CVEN3203 Applied Geotechnics and Engineering Geology

Semester 2, 2016

Never Stand Still | Faculty of Engineering | School of Civil and Environmental Engineering

COURSE DETAILS

Units of Credit	6		
Contact hours	5 hours per week		
Class	Tuesday,	12:00 – 2:00	CLB 7
	Thursday,	9:00 – 10:00	Science Theatre
Workshop	Thursday	10:00 – 12:00	Various (to be assigned in class)
Course Coordinator and Lecturer	Dr Kurt Douglas email: k.douglas@unsw.edu.au (preferred) office: CE 506		
Lecturers	Adnan Sufian email: a.sufian@unsw.edu.au David Green email: d.k.green@unsw.edu.au		

INFORMATION ABOUT YOUR COURSE AND GEOTECHNICAL ENGINEERING FUTURE

Geotechnical Engineering is the study of the behaviour of soil, rock and groundwater under engineered environments. Most engineering structures will inevitably have some sort of interaction with the ground surface. Geotechnical Engineers attempt to describe and/or model this interaction to achieve a safe and efficient design.

So far, you have studied CVEN3202 Soil Mechanics. Therefore, by now you should understand: the basic engineering classification of soil; how soil behaves under imposed stresses and strains; how groundwater flows through soil and its effect on engineered structures; and also basic slope stability. There are two main areas that you have not covered that will be addressed in this course:

(A) How to relate the 'real-world' geological environment to your knowledge of 'class-room' soil; and

(B) How to combine your current knowledge and Part (A) to perform a Geotechnical Engineering design.

Part (A) Engineering Geology

A Geotechnical Engineer must have an understanding not only of engineering principles but also of geology and the inherent variability and challenges it has for engineering. This course will teach you a basic understanding of geology including how geotechnical materials are formed, what their characteristics are and how to describe them using engineering and geological terms. It will attempt to give you some understanding of the challenges a geological environment may have for a particular engineering project. At the end of the course you should, for any site and engineering project, be able to either: (a) develop a preliminary geotechnical model for the site that can be used for design or (b) be able to discuss more complex geology with Engineering Geologists to again come up with a suitable geotechnical model.

Part (B) Applied Geotechnics

This part of the course represents the 'final stage' of a Geotechnical project. It will require you to study the conventional methods for the design and analysis of common geotechnical constructions including shallow and deep (pile) foundations and retaining walls. For many of you, this will be your final course in Geotechnical Engineering and we hope you gain an appreciation of some of the complexities of Geotechnical Engineering.

Those, no doubt attractive and highly intelligent students, looking for a demanding and challenging yet very satisfying career will obviously wish to pursue Geotechnical Engineering further. We have a number of Geotechnical electives in final year that will extend your knowledge even further into areas like advanced soil mechanics; applications of computer simulation techniques to geotechnical engineering problems; ground improvement and the design of pavements, tunnels and slopes.

As a graduate Geotechnical Engineer, you might expect to work on projects as diversified as: building and bridge foundation design; dam design and construction; road pavement design; slope stability analysis and stabilisation and tunnel and mine design. Most typically you will do a part-time coursework masters with us after working for a year or two to supplement your knowledge (and provide an excuse for your high charge-out rate). Some of you may even wish to do a PhD (if interested come and talk with us any time, we have lots of projects/scholarships available).

HANDBOOK DESCRIPTION

See link to virtual handbook:

http://www.handbook.unsw.edu.au/undergraduate/courses/2016/CVEN3203.html

OBJECTIVES

To introduce you to geology and geotechnical engineering.

To show you how to describe geotechnical materials.

To show you how to assess the geology and geological history of a site so as to develop a preliminary geotechnical model that can be used as a basis for engineering design.

To give you an appreciation and ability to converse with Engineering Geologists so as to develop geotechnical models for geologically complex sites.

To study the basic principles related to the theory and design of shallow foundations, deep foundations and retaining walls.

TEACHING STRATEGIES

The contents of this subject will be presented to you in a number of formats. Each of these are explained below together with our expectations of you.

Lectures: In the first part of the course, formal lectures will be presented to discuss the basic geological principles. As geology is a very visual subject, PowerPoint and video presentations will be used to enhance various aspects of the course. In the second part of the course, the lectures will provide and familiarise you with the design and analysis methods used in engineering practice. Equally important, you will be exposed to the theories on which these methods are based so that you can understand the assumptions and limitations of the methods, and possible modifications. Alternative methods other than those covered in the lectures exist in practice. It is important for a qualified engineer to understand and to critically examine those using fundamental theories.

You are expected to attend all the lectures as they will greatly assist in understanding what is presented in the textbook and lecture notes. The lectures will also be a primary point of communication between the class and us. Further communication will be via your student email and Moodle. It is very important that you frequently check your messages.

Demonstrations/workshops: The demonstrations/workshops in the first half of this subject are used to teach you 'hands on' rock and mineral description and classification; geological processes, geological mapping and the preparation of preliminary geotechnical models. You will be expected to be present and participate at all workshops,

as they will contain material not covered in the lectures. In the second half of the course, the workshops will provide you with the opportunity to discuss the lecture material with your demonstrators and to solve the set workshop problems. The problems may consist of past exam papers as well as problems given in the recommended texts or others. In order to understand the subject matter well, it is essential to attend the workshop classes and solve the workshop problems by yourself (preferably prior to the workshop timeslot so that you can maximise your outcomes from the workshops).

Assignment: It is important that you participate fully in your group assignments. The assignments contain a considerable amount of self-learning that will be critical to your understanding of Sydney geology and mapping and descriptive techniques. You may approach your demonstrators or me for guidance when doing the assignment. This includes showing drafts of your work to me for comment prior to submission. A lot of the assignment information will be provided on Moodle.

Moodle: will be used to provide you with copies of lecture notes and some presentations for review. Additional quizzes will be available and solutions to workshops will be given. Lots of useful links will also be provided. Note that the pages have been split into: A – Geology and B – Applied Geotechnics. If something doesn't work or is missing, feel free to email.

Private study: Your private study should include a review and reflection of lecture material; doing workshop and assignment problems; and generally taking notice of the characteristics of the geological/geotechnical environments that you travel through each day.

GRADUATE ATTRIBUTES

It is an aim of this course to help develop the following graduate attributes:

To give students a solid grasp of the theory and practice of geotechnical engineering, and to be familiar with the bases of research to further develop its technology. In addition, graduates should be able to apply theory to practice in familiar and unfamiliar situations;

To stimulate the intellectual curiosity of students so that they will be motivated to undertake independent reflective learning as a lifelong skill;

To teach students how to define, analyse and solve problems clearly and logically and in doing so be able to find, evaluate, interpret and collate information;

To develop independent critical thought within students so that when necessary they will be able to challenge current knowledge and thinking;

To encourage proactive behaviour in students and to give them the associated entrepreneurial skills necessary;

To promote a respect within students for individual human rights and dignity, particularly when it relates to members of the public or other people who will be affected by the projects that they design and execute;

To foster effective self-management skills;

To nurture the skills required for effective leadership including an ability to manage and deliver projects, an understanding of the social dynamics of group performance, a repertoire of processes for the effective management of groups, and the ability to value diverse backgrounds and opinions and function effectively in multidisciplinary teams; and

To impart sound IT working skills.

ASSESSMENT

The final grade for this course will normally be based on the sum of the scores from each of the assessment tasks. The Final Examination is worth 40% of the Final Mark if class work is included and 100% if class work is not included. The class work is worth 60% of the Final Mark if included. A mark of at least 40% in the final examination is required before the class work is included in the final mark. The formal exam scripts will not be returned. Students who perform poorly in the assessment tasks and workshops are recommended to discuss progress with the lecturers during the

semester. Note: The co-ordinator reserves the right to adjust the final scores by scaling if agreed by the Head of School.

ASSESSMENT COMPONENTS

Assignment	Assignment Details	Issued	Due Date	Value
Workshops	The geology workshops will be used to teach you more about practical 'hands-on' geology. Marks will be awarded by demonstrators primarily for attendance and a reasonable effort (both prior to and during the workshop) with the activities.	Prior to workshop	During workshop	5%
Assignment	Comprises two parts. A field mapping component will give you experience in mapping rock defects (joints, bedding etc.). This will be carried out in Bronte and I will attend the site on occasions to assist. A self-guided field trip will require you to explore the geology of a part of Sydney, giving you a better understanding of what the rocks and geological structures of Sydney look like in the field.	Week 3	4:00pm Monday Week 9	25%
Quizzes	Quiz 1 will be **closed book** and will test your understanding of the geology component of the course. Quiz 2 will be **open book**. and will test the fundamentals/principles of applied geotechnics.	Workshop	Q1 – Thurs Wk 7 Q2 – Thurs Wk 11	20% 10%
Exam	The final exam will **only** cover the Applied Geotechnics component of the course.		Exam period	40%

Note: Late work will be penalised at the rate of 10% per day after the due time and date have expired.

