CIV 333 SOIL MECHANICS LABORATORY

Fall 2005

Course Hours:
   F 2:00pm – 4:50pm  AR 129

Instructor:
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   Phone, 771-2926
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   Web page, http://www.tcnj.edu/~krstic
   Office Hours, T 2-3:30 pm & TH 9-10:00 am

Textbooks:

References:

Course Objective

Soil Mechanics Laboratory (CIV 333) is a companion course to Soil Mechanics (CIV 331). It will enhance your understanding of soil mechanics by focusing on the engineering soil properties and their measurement. A student completing the course will:

1. Learn the relevant terms and soil tests needed to describe and predict the behavior of a soil, permitting the student to work effectively with specialists in geotechnical engineering. As applicable, testing will follow standard practices as in ASTM (American Society of Testing Materials), AASHTO (American Association of State Highway and Transportation Officials) and/or standard laboratory procedures.
2. Improve professional engineering skills, including the presentation of technical data and written communications.
Schedule

A schedule of the laboratory experiments is attached. Reading assignments from the course textbook are indicated on the laboratory schedule. Additional handouts may be given in class. Make-up laboratory sessions will be carefully considered on a case-by-case basis. If you are absent due to health reasons you must provide a doctor’s report. For absences due to other reasons see the instructor before the scheduled class. If you miss the experiment and cannot excuse your absence, you will not be able to attend the make-up class. You will still have to prepare a report addressing as many sections as you can. The report will be graded to a maximum of 25 points.

Laboratory Procedures and Policies

1. You must come in the laboratory on time. Students late more than 15 minutes will miss majority of the instructions and will not be able to attend the class.
2. Read the appropriate laboratory manual section and ASTM standard, and review lecture notes prior to the laboratory class. Prepare a short summary of the test scheduled including the purpose and importance of the experiment and the means of execution, and hand it in as you come into the laboratory. Students without the summary will not be allowed to participate in the class. The summary will be signed by the instructor and returned to you at the end of the experiment to be used as a part of your laboratory report.
3. All experiments will be conducted in groups. Each group will have laboratory equipment assigned to them from the group’s shelf. All members of the group are required to sign out/in the equipment they will be using on the appropriate form located on the shelf. Each student will be individually responsible for the equipment he/she will be using. The entire group shares responsibility in establishing that the equipment is in proper working order prior to the start of the work. If any equipment is not functioning correctly, please bring it to the instructor’s attention.
4. Soil is dirty. Students must thoroughly clean all laboratory equipment after completing an experiment and return all equipment pieces to the appropriate shelves. A penalty in the report grade of 25% will be imposed if this is not done properly. The work place must also be properly cleaned, and all soil must be discarded as instructed.
5. Use data sheets in the laboratory manual to record all data, not notebook or scrap paper. After the completion of an experiment, neatly complete as much of the computation as possible and have the instructor sign it before leaving. Before approaching the instructor check that all information has been recorded on the data sheet (group number, sample number, date, etc.). These sheets must be attached to the laboratory report.
Laboratory Reports

Each student is required to submit an individual laboratory report describing the experiment conducted in the class. Reports will be due at the beginning of the class on the week following the completion of the experiment. Late reports will be accepted but with the penalty of 25 points. Reports late for longer than a week will not be accepted. Word processor is required for report preparation. Hand written reports will not be accepted. Graded reports will be returned in class.

The report should consist of the following:

1. **Title Page**: Download title page or obtain one in the class. Reports without the title page will not be accepted.
2. **Table of Contents**
3. **Summary**: Prepared as noted in Laboratory Procedures and Policies section and signed by the instructor.
4. **Pre-laboratory Activities**: Include all activities performed before the actual class experiment such as soil sampling, sample preparation, etc. Soil sample used in the experiment should be identified in this section. Include illustrations and bibliographical references if appropriate.
5. **Test Procedure and Equipment**: The Test Procedure should list the steps necessary to complete the experiment and describe the necessary equipment. Do not copy the textbook. Concisely describe the procedure in your own words. It is not necessary to give every single detail, just basics. List any deviations from the procedure described in the manual. Also state the relevant ASTM or AASHTO standards. Include appropriate bibliographical references and illustrations.
6. **Results (tables, graphs, figures, illustrations)**: If appropriate, the report should contain tables, graphs, figures, and illustrations which will help in your Discussion and Analysis of Results. These tables/graphs/figures should appear at the point in the text where they are discussed. These graphics will be of a quality (not pencil) appropriate for a formal report, however, you may add neatly typed handwritten notes, calculations or graphical procedures to the graphs. Each graphic entry will include a caption, and there should be no graphic entry which is not part of the text discussion. Pay attention to axis labels, scales and units.
7. **Discussion and Analysis**: Comment on the results and accuracy of your lab exercise. If applicable compare the results with given examples in your textbook or lecture class and discuss differences. Identify specific design and/or field application of the experiment.
8. **Conclusions and Recommendations**: The conclusions will be drawn from your analysis, while the recommendations should indicate elements that might be done differently next time.
9. **Bibliography**: An "Annotated Bibliography" will follow your Conclusions and Recommendations and immediately precede your Appendix. Each bibliographic entry
will include annotative comments about the source. The bibliography should include the class text, and may include a section listing.

