

University of Tennessee at Chattanooga
College of Engineering and Computer Science
ENCE 4610 - Foundation Analysis and Design (3)
CECS Differential Course Fee, Upper Division Credit
TR 0925-1040, EMCS 203
40121 - 0 - Fall 2023

Catalog Description

Fundamental of soil mechanics as applied to the analysis and design of foundation systems; subsurface investigations; design of shallow and deep foundations. Retaining structures and lateral earth pressures. Fall semester. Lecture 3 hours. Prerequisite: ENCE 3610 with a minimum grade of C or department head approval. Differential Course Fee will be assessed.

Instructor

Don C. Warrington, P.E., PhD.

Office: EMCS 418F¹

Email cbv526@mocs.utc.edu

Telephone (423) 488-8590 (also accept text messages, you should identify yourself as you're probably not in my contacts list.)

I attempt to respond within six (6) hours to your emails or messages.

Website for Course Slides and other important material:

<https://vulcanhammer.net/geotechnical-courses/foundation-design-and-analysis/>

Office Hours as posted on UTC Learn.

More information on the instructor can be found at

<https://www.vulcanhammer.info/about/>

Campus Syllabus

The [campus syllabus](#) covers many things that have been mandated for the professor's syllabus but have been moved to one document for everyone. You need to read this, especially as they relate to

topics such as academic integrity and student accommodations.

Textbooks

- Verruijt, A., *Soil Mechanics*. Delft, The Netherlands: VSSD, 2012.
- Naresh C. Samtani and Edward A. Nowatzki, *Soils and Foundations Reference Manual*, Vols. 1 and 2. Washington, DC: National Highway Institute, Department of Transportation, 2006.

The textbooks are available in the bookstore. For accessibility purposes, all the textbooks are available in pdf format, downloadable from my course site.

Recommended Reference Books

- NAVFAC DM 7.1: *Soil Mechanics*. UFC 3-220-10. Naval Facilities Engineering Command, Alexandria, Virginia, 2022.
- NAVFAC DM 7.02, *Foundations and Earth Structures*. Naval Facilities Engineering Command, Alexandria, Virginia, 1986.
- Tsytoovich, N.A. *Soil Mechanics*. Mir Publishers, 1976.

All of these books are available from my website, in free pdf format.

Course Fees

Engineering Differential, USD 180.00 😞

Technology

I attempt to make the technology as simple to implement as possible, these are the requirements:

¹ That's at the wrong end of the building, according to Dr. Owino.

- Adobe Acrobat Reader, at least version 7.0. You can also use an alternative such as Mac Preview, Okular, etc. All the course slides and many of the online handouts are in this format.
- YouTube Videos. All the lectures are on YouTube, linked from both Canvas and my own course page. They are closed captioned as well.
- Microsoft Excel spreadsheets, which can also be read in programs such as LibreOffice.
- Homework solutions are generally in Google Sheets.
- Windows 32-bit executables which generally do not need to be installed on your computer or UTC's. These will work in Windows 2000 or later (sometimes earlier) and do fine in Linux or Mac on Wine.
- You will need your browser for some of the online routines (such as those for driven piles.) There are no fancy requirements for this either.

Course Objectives²

At the completion of the course, students will have demonstrated the ability to:

1. Design a shallow foundation for maximum allowable capacity. (1)
2. Design a deep foundation for geotechnical capacity, and (for driven piles) evaluate drivability. (1)
3. Design a retaining wall for structural and geotechnical capacity and integrity. (1)
4. Apply one or more of the above to a design project, depending upon the nature of the project (5)

² Numbers in parentheses indicate relationship to UTC civil engineering program outcomes.

Course Outline

- 1) Introduction
- 2) Shallow Foundations
 - a) Bearing Capacity
 - b) Settlement
 - c) Other Topics
- 3) Retaining Walls
 - a) Lateral Earth Pressures
 - b) Gravity Walls
 - c) Mechanically Stabilized Earth (MSE) Walls
 - d) Cantilever and Anchored Sheet Pile Walls
 - e) Braced Cuts
- 4) Deep Foundations
 - a) Overview of Driven Piles
 - b) Driven Pile Capacity, Static Methods
 - c) Driven Pile Settlement and Group Methods
 - d) Lateral Loading of Piles
 - e) Drilled Shafts and Auger-Cast Piles
 - f) Static Load Testing
 - g) Pile Dynamics
- 5) Other Topics
 - a) Foundations in collapsible and expansive soils
 - b) Analysis and Use of Boring Logs
 - c) Geotechnical Design using LRFD

Course Assessments and Requirements

- Eight (8) Homework Assignments @ 4% each: 32% (This is different from many of my colleagues, you cannot skip the homework and hope to exit this class with

anything but a D at best, which is unlikely since you'd be taking tests without any preparation from the homework.)

