

CE 401 - Health Monitoring & Retrofit of Geotechnical Systems

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1. Introduction/Motivation
2. Brief review of soil mechanics.
3. Brief review of foundation engineering
4. Field monitoring methods

Retrofit of geotechnical systems. This topic is seldom offered as an undergraduate course due to its specialized focus and its closest related topics are geotechnical instrumentation - monitoring or geotechnical failures. The course name is "Health Monitoring and Retrofit of Geotechnical Systems". This course was approved as an experimental course for the FS2000 by the UMR/Civil Engineering graduate affairs committee and was offered jointly with Dr. Stephenson. A detailed course syllabus is presented in the following in pages 2 thru 4. The UTC funding allowed the purchase of equipment for use by the graduate students. The following table is a list of the equipment:

1. SINCO DataMate MP
2. Borehole piezometer to 100 psi with signal cable.
3. Modular rod extensometer
4. VW Settlement Cell
5. Tiltmeter
6. VW Total Pressure Cell

This course was offered only once due to the low enrollment from the non-geotechnical disciplines. Five (5) students enrolled in the fall of 2000 and they all had a final report associated with monitoring and instrumentation of geotechnical systems. A list of the student topics for term papers are listed below and the presentations are available for distribution:

- Monitoring Instrumentation for Landfill Construction on Compressible Soils (Jadi)
- Embankment Stability in Southeast MO highway corridors (Myers)
- Use of Inclinometers in Geotechnical Instrumentation Programs (Stone)
- Use of Spectral Data to Identify Expansive Soils (Wu)
- Instrumentation Features Associated with Collapse of Caverns (Zur)

Additional course offerings in Civil Engineering program that merge the geotechnical and structural programs are available. The geotechnical faculty members are involved in several projects that make use of field instrumentation for the measurement of substructure performance. The students trained in the health monitoring of geotechnical systems will be ready to apply the knowledge to research and engineering projects.

EC1 - 401 Health Monitoring and Retrofit of Geotechnical Systems

Course Syllabus

Summary and objective:

The design of foundations and earth structures of significant importance (e.g., tunnels, dams, nuclear power plants, etc.) often require the concurrent design of a field instrumentation program. These programs consist of the installation of devices, data acquisition and engineering interpretation of the behavior of the geotechnical system. The objective of such programs is to provide feedback regarding the performance of the structure and potentially initiating measures to rectify undesired conditions. This course will focus on the methods for health monitoring of geotechnical systems and then will move on to addressing engineering methods to retrofit these systems for modified or improved performance. The course is intended for a broad audience within the civil engineering disciplines.

Instructors: Ronaldo Luna (Rm. 306, x4484, rluna@umr.edu)
Richard W. Stephenson (Rm. 109, x6549, stephens@umr.edu)

Meeting time: Tuesday and Thursdays at 8:05 - 9:30 am.

Classroom: Civil Engineering Building, Rm. 301

Textbook: No required textbook for this course. Texts will be recommended and selected references and handouts distributed during class.

The course was designed around selected topics that require the monitoring of the performance of the geotechnical systems and a typical approach to each topic is presented as modules.

Themes and Topics	Dates
Introduction and Motivation	
Course focus and overview Soil Mechanics – deformation vs. stability	Week 1
Module Topics	
Subsidence (sinkholes and collapsible soils)	Weeks 2-5
Landslides and slope failures	Weeks 5-8
Foundations on filled ground	Weeks 9-11
Foundations on expansive soils	Weeks 11-13
Substructures in the urban environment	Weeks 14-15

Typical Module
Threat to structures and mechanisms of failure
Parameters to observe and monitor
Instrumentation plan and data development
Laboratory and field tests
New construction or Remediation/repair

Grading

Class Participation	10%	based on attendance and discussion during class.
Homework	20%	about 10 homeworks will be assigned during semester.
Midterm	20%	a take home assignment in mid October.
Final Exam	25%	in classroom during finals week.
Term Paper	25%	topic selected in one of the homework assignments during first month. Term paper can be turned in at any time.

Course Website: <http://www.umr.edu/~rluna/401>

Lecture Schedule:

THEMES AND TOPICS	DATES	INSTRUCTOR
Introduction and Motivation		
Course focus and overview	Aug. 22	Luna/Stephenson
Soil Mechanics – deformation vs. stability	Aug. 24	Luna
Subsidence (sinkholes and collapsible soils)		
Threat to structures and Mechanisms of failure	Aug. 29	Luna
Parameters to observe and monitor	Aug. 31	Luna
Instrumentation plan and data development	Sep. 5 – Sep 7	Luna
Laboratory and field tests	Sep. 12	Luna
New construction on subsidence prone ground	Sep. 14	Stephenson
Remediation/repair of sinkholes	Sep. 19	Stephenson
Landslides and slope failures		
Threat to structures and Mechanisms of failure	Sep. 21	Luna
Parameters to observe and monitor	Sep. 26	Luna
Instrumentation plan and data development	Sep. 28 - Oct. 3	Luna
Laboratory and field tests	Oct. 5	Luna
New construction on metastable slopes	Oct. 10	Stephenson
Remediation/repair of sinkholes	Oct. 12	Stephenson

Foundations on filled ground		
Threat to structures and Mechanisms of failure	Oct. 17	Luna
Parameters to observe and monitor	Oct. 19	Luna
Instrumentation plan and data development	Oct. 24	Luna
Laboratory and field tests	Oct. 26	Luna
New construction on filled ground - Remediation/repair of filled ground (drainage, stone columns, soils improvement, grouting)	Oct. 31	Stephenson
Foundations on expansive soils		
Threat to structures and Mechanisms of failure	Nov. 2	Luna
Parameters to observe and monitor	Nov. 7	Luna
Instrumentation plan and data development	Nov. 9	Luna
Laboratory and field tests	Nov. 14	Luna
Remediation/repair (groundwater control, stabilization, overexcavation)	Nov. 16	Stephenson
Substructures in the urban environment		
THANKSGIVING BREAK	Nov. 22 - 26	
Threat to structures and Mechanisms of failure	Nov. 21	Luna
Parameters to observe and monitor	Nov. 28	Luna
Instrumentation plan and data development	Nov. 30	Luna
Laboratory and field tests	Dec. 5	Luna
Remediation/repair of foundations (underpinning, buttress, temporary bracing, for deep excavations, access shafts and tunnels.)	Dec. 7	Luna/Stephenson