COURSE PROGRAM

SEMESTER 2, 2016 (Table indicative and subject to change)

Week		Assessments Due
1	Introduction to course. The earth, its formation, geological time, plate tectonics.	
2	Rock cycle and the formation of different rocks.	Geology workshop
3	Rock classification. Engineering rock descriptions and geotechnical mapping.	Geology workshop
4	Structural geology, geological maps and mapping, plotting information.	Geology workshop
5	The geotechnical model and site investigations. Geology case study.	Geology workshop
6	Soils – including alluvial, aeolian, colluvial, residual. Soil case study. Foundation systems and their application	Geology workshop
7	Geotechnical design methods, Basics of bearing capacity of shallow foundations; Presumptive bearing capacity.	Geology Quiz
8	Settlement of shallow foundations, Allowable settlements.	
9	Foundations on sand: Modified Meyerhof's method, Strain influence factor method	Assignment Due
	Mid-Session Break	
10	Pile foundations: Ultimate load and settlement due to vertical and lateral loading	
11	Lateral earth pressure, Basic design of retaining walls	Applied Quiz
12	Design of gravity and embedded retaining walls	

RELEVANT RESOURCES

Textbooks - Geology

No compulsory text for geology however the following gives a good summary of various engineering geology topics:

Waltham, A. (2009) Foundations of Engineering Geology, 3rd Edition, Spon Press. [E-book Available Online through library]

Additional Readings - Geology

The following books may give you a better and deeper understanding of various aspects of the course. Duff (1997) and Skinner and Potter (2000) provide the geology basics whilst Fell et al (2015), Hencher (2012), Goodman (1993) and Bell (2007, 2008) do a good job of relating geology (Goodman - rock only) to engineering using a number of geotechnical engineering case studies. The books can be sourced via UNSW library at the locations shown. This is only a sample, there are also a lot of other geology books in the library that you may find useful. You are encouraged to do your own research.

Bell, F.G. (2007) *Engineering Geology*. Burlington : Elsevier. [E-book Available Online through library]

Bell, F.G. (2008) *Basic Environmental and Engineering Geology*. Whittles Publishing. [551/227 C]

Branagan, D. (2000) *Field Geology of New South Wales*. NSW Department of Mineral Resources. [P 559.44/12]

Duff, D. (1997) *Holmes' Principles of Physical Geology*, 4th Edition, Chapman and Hall. [PQ551/18 AB]

Fell, R., MacGregor, P., Stapledon, D., Bell, G. and Foster, M. (2015) *Geotechnical Engineering of Dams*, Balkema, 2nd Edition [627.83/31 B and Online via library]

Goodman, R.E. (1993) *Engineering Geology: Rock in Engineering Construction*, Wiley. [P624.151/166]

Hencher, S. (2012) *Practical Engineering Geology*, Spon Press, London. [624.151/214 and Online via library]

Johnson, R.B. and DeGraff, J.V. (1988) *Principles of Engineering Geology*, Wiley, 1st Edition. [P 624.151/157 A]

Skinner, B. and Porter, S. (2000) *The Dynamic Earth*, 4th Edition, Wiley. [PQ551/194]

Standards Association of Australia, (1993) AS1726-1993: Geotechnical Site Investigations [All available online through UNSW – search for resource: Australian Standards (SAI Global)] - Note currently under review

Standards Association of Australia, (1993) AS4482.1-2005: Guide to the investigation and sampling of sites with potentially contaminated soil - Non-volatile and semi-volatile compounds

iPhone (and other almost as smart phones)

There are numerous apps being developed for various smart phones. At the moment, there are only a handful developed for geology that are free. Many of the ones for the iPhone are still pretty basic and look like they are still in development. Some that I have looked at include:

- GeoID (preferred) or similar - works as a geological compass. It allows you to measure the dip and dip direction of a defect by simply sitting the phone on the defect. Very useful for Bronte. There is a charge.
- Geotimescale – gives a summary of the geological time scale (turn 'Ages' off for this course)
- Microscope – shows examples of rock samples under a microscope – only a limited number of examples at the moment
- Jurassic – an application that explores the geological history of the Dorset and East Devon coast. The location is not really relevant but the example of how geology develops over deep time is. In the menu check out: 'Pangaea' – this includes an animation of the movement of continents from when Pangaea existed to the present; 'A walk through time' – this discusses the development of the local geology and includes an animation showing how geological sections develop over time (in this case a sedimentary sequence developing over the last 250 million years).

