Instructor: Professor Muniram Budhu, Room 324K, Civil Engineering

Phone: 621-2145 Email: budhu@d2l.arizona.edu

Lecture: TR 12:45 pm - 2:15 pm, CE201

Office hours: TR 2:30 pm - 3:30 p.m.

Prerequisite: CE 343 or equivalent

Course website: http://d2l.arizona.edu


Recommended code book: IBC2010 or latest (you can purchase this at a student discount rate at this site)

Handouts delivered from this course site

Additional materials: Go to the GROW site at http://www.grow.arizona.edu

OVERVIEW

In this course, we will discuss fundamental principles and practices of foundation engineering. We will apply the concepts learned in CE 343 to plan, analyze and design foundations for structures. A structure, for example, a building, may be adequately designed (an adequate margin of safety against collapse) but if the foundation fails, the structure will fail. The foundation could be the weak link in the "design chain" in Civil Engineering. Therefore, you must have a good understanding of how foundations behave under loads and exercise professional judgment in analysis and design. Foundations must satisfy five requirements.
(1) They must be capable of safely transferring the loads from a structure to the soil without shear failure.
(2) They must not settle excessively so as to impair the structure during its design life or to reduce the use of the structure or to create unsightly appearances.
(3) They must be designed for overall stability - resistance against sliding, tilting (rotation), uplift (floating) or piping.
(4) They must be economical
(5) They must be constructible
Successful civil engineering projects are heavily dependent on foundation design.

PRE-REQUISITE
You are expected to know CE 343 (old CE340) course materials, particularly, stresses in soils, shear strength, and consolidation.
OBJECTIVE: The overall objective of this course is to bridge the students' understanding of the principles of soil mechanics gained in CE 343, and the application of those principles to engineering problems related to shallow and deep foundation analysis and design.

GOALS TO BE ACHIEVED:

It is expected that at the end of this course, you should be able to:

1. Understand failure criteria applicable to foundations, design criteria and uncertainties in foundation design.
2. Determine bearing capacity of shallow and deep foundations
3. Determine settlement of shallow and deep foundations
4. Plan, analyze and design foundations such as footings and piles
5. Develop and use computer codes/spreadsheet for foundation design.

CLASS SCHEDULE S2011

Minor deviations from this schedule are to be expected. The bold question number in the HW column must also be answered by graduate students. Undergraduates are not required to submit the answer to the bold numbered question.

<table>
<thead>
<tr>
<th>Week</th>
<th>Date</th>
<th>Topics</th>
<th>Reading</th>
<th>HW &amp; Quizzes</th>
<th>HW due date</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>1/13</td>
<td>Introduction, review of basic soil mechanics</td>
<td>CH:1</td>
<td>Quiz 1</td>
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<td>2</td>
<td>1/18</td>
<td>Review of basic soil mechanics Pre-test Test must be completed by 10:00pm Foundation loads, stresses</td>
<td>Ch-1</td>
<td>Quiz 2</td>
<td>#1: 2.4, 2.5, 2.9, 2.10</td>
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<td>1/20</td>
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<td>CH-2: 2.0 – 2.4</td>
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<td>2/1</td>
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<td>3</td>
<td>1/25</td>
<td>Lateral stresses, stress state, stress paths</td>
<td>CH-2: 2.5 – 2.8</td>
<td>Quizzes 3 &amp; 4</td>
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<td>4</td>
<td>2/1</td>
<td>Failure criteria Limit equilibrium, limit analysis, numerical methods</td>
<td>CH-3: 3.0 – 3.4, 3.5 – 3.10</td>
<td>#2: 3.3, 3.4, 3.6, 3.7, 3.8 Quizzes 5 &amp; 6</td>
<td>2/8</td>
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<td>2/3</td>
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<td>5</td>
<td>2/8</td>
<td>Soil settlement and shear strength Soil stiffness and difficult soils</td>
<td>CH-4: 4.0 – 4.4, 4.5 – 4.8</td>
<td>#3: 4.1, 4.2, 4.3, 4.5, 4.8, 4.9 Quiz 7</td>
<td>2/15</td>
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<td>2/10</td>
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<td>6</td>
<td>2/15</td>
<td>Site investigations Correlations, liquefaction</td>
<td>CH-5: 5.0 – 5.8, 5.9 – 5.11</td>
<td>#4, 5.7, 5.9, 5.11 Quiz 8</td>
<td>2/22</td>
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<td>2/17</td>
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<td>Project 1 – Interpreting soils report for foundation analysis Due date: 3/1</td>
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<td>7</td>
<td>2/22</td>
<td>Uncertainties in foundation design, philosophy and methodologies Foundation types, Bearing capacity</td>
<td>Ch-6: 6.0 – 6.8 Ch-7: 7.0 – 7.3</td>
<td>#5: 6.6, 6.8, 6.9, 6.10 Quiz 9</td>
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<td>2/24</td>
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<td>3/1</td>
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<td>8</td>
<td>3/1</td>
<td>Bearing capacity and Settlement of shallow foundations Seismic bearing capacity issues</td>
<td>Ch-7: 7.3 – 7.8 Ch-7: 7.8 – 7.11</td>
<td>#6: 7.1, 7.2, 7.7, 7.9, 7.14 Quiz 10</td>
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<td>3/3</td>
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<td>3/8</td>
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<td>9</td>
<td>3/8</td>
<td>Review</td>
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<td>Quiz 11</td>
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Exam 1: 3/10: Cover course materials from weeks 1 through 8
March 12 – 20: Spring Recess

