# CEE 581 – Dams, Embankments, and Slopes (Fall, 2023)

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## Prerequisite:
CEE 483 – Applied Soil Mechanics or Consent of Instructor.

### Required Textbook:
Selected Technical Papers Available on the Course COMPASS-2G Website

### Recommended Textbook:

### CEE 581 Course Outline and Schedule:

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| **PART II – Static Shear Strength and Slope Stability** | |
| Purpose | Peck (1988); Lane (1961); Stark & Eid (1994, 1997); Stark and Idries (2021); St. John et al. (1969); Deere and Peck (1958); Kezdi (1969); Pearce et al. (2010); CH2M-Hill (2013); Duncan and Wright (1979); Duncan et al. (1987); Duncan (2000); Sherman and Clough (1968); Duncan and Wright (2005) |
| Shear strength modeling | |
| Methods of evaluating slope stability | |
| Stability analysis using microcomputer programs and charts | |
| Construction induced pore pressures | |
| Stability analysis during reservoir operations | |

| **PART III – Geotechnical Earthquake Engineering** | |
| Introduction | Seed (1979) |
| Ground and site response (DMOD) | Idriss and Boulanger (2009) |
Dynamic soil properties
Idriss and Boulanger (2009)

Seismic slope stability of earth dams
Makdisi & Seed (1978)

Earthquake-induced permanent deformations
Harder (1991); Swaisgood (2003)

Earthquake-induced liquefaction – triggering & post-triggering
Idriss and Boulanger (2009)

Remediation of seismic hazard
Marcuson et al. (1996)

PART IV – Saturated and Partially-Saturated Seepage
Seepage through dams and levees
Casagrande (1937)

Two-dimensional steady flow in soils
Wong and Duncan (1984)

2D Numerical techniques
Stark (1987)

Methods for estimating location of line of seepage
Freeze and Cherry (1979), pp. 38-49

Partially Saturated Flow

Partially Saturated Seepage Software
Casagrande (1961)

Flow nets for earth dams
Terzaghi (1960)

Seepage forces on soils, erosion, and piping
Sherard et al. (1984 & 1989);

Filter requirements
USACE (2000)

Seepage control measures
Lane (1934); Hendrix & Stark (2009)

Cutoff walls and grouting for dams
Rice & Duncan (2009a;b); Rice et al.

FLOW NETS FOR EARTH DAMS
(2006); Houlsby (1977); Stark et al.

Geotextiles in Dams: Forging Federal Regulations
(2009)

Crum (2008)

PART V – Earth Dam Design, Construction, and Case Histories
Current Embankment Trends
Milligan (2003);

Elements of earth dams
Sherard et al. (1963)

Causes of earth dam failures
Sherard (1987)

Types and comparison of dams
Wilson and Marsal (1979)

Factors influencing design section of earth dams and concrete dams
Sherard and Cooke I & II (1987)

Rockfill dams
Terzaghi & Lacroix (1964), ENR(1961)

Asphalt Core Dams
Taylor (1969), Terzaghi, Peck, & Mesri

Case Histories – Mission Dam
(1996)

Case Histories – Lower Notch Dam
Tawil & Harriman (2001)

Case Histories – Mactaquac Dam
Whitehead (2001)

Case Histories – Peribonka Dam
DFI (2010)

Case Histories – Mica Dam

Dam construction

COMPREHENSIVE FINAL EXAM
Monday, December 11, 2023 – 1:30 – 4:30 p.m.
Required Reading:
Course Topics and Overview – (1) Slope Stability, (2) Earthquake Engineering, (3) Seepage, (4) Dam Design

Static Shear Strength and Slope Stability

Geotechnical Earthquake Engineering


### Seepage


### Design and Construction of Earth Dams and Levees


**Suggested Reference Books:**

*Soil Mechanics in Engineering Practice*, Terzaghi, Peck, and Mesri, John Wiley and Sons, 1999

**eMail Contact:**

Please feel free to correspond with me using email, HOWEVER, please make sure that the email subject starts with “CEE581:” followed by the topic of your message. This will ensure that your message is directed to my CEE581 email box and I respond promptly to your message. If you do not receive a response in a short period of time, please ensure your subject line starts with “CEE581” and resend your message.

**Compass Website:**

The class will have a website in the “Illinois Compass” system. Class lecture notes/PowerPoint slides, homework assignments, exams, and solution keys will be posted on the course website. Students are responsible for announcements and course materials that will be posted periodically on the website. I hope that students will use the discussion board on the site, as well as other features, and I will monitor the discussions when I am online. If you are new to Compass, a number of Compass Help documents for students can be obtained from [http://go.illinois.edu/student_help](http://go.illinois.edu/student_help).

**Homework Assignments:**

Civil Engineering, in particular, geotechnical engineering, can have serious consequences to society and can result in significant construction and legal costs. Consequently, all civil engineering documents and calculations are important and should be given significant attention. **Analysis and design computations of a geotechnical engineer are also legal documents and are used in legal proceedings.** To emphasize this point, homework assignments are subject to the following guidelines and **are an essential part of this course so they should be given the attention due a professional or job assignment:**
Homework is due at the beginning of the designated class period.

Late homework will not be accepted.

Because this class is design oriented, all homework assignments must reflect a professional approach. Free-hand drawings and curves, smudged and/or sloppy lettering, and undocumented calculations do not reflect a professional approach. *Homework with these characteristics will be returned ungraded.*

All graphs, tables, figures, etc. must be clearly labeled with descriptions, units, scales, sign conventions, etc.

