Civil Engineering 4S04 - Foundation Engineering

Principles of foundation design(*) : bearing capacity, settlement and location, footings, deep foundations, piles, pile groups and drilled piers, retaining walls, slope stability, culverts and conduits.
(*) Not all topics will receive the same coverage

Session: Term I: 04/09/2018 – 05/12/2-18

Instructor: Dr. Dieter Stolle
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E-Mail: stolle@mcmaster.ca
Office Hours: By appointment

Teaching Assistants: TBA

Lectures: Monday/Wednesday 11:30-12:20; Room: T13-125
Friday 11:30-13:20

Tutorials: Friday 11:30-13:20; Room: T34-103

Course Outline – 2018

All structures that are designed and built by Civil Engineers are connected in some way to the surface of the earth. Foundations provide the connection between man-made structures and the geosphere. Foundation Engineering is concerned primarily with soil-structure interaction and is therefore important in all areas of civil engineering, in particular for structural engineering including, for example, building and bridge design.

Course Description

This is a four credit undergraduate course in civil engineering. The main purpose of the course is to apply the principles of geology and soil mechanics to the design and analyses of foundations of structures, such as buildings, bridges, and retaining structures. Theoretical and empirical design methods for stability and settlement are discussed using example problems and case histories. Practical application is emphasized through the assignments, which require interpreting results of a soil investigation, engineering analyses and design (applying the principles and concepts of Geotechnical Engineering to ‘real’ structures). Foundation designs are not unique; although some are better than others.

Teaching Approach

The topics in this course will be presented using a traditional lecture format. Students are expected to attend lectures to ensure that they appreciate what material is considered to be most important. Tutorials will be used to present examples and case histories, or as a problem solving session during which assignments will be completed and handed in.
Assignments are intended to help consolidate the understanding of material presented in lectures as well as extend concepts covered in lectures.

**Assessment of Learning**

Assignments: 35%
Term Tests/Quizzes: 40%**
Exam: 25%***

* A student must achieve a weighted average grade of at least 50% for the term tests and final examination combined for the assignments/quizzes to be counted as part of the final grade.
** Missed work forms will not be accepted for quizzes/tests. Each quiz has a weight of 1%. The weight of test will depend on number of tests and quizzes. Each test/quiz emphasizes the material covered during the previous two weeks unless otherwise informed.
*** The weight of the exam will be decided based on discussion with class regarding the marking scheme. It will be proposed that those obtaining over 70% on tests and quizzes will not be required to write the exam.

**Textbook**

Any undergraduate soil mechanic’s textbook.

**References**

1. Any Level III textbook (Craig is preferred)
2. Bowles, J.E. Foundation analysis and design, McGraw-Hill.
   Complementary K provides additional information for the National Building Code of Canada (NBCC) 2005 provisions regarding the design of foundations and temporary excavations. Pertinent NBCC Sections include Section 4.2 (Foundations) Subsection 4.1.3 (limit states design).
4. NAVFAC Manuals: DM 7.01 and DM 7.02

**Learning Outcomes**

After completing the course, the student will be capable of,

- appreciating the design process in foundation engineering and designing simple foundations (Design: 4.3, 4.3)
- identifying applicable theory to solve practical problem under consideration (Analysis: 2.1, 2.3)
- selecting appropriate model and methods and identify assumptions and constraints leading to solution of problem (Investigation: 3.2, 3.3)
- using modern/state of the art tools (Tools: 5.2)
The emphasis in the course will be on relating theory to practice, which is not always clear. Skills and theoretical background obtained in Civ Eng 3A03 and 3B03 should be sufficient to carry out analysis and design in this course. Students will be introduced to use of software to perform sensitivity analysis, an important task in design.

Sufficient review of material covered in the Level III courses is provided, focusing on the practical. You are expected to have mastered what was taken in Level III. Please remember that design is the application of theory to problems, which are not necessarily well defined to provide a solution for the task at hand.

Course Topics (Tentative)

<table>
<thead>
<tr>
<th>Topic</th>
<th>Lectures**</th>
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<tbody>
<tr>
<td>1. Introduction</td>
<td>1</td>
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<td>2. Review of Soil Mechanics (First tutorial will be used as a review)</td>
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<td>3. Site Investigation</td>
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<td>• Site Characterization</td>
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<td>• Exploration and sample techniques</td>
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<td>• In-situ tests (SPT, CPT, Vane shear, etc.)</td>
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<td>4. Observational Approach in Foundation Engineering</td>
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<td>5. Limit States Design in Geotechnical Engineering</td>
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<td>6. Shallow Foundations</td>
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<td>• Bearing capacity</td>
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<td>• Settlements</td>
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<td>• Spread Footing Design</td>
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<td>7. Mat Foundations</td>
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<td>8. Lateral Earth Pressure and Retaining Structures</td>
<td>3</td>
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<td>9. Gravity Retaining Structures (John Emery)</td>
<td>2</td>
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<td>10. Coulomb Analysis and Braced Excavations (dewatering)</td>
<td>3</td>
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<td>11. Deep Foundation Analysis and Design</td>
<td>4</td>
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<td>• Types, installation, load transfer etc.</td>
<td>4</td>
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<td>• Single Piles</td>
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<td>• Pile Groups</td>
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<td>12. Slope Stability for Foundation Problems</td>
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<td>13. Miscellaneous – depends on time constraints</td>
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** The number of lectures per topic is approximate. Order of lectures may be switched around, depending on lecture constraints and time to cover each topic.
Policy Reminders

Only the McMaster Standard Calculator may be used on tests and examinations!!!!

The Engineering Faculty has a specific policy statement on discrimination. If you are unfamiliar with it, please obtain a copy from the Faculty Office.

All students are expected to conduct themselves in an ethical and honest manner. Academic dishonesty consists of misrepresentation by deception or by other fraudulent means and can result in serious consequences, e.g. the grade of zero on an assignment, loss of credit with a notation on the transcript (notation reads: “Grade of F assigned for academic dishonesty”), and/or suspension or expulsion from the university.

It is your responsibility to understand what constitutes academic dishonesty. For information on the various kinds of academic dishonesty please refer to the Academic Integrity Policy, specifically Appendix 3, located at

http://www.mcmaster.ca/senate/academic/ac_integrity.htm

The following illustrates only three forms of academic dishonesty:

- Plagiarism, e.g. the submission of work that is not one’s own or for which other credit has been obtained. (Insert specific course information, e.g. style guide)
- Improper collaboration in group work. (Insert specific course information)
- Copying or using unauthorized aids in tests and examinations.

Health and Safety

The Department of Civil Engineering is committed to McMaster’s University Workplace and Environmental Health and Safety Policy which states: “Students are required by University policy to comply with all University health, safety and environmental programs”.

It is your responsibility to understand McMaster University Workplace and Environmental Health and Safety programs and policies. For information on these programs and policies please refer to McMaster University Environmental and Health Support Services Occupational Safety Risk Management Manual at: