meaning of foundation engineering

During the period of the 1930's through the 1960's, the soils part of the current field of geotechnical engineering was called soil mechanics and foundation engineering (loosely translated from the title of Terzaghi’s original text book Erdbaumekanic auf bodenphysikalischer Grundlage) and everything not considered to be mechanics or material properties was classified as foundation engineering. Thus, the term foundation engineering referred to everything that involved engineering practice.

The term foundation engineering is now evolving more toward foundations for structures, where the word structures includes buildings, bridges, retaining walls, tanks, offshore structures, and sometimes even highway pavements.

In CE 387L.2, we will be concerned mainly with deep foundations. We will cover bearing capacity of both shallow and deep foundations but settlement of shallow foundations is covered in CE 387R.1 "Consolidation and Settlement".

Prerequisite Knowledge

It would be great if everyone had a good undergraduate course in foundation engineering but experience indicates that this will not be the case. Consequently, we will cover material we include in our undergraduate course but will move through that material more rapidly than in an undergraduate class. If you have questions about class material, whether undergraduate or not, you should ask about it in class because others probably have the same question but may lack courage to ask. I will try to respond in class but if that is not sufficient we can talk about the matter outside of class.

Our goal is to provide material that is useful in engineering practice. If you have had a good undergraduate foundation engineering course and find some of the material too elementary, you may want to do additional reading in the current topic. You may also want to give me some feedback and we may modify coverage for the whole class. It would be easy, for example, to just assign a section of the notes and move on without class discussion.

We often need an understanding of shearing properties of soils, such as is included in our course CE 387L.1. It is preferable that you have had this course but we will cover shearing properties of soils as the need arises so CE 387L.1 is not a prerequisite.
Judgment and Experience

By the very nature of the activity, foundation design involves the need to work with a lot of uncertainties and still come up with acceptable solutions. Analysis is important but my experience indicates that failures do not result from inability to analyze the problem but rather occur because the designer analyzed the wrong problem, missed some important point, didn't understand what was happening, or was just blindly following “company policy”. Although we will spend a significant amount of time on analysis, our goal is less to build up our analytical skills and more to develop our judgment and develop a proper attitude for practical work. It is clear from my experience that solutions to problems may be instantly clear to the experienced engineer and quite beyond the understanding of others who apparently possess good analytical skills.

Experience does not necessarily come from years of practical work; indeed most of the grossest errors I have seen in engineering practice were made by engineers with decades of experience. "Experience" involves an appropriate blend of understanding of material properties, analytical methods, and practical observations. Real engineers know far more than analysis and design. They know costs, sources of supply, personnel management, report writing, oral presentations, and a host of other things too numerous to list here.

Class Participation

"Experience" in this course comes about from extended discussions of the issues, both in class and outside of the classroom. If you do not participate actively in the discussions, then much of the benefit of the course will be lost. Discussions among students outside of class are an important part of the learning process. Students at major universities have often commented that they learned a lot from discussions with other students.

Textbook and Reading Assignments


In lieu of a textbook, we will use notes and occasionally read papers from the technical literature. I plan to place notes in the class folder in the “Learning Resource Center” in pdf format. You can then print them, or copy them to a computer and read them on screen.

The class notes are updated prior to the start of lecture on that topic, as well as sometimes during the lectures.

Class notes were originally written on Macs. The last time this course was offered, I changed the notes over to PC’s, which involved a massive investment of time and caused hidden errors, particularly with fonts, e.g., b appeared instead of β, or s in place of σ. If you find errors please let me know by e-mail, so I will have a record to refer to when making the corrections, and I will correct the copy on the network so you can reprint corrected pages if you wish.
With respect to assigned reading, I will try to assign papers a reasonable time in advance and try to place a scanned image of each paper on the network.

Generally, I will not discuss the assigned papers in any detail, but will, instead, discuss the topic covered in the assignments. You should read the papers in advance of the lectures, if possible, and ask questions in class when you have problems with a paper or when comments in the paper and in lecture are in conflict. Material included in the papers will be covered on examinations. In the past, students have complained that I did not discuss the papers in detail, point out important points, etc. My view is that, as intelligent graduate students, you must have, or develop, the ability to read papers and think critically about them, on your own. It is not my responsibility to tell you what to think as much as it is my responsibility to expose you to ideas and encourage you to think along constructive lines.

**Slides**

I will put a lot of material on Power Point slides. The slides will be placed in my folder on the network so you can copy them onto your own computer. They will provide the figures I use in class. I update them during the semester so they will appear on the network just prior to the lectures on that topic.

**Blackboard**

“Web-based, password-protected class sites will be associated with all academic courses taught at the University. Syllabi, handouts, assignments and other resources are types of information that will be available within these sites. Site activities could include exchanging e-mail, engaging in class discussions and chats, and exchanging files. In addition, electronic class rosters will be a component of these sites. Students who do not want their names included in these electronic class rosters must restrict their directory information in the Office of the Registrar, Main Building, Room 1. For information on restricting directory information, see the Undergraduate Catalog or go to: http // www.utexas.edu / student / registrar / catalogs /ug02-04/index/html

Recently, UT implemented this policy by using a computer program called “Blackboard”. I have never used Blackboard and have not been informed of classes on such use but will try to use it when time permits.