Use either engineering paper or white ruled paper of size 8.5" x 11". Spiral bound paper with frayed edges is unacceptable. Use only the front side of the paper, put your name on each page, number the pages, e.g., 1/5 or 1 of 5, and use only pencil. Ball-point pens and felt tip pens are inappropriate for engineering computations. All assignments must be stapled together. Loose pages will not be accepted.

**Examinations and Grading:**

Reading assignments will be assigned every week and must be studied in depth. Unannounced quizzes on the reading will be given periodically and included in the Class Participation grade. Discussing and asking questions about the course material is vital to **really learning** the subject matter. As a result, class participation is required and will be a major part of your total grade (30%; see below). Please read the course material and bring questions and comments to class. At the start of each class I will select “volunteers” to comment on the current readings, homework assignment, and term project analyses.

- Class Participation, Homework, and Quizzes: 30%
- Mid-Term Exam (NEW): 20%
- Term Project: 20%
- Final Exam: 30%

The final exam is tentatively scheduled for Monday, December 11, 2023 – 1:30 – 4:30 p.m.

**Office Hours in Room 2217 NCEL:**

- Tuesday: 5:00 p.m. - 6:00 p.m.
- Thursday: 5:00 p.m. - 6:00 p.m.

**Purpose and Scope of Course:**

This course will focus on the geotechnical aspects of analysis, design, and construction of earth structures, such as dams, levees, heap leach pads, waste containment facilities, and compacted fills. In particular, this course will cover saturated and partially saturated seepage, static and seismic slope stability, and earthquake effects of earth structures. The importance of precedence will be emphasized in relation to the design section of concrete and earth dams and levees, the causes of failures, possible failure mechanisms, and viable remedial measures. Finally, emerging issues concerning the design, inspection, maintenance, and inspection of dams and levees will be addressed.
Graduate Student Term Project:

Graduate students should take this course for one unit and complete the following term project in addition to the other course requirements. Term project reports will be due Thursday, November 18, 2021. A comprehensive and in-depth report that is typed with a 12 point font and does not exceed a total of five (5) pages (including cover page, figures, tables, and references) must be submitted by each student on Thursday, November 18, 2021. Afterwards, selected students will give a 10 to 15 minute oral presentation to the class near the end of the semester, e.g., December 3 or 8, 2021. Each student or group will give a periodic 5 minute update presentation during class to demonstrate progress and present preliminary results. These update presentations are tentatively scheduled for September 9, October 7, and October 28, 2020 and should use the PowerPoint template on the COMPASS website.

The main objective of the term project is to research a slope stability failure, e.g., embankment, levee, landfill, tailings dam (mining or coal ash) failure, and apply the various analysis techniques, e.g., shear strength, stability, seismic, seepage, etc., to the case history. To accomplish this objective, each student will research a slope stability failure, e.g., one of the tailings dams failures that are listed at: http://www.wise-uranium.org/mdaf.html or a levee failure. Each student or group should submit their term project topic to Professor Stark by September 9, 2021 to ensure each student or group is studying a different case history.

Teachings of Ralph B. Peck:

Professor Peck had a profound impact on geotechnical engineering. He was world renowned and received the Medal of Science from President Gerald Ford. In addition to his teaching research, and consulting expertise, he left the geotechnical engineering profession with many “words of wisdom”. Some are repeated below and will probably be useful throughout this course and your career.

- “If you can’t reduce a difficult engineering problem to an 8 ½ x 11-inch sheet of paper, you will probably never understand it.”
- “Geology enables us to establish what constraints may exist for a particular project.”

Acquire two additional skills besides your course work: engineering judgment and professional and public responsibility

1) Engineering Judgment – a good sense of proportion
   - Make every assignment count because there is “always something to be learned”
   - “teach your brain to register what your eyes see” – keep a notebook
   - “learn how to think quantitatively” – visualize numerical quantities, dimensions, rates, and loads to develop a sense of proportion
   - “continue to read and study”, and
   - “study precedents to cultivate engineering judgment”.

2) Professional and Public Responsibility
   - “Our personal, individual attitudes toward engineering and toward society have a potential impact on our country’s future. However small that impact, each of us should try to make it for good.”
Teachings of Karl Terzaghi: Rules for the Game of Engineering

- “Engineering is a noble sport which calls for good sportsmanship. Occasional blundering is part of the game. Let it be your ambition to be the first one to discover and announce your blunders. If somebody else gets ahead of you, take it with a smile and thank him for his interest.”
- “The worst habit you can possibly acquire is to become uncritical towards your own concepts and at the same time skeptical towards those of others.”
- “When you commit one of your ideas to print, emphasize every controversial aspect of your thesis which you can perceive.”
- “Very few people are either so dumb or so dishonest that you could not learn anything from them.”

Words of Wisdom from John Wooden: Legendary Basketball Player and Coach

- It's what you learn after you know it all that really counts.
- If you don't have time to do it right, when will you have time to do it over? (If you have time to do it, you have time to do it.)
- It isn't what you do, but how you do it.
- It's not so important who starts the game but who finishes it.
- Little things make big things happen.
- Failure to prepare, is preparing to fail.
- Never mistake activity for achievement.

Darryl Royal: University of Texas Football Coach

- Potential is a fancy way of saying you have not done it yet.

Timothy D. Stark: University of Illinois at Urbana-Champaign

- Substance over hype.
- Study in-depth.