<table>
<thead>
<tr>
<th>10</th>
<th>3/22</th>
<th>No lectures. Work on Project 2: Design of a shallow foundation for a health science building Due date: 3/31</th>
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<tbody>
<tr>
<td>11</td>
<td>3/29</td>
<td>Pile foundations Pile load capacity</td>
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<td>3/31</td>
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<td>12</td>
<td>4/5</td>
<td>Uplift, pile test, group piles, pile settlement Laterally loaded piles and design issues</td>
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<td>4/7</td>
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<td>13</td>
<td>4/12</td>
<td>No lectures. Work on Project 3: Design of a pile foundation for a health science building Due date: 4/21</td>
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<td>4/21</td>
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<td>15</td>
<td>4/26</td>
<td>Computer methods Review</td>
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<td>4/28</td>
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<td>5/3</td>
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FINAL EXAM: Wednesday May 11, 1:00 pm – 3:00 pm

**GRADING**

Your final course grade will be determined on the basis of your performance in the following areas:

- Quizzes (14@1%) 14%
- Assignments (9 @ 2%) 18%
- Project 1 8%
- Project 2 10%
- Project 3 10%
Exam 1 10%
Final Exam 30%

GRADES
A: 100 -90
C : 70-79
B : 80-89
D : 60-69

Grades will not be curved. Grade points will be rounded to the nearest point, e.g. 89.6% will be rounded to 90%; 89.4% will be rounded to 89%.

There will be no make up exam. If you miss Exam 1, under exceptional circumstances (e.g. sickness, hospitalization, loss of a family member), then the final exam will be graded out of 40% rather than 30%. You must inform the instructor prior to missing Exam 1 of the circumstances.

GRADING CHANGE REQUEST

Grading change request will only be accepted under exceptional circumstances such as grader's math error. Grading change request should not be made for such circumstances as 'I know the stuff but forget it in the exam' or 'You know that I know the material' or "I need to get a B in this class" or 'I made a simple math error' or 'I had other things on my mind'. To request a grading change, fill out the GRADE FORM. All grading change request must be made within 48 hours from the time the graded material was returned to the class.

HOMEWORK POLICY

Additional homework problems will be assigned during the course. Not all homework problems will be graded but you must attempt all questions. No late homework will be accepted. You are expected to read any supplemental material on foundation analysis and design.

HOMEWORK FORMAT

General
1. All work must be neatly and legibly done on engineering computation paper.
2. Use one side of the paper only.
3. At the top of each sheet, write your name, the problem # and page #.
4. Only one problem solution per page.
5. Staple all pages together.

Diagrams and Sketches
1. Be neat and try to reasonably proportion all parts.
2. All figures must be large enough to show all important details clearly.
3. All important details must be labeled.

Problem Solution
1. All important steps must be clearly shown.
2. All symbols used must be defined or shown on a sketch.
3. Include proper units in all calculations.
4. All answers must be underlined, boxed, or clearly indicated.
ABSENCES
Students are expected to be regular and punctual in class attendance. Excessive or extended absence from class is sufficient reason for the instructor to recommend to the College Dean that the student be administratively dropped from the course. In this course, more than (3) absences will be deemed "excessive." If the student is administratively dropped after the end of the fourth week of classes, it will result in a failing grade for the course. The student is encouraged to notify the Office of the Dean of Students when an absence from class of one week or more is unavoidable.

STUDENTS ENROLLED IN CE 540
You are expected to perform at the graduate level. Accordingly you will be assigned additional problems, projects and case studies.

PLAGIARISM: The plagiarism policies within the Student Code of Academic Integrity will be strictly followed: [http://doc.web.arizona.edu/uapolicies](http://doc.web.arizona.edu/uapolicies).

THREATENING BEHAVIOR: The general policies against threatening behavior by students will be followed: [http://policy.web.arizona.edu/~policy/threaten.shtml](http://policy.web.arizona.edu/~policy/threaten.shtml) Students should use appropriate etiquette and general guidelines are available online through a Google search.

SALT CENTER AND DISABILITY RESOURCE CENTER: Students who are able to use the services of the Strategic Alternatives Technology Center or may have other educational needs may contact the professor at any time to discuss accommodations for their needs. However, this should be done at least 1 week prior to the first exam to allow for preparations that may be needed. Students who are registered with the Disability Resource Center must submit appropriate documentation to the instructor if they are requesting reasonable accommodations: [http://drc.arizona.edu/teach/syllabus-statement.html](http://drc.arizona.edu/teach/syllabus-statement.html).

