

**CEEB458 Introduction to Soil Improvement
Syllabus**

Coordinating Unit:	Department of Civil and Environmental Engineering, Faculty of Science and Technology		
Supporting Unit(s):	Nil		
Course Code:	CIVL4012	Year of Study:	4
Course Title:	Introduction to Soil Improvement		
Compulsory/Elective	Elective		
Course Prerequisites:	CIVL2007 Soil Mechanics		
Prerequisite Knowledge:	Nil		
Duration:	One semester	Credit Units:	3
Class/Laboratory Schedule:	Three hours of lecture per week		
Laboratory/Software Usage:	Nil		
Course Description:	This is the introductory course of ground improvement techniques for marginal and problematic soil. The content includes the basics of laboratory and in situ tests for geotechnical projects. Then, surface compaction, admixture stabilization and deep densification are covered. Ground modification by consolidation and vertical drains are then covered. Various types of insitu reinforcement techniques such as stone columns, soil soils are introduced.		
Course Objectives:	<ol style="list-style-type: none"> 1. To introduce the various types of improvement methods of engineering properties soils. 2. To introduce the application of engineering methods to ground improvement projects. 3. To develop the ability to analyze geotechnical problems and use the soil improvement methods to solve them. 		
Learning Outcomes (LO):	<p>Upon completion of this course, students should be able to:</p> <ol style="list-style-type: none"> 1. Understand the use and importance of soil improvement in engineering projects. 2. Acquire the knowledge of laboratory and in situ tests for soil improvement projects. 3. Acquire the knowledge of surface compaction. 4. Understand the concept of admixture stabilization. 5. Understand the concept of deep densification. 6. Understand the concept of using consolidation and vertical drains for soft soil improvement. 7. Understand the concept of insitu reinforcement 		
Texts & References: (* recommended textbook(s))	<ol style="list-style-type: none"> 1. * Nicholson P G. (2014). Soil Improvement and Ground Modification Methods, 1st Edition, Butterworth-Heinemann. 2. Mitchell, J K (1981). "Soil improvement : state -of - the -art", Proceeding of 10th International Conference of Soil Mechanics and Foundation Engineering, Stockholm, Sweden, Vol. 4, 509 - 565. 3. Hausmann M R (1990). Engineering Principles of Ground Modification, by, McGraw Hill Publishing Co. 4. Mitchell, J K (1993). Fundamentals of Soil Behaviour, 2nd edition, John Wiley & Sons, New York. 5. Xanthakos, P P, Abramson L W and Bruce D A (1994). Ground Control and Improvement, John Wiley & Sons, New York. 6. Bergado D T, Anderson L R, Miura N and Balasubramaniam A S (1996). Soft 		

