CEE-GETS

Winter 2013

Civil and Environmental Engineering @ RPI

Geotechnical Engineering

Dr. Victoria Bennett is the Newest Faculty member joining the group as an Assistant Professor in the Fall 2013 semester after obtaining her BS, ME, and PhD at RPI. As a postdoctoral associate, Victoria managed the National Institute of Standards and Technology (NIST) project entitled, "Development of a Multi-scale Monitoring and Health Assessment Framework for Effective Management of Levees and Flood-Control Infrastructure Systems." Victoria came with teaching experience (co-teaching Experimental Soil Mechanics) and is now teaching Introduction to Geotechnical Engineering. Her PhD studies included the first field installations of the ShapeAccelArray (SAA). This in-place inclinometer-accelerometer sensor array is now manufactured by Measurand, Inc. To date, twenty-four miles of SAA have been installed around the world. Victoria serves the Transportation Research Board (TRB) as Secretary to the Committee on Soils and Rock Instrumentation and Communication Coordinator for the Committee on Modeling for the Design, Construction, and Management of Geosystems. If she was not pursuing an academic career, she would be a trophy wife so that she could spend more time with her new puppy and start a pizza shop. Any offers should be directed to bennev@rpi.edu.

Geotechnical Engineering researchers in civil engineering at RPI are leading a $5 million project to develop a new comprehensive system for monitoring and assessing the condition of aging levees and dams. The five-year project, which includes $2.5 million in funding from a U.S. National Institute of Standards and Technology (NIST) Technology Innovation Program grant, aims to create an integrated suite of technologies and methods for ensuring the reliability and safety of flood-control infrastructure. Rensselaer partners with Geocomp Corp., lead by Dr. Allen Marr, on this new framework, which incorporates satellite-based radar with GPS and locally installed sensors. Such a system could help to significantly reduce the risk of catastrophic events akin to the 2005 New Orleans levee failure during Hurricane Katrina. The proposed framework also requires sensor arrays to be installed into the ground beneath and around levees and dams. These SAAP (shape-acceleration-pore pressure) arrays are cost effective for long-term autonomous monitoring and will help to accurately measure soil deformation, vibration, and pore pressure at critical points of a flood-control system. To bridge the gap between InSAR satellite data and below-ground SAAP measurements, the researchers have augmented the framework with a network of high-resolution GPS sensors to track the physical movement of structures. Data collected from the three systems is integrated into an automated "smart network" that provides, for the first time, a long-term continuous assessment of the health of levee systems from both underground and aerial perspectives. In case of a levee failure, data collected by the proposed automated monitoring system will be used to organize a quick emergency response to repair levees and minimize the extent of flooding. Collected data will also be paired with computational simulation techniques to build accurate, predictive models of how different levees should react to different environmental conditions. Such models will be invaluable for developing plans to mitigate levee damage and respond to disasters.

The Department of Civil and Environmental Engineering (CEE) recently hosted a reception honoring **Dr. James Mitchell, NAE** '51 (2010 Davies Medal Recipient) for his generous support in renovating the CEE main office. The CEE Office is the heart of the department and had not been updated since the Jonsson Engineering Center opened in the 70's. With the support of Dr Mitchell and departmental funds, the office was completely modernized; fresh paint, furniture and best of all, state-of-the-art solid state lighting serving as a test bed for the Smart Lighting Research Center at RPI. Thanks to Drs Bob Karlicek and Silvia Mioc from Smart Lighting!

CEE-GETS is the Newsletter of the Department of Civil and Environmental Engineering at Rensselaer Polytechnic Institute. www.cee.rpi.edu

Professor Tarek Abdoun is the Thomas and Judith Iovino Chair Professor in Civil and Environmental Engineering and the NEES Technical Director of Rensselaer's NEES facility. He also serves as Associate Dean for Research and Graduate Programs in the School of Engineering. He earned his MS and PhD degrees from RPI in 1994 and 1997, respectively. Dr. Abdoun's primary research interests are centrifuge modeling, soil-structure interaction, soil remediation, field advanced sensing, and data visualization. He has conducted, and/or advised other researchers on several hundreds of successful high-quality centrifuge model tests conducted at the RPI centrifuge. The centrifuge experiments, supplemented by high-quality reliable measurements, have been used to develop or calibrate new design or retrofit engineering methods.

