$\Delta \sigma = \frac{6672.33 \text{ kN}}{\text{Area of shallow}} = \frac{6672.33 \text{ kN}}{(9.44 \text{ m})^2} = 74.87 \text{ kN/m}^2$$

$$S_c = \frac{0.25(9\text{m})}{1 + 0.90} \log \left(\frac{147.6 \text{ kN/m}^2 + 74.87 \text{ kN/m}^2}{147.6 \text{ kN/m}^2} \right)$$

$$S_c = 0.21\text{m}$$



(5)