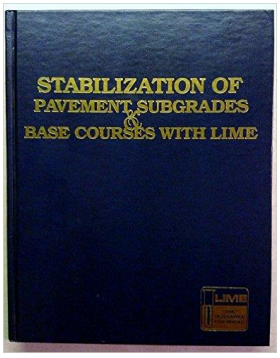
CE 5390 Stabilization of the Aggregate Soils
Lecture Sessions: TR 4:30-5:50 pm
Undergraduate Learning Center, UGLC 340
Spring 2017



Instructor: Reza Ashtiani, Ph.D. (reza@utep.edu)
Office: Engineering Annex. Room 217.

Office Hours: Students are always welcome.

Course References:

1. Little, D.N., "Handbook for Stabilization of Pavement Subgrades and Base Courses with Lime," National Lime Association, APG Lime Company, Published by Kendall/Hunt Publishing Company, 1995
2. "Soil Stabilization For Pavements," UFC 3-250-11, Manual for the Departments of US Army, US Air Force and US Navy, University Press of the Pacific, 2004.
3. "Soil Stabilization for Roads and Airfields," Chapter 9, Military Soils Engineering, FM5-410, Department of the Army, Washington, DC, June 1997.
4. "Subgrade Stability Manual," Illinois Department of Transportation, Bureau of Bridges and Structures, May 1, 2005.
5. Little, D.N. and Nair, S., "Recommended Practice for Stabilization of Subgrade Soils and Base Materials," Final Task Report for NCHRP Project 20-07, Web-only Document 144, National Cooperative Highway Research and Program (NCHRP), Transportation Research Board, Washington, D.C., August 2009, 57 pages.
6. "Technical Memorandum: Guidelines for Stabilization of Soils Containing Sulfates": detailed discussion and guidelines for using lime in sulfate-bearing soils, NLA (2001).
7. "Soil Stabilization and Pavement Recycling with Self Cementing Coal Fly Ash," American Coal Ash Association (ACAA) Educational Foundation, January 2008.
8. "Thickness Design for Soil-Cement Pavements," Portland Cement Association, 2001.
9. "A Basic Emulsion Manual," MS-19, Asphalt Institute, Third Edition.
10. Technical Guideline: Bitumen Stabilized Materials A Guideline for the Design and Construction of Bitumen Emulsion and Foamed Bitumen Stabilized Materials, TG2 Second Edition, Published by the Asphalt Academy c/o CSIR Built Environment, PO Box 395, Pretoria, South Africa, May 2009, 136 pages.
11. Salomon, D.R. "Asphalt Emulsion Technology," Circular E-C102, Characteristics of Bituminous Materials Committee, Transportation Research Board, Washington DC, August 2006.

Class Website: www.rezasalehi.com/CE-5390-Stabilization

COURSE OBJECTIVES

The objective of this course is to provide the civil engineering graduate students with an in-depth understanding of the soil-stabilizer interactions. The course is designed to strike a balance between the theoretical concepts such as interfacial analysis of modifies soils, as well practical construction considerations of stabilized layers. The course requires sufficient background knowledge of soil mechanics, pavement analysis and design, and mechanics of materials.

Upon successful completion of this course, the student will have gained knowledge in the following areas:

- ***General Methods of Ground Improvement:*** methods such as mechanical compaction, chemical stabilizers, and structural elements such as geo-textiles, geo-membranes, geo-fabrics, and etc.
- ***Soil Mineralogy:*** consideration of soil mineralogy for selection of the type and amount of stabilizers.
- ***Soil Stabilization vs. Soil Modification:*** considerations regarding the beneficial influence of the stabilizers to improve the stiffness and the moisture susceptibility of granular and fine grained soils.
- ***Cementitious Stabilization Methods:*** detailed laboratory and field protocols for the stabilization of granular aggregate soils using cementitious materials such as lime, cement, fly ash CCB, and etc.
- ***Bituminous Stabilization Methods:*** detailed laboratory and field construction protocols for the stabilization of soils using asphalt emulsions and foamed asphalt.
- ***Ground Improvement using Structural Elements:*** design criteria for the selection of the type of geo-textile, geo-cells and etc. Tensar case studies to improve the orthogonal load bearing capacity of base layers.
- ***Analysis and Design of Airfield Runways-Case Study:*** numerical analysis of a candidate multi-layer structure with and without chemical soil stabilization for comparative analysis of runway responses.