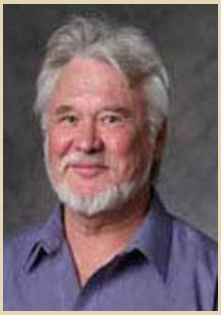
Professor Abdoun led Rensselaer's physical modelling research team that clarified the failure mechanisms of some of the New Orleans levees during Hurricane Katrina, providing critical feedback to the corresponding numerical analyses. He worked closely on this with the US Army Corps of Engineers and the corresponding US National Academies Oversight Committee, and his work was shown on national networks (CNN, NBC, Discovery, ASCE News, etc.) and cited in great detail in an article evaluating the lessons from Hurricane Katrina in the Spring 2007 issue of The Bridge, published by the National Academy of Engineering.

Professor Abdoun designed & developed the novel wireless shape-acceleration sensor array, taking advantage of new advances in fiber optic and MEMS sensor technologies. The sensors are capable of measuring ground acceleration and permanent deformation to a depth of about 15 m, at a cost 1/10th or 1/20th of existing inclinometer and borehole technologies. In situ 3D ground deformation and 2D soil acceleration are measured at close intervals. Each sensor array is connected to a wireless sensor node to enable real time monitoring and informed assessment of pending failure.

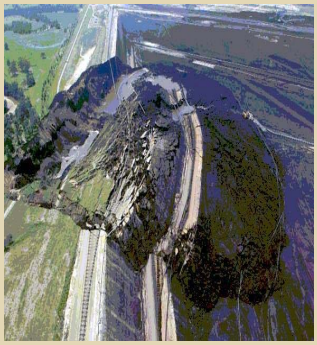
He is a member of several technical committees and the editorial board of technical journals, including ASCE Geo Institute Committee for Earthquake Engineering and Soil Dynamics, and ASCE Journal of Geotechnical and Geoenvironmental Engineering. Dr. Abdoun is the recipient of Rensselaer's 2004, 2006, & 2007 School of Engineering Excellence in Research & Teaching Award, and the prestigious 2004 Casimir Gzowski awarded by the Canadian Society for Civil Engineering.

Professor Ricardo Dobry NAE, mentions two main reasons why he has always liked being a Geotechnical Engineer. Firstly, Civil Engineering produces results that are clearly useful to the whole society; particularly providing large public works for the benefit of many. Secondly, every geotechnical project is new and contains unexpected findings because soils are typically made by nature and not by people. Likening his work to being that of a detective, beginning with finding out what's there, getting a sense of the material and finally developing a working model of the site to predict outcomes. A real-life GSI! (Geotechnical Scene Investigation).

Currently his research is focused on the liquefaction of water saturated sands in earthquakes; especially working on the effect of the shaking by previous earthquakes on soil liquefaction resistance. In this, he is using advanced new tools such as field recordings at instrumented sites, centrifuge model testing and large scale testing. This project stretches through multiple years and is funded by NSF.



Professor Tom Zimmie is currently working on Hurricanes Irene and Lee recovery work, compiling data and producing a website. He is also undertaking fundamental research dealing with soil erosion of embankments, dams and levees. Additional research involves physical modeling of explosive effects on dams, embankments, tunnels and pipelines utilizing the RPI geotechnical centrifuge facilities. His geoenvironmental engineering work continues, dealing with landfills, geosynthetics, and recycling and reuse of waste materials, especially waste paper sludge used in landfill covers. He was selected as a member of an independent scientific board for FEMA dealing with new recertification rules for levees.



