CEE 8813 - K Critical State Soil Mechanics Fall 2019

Instructor: Prof. Jorge Macedo, Ph.D., P.E
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Time and Place: TR 3:00 pm – 4:15 pm, Swann 325.

Office Hours: Tu 11.00 am- 12.00pm/1.00 pm-2.00pm, Mason 2279, or by appointment.

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.
- Soil Behaviour and Critical State Soil Mechanics. Wood, D, Cambridge: Cambridge University Press, 1991.
- 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 handed in 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. 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.