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Colorado State University OnlinePlus

CIVE 680A5

Design of Foundations for Expansive Soils

Spring 2014

(Jan 21 to May 9, 2014)

Presented by
Colorado State University
Department of Civil and Environmental Engineering

Introduction

Design of foundations for expansive soil sites is one of the most challenging problems facing engineers, builders, and homeowners today. This is made even more serious by the litigious nature of the profession. Where these problems were thought to occur only in the arid Western United States, problems are being identified in the Midwestern and Eastern states. Many of the problems result from failure to identify expansive soils on the sites, inadequate design and construction, failure to accurately predict heave, use of inappropriate foundation systems, and/or improper construction practices. Damage to structures and infrastructure due to expansive soils is a billion dollar issue. Increasing basic knowledge of soils engineering is the key to identification of design and construction defects for structures on problem soils.

Foundation engineering for expansive soil sites is dramatically different than for “ordinary” sites. This course will present the basic fundamentals of design of foundations on expansive soil sites. Primary topics include general nature of expansive soil, field investigation and laboratory testing performed to characterize expansive soils, heave prediction methods, water migration in expansive soils, foundation design alternatives, lateral earth pressure, and design and construction defect case studies.

Cut-Off of Wall Studs

Objectives

The seminar is intended to provide geotechnical, structural, and construction engineers, engineering geologists, and architects with the tools necessary to design and construct foundations on expansive soils. The following topics will be included:

- Identification and characterization of expansive soils
- Field investigation and laboratory testing to characterize expansive soils
- Evaluation of migration of water in expansive soils
- Prediction of heave for shallow and deep foundations
- Design of appropriate foundation systems for sites on expansive soils
- Identification of design and construction defects for foundations on expansive soils

Course Schedule/Mode of Delivery

This 3 credit course will meet on campus in Fort Collins twice a week (Mondays and Fridays from 7:30 am to 8:45 am). Additionally, the course is offered online through the CSU OnlinePlus program. The on campus lectures will be recorded and available online.

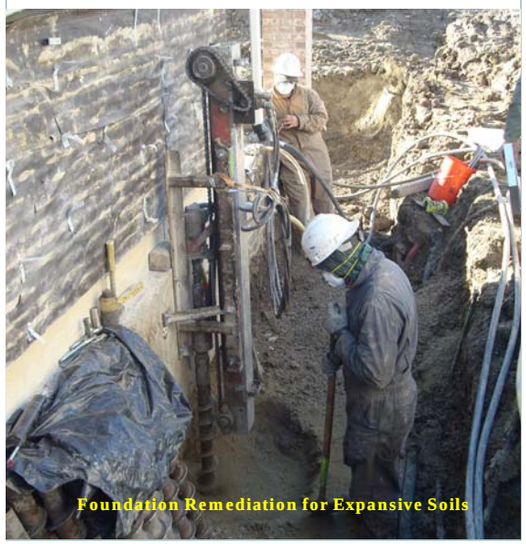
Who Should Attend

This course is intended for students, engineers, and geologists with a basic understanding of soil engineering. The material will be of important and practical value to:

- Engineering Students
- Geotechnical Engineers
- Structural Engineers
- Engineering Geologists
- Architects
- Construction Engineers
- Builders/Contractors
- Building Inspectors

Textbook

Nelson, Chao, Overton, and Nelson (2014). *Design of Foundations for Expansive Soils*. John Wiley & Sons, Inc., New York (Manuscript will be available through the CSU Copy Center).



Foundation Remediation for Expansive Soils

Course Instructor

GEOFF CHAO, Ph.D., P.E. Dr. Chao has over 20 years of geotechnical and construction engineering experience. He is the Vice President of Engineering Analytics, Inc., a geotechnical and environmental engineering consulting company with offices in Fort Collins and Denver, Colorado and Lewisville, Texas. He is also an Adjunct Professor at the Department of Civil and Environmental Engineering, Colorado State University. Dr. Chao has extensive experience in the areas of construction and design defect investigation and construction remediation and mitigation for foundations on expansive soils. Dr. Chao is a member of Technical Committee TC106 on Unsaturated Soils of the International Society of Soil Mechanics and Geotechnical Engineering (ISSMGE) and also a member of Unsaturated Soils Technical Committee of the American Society of Civil Engineers (ASCE). He has authored over 40 technical papers, many of them dealing with foundations on expansive soils.

Guest Speakers

JOHN D. NELSON, Ph.D., P.E., D.GE, Professor Emeritus at Colorado State University and Principal Geotechnical Engineer at Engineering Analytics, Inc.

DANIEL D. OVERTON, P.E., President and Principal Geotechnical Engineer at Engineering Analytics, Inc.

DEAN R. READ, P.E., Vice President and Forensic Engineer at MLAW Consultants & Engineers.

Course Outline

Week	Topic
1	**Introduction:** Course Objectives, General Aspects of Expansive Soils, Nature of Distress, and Case Studies.
2	**Nature of Expansive Soil:** Physical and Chemical Aspects of Expansive Behavior, Characteristics of Expansive Soil Profiles, Constitutive Relationships for Expansive Soils, and Identification of Expansive Soils.
3	**Site Investigation:** General Considerations of Site Investigation, Subsurface Exploration and Sampling, and Field Testing.
4	**Soil Suction:** Suction Components, Soil Water Characteristic Curve, and Measurement of Soil Suction.
5	**Oedometer Testing:** Consolidation-Swell and Constant-Volume Tests, Correction Factors for Oedometer Test Data, and Factors Influencing Swelling Pressure and Percent Swell.
6-7	**Water Migration in Expansive Soils:** Water Flow in Unsaturated Soils, Depth and Degree of Wetting, Computer Modeling, and Challenges in Water Migration Modeling for Expansive Soils.
8-9	**Heave Prediction:** Oedometer Methods, Soil Suction Methods, Empirical Methods, and Progression of Heave with Time.
10-14	**Design Alternatives:** General Considerations for Foundation Design, Shallow Foundations, Deep Foundations, Floor Slabs, Soil Stabilization Methods, and Soil Retaining Structures.
15	**Course Summary and Case Histories:** Course Review and Summary, and Presentation of Case Histories.

Concrete Pavement Distress