- Rocks – gives examples of various rock types with photos and (for a couple of rocks) thin sections – still a limited number and (probably) more will be added with time.
- Mohs – Gives Mohs hardness scale. You can tap on the numbers which will give you the mineral names. Tap on these and it will give you a mineral description and photo. Useful for class when we talk about minerals.
- Brightstones – Mineralogical database (with photos) from Delft.
- USGSSeismic – Gives a list of the latest earthquakes around the world.
- EarthObserver – Maps of the Earth. Includes *large scale* geology maps. Click on '>' to change base map.
- QuakeFeed – get the latest large earthquake notices to your phone.
- Theodolite – works as a hand-held theodolite. Not of huge use to the course but I like playing with it.

I have not looked at many you have to pay for. The best glossary would be the one by AGI however, at $36.99 best to use the UNSW library.

Textbooks – Applied Geotechnics

No texts are required. Although the texts below may be useful.

Additional Readings – Applied Geotechnics

A list of references is provided below of which Das (2011) is recommended.

- Bowles, J.E. *Foundation Analysis and Design*, McGraw-Hill (any edition)
- Das, B. (2016) *Principles of Foundation Engineering*, 8th edition, Cengage Learning – concentrates on foundations (other editions still useful)
- Das, B. (2013) *Principles of Geotechnical Engineering*, 8th edition, Cengage Learning – concentrates on geotechnical properties
- Holtz, R.D., Kovacs, W.D. & Sheahan, T.C. (2010) *An Introduction to Geotechnical Engineering*, 2nd edition, Pearson International
- Poulos, H.G. and Davis, E.H. (1980) *Pile Foundation Analysis and Design*, Wiley
- Smith, I. (2006) *The Elements of Soil Mechanics*, 8th edition, Blackwell Scientific
- Standards Association of Australia, (2009) *AS2159-2009: Piling – Design & Installation*
- Standards Association of Australia, (1996) *AS2159 Supp 1-1996: Piling - Design and installation - Guidelines (Supplement to AS 2159-1995)*
- Standards Association of Australia, (2011) *AS2870-2011: Residential Slabs and Footings*
- Standards Association of Australia, (2002) *AS4678-2002: Earth-Retaining Structures*
- Tomlinson, M.J. (2001) *Foundation Design & Construction*, 7th edition, Harlow : Prentice Hall
- Tomlinson, M. and Woodward, J. (2014) *Pile Design and Construction Practice*, 6th edition, CRC Press

Moodle

Materials including lecture notes and presentations, workshop solutions, quizzes, past papers, Web links and student submissions will be provided through Moodle. Note that the pages have been split into: A – Geology and B – Applied Geotechnics.

Group work for assignments will also be facilitated via Moodle.

Other Useful Geotechnical Sources

Journals:

All journals can be found in The University of New South Wales Library (or online via the library resource database – i.e. catalogue).

Australian Geomechanics Journal	PJ624.1513205/3
Canadian Geotechnical Journal	PJ620.19105/1
Engineering Geology: an International Journal.	PJ624.1505/12
Ground Engineering	PJ624.05/91
Journal of Geotechnical and Geoenvironmental Engineering.	PJ624.05/66
Geotechnical and Geological Engineering.	PJ622.05/158
Environmental & Engineering Geoscience.	PJ550/E650
Geotechnique.	PJ624.15105/10
Proc. of the Institution of Civil Engineers. Geotechnical Engineering.	PJ624.05/46
Bulletin of Engineering Geology and the Environment.	PQ624.1505/11
Rock Mechanics and Rock Engineering.	PJ624.1505/7
International Journal of Rock Mechanics and Mining Sciences.	PJ622.05/4

Internet sites:

Many Internet sites exist. The following are links to some of the main Geotechnical sites.