In the past, I have placed class material in a folder on the network (3rd floor computer system). That system seems to serve my purposes well and I will probably use it even if I need to use Blackboard. My class folder is at: Microsoft Windows Network / Lrc / civil5 / lrc / Class / Olson / CE 387L.2. Class notes, Power Point slides, back exams, and other material are there currently. I suggest that you not copy files off until we get ready to cover that topic because the material changes every semester.

**Outline**

I include a tentative outline of this course at the end of this syllabus. It is based on more than thirty years of experience but the material changes every time the course is taught, with new material added and dated material gradually fading away. The result is that
the time spent on topics changes from semester to semester and I will not try to predict needed time accurately.

**Homework**

The emphasis in this course is on thinking and understanding, not on memorizing methods of performing analyses, and thus the number of homework assignments is less than for our undergraduate course. Further, the homework that we will have is designed to help you understand the topic, not as a means of grading. Thus, it is quite permissible for you to work with other students. You should clearly do your own thinking, however, because classmates will not be able to help you on exams.

We are unlikely to have a grader for this class and the enrollment is larger than for most graduate courses. I will probably grade some of the homework but just tabulate answers for others.

A due date will be set for each assignment, typically by class agreement. It is difficult enough for me to find time to go through homework assignments when I can do them all at once. When homework comes in late it compounds the problem so I will not usually accept late homework.

**Attendance**

University regulations require that I comment on “attendance”. The course is built around the lectures so you should plan to attend the lectures regularly. I do not take attendance and it is clear that some of you will occasionally miss class because of work on research projects. However, people who just neglect to attend class have, statistically, a high probability of receiving a non-passing grade.

**Exams**

We will have two exams during the semester and a final exam. Each is planned for a duration of two hours. For exams during the semester we will have to find a two-hour period when everyone can attend.

The scheduled final exam is on Tuesday, December 14, 2004, from 9 to Noon and grades are due in the Department office the following Friday at 9AM.

Back copies of exams from this course, in pdf format, are on the network.

Examinations in this course are closed-book but sheets of relevant equations are provided with the exams (see back-files for examples).

**Grading**

The three exams will count equally and the homework will count from nothing to half an exam depending on how many assignments are actually made and graded.

When the semester is over, I will make a frequency curve of average course score (exams and homework) and pick dividing lines between the various grades in accord with my impression of how well the class has done. I make an effort to set break points in gaps so scoring a few points more or less on one exam will not change anyone’s grade. Distributions of grades in recent years have included 1988 (6 A’s, 6 B’s, 2 D’s), 1991 (11 A’s), 1993 (6 A’s, 11 B’s), 1995 (6 A’s, 5 B’s), 1996 (2 A’s, 7 B’s, 1 C), 1998 (6 A’s, 5 B’s, 2 C’s, 1
F), 1999 (9 A’s, 7 B’s, 2 C’s), 2001 (9A’s, 7 B’s, 2 C’s), and 2003 (5 A’s, 11 B’s, 4C’s). The one F went to a student who attended all of the classes but skipped two of the exams.

Almost all of the grades less than B are for students who do not understand spoken English well and who have problems expressing themselves on exams. We try to set entrance standards to avoid such problems but the TOEFL doesn’t seem to do as good a job of separating applicants in accord with their ability to understand spoken English, as it did years ago. Further, some students understandably choose to spend their non-class time with people who speak their home-country language and thus never develop a reasonable facility with the English language. While faculty are sympathetic with such problems, students who do not comprehend the material in a course cannot expect to pass the course.

The high averages are generally around 90. The A/B split is usually somewhere between about 67 and 75 and the B/C split somewhere around 60. Scores in the 30's and 40's typically rate D's or F's and those students usually drop out of the program. If you get any exam score less than 50 you should meet with me so we can try to figure out the cause of the low score and fix the problem before it is too late.

Honesty

I am unaware of any past problems with cheating by graduate students, and we don’t anticipate any problems this semester. However, in accord with University regulations, we will prosecute any example of dishonesty to the full extent of University rules.

Neatness

As engineers, you should inherently be neat and organized. You should certainly strive for neat work because you will probably have to return to design calculations at a variety of times in your careers and if you cannot figure out your own work you could be in severe difficulty. On exams, I will not give credit for answers I cannot read and will not change grading based on subsequent verbal explanations. It is your responsibility to communicate effectively with me on exams. Do not write in such tiny letters, or write so lightly, that I can’t read your material.

Computer Programs

Years ago, we had regular homework assignments involving the writing of simple computer programs. Most current students seem not to be able to write simple programs, but most are now accomplished at using Excel or some similar spreadsheet. We will have several homework assignments where you could use coding or spreadsheets.

We will use programs written by me or by others in several assignments. There are hundreds of commercial and shareware computer programs available in geotechnical engineering. You might want to check the website: http://www.ggsd.com for a listing of available codes (1578 codes listed as of September 1, 2004).