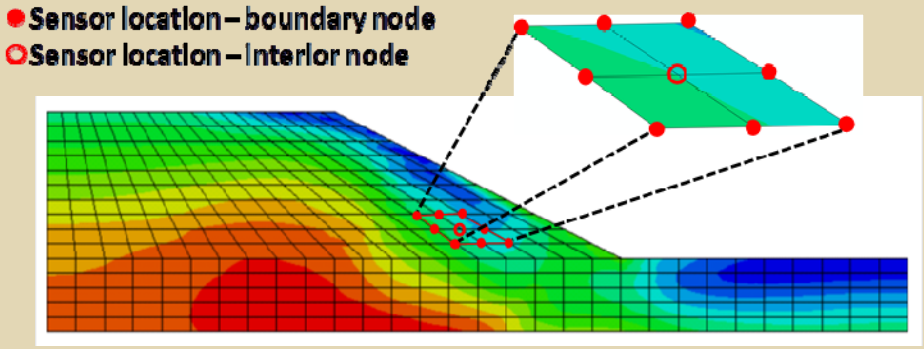
Prof. Zimmie has been with RPI for 41 years and has served as the ASCE student chapter faculty advisor for 39 of those years. It is believed that he is the longest serving active ASCE Faculty advisor in the country and it is also believed he holds the record for length of service. If he were not an academia he would be a consultant in private practice, flying a much larger plane than he currently does!

Dr. Inthuorn Sasanakul is currently a Research Assistant Professor overseeing the day-to-day operations of the NEES Geotechnical Centrifuge Facility since 2005. Dr. Sasanakul has expertise in geotechnical centrifuge modeling, specializing in; soil dynamics, soil characterization, instrumentations, and behavior of soils, and soil-structure systems that are subjected to earthquakes and other natural hazards. Her research includes work on advance soil testing using resonant column and torsional shear devices, centrifuge modeling of New Orleans levees and T-walls system, centrifuge soil model characterization using bender element, CPT, and T bar, centrifuge modeling of contaminant migration through soil cement barriers. Currently, Dr. Sasanakul is conducting research studies on sloping mine tailings. The objective of this research is to investigate the static and dynamic behaviors of mine tailings through the use of centrifuge modeling and resonant column testing, so that better understanding of the behavior of mine tailings will lead to a safer mine waste storage. In her professional opinion this aspect of research is one of the key areas in geotechnical engineering research that needs to be further evaluated in moving toward a sustainable future.

She became an engineer after she was inspired by her uncle, also a civil engineer who designed dams and irrigation systems in Thailand. She was intrigued by the fact that her uncle's work improved many people's way of life in Thailand. If she was not in academia she would work in engineering research facilities or consulting firms where she can do both engineering research and design.

After obtaining his PhD from RPI in the Spring of 2012, **Dr. Vicente Mercado** has been working as a Research Assistant Professor at the Civil and Environmental Engineering Department. His research experience includes numerical modeling, implementation of constitutive models, and inverse analysis of geotechnical systems.

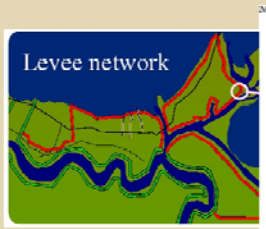
Dr. Mercado has been responsible for the dynamic analysis in the research projects entitled "Study of Pile Foundations Subjected to Liquefaction-Induced Lateral Spreading" and "Advanced Site Monitoring and Effective Characterization of Site Nonlinear Dynamic Properties and Model Calibration", funded by the Network for Earthquake Engineering Simulation (NEES). He is currently working in the development of a new health assessment framework to monitor and assess the health of flood-control infrastructure.

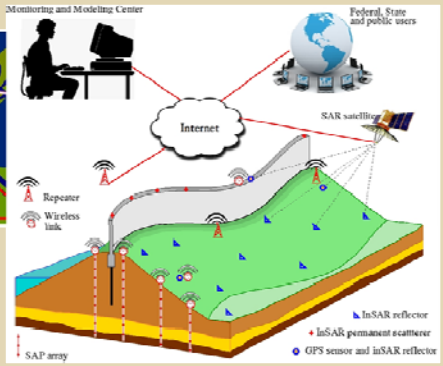


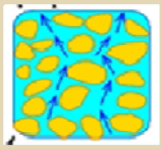
Professor Mourad Zeghal has been with RPI for 14 years. His area of research contributes to the national effort to reduce the impact of geo-hazards and includes smart civil infrastructure, mutiscale modeling and simulation, and information technology applications in geomechanics. He is still very active with the Center for Network for Earthquake Engineering Simulation (CEES), Scientific Computation Research Center (SCOREC) and the Inverse Problems Center (IPRPI). Currently Prof. Zeghal is working on a project entitled "Development of a Mutiscale Monitoring and Health Assessment Framework for Effective Management of Levees and Flood-Control Infrastructure Systems." funded by the Technology Innovation Program of the National Institute of Science and Technology (NIST), which aims to create an integrated suite of technologies and methods for ensuring the reliability and safety of flood-control infrastructure.