GUIDE TO THE LECTURES
Each topic is presented with the following format.

- Slide 1: The topic(s) to be covered and where it(they) are located in your textbook
- Slide 2: Itemized the learning outcomes. You will be tested by quizzes, homework assignments and tests to evaluate whether you have achieved the learning outcomes
- Slide 3: Where necessary, a brief description of the practical importance of the topic. One or more videos and/or images may be included. Please view the video(s).
- Slide 4 onwards
  - Presentation of the topic including where appropriate videos. Please view these videos. Most of them show practical application of the topic.
  - One or more quizzes to test your short term knowledge retention.
  - Worked example
  - An example for you to try. A slide “You turn to try” preempt a problem that you should work out completely. Click to the next slide to view the problem and then solve it. When you are done, click the next slide(s) to view the solution
  - The key points of the topic are presented
- Last slide: What’s the next topic and where in the textbook it is located. You are expected to read the stated pages before starting the next lecture
- In class example: You will be presented with one or more problems to solve. Solve it or them and then see the video of the instructor’s solution
PROJECTS

To prepare you for practice, you will undertake three actual projects and work as a productive member or leader of a team. Each team will emulate a consultant firm and will compete with other forms in the class. Each team must submit a well prepared report for each project. As a minimum, the following is required.

1. A letter addressed to the client about the report.
2. An executive summary
3. Introduction: Project overview, scope of work, project coordination
4. Design information: Review of soils report, loads including seismicity
5. Design methodology: methods used, calculations (most of these should be in an Appendix)
6. Recommendations
7. AutoCAD drawings

All reports must be bound. You will be graded as follows.

<table>
<thead>
<tr>
<th>Component</th>
<th>Sophisticated</th>
<th>Competent</th>
<th>Not Yet Complete</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teamwork</td>
<td>The team worked well together to achieve objectives. Each member contributed in a valuable way to the project. All data sources indicated a high level of mutual respect and collaboration.</td>
<td>The team worked well together most of the time, with only a few occurrences of communication breakdown or failure to collaborate when appropriate. Members were mostly respectful of each other.</td>
<td>Team did not collaborate or communicate well. Some members would work independently, without regard to objectives or priorities. A lack of respect and regard was frequently noted.</td>
</tr>
<tr>
<td>Contribution</td>
<td>All requirements and objectives are identified, evaluated and competed. The deliverable offered new information or approach to the topic under discussion. Likewise, the application is based on stated criteria, analysis and constraints.</td>
<td>All requirements are identified and evaluated but some objectives are not completed. The deliverable offered some new information or approach to the topic under discussion. The application is reasonable; further analysis of some of the alternatives or constraints may have led to a different recommendation.</td>
<td>Many requirements and objectives are not identified, evaluated and/or completed. The deliverable offered no new information or approach to the topic under discussion. Few application considerations are analyzed and other factors were ignored or incompletely analyzed.</td>
</tr>
<tr>
<td>Subject Knowledge</td>
<td>The deliverable demonstrated knowledge of the course content by integrating major and minor concepts into the response. The deliverable also demonstrated evidence of extensive research effort and a depth of thinking about the topic.</td>
<td>The deliverable demonstrated knowledge of the course content by integrating major concepts into the response. The deliverable also demonstrated evidence of limited research effort and/or initial of thinking about the topic.</td>
<td>The deliverable did not demonstrate knowledge of the course content, evidence of the research effort or depth of thinking about the topic.</td>
</tr>
<tr>
<td>Supporting Material</td>
<td>All relevant information was obtained and information sources were valid. Analysis and design considerations were well supported by the information.</td>
<td>Sufficient information was obtained and most sources were valid. Analysis and design considerations were mostly supported by the information.</td>
<td>Insufficient information was obtained and/or sources lack validity. Analysis and design considerations were not supported by the information collected.</td>
</tr>
<tr>
<td>Composition</td>
<td>The deliverable was well organized and clearly written. The underlying logic was clearly articulated and easy to follow. Words</td>
<td>The deliverable was organized and clearly written for the most part. In some areas the logic and/or flow of ideas were difficult to follow. Words were</td>
<td>The deliverable lacked overall organization. The reader had to make considerable effort to understand the underlying logic.</td>
</tr>
</tbody>
</table>
were chosen that precisely expressed the intended meaning and supported reader comprehension. Diagrams or analyses enhanced and clarified presentation of ideas. Sentences were grammatical correct and free from errors.

well chosen with some minor expectations. Diagrams were consistent with the text. Sentences were mostly grammatical correct and/or only a few spelling errors were present but they did not hinder the reader.

logic and flow of ideas. Diagrams were absent or inconsistent with the text. Grammatical and spelling errors made it difficult for the reader to interpret the text in places.

Source: www.cmu.edu

**THE POLICIES STATE ABOVE WILL BE STRICTLY AND RIGOROUSLY ENFORCED**