Finite Element Codes

Geotechnical engineers are making increasing use of finite element codes on major projects. I sat-in on a one-semester course on Abaqus and took an
intensive one-week PLAXIS course, in the hope that they would be useful in my classes. The time needed to get up to speed proved excessive and the cost was also excessive for someone not using them in industry, and thus I will not plan on using any in this class. Z_Soil.PC supplied by ZACE Services Ltd. Use http://www/zace.com. Price seems to be around $6000. Abaqus – available for use at UT but seems to be too expensive for use by small engineering firms. PLAXIS – last price I saw was around $12000 depending on which of their packages you choose.

**Dropping Courses**

From the 1st through the 4th class day ("class day" means Monday through Friday when classes are in session, not the days any given class actually meets), graduate students can drop or add a course on Rose or TEX and receive a refund. During the 5th through 12 class day, no refund is given. From the 13th through 20th class day, an automatic Q is assigned on approval from the graduate advisor and the Graduate Dean. From the 21st through the last class day, graduate students may drop a class with permission from the instructor, graduate advisor, and the Graduate Dean. Students with 20 hr/week appointment or a fellowship may not drop below 9 hours.

**Office Hours**

For graduate classes, I think scheduling office hours restricts your opportunity to talk with me at the time you actually have a need. Consequently, I do not schedule office hours. You are free to see me any time I am in my office (most of the time Monday through Saturday and generally Sunday afternoon).

**Course/Instructor Evaluation**

In accord with College policy, you will have the opportunity to turn in anonymous evaluations of both the course and the instructor at the end of the semester.

**Instructor Absences**

Faculty at all major universities miss class periodically for conferences, project meetings, etc. Missed classes may be made up using exams scheduled outside the regular class time or with lectures outside the scheduled class time. I presently have two trips planned, so I expect to miss class on September 10, and October 4.

**Guest Lecturers**

I occasionally use guest lecturers who are particularly expert in some aspect of foundation engineering. They may speak during a scheduled class period or at some other time.

**Students with Disabilities**

The University of Texas at Austin provides, upon request, appropriate academic adjustments for qualified students with disabilities. Any student with a documented disability (physical or cognitive) who requires academic accommodations should contact the Services for Students with Disabilities area of the Office of the Dean of Students at 471-6259 as soon as possible to request an official letter outlining authorized accommodations. For more information, contact that Office, or the
College of Engineering Director of Students with Disabilities at 471-4321.

**Class Web Sites and Student Privacy**

I am required to provide the following message:

“Web-based, password-protected class sites will be associated with all academic courses taught at the University. Syllabi, handouts, assignments and other resources are types of information that may be available within these sites. Site activities could include exchanging email, engaging in class discussions and chats, and exchanging files. In addition, electronic class rosters will be a component of the sites. Students who do not want their names included in these electronic class rosters must restrict their directory information in the Office of the Registrar, Main Building, Room 1. For information on restricting directory information, see the Undergraduate Catalog or go to: http://www.utexas.edu/student/registrar/catalogs/ug02-04/index.html.
Outline

This outline is intended to indicate generally the topics and estimated amount of time spent on each. It will not be followed rigidly.

<table>
<thead>
<tr>
<th>Topic</th>
<th>Lectures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction</td>
<td>1</td>
</tr>
<tr>
<td>Ground Improvement</td>
<td>2</td>
</tr>
<tr>
<td>brief discussion of methods used to improve site conditions so as to allow use of less expensive foundations</td>
<td></td>
</tr>
<tr>
<td>Bearing Capacity</td>
<td>7</td>
</tr>
<tr>
<td>circular arc analyses, Terzaghi's theory, layered systems, anisotropy, progressive failure, drained versus undrained, special factors (depth, slope, inclined load, shape), knowledge gained from case histories</td>
<td></td>
</tr>
<tr>
<td>Incidental discussions, as needed, of such topics as shearing strength, boring and sampling, sampling disturbance, use of quasi-static cone tests, and related matters that come up as part of other topics</td>
<td>1</td>
</tr>
<tr>
<td>Fundamentals of Pile Foundations</td>
<td>7</td>
</tr>
<tr>
<td>pile types, pile driving, allowable stresses, pile deterioration, construction and inspection, specifications, load tests</td>
<td></td>
</tr>
<tr>
<td>Static Design</td>
<td>11</td>
</tr>
<tr>
<td>static analyses of piles in clay and sand, time dependency of capacities, settlement analyses using t-z curves and elastic analyses, reliability analyses, model and field data for groups, lateral loading of piles and pile groups</td>
<td></td>
</tr>
<tr>
<td>Dynamic Design</td>
<td>6</td>
</tr>
<tr>
<td>dynamic formulas, wave equation analyses</td>
<td></td>
</tr>
<tr>
<td>Drilled Piers</td>
<td>5</td>
</tr>
<tr>
<td>construction procedures, inspection, remedial measures, capacity in clays and sands, load-transfer analyses, soil-structure interaction, case histories</td>
<td></td>
</tr>
<tr>
<td>Exams During the Semester</td>
<td>2</td>
</tr>
<tr>
<td>Total M-W-F Class Days</td>
<td>42</td>
</tr>
</tbody>
</table>