- Two (2) Tests @ 19% each: 38%
- One (1) Design Project: 30%

The due dates for these are on Canvas.

Course Grading³

1. 90 – 100: A
2. 80 – 90: B
3. 70 – 80: C
4. 60 – 70: D
5. < 60: F

Course Learning Evaluation

Course evaluations are an important part of our efforts to continuously improve the learning experience at UTC. Toward the end of the semester, you will receive a link to evaluations and are expected to complete them. We value your feedback and appreciate you taking time to complete the anonymous evaluations.

Course Policies

- All assignments (homework, tests, and projects) are scheduled on UTC Learn, along with the due date. Please pay attention to these. One half (½) point will be taken off for each hour a homework submission is late. Homework assignments themselves are also posted on UTC Learn as well, along with the solutions.
- Homework **must** be turned in electronically. The following **must** be adhered to for you to receive full credit:
 - ✓ The homework should be in **one** file acceptable to UTC Learn. Multiple

image files will be accepted *if and only if they are in order*.

- ✓ It must be submitted via the UTC Learn system. This is for your protection as much as mine: the submission time is noted, which establishes whether your homework was on time or late.
- ✓ If you scan your homework, make sure your scans⁴ are legible and have enough contrast to be read. (If your homework isn't legible before you scan it, take care of that first.) The use of green or buff engineering paper, hallowed by many years of use going back to the Dinosaur Age, should be avoided as it tends to reduce the contrast of a scanned document.⁵

□ Homework Format:

- When applicable, all problems must include a figure. All figures are to be neat and legible.
- Also, when applicable, all problems must include the following:
 - a. Given
 - b. Find
 - c. Solution.
- Putting more than one problem on a page is permitted. However, **the problems must be presented in the same order as they were given and numbered in the assignment**. Problems should be clearly demarcated between one problem and the next.

³ I have been known to curve specific items from time to time. Also, this applies to how mid-term and final grades are translated into your GPA; rubrics for assignments can and will vary from this.

⁴Sorry looking cell phone camera photos are a good way to put the instructor in a bad mood.

⁵This is especially true if you are using a very hard lead you bought on sale.

- On the first page of each problem set or test, in the upper right-hand corner write the following:
 - ♦ Your Name
 - ♦ Course Number
 - ♦ Problem Set or Test Number.
- Each time you use an equation, write down what it is: don't just put a bunch of numbers on the page and expect anyone to know what you did.
- You are encouraged to work homework with someone but your turned in work must be your own work. All work is subject to the honor code; however, on problems solved with software, if you turn in an identical software solution to anyone else in the class, both (or all) of you are subject to an automatic twenty-five (25) point collusion penalty.
- All quizzes and exams are open book(s) and open notes. I now permit the use of a computer during the tests; my experience is that it does not improve the grade performance during the tests.
- **Alternative Methodologies:** Geotechnical Engineering is replete with different ways of doing different things. In putting together a course like this, one of the challenges is to choose between multiple methods, all of which may be valid (or questionable) depending upon the application. In this course I expect you to use the methods described in class and in the slides. This is, as much as anything, to ensure uniform grading. If you use another method, you need to a) use it correctly and b) explain where you got it from and how it works. That turns using a different method something of

a crapshoot, because most students a) have no idea of the original source of a method⁶ and b) don't understand how to really use it. So be forewarned.

- **Videos and Lectures:** COVID-19 forced me to put all my lectures online, which was a progression from the extensive online slides and materials I have been doing for many years, going back to my first teaching of Soil Mechanics in Fall 2001.

However, since COVID I am making major revisions to the course. You need to come to class to see what's expected from you on homework and tests.

⁶ For a discussion of this problem in a different context, see Moses Maimonides, *Guide for the Perplexed*, Part I, Chapter LXXI.

Student Outcome Objectives

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