

December 4th-6th , 2017

Albenga Room

Entrance 1, Second floor

Department of Structural, Geotechnical and Building Engineering

Corso Duca degli Abruzzi, 24 - Torino

Ph.D. Course: **Risk Analysis in Civil Engineering**

**Prof. Adrian Rodriguez-Marek**, Virginia Polytechnic and State University

**Overview**

This course introduces risk and reliability analysis with particular applications in geotechnical engineering and seismic hazard analysis. The first part of the course is dedicated to probability theory and reliability analysis, with applications on risk-based decision making and reliability analyses for geotechnical systems. The second part of the course deals with probabilistic seismic hazard analysis and applications in performance-based earthquake engineering.

Students that take this course will be able to incorporate concepts of risk and reliability analysis in design of civil engineering systems. Students will also have the basic knowledge needed to understand the research literature in reliability analysis and seismic hazard analysis.

The course is taught over 18 class hours over three days from Dec. 4 to Dec. 6, 2017.

**Biographical Sketch**

Adrian Rodriguez-Marek is professor of Geotechnical Engineering and Seismic Hazard Analysis within the Civil an Environmental Engineering Department at the Virginia Polytechnic and State University. He received his Master of Science in Civil Engineering in 1996 from Washington State University and his Ph.D. in Civil Engineering from University of California at Berkeley in 2000.

Professor Rodriguez-Marek's research is in the general area of Geotechnical Earthquake Engineering. His research focuses on seismic hazard analysis, ground motion prediction, and site response analyses. In particular, his research projects address the quantification of the standard deviation of earthquake induced ground motions accounting for repeatable path or site effects, and studies on the application of non-ergodic seismic hazard analysis including various effects such as surface topography or soil nonlinearity. Other current research projects include collaborative research with Dr. Russell Green on liquefaction triggering using energy-based methods within a probabilistic framework.

 **Course Objectives**

The goals of this course are to introduce basic concepts of structural reliability, geo-statistics and risk analysis; and apply these concepts to problems in geotechnical engineering. Specific course objectives are listed below:

1. Demonstrate an understanding of probability theory.
2. Calculate the main statistics of random variables.
3. Demonstrate familiarity with common uni- and multi-dimensional distributions.
4. Understand the information provided by factor of safety, reliability index, and probability of failure.
5. Understand First Order reliability methods.
6. Understand concepts of risk analysis and risk management.
7. Understand the concepts involved in Probabilistic Seismic Hazard Analysis and Performance-Based Earthquake Engineering and perform such analysis for simplified situations.

**Course Schedule:**

*Monday, December 4th: 10:00 – 13:00*

* Introductory concepts.
* Basic elements of probability.
* Risk analysis through event trees and decision trees.

*Monday, December 4th: 15:00-18:00*

* Function of Random Variables.
* Vectors of Random Variables.

*Tuesday, December 5th: 9:00 – 12:00*

* Basic reliability concepts: First order-second moment approximations.
* Methods to estimate the reliability index.

*Tuesday, December 5th: 15:00 – 18.00*

* Monte Carlo Methods.
* Worked example: Bearing Capacity analyses.

*Wednesday, December 6th: 9:00 – 12:00*

* Introduction to Seismic Hazard Analysis: ground motion characterization and source characterization.
* Probabilistic Seismic Hazard Analysis.
* Performance-based earthquake engineering.

*Wednesday, December 6th: 14:00-17:00*

* Spatially variable random variables: random fields and stochastic processes.