Course: CEG 4104: Retaining Wall and Embankment Design (6131)
CEG 6515: Earth Retaining Systems and Slope Stability (0846, EDGE)

Time & Place: 3rd Period (9:35 - 10:25 A.M.) Monday, Wednesday, and Friday
E122 Computer Science and Engineering Building (CSE)

Instructor: Dr. D. R. Hiltunen
265G Weil Hall
392-9537 × 1468 and dhilt@ce.ufl.edu

Office Hours: 1:00 – 3:00 P.M. Monday, Wednesday, and Friday

Prerequisites: CEG 4011, CEG 4012


Course objectives and/or goals: See instructor.

Grading:*

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* Notes on grading:

1. Homework assignments will typically be due at beginning of class period, and before lecture begins. Solutions submitted after this time will receive a 10 percent deduction per day late, and no solutions will be accepted after one week. Prepare all homework solutions on one side of sheet only (no spiral bound paper) and staple all pages together.
2. Questions, comments, etc. regarding the grading of exams or homework assignments must be submitted to the instructor within 48 hours (excluding weekends and holidays) of their return, after which time the discussion is closed.

3. Homework solutions will be made available on E-Learning course management system.

**Grade Points:** Undergraduate students, in order to graduate, must have an overall GPA and an upper-division GPA of 2.0 or better (C or better). Note: a C– average is equivalent to a GPA of 1.67, and therefore, it does not satisfy this graduation requirement. Graduate students, in order to graduate, must have an overall GPA of 3.0 or better (B or better). Note: a B– average is equivalent to a GPA of 2.67, and therefore, it does not satisfy this graduation requirement. For more information on grades and grading policies, please visit: https://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx or http://gradcatalog.ufl.edu/content.php?catoid=4&navoid=907#grades

**Attendance policy:** See instructor.

**Make-up of exams or other work:** See instructor.

**Accommodation for Students with Disabilities:** Students requesting classroom accommodation must first register with the Dean of Students Office. The Dean of Students Office will provide documentation to the student who must then provide this documentation to the Instructor when requesting accommodation.
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1. Introduction (1)
   a. Schedule
   b. Assignments, Exams, Grading Policies
   c. WebCT, Ereserves
   d. Content
      i. Soil
         1. Particulate
         2. Weak
         3. Soft and compressible
         4. Nonhomogeneous
      ii. Geotechnical design elements: foundations, retaining systems
      iii. Lateral earth pressure
      iv. Retaining walls: gravity, cantilever, mechanically (internally) stabilized
      v. Excavations: open, braced, bottom stability
      vi. Sheet pile walls: cantilever, anchored
      vii. Earth mass stability: natural slopes, embankments, earth dams

2. Lateral Earth Pressure (4)
   a. Introduction
      i. Applications
      ii. $\sigma_h'$
      iii. $K$
   b. States of Equilibrium
      i. $K_0$
      ii. $K_d$
      iii. $K_p$
   c. Earth Pressure Theories
      i. Purpose
      ii. Coulomb
         1. Schematic
         2. Assumptions
         3. Free body diagram and equilibrium
         4. Highlights of equation derivation
         5. Results
      iii. Rankine
      iv. Others, e.g., log spiral, Culman
   d. Additional Factors
      i. Ground water table
      ii. Layered soil profile
      iii. Surcharge

3. Retaining Walls (11)
   a. Introduction
      i. Types: gravity, cantilever, MSE, other
      ii. Design criteria
         1. External: sliding, overturning, bearing capacity
         2. Internal: tensile strength, pullout
      iii. Design process
b. Gravity Walls (4)
   i. Free body diagrams
   ii. Overall stability: sliding, overturning, bearing capacity
   iii. Example

c. Cantilever Walls (2)
   i. Free body diagram
   ii. Overall stability: sliding, overturning, bearing capacity
   iii. Structural design: stem, heel, toe
   iv. Example

d. Mechanically-Stabilized Earth (MSE) Walls (5)
   i. Introduction
      1. Wall concept
      2. Reinforcement alternatives
      3. Geosynthetics
   ii. Design Criteria
      1. Internal: tensile strength, pullout resistance
      2. External: sliding, overturning, bearing capacity
   iii. Design Methodology
      1. Properties and parameters
         a. Geometry
         b. Soil properties
         c. Reinforcement properties
         d. Factors of safety
         e. Earth pressure theory
      2. Internal stability
         a. Tensile strength factor of safety >> vertical spacing
         b. Pullout factor of safety >> design length
      3. External stability
         a. FBD
         b. Sliding factor of safety >> design length at base
         c. Overturning
         d. Bearing capacity

4. Excavations (5)
   a. Stability of Unsupported (1.5)
      i. Planar failure surface
         1. Rankine analysis: upper bound solution
         2. Terzaghi
            a. y=zo: lower bound
            b. y=Hc/2: observation
      ii. Other failure surfaces
   b. Braced (3.5)
      i. Introduction
         1. Strategies
         2. Simple, approximate analysis for strut loads, etc.
ii. Apparent pressure distributions
   1. Different than retaining walls since deformation pattern is different
   2. Total area approximates resultant load on braced wall
iii. Strut loads
iv. Bottom stability
   1. Heave in clays
   2. Quick condition in sands below GWT
v. Flowchart
   1. Cohesionless: pressure, strut loads, quick if below GWT
   2. Stiff clays: pressure, strut loads
   3. Soft clays: heave, pressure, strut loads

5. Sheet-Pile Walls (9)
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   i. Applications
   ii. Material Types
   iii. Design/Construction Methods: Cantilever, Anchored
b. Cantilever Wall in Cohesionless Soil
   i. Soil/wall model
   ii. Free body diagram
   iii. Net pressure diagram
   iv. Example: design steps
c. Anchored Wall in Cohesionless Soil
   i. Soil/wall model
   ii. Free body diagram
   iii. Net pressure diagram
   iv. Example: design steps
d. Anchors
   i. Types
   ii. Placement
   iii. Design Methods
      1. Teng
      2. Ovesen and Stromann
   iv. Example

6. Earth Mass Stability: Natural Slopes and Embankments (10)
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   i. Types of Slope Failures
   ii. Causes of Slope Failures
   iii. Definition of Stability
   iv. Methods of Analysis
      1. Limiting Equilibrium
      2. Finite Element
b. Infinite Slopes
c. Finite Slopes
   i. Planar
ii. Circular
   1. Mass stability charts for homogeneous slopes
      a. Taylor
      b. Cousins
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   i. Introduction
      1. Geo-Slope Website
      2. GeoStudio
      3. Student Download
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   ii. Overview of Capabilities: Examples
   iii. Problem Definition: Define
      1. Layout: scale, grid
      2. Geometry
      3. Material Properties
      4. Pore Water
      5. Reinforcement
      6. Slip Surface Definition
      7. Calculation Methods
      8. Verify
   iv. Analysis: Solve
   v. Results: Contour