Australian Geomechanics Society: http://australiangeomechanics.org

Australian Geomechanics Society, Sydney: http://australiangeomechanics.org/chapters/sydney/ (has monthly Geotechnical talks)

International Society for Soil Mechanics and Geotechnical Engineering: http://www.issmge.org

International Society for Rock Mechanics: http://www.isrm.net

International Association of Engineering Geology: http://www.iaeg.info

The Australasian Institute of Mining and Metallurgy: http://www.ausimm.com.au/

The U.S. Geological Survey: http://www.usgs.gov/

Google Scholar: https://scholar.google.com.au/ (good for looking at research papers on specific topics)

DATES TO NOTE

Refer to MyUNSW for Important Dates available at:

https://my.unsw.edu.au/student/resources/KeyDates.html

SCHOOL PRIZES

Results in this course may contribute to the Geotechnical Engineering Discipline Prize presented at the fourth year dinner. In 2015 the prize was worth $1000 and was sponsored by the geotechnical consultancy Pells Sullivan Meynink.

PLAGIARISM

Beware! An assignment that includes plagiarised material will receive a 0% Fail, and students who plagiarise may fail the course. Students who plagiarise are also liable to disciplinary action, including exclusion from enrolment.

Plagiarism is the use of another person's work or ideas as if they were your own. When it is necessary or desirable to use other people's material you should adequately acknowledge whose words or ideas they are and where you found them (giving the complete reference details, including page number(s)). The Learning Centre provides further information on what constitutes Plagiarism at:

https://student.unsw.edu.au/plagiarism

ACADEMIC ADVICE

For information about:

- Notes on assessments and plagiarism,
- School policy on Supplementary exams,
- Special Considerations,
- Solutions to Problems,
- Year Managers and Grievance Officer of Teaching and Learning Committee, and
- CEVSOC.

Refer to Academic Advice on the School website available at:

https://www.engineering.unsw.edu.au/civil-engineering/student-resources/policies-procedures-and-forms/academic-advice

COURSE EVALUATION AND DEVELOPMENT

The School of Civil and Environmental Engineering evaluates each course each time it is run through (i) the UNSW Course and Teaching Evaluation and Improvement (CATEI) process, and (ii) Focus Group Meetings. As part of the CATEI process, your student evaluations on various aspects of the course are graded; the Course Coordinator prepares a summary report for the Head of School. Any problem areas are identified for remedial action, and ideas for making improvements to the course are noted for action the next time that the course is run.

We request that you please complete the CATEI form. To make the process more valuable could you also provide both positive AND negative (constructive) comments. This enables the course to be improved each year.

Focus Group Meetings are conducted by the four Year Managers (academic staff) for any students who wish to attend, in each year of the civil and/or environmental engineering programs. Student comments on each course are collected and disseminated to the Lecturers concerned, noting any points which can help improve the course.

ASSIGNMENT SUBMISSION

When hard copy assignments are required, they should be placed in the submission box at the Eastern end of the Level 5 Civil Engineering corridor. All assignments should be submitted with a signed Assessment Cover Sheet (attached).

KEEP A COPY OF ALL WRITTEN ASSIGNMENTS

CVEN3203 Engineering Geology Assignment

Assignment Cover Sheet 2016

Group Number: ……

Bronte Chainage: ……

Name: …… **SID:** ……..

Name: …… **SID:** ……..

Name: …… **SID:** ……..

Name: …… **SID:** ……..

Name: …… **SID:** ……..

Date: ……

I/We declare that this assessment item is my/our own work, except where acknowledged, and has not been submitted for academic credit elsewhere, and acknowledge that the assessor of this item may, for the purpose of assessing this item:

Reproduce this assessment item and provide a copy to another member of the University; and/or,

Communicate a copy of this assessment item to a plagiarism checking service (which may then retain a copy of the assessment item on its database for the purpose of future plagiarism checking).

I certify that I have read and understood the University Rules in respect of Student Academic Misconduct.

Signed: .....date: ☐☐ ☐☐ ☐☐

Signed: .....date: ☐☐ ☐☐ ☐☐

Signed: .....date: ☐☐ ☐☐ ☐☐

Signed: .....date: ☐☐ ☐☐ ☐☐

Signed: .....date: ☐☐ ☐☐ ☐☐

Please place this assignment in the submission box for Dr Kurt Douglas located at the eastern end, Level 5, School of Civil & Environmental Engineering.

PLEASE ENSURE THAT YOU KEEP A COPY OF YOUR ASSIGNMENT