CEE 8813 - Critical State Soil Mechanics - Fall 2021

Instructor: Prof. Jorge Macedo, Ph.D., P.E
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Time and Place: MW 3:30 pm – 4:45 pm, Howey (Physics) S106

Office Hours: MW 2:15 - 3:15 pm.

COURSE OBJECTIVE

The aim of this course is to provide students with a comprehensive look at critical state soil mechanics (CSSM) and its application in geotechnical engineering (i.e., engineering practice and research). The course is intended for graduate students who want to use CSSM in their own research, but also for graduate students who want to apply CSSM in the context of engineering projects. In this course, students will be exposed to the critical state theory (CST), and also to the relatively new anisotropic critical state theory (ACST). The canvas website will be used to share information in this course.

COURSE TEXTBOOK

- Soil Liquefaction: A Critical State Approach, Second Edition. Mike Jefferies, Ken Been. CRC Press. Published September 21, 2015.
- Critical State Soil Mechanics, Schofield, A.N. and Wroth, C.P., McGraw Hill, 1968.
- Several other publications will be cited during the course. The most important of these publications will be available in the "Files" folder at the Canvas course website.

ASSIGNMENTS

Assignments are mandatory – all assignments must be submmited to receive a grade. Assignments are due at the start of class on the due date. Late assignments will be docked 15% the first week and 10% every subsequent week. Assignments will be graded on content, clarity, and neatness.

READINGS

Reading assignments will be given throughout the semester. Please check the course website regularly for updates.

PROJECT

A project will be assigned and due during the last week of the semester. The projects will include an oral presentation of results. More details about the project will be disseminated during the course.

GRADING *Assignments*: 35%, *Exams*: 25%, *Project:* 35%, *Participation/Quizzes*: 5%
A ≥ 90% > B ≥ 80% > C ≥ 70% > D ≥ 60% > F

COURSE OUTLINE

The course will break down roughly into the following content modules.

I. Introduction

- Case histories
- Soil mechanics review
- Definitions for stress and strain
- Stress paths

II. Why soil behaves as it does?

- Preliminaries (i.e. Taylor and Bishop postulates)
- Dilatancy
- Critical state
- Stress-dilatancy
- State parameter (and alternative definitions)
- Evaluating the critical state

III. Numerical Framework, Part I: Static response

- Basic notions
- Original Cam Clay model
- Cam Clay model limitations
- State parameter view
- NorSand model
- Static Liquefaction

IV. Determining state parameter in-situ

- CPTu test and its interpretation
- The inverse problem framework
- Calibration chambers and the evaluation of state
- Estimating state from the CPTu
- Effects of soil variability and characteristic states

V. Numerical Framework, Part II: Cyclic response

- Bounding surface plasticity
- Cyclic liquefaction
- CSSM-based constitutive models: (e.g. PM4Sand, PM4Silt, Sanisand)
- Anisotropic critical state theory (ACST)

VI. CSSM applications in "real" projects

- Applications in design (i.e. screening and simplified procedures).
- Numerical- based evaluations (i.e. Finite elements (FEM), finite differences (FD)).
- Forensic engineering

VII. Course Summary and Review

COLLABORATION POLICY

For all assignments, students may collaborate through discussion, but all calculations, coding (when needed), and writing should be done individually. Students who submit unattributed material will be found in violation of the Honor code (see Academic Integrity below).

ACADEMIC INTEGRITY

Georgia Tech aims to cultivate a community based on trust, academic integrity, and honor. Students are expected to act according to the highest ethical standards. For information on Georgia Tech's Academic Honor Code, please visit:
http://www.catalog.gatech.edu/policies/honor-code/ or http://www.catalog.gatech.edu/rules/19/.

ATTENDANCE

Attendance at all lectures is mandatory (including remote lectures). In accordance with the Institute requirement, verification of participation of the class will be reported to the Registrar's Office and the Office of Scholarships and Financial Aid.

ACCOMMODATIONS FOR INDIVIDUALS WITH DISABILITIES

If you are a student with learning needs that require special accommodation, contact the Office of Disability Services at (404)894-2563 or http://disabilityservices.gatech.edu/, as soon as possible, to make an appointment to discuss your special needs and to obtain an accommodations letter. Please also e-mail me as soon as possible in order to set up a time to discuss your learning needs.

DIVERSITY STATEMENT

We consider the class environment to be a place where you will be treated with respect, and we welcome individuals of all ages, backgrounds, beliefs, ethnicities, genders, gender identities, gender expressions, national origins, religious affiliations, sexual orientations, ability – and other visible and nonvisible differences. All members of this class are expected to contribute to a respectful, welcoming and inclusive environment for every other member of the class.

SAFE ZONE STATEMENT

We are members of a Safe Zone Ally community network, and we are available to listen and support you in a safe and confidential manner. As Safe Zone Allies, we can help you connect with resources on campus to address problems you may face that interfere with your academic and social success on campus as it relates to issues surrounding sexual orientation and gender identity. We will gladly honor your request to address you by an alternate name or gender pronoun. Please advise us of this preference early in the semester so that we may make appropriate changes to our records. Our goal is to help you be successful and to maintain a safe and equitable campus.