10. Appendix:
   - **Laboratory Data Sheets:** Completed during the class and signed by the instructor.
   - **Equations and Calculations:** List all appropriate equations as well as any additional calculations not shown in the laboratory data sheets. This can be neatly handwritten. List those equations appearing in the laboratory data sheets first, additional equations and calculations last.

### Laboratory Report Grading

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<td>Table of Contents</td>
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<tr>
<td>Summary</td>
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<td>Pre-laboratory Activities</td>
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<tr>
<td>Test Procedure with Equipment</td>
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<tr>
<td>Results (tables, graphs, figures, illustrations)</td>
<td>10</td>
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<tr>
<td>Discussion and Analysis</td>
<td>10</td>
</tr>
<tr>
<td>Conclusions and Recommendations</td>
<td>10</td>
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<tr>
<td>Bibliography</td>
<td>5</td>
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<tr>
<td>Appendix</td>
<td></td>
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<tr>
<td>Laboratory Data Sheets</td>
<td>10</td>
</tr>
<tr>
<td>Equations and Calculations</td>
<td>10</td>
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<tr>
<td>General Neatness and Quality of Presentation</td>
<td>15</td>
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<tr>
<td>Total</td>
<td>100</td>
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</table>

### Useful Comments from Students

- Be familiar with Excel and Word.
- Know the lab procedures before starting. Read the manual.
- Have responsible people in your group, so the best job is done.
- Pick group members with similar schedule. Easier to get together.
- Assign duties and keep them each week. Write them up.
- Be careful when conducting tests and do the lab.
- Do not cut corners.
- Make sure you have all relevant information before leaving the lab.
- Have open mind and be willing to get dirty.
- Do not forget what you learned in CIV 331 lecture.
- Learn to use semi-log graph.
- Learn to use balance, ruler, calipers, etc.
- Do all computation before leaving the lab.
• Take good notes as the Professor is giving instruction.
• Do all labs.
• Do not forget about void ratio.

The Terzaghi Quote

When Yves Lacroix asked Terzaghi how much time he ought to spend on writing his report, he got the following advice:
“Spend on it as much time as necessary to inform the reader with as few words as practicable about all the significant findings and about the essential features of the construction operations which have been performed.”

Laboratory Safety

Use extreme care in performing all experiments. If you observe or feel that unsafe working conditions exist, report immediately to the instructor and do not continue work until safe working conditions have been restored. Laboratory Safety Guidelines will be provided for your reference. You are required to read the Safety Guidelines.

Exams

Final exam and semester exams will not be scheduled for this course.

Grading Procedures

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<tbody>
<tr>
<td>Reports</td>
<td>85%</td>
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<tr>
<td>Class Participation and Testing</td>
<td>15%</td>
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</tbody>
</table>

Letter grade equivalent (%):

- A = 100 - 93
- A- = 92.9 - 90
- B+ = 89.9 - 87
- B = 86.9 - 83
- B- = 82.9 - 80
- C+ = 79.9 - 77
- C = 76.9 - 73
- C- = 72.9 - 70
- D+ = 69.9 - 67
- D = 66.9 - 60
- F = 59.9 - 0
Course and Instructor Evaluation

A formal course and instructor evaluation will be conducted at the end of the semester. Suggestions for improving the instruction and course content are welcome at any time and are particularly appreciated.

Educational Objectives
(What TCNJ engineers should be able to accomplish during the first few years after graduation)

The School of Engineering at The College of New Jersey seeks to prepare its graduates:

a) To contribute to the economic development of New Jersey and the nation through the ethical practice of engineering;

b) To become successful in their chosen career path, whether it is in the practice of engineering, in advanced studies in engineering or science, or in other complementary disciplines;

c) To assume leadership roles in industry or public service through engineering ability, communication skills, teamwork, understanding of contemporary global and socio-economic issues, and use of modern engineering tools;

d) To maintain career skills through life-long learning and be on the way towards achieving professional licensure.

Civil Engineering Program Outcomes

The Program Outcomes listed below are expected of all graduates of the Engineering Science/Civil Engineering Specialization Program. Highlighted are program outcomes expected to be achieved in this course.