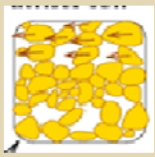
Prof. Zeghal is excited the multiscale dimensions of his projects "Stretching from the levees that are tens of miles long to the level of soil grains". This last aspect is where you try to figure out what is happening to individual soil particles. It is a fundamental approach that provides explanations to the soil behavior that we observe in the lab and the field. It is where you begin to see less empiricism and more mechanics.

He always wanted to be an engineer!









Dr. Anthony Tessari secures Assistant Professor at University of Buffalo.
Tony was a student at RPI for nearly a decade, completing his BS, MS and PhD. After several years as a research engineer working on the long-term stability of flood protection systems in the New Orleans area, Tony now takes up his new position in Buffalo in the spring. Dr. Tessari has extensive experience with designing and developing advanced sensing technologies, data analysis algorithms, and data acquisition software. His research includes pile-founded concrete floodwalls, blast mitigation, and system identification via in-situ testing methods. He is currently aiding in the development and implementation of an NSF TUES Type 1 Project, "A Multi-Institutional Classroom Learning Environment for Geotechnical Engineering Education," for undergraduate soil-mechanics students. In addition, he has been involved in several ASCE competitions and is passing along his knowledge to graduate and undergraduate students.

Geo-Challenge's objective is to design and build a mechanically stabilized earth (MSE) retaining wall model using paper reinforcement taped to a poster board wall facing. The design objective is to use the least amount of reinforcement needed to support the retained soil plus both vertical and horizontal surcharge loads. The ASCE hosts the Geo-Challenge competition at its annual Geo-Institute meeting. Teams of two to four members are allowed to compete, however the number of students involved in the design is unlimited. There must be a minimum of two undergraduate students on each team. The competition takes place at both the regional and national levels. At the 2011 national competition in Dallas, Texas, the RPI team placed first! This was followed by other high placing's in 2012 and 2013.

The Geo-Challenge Competition is beneficial because it allows students to learn new skills which are not covered in much undergraduate or graduate coursework. Students learn about the design of mechanically stabilized earth (MSE) retaining walls from theoretical design to practical application. They also learn long term teamwork and leadership skills. Finally, the conference is a venue where students can learn about specialized topics in the field, and most importantly make valuable industry connections which will last their entire career.

Seeking to continue our success at Geo-Challenge, the RPI assembles again in Atlanta in Spring 2014. The team consists of two graduate students Nonika Antonaki, and Maria Hernandez , three undergraduates; Megan Remsen, Adam Bryant, Yiding Zhang and two undergraduates student consultants; Arpana Sabu and Morgan Miller.

Geotechnical Graduate Students and Current Projects

Nonika Antonaki (Greece) *Centrifuge modelling of disposal, consolidation and dynamic loading of fine-grained mine tailings (Golder Associates)*

Waleed El-Sekelly (Egypt) *Effect of Preshaking by Repeated Earthquakes on Liquefaction Potential of Natural Sands in High Seismicity Regions* (*NSF)*

Omar El-Shafee (Egypt) *Characterization of Dynamic Soil Properties of Seismically Vulnerable Sites Using Centrifuge Modeling (NSF)*

Maria Hernandez (Columbia) *EU Industrial Research Collaboration Project*

Panagiota Kokkali (Greece) *Centrifuge Modeling of Downdrag Bending Moments in Floodwall Support Piles (USACE)*

Bo Li (China) *Micro-Mechanical Analysis of Site Liquefaction Subject to Bi-Axial Excitation (NSF)*

Kathleen O'Meara (United States) *Testing instrumentation installed in New Orleans to evaluate levee stability to be used an early warning system for flood control (USACE)*

Markella Spari (Greece) *Analysis of site dynamic response to bi-axial shaking (NSF)*

Matthew Sylvain (United States) *Laboratory Testing to Evaluate Effects on Dynamic Properties of Mine Tailings measured in the Resonant Column device (Golder Associates)*