	<p>7. Ground Improvement in Lowland and Other Environments, ASCE Press, New York.</p> <p>7. Mitchell J K and Gallagher P M (1999). Engineering and Design Guidelines on Ground Improvement for Structures and Facilities, Publication No. ETL 1110-1-185, US Army Corps of Engineers, Washington DC.</p> <p>8. Mitchell J M and Jardine F M (2002). A Guide to Ground Treatment, CIRIA, London.</p>																
Student Assessment:	<ul style="list-style-type: none"> • Quiz and assignments: 25% • One midterm: 25% • One final examination: 50% 																
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Pedagogical Methods:	<table style="width: 100%; border: none;"> <tr> <td style="width: 50%; border: none;"><input checked="" type="checkbox"/> Lecture</td> <td style="width: 50%; border: none;"><input type="checkbox"/> Service learning</td> </tr> <tr> <td style="border: none;"><input type="checkbox"/> Guest speakers</td> <td style="border: none;"><input type="checkbox"/> Internship</td> </tr> <tr> <td style="border: none;"><input checked="" type="checkbox"/> Case study</td> <td style="border: none;"><input type="checkbox"/> Field study</td> </tr> <tr> <td style="border: none;"><input type="checkbox"/> Role playing</td> <td style="border: none;"><input type="checkbox"/> Company visits</td> </tr> <tr> <td style="border: none;"><input type="checkbox"/> Student presentation</td> <td style="border: none;"><input type="checkbox"/> e-learning</td> </tr> <tr> <td style="border: none;"><input type="checkbox"/> Project</td> <td style="border: none;"><input checked="" type="checkbox"/> Independent study</td> </tr> <tr> <td style="border: none;"><input type="checkbox"/> Simulation game</td> <td style="border: none;"><input checked="" type="checkbox"/> Others: _Computer software Lab.</td> </tr> <tr> <td style="border: none;"><input checked="" type="checkbox"/> Exercises and problems</td> <td style="border: none;"></td> </tr> </table>	<input checked="" type="checkbox"/> Lecture	<input type="checkbox"/> Service learning	<input type="checkbox"/> Guest speakers	<input type="checkbox"/> Internship	<input checked="" type="checkbox"/> Case study	<input type="checkbox"/> Field study	<input type="checkbox"/> Role playing	<input type="checkbox"/> Company visits	<input type="checkbox"/> Student presentation	<input type="checkbox"/> e-learning	<input type="checkbox"/> Project	<input checked="" type="checkbox"/> Independent study	<input type="checkbox"/> Simulation game	<input checked="" type="checkbox"/> Others: _Computer software Lab.	<input checked="" type="checkbox"/> Exercises and problems	
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Major Assessment Methods:	Case Study	Role Playing	Student Presentation	Individual project/paper	Group project/paper	Simulation Game	Exercises & problems	Service learning	Internship	Field Study	Company visits	Written examination	Oral examination	Others (please specify)
Class Participation/ Discussion														
Quiz/Assignment /Report							✓							
Test(s)												✓		
Examination												✓		
Others (please specify)														
Course Web: (if any)	Course materials are available in UMMoodle (http://ummoodle.umac.mo/).													

Weeks	Topics	Assignment no.	LO no.
1	INTRODUCTION -Need and objective of soil improvement -Fundamental soil behaviour relevant to soil improvement		1
2	LABORATORY AND IN SITU TEST -Laboratory tests -In situ tests: SPT and CPT -Other in situ tests	1	2
3-4	SURFACE COMPACTION -Principles -Properties of compacted soil -Control and specifications	2	1,3
5-6	ADMIXTURE STABILIZATION -Principles -Reactions -Lime stabilization -Cement stabilization -Asphalt stabilization -Case study	3	1,4
7-8	DEEP DENSIFICATION -Mechanism of Dynamic compaction -Mechanism of Vibro-compaction -Mechanism of Blasting -Case study	4	1,5
9-10	HYDRAULIC MODIFICATION -Consolidation -Preloading -Prefabricated vertical drains (PVD) -Design of PVD in soft soil -Case study	5	1,6
11	MID TERM EXAMINATION		
12-14	IN SITU REINFORCEMENT -Granular column -Soil nailing -Grouting -Case study	6, 7	1,7

Percentage Content of:	Mathematics and Basic Sciences	Engineering Subjects	Complementary Studies	Total	
	20	80	0	100	
Timetabled work in hours per week:	Lecture	Tutorial	Laboratory	Other	Total
	3	---	---	---	3

Contribution to Programme Outcomes:	Programme Outcomes	Contribution to POs	
		Primary	Secondary
	(a) an ability to apply knowledge of mathematics, science, and engineering appropriate to the degree discipline	✓	
	(b) an ability to design and conduct experiments, as well as to analyse and interpret data		✓
	(c) an ability to design a system, component or process to meet desired needs within realistic constraints, such as economic, environmental, social, political, ethical, health and safety, manufacturability and sustainability		
	(d) an ability to function on multi-disciplinary teams		
	(e) an ability to identify, formulate and solve engineering problems	✓	
	(f) an ability to understand professional and ethical responsibility		
	(g) an ability to communicate effectively		
	(h) an ability to understand the impact of engineering solutions in a global and societal context, especially the importance of health, safety and environmental considerations to both workers and the general public		
	(i) an ability to stay abreast of contemporary issues		
	(j) an ability to recognise the need for, and to engage in life-long learning		
	(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice appropriate to the degree discipline		✓
	(l) an ability to use the computer/IT tools relevant to the discipline along with an understanding of their processes and limitations		
Course Instructor(s):	Mr. I. M. Wan (Please refer to the following link for the consultation hours of the course instructor: http://www.fst.umac.mo/cee/contacthour.html)		