SCHEDULE

A tentative lecture schedule is on the class website. All course materials including lecture notes, reading assignments, supplemental materials such as calculation Excel spreadsheet, Homework Assignment, and etc. will be posted on class website. Please refer to the following link: *http://www.rezasalehi.com/CE-5390-Stabilization.html* to download course materials. The site password is students. Reading assignments from your text and handouts will be assigned in class at the end of each lecture session. Prepared notes will occasionally be handed out in class to supplement, or in some cases to substitute for, reading materials from the references list. Be sure to save the notes because you will be tested over at least some of the material in them.

GRADING POLICY

Your grade for this course will be determined on the basis of ***1050 points*** as follows:

1. Final comprehensive examination (300 points)
2. Homework Assignments (200 points)
3. Term Paper (250 points)
4. Final Presentation (250 Points)
5. Critical Assessment (attendance and active participation in class discussions) (50 points)

In accordance with University regulations, students who miss examinations will receive grades of zero. Exceptions to this rule will be made only on a carefully considered individual basis and only if the student contacts the instructor ***before*** the exam. If you know in advance that you are going to miss an exam, it is ***your*** responsibility to inform the instructor before the exam.

GRADE STRUCTURE

Final grades assigned for this course will be based on the percentage of total points earned and are assigned as follows:

Letter Grade	Percentage	Performance
A	90-100	Excellent Work
B	80-89%	Very Good Work
C	70-79%	Average Work
D	60-69%	Poor Work
F	0-59%	Failing Work

HOMEWORK

All homework problems will be assigned in the class. The due date for homework submission will appear on the homework assignment and is due before 7:30 pm. Past experience clearly shows that a student's grade is strongly dependent upon the effort that is put into working and understanding the homework. Homework solutions will be available on due dates. Please note that each student is responsible to submit the homework assignment individually.

POLICY ON CHEATING

Students are expected to be above reproach in all scholastic activities. Students who engage in scholastic dishonesty are subject to disciplinary penalties, including the possibility of failure in the course and dismissal from the university. Scholastic dishonesty includes but is not limited to cheating, plagiarism, collusion, the submission for credit any work or materials that are attributable in whole or in part to another person, taking an examination for another person, any act designed to give unfair advantage to a student, or the attempt to commit such acts (Regents' Rules and Regulations, Part One, Chapter VI, Section 3, Subsection 3.2, Subdivision 3.22). Scholastic dishonesty harms the individual, all students, and the integrity of the university. Policies on scholastic dishonesty will be strictly enforced.

COURSE/INSTRUCTOR EVALUATION

An online course/instructor evaluation will be conducted near the end of the semester. I strongly urge you to participate in the survey. Your comments and suggestions will be of great value to streamline the future direction of this course.

FINAL COMMENT

Good luck to all of you in this course. Please do not hesitate to ask questions in class, or if necessary, to see me outside of class. Any specific comments that students have on how the course might be improved are particularly welcomed, especially during the semester.

CE5390-Stabilization of Aggregate Soils

Course Outline

Topic No.	*Description*
1	**Review of Physical Soil Properties:** Soil Structure, Consistency of Cohesive Soils, plasticity, Clay Activity, Atterburg Limits, USCS and AASHTO Soil Classification.
2	**Soil Mineralogy:** Clay minerals, building blocks, diffuse double layer of water, cation exchange capacity, moisture susceptibility of clays. Ettringite formation.
3	**Methods of Ground Improvement:** Introduction to chemical and mechanical soil improvement. Stabilization vs. modification concepts. Use of structural element to improve the load bearing capacity of foundation.
4	**Cement Stabilization:** Pozzolanic reactions, mechanistic characterization of cement stabilized materials in the laboratory. Available lab and field tests. Construction techniques. Durability and leaching concerns.
5	**Lime Stabilization:** chemical reactions, selection of the lime content for stabilization or modification of highly plastic soils. Eades and Grimm test. Case studies: Denver Airport. Considerations of high sulfate soils, mellowing technique.
6	**Bituminous Stabilization:** chemical reactions, Superpave laboratory tests, asphalt emulsions vs foamed asphalt. South African and New Zealand specifications for emulsified asphalt. Considerations regarding the curing period of emulsions.
7	**Structural Elements**: Use of geotextiles, geo-membranes, geo-grids, geo-cells, geo-fabric, and etc. in ground improvement. Case studies by Tensar regarding the construction and performance of geo-grid reinforced segments.
8	**Numerical Analysis:** Analysis of a candidate multi-layer structure with and without stabilization. Analysis of the runway responses subjected to heavy aircraft loading conditions.