

# GEOTECHNICAL ENGINEERING RESEARCH

Geotechnical Engineering research in the Department of Civil Engineering at Clemson University includes analytical, experimental and numerical investigations of liquefaction of various soils, dynamic behavior of saturated and unsaturated earth structures, soil-structure interaction, earthquake ground response, landslides, pile foundations, braced excavation systems, and dynamic soil/rock properties.

A brief description of the geotechnical faculty, facilities, applied highway research capabilities, and contact information is presented below.



## Geotechnical Engineering Faculty

**Ronald D. Andrus**, P.E., Ph.D. (University of Texas at Austin, 1994). Dr. Andrus' primary research interests are in the areas of geotechnical earthquake engineering, soil/rock dynamics, laboratory and in-situ testing, site characterization, and slope stability. His research has included a National Institute of Standards and Technology project to develop a guide for evaluating liquefaction potential using shear-wave velocity measurements, a S.C. Department of Transportation project to develop a guide for estimating the dynamic properties of soils, two U.S. Geological Survey projects to improve seismic ground motion and soil liquefaction hazards assessment in Charleston, South Carolina, and a National Science Foundation project to characterize the liquefaction resistance of aged soils.

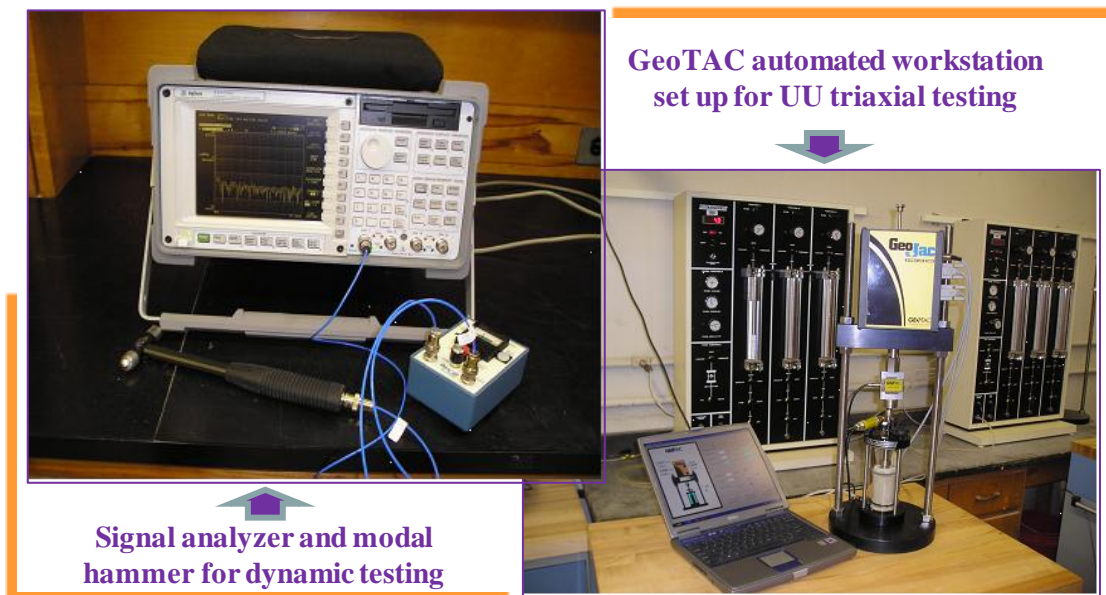


**C. Hsein Juang**, P.E., Ph.D. (Purdue University, 1981). Dr. Juang's primary research interests are in the application of reliability theory, statistics/probability, neural networks, fuzzy sets and finite element methods in geotechnical engineering. He is currently conducting research on liquefaction and ground failure potential, pile foundations, and braced excavation systems. A Fellow of ASCE, Dr. Juang has received funding primarily from National Science Foundation and U.S. Geological Survey. He is a past winner of the prestigious T. K. Hsieh Award 2001 by the Institution of Civil Engineers of the United Kingdom.

**Nadarajah Ravichandran**, Ph.D. (University of Oklahoma, 2005). Dr. Ravichandran's research interests are in the areas of computational modeling of multiphase porous media at macro and micro scales using finite element and discrete element methods, high performance computing, centrifuge testing, and constitutive modeling of multiphase porous media. Dr. Ravichandran is developing a framework based finite element software incorporating parallel computing technologies for simulating large, static and dynamic problems of multiphase porous media with structural inclusions.