a. an ability to apply knowledge of mathematics, science and engineering; soil mechanics
b. an ability to design and conduct experiments, as well as to analyze and interpret data; students will conduct experiments, analyze and interpret data
c. an ability to design a system, component, or process to meet desired needs;
d. an ability to function in multidisciplinary teams;
e. an ability to identify, formulate and solve engineering problems;
f. an understanding of professional and ethical responsibility;
g. an ability to communicate effectively; students will work in teams
h. the broad education necessary to understand the impact of engineering solutions in a
global and societal context;
i. a recognition of the need for and an ability to engage in life-long learning;
j. a knowledge of contemporary issues;
k. an ability to use the techniques, skills and modern engineering tools necessary for
engineering practice;
   students will use various laboratory equipment including state-of-the-art data
   acquisition system; students will analyze data using Excell
l. proficiency in mathematics through differential equations; probability and statistics;
   calculus-based physics and chemistry;
m. proficiency in a minimum of four (4) recognized major civil engineering areas;
n. an ability to conduct laboratory experiments and to critically analyze and interpret data in
   more than one of the recognized major civil engineering areas;
   in addition to conducting experiments in soil mechanics, students will learn how
   the obtained results can influence design and construction decisions in other civil
   engineering areas
o. an ability to perform civil engineering design by means of design experiences integrated
   throughout the professional component of the curriculum;
p. an understanding of professional practice issues such as procurement of work; bidding
   versus quality based selection processes; how the design professionals and the
   construction professions interact to construct a project; the importance of professional
   licensure and continuing education; and/or other professional practice issues.

Design Activity:
Following instructions in the textbook and appropriate standards, students are required to design
one field experiment.

Engineering Standards:
Students will become familiar with ASTM and AASHTO standards related to testing in
Geotechnical Engineering.

Realistic Constraints:
Realistic constraints such as economic, manufacturability, ethical, health and safety are discussed
at the appropriate times when experiments are being discussed.

Modern and Professional Engineering Tools Usage:
EXCEL, and data acquisition system are used for data collection and interpretation.

Computer Usage:
Computer usage is required for the report preparation and data analysis. Students will also use
state-of-the-art data acquisition system.
<table>
<thead>
<tr>
<th>#</th>
<th>Date</th>
<th>Laboratory Exercise</th>
<th>Sections in Das</th>
<th>ASTM</th>
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<tbody>
<tr>
<td>1</td>
<td>F, Sept 2</td>
<td>Introduction, Soil Sampling (water content, specific gravity, sieve analysis), Water Content, Specific Gravity (sample preparation)</td>
<td>1, 2</td>
<td>D2216 D422</td>
</tr>
<tr>
<td>2</td>
<td>F, Sept 9</td>
<td>Water Content, Specific Gravity</td>
<td>2, 3</td>
<td>D2216 D854</td>
</tr>
<tr>
<td>3</td>
<td>F, Sept 16</td>
<td>Sieve Analysis</td>
<td>4</td>
<td>D422</td>
</tr>
<tr>
<td>4</td>
<td>T, Sept 20</td>
<td>Liquid Limit, Plastic Limit, Shrinkage Limit (sample preparation)</td>
<td>6, 7, 8</td>
<td>D4318 D427</td>
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<tr>
<td>5</td>
<td>T, Sept 27</td>
<td>Hydrometer Analysis</td>
<td>5</td>
<td>D422</td>
</tr>
<tr>
<td>6</td>
<td>F, Oct 7</td>
<td>Shrinkage Limit, Soil Classification</td>
<td>8, 9</td>
<td>D427 D3282 D2487</td>
</tr>
<tr>
<td>7</td>
<td>F, Oct 14</td>
<td>Field Unit Weight (Sand Cone, Rubber Balloon), In-situ Moisture Content, Soil Sampling (Proctor)</td>
<td>14</td>
<td>D1556 D2167 D4944</td>
</tr>
<tr>
<td>8</td>
<td>T, Oct 18</td>
<td>Compaction (Standard Proctor, Modified Proctor, CBR)</td>
<td>12, 13</td>
<td>D698 D1557 D1883</td>
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<td>9</td>
<td>F, Oct 28</td>
<td>Permeability (Constant Head, Falling Head, Compaction)</td>
<td>10, 11</td>
<td>D2434 D5856</td>
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<tr>
<td>10</td>
<td>F, Nov 4</td>
<td>Introduction to software and data acquisition. Test demonstrations.</td>
<td>-</td>
<td>-</td>
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<td>11</td>
<td>T, Nov 8</td>
<td>Consolidation</td>
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<td>D2435</td>
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<td>12</td>
<td>F, Nov 18</td>
<td>Consolidation (data reduction)</td>
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<td>D2435</td>
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<td>F, Nov 25</td>
<td>Thanksgiving Break – No Classes</td>
<td>-</td>
<td>-</td>
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<td>13</td>
<td>F, Dec 2</td>
<td>Shear Strength (Direct Shear, Unconfined Compression, UU Triaxial Test, Pocket Penetrometer, Torvane) *</td>
<td>15, 16, 18</td>
<td>D3080 D2166 D2850</td>
</tr>
<tr>
<td>14</td>
<td>T, Dec 6</td>
<td>Shear Strength (Direct Shear, Unconfined Compression, UU Triaxial Test, Pocket Penetrometer, Torvane) *</td>
<td>15, 16, 18</td>
<td>D3080 D2166 D2850</td>
</tr>
</tbody>
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* Experiments will be conducted simultaneously.