### **Facilities**

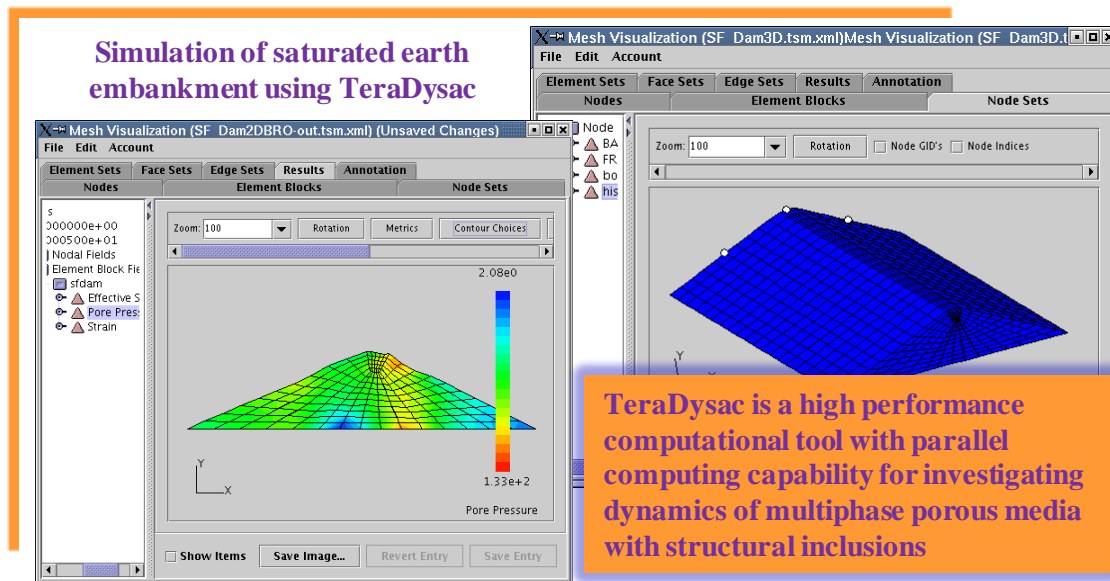
The Geotechnical Engineering laboratories occupy about 3500 square feet of floor space, and have standard and advanced testing equipment. Advanced soil mechanics testing equipment includes: four Trautwein GeoTAC computer-automated workstations for consolidation, triaxial, direct shear, and permeability testing; two 3-position pressure panels; and one shake table for relative density testing.



Advanced soil dynamics testing equipment includes: one four-channel dynamic signal analyzer (Agilent 35670A); a seismic borehole source and two 3-component receivers; various velocity and acceleration sensors; two modally turned impact hammers of different sizes; and one free-free resonant column/pulse test system. This equipment can be used for determining small-strain dynamic properties (i.e., Young's modulus, shear modulus,

Poisson's ratio, damping ratio) of various civil engineering materials (e.g., soil, rock, asphalt, concrete) in both the laboratory and field. Field tests possible with the equipment include: spectral analysis of surface waves (SASW), seismic crosshole and downhole, reflection/refraction, and vibration monitoring.

Computational facilities include widely used commercial and in-house (*TeraDysac*) finite element software, networked PC's and multiprocessor workstations clusters. PCs and printers are located in all faculty offices, most graduate offices, and all geotechnical engineering laboratories. In addition, the University has state-of-the-art high-performance computing capabilities that are available for research purposes. Sample simulation using TeraDysac is shown below.



### Applied Research Capabilities

- Liquefaction susceptibility of soils.
- Field and laboratory measuring small-strain dynamic properties of soil, rock, asphalt, and concrete.
- Shear strength and slope stability of highway embankments.
- Development of a geotechnical database to aid in highway design.
- Guidelines for implementing reliability-based techniques to reduce project costs in bridge foundations.
- Performance-based geotechnical engineering considering model uncertainty.
- Stability of unsaturated soil slopes.
- Soil-structure interaction of bridges foundations.

### For More Information

Contact Dr. R. D. Andrus at [randrus@clemsn.edu](mailto:randrus@clemsn.edu), Dr. C. H. Juang at [hsein@clemsn.edu](mailto:hsein@clemsn.edu), Dr. N. Ravichandran at [nrvavic@clemsn.edu](mailto:nrvavic@clemsn.edu) or visit the Department of Civil Engineering's Website at <http://www.clemsn.edu/ce>.