Lessons Learned in Geotechnical Engineering

Williamsburg, Virginia
April 27 to April 29, 2015
PLATINUM SPONSORS

ECS

In-Situ Soil Testing, L.C.

menARD
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PROGRAM

**Monday, April 27, 2015**

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<th>Time</th>
<th>Event</th>
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<tbody>
<tr>
<td>10:30 AM</td>
<td><strong>Golf Outing</strong> (Golden Horseshoe Golf Course)</td>
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<td></td>
<td>Tee times 10:30 AM until noon</td>
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<tr>
<td>5:00 PM to</td>
<td><strong>Reception</strong> (Exhibit Hall Virginia Rooms EF)</td>
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<tr>
<td>8:00 PM</td>
<td>Ham, Turkey, and Beef Carving Stations, Vegetables, Dessert</td>
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<tr>
<td></td>
<td>Two Complimentary Drinks</td>
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<td></td>
<td>Sponsored by The Reinforced Earth Company</td>
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**Tuesday, April 28, 2015**

<table>
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<tr>
<th>Time</th>
<th>Event</th>
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<tbody>
<tr>
<td>7:00 AM to</td>
<td><strong>Continental Breakfast</strong> (Exhibit Hall – Virginia Rooms EF)</td>
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<tr>
<td>8:00 AM</td>
<td>Fruits, pastries, muffins, bagels, yogurts, hard boiled eggs. All day juice, coffee,</td>
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<td></td>
<td>granola bars, trail mix and fruit</td>
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**Morning Session Location:** Virginia Rooms ABCD

*Exhibit Hall (Virginia Rooms EF) will be open throughout the conference*

<table>
<thead>
<tr>
<th>Time</th>
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<tbody>
<tr>
<td>8:00 AM</td>
<td><strong>Welcome Remarks</strong></td>
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<tr>
<td></td>
<td>Jose N. Gómez S., PE, MSCE, F ASCE</td>
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<td></td>
<td>Conference Chair</td>
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<td></td>
<td>ECS Mid-Atlantic, LLC</td>
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<tr>
<td>8:05 AM</td>
<td><strong>Thanks to the Exhibitors</strong></td>
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<tr>
<td></td>
<td>Greg Simmons, MSCE, PE</td>
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<td></td>
<td>Exhibitor Chair</td>
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<td></td>
<td>Menard USA</td>
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<tr>
<td>8:10 AM</td>
<td><strong>Some Lessons Learned from Geotechnical Site Investigations</strong></td>
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<td></td>
<td>P. K. Robertson, PhD</td>
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<td></td>
<td>Greg Drilling &amp; Testing Inc.</td>
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<tr>
<td>8:50 AM</td>
<td><strong>Design of Aggregate Pier Groups to Control Settlement</strong></td>
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<td></td>
<td>Roy H. Borden, PhD</td>
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<tr>
<td></td>
<td>North Carolina State University</td>
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<tr>
<td>9:30 AM</td>
<td><strong>Break</strong> (Exhibit Hall – Virginia EF)</td>
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<tr>
<td></td>
<td>Warm apple turnovers</td>
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<tr>
<td>9:55 AM</td>
<td><strong>Settlement of Kansai International Airport Islands</strong></td>
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<td></td>
<td>Gholamreza Mesri, PhD</td>
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<td></td>
<td>University of Illinois at Urbana-Champaign</td>
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<tr>
<td>10:35 AM</td>
<td><strong>I-495 Capital Beltway Express Lanes Project – Challenges, Solutions, and Lessons Learned</strong></td>
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<td>J. Christopher Giese, PE</td>
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## Tuesday, April 28, 2015 (Continued)

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
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<tr>
<td>11:15 AM</td>
<td>Seismic Evaluations for Geotechnical Site Investigations: Success,</td>
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<td></td>
<td>Lessons Learned, and the Future</td>
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<td></td>
<td>Barbara Luke, PhD, DGE</td>
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<td></td>
<td>University of Nevada, Las Vegas</td>
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<tr>
<td>11:55 AM</td>
<td>Diplomate, Geotechnical Engineering (DGE)</td>
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<td></td>
<td>Ray Martin, PhD and Dave Pezza, PE</td>
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<tr>
<td>12:00 Noon</td>
<td>Luncheon with Exhibitors (Virginia Lawn – outside Exhibit Hall)</td>
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<td></td>
<td>Southern BBQ with chicken, pulled pork, sides and dessert</td>
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<tr>
<td></td>
<td>Over $1,500 worth of prizes. Must be present to win</td>
</tr>
</tbody>
</table>

### Afternoon Session Location: Virginia Rooms ABCD

- **1:30 PM**  
  Geolnstitute  
  Allen Cadden, PE, DGE, F ASCE  
  President, Geolnstitute  
  Schnabel Engineering Consultants, Inc.

- **1:35 PM**  
  **Keynote Speaker:**  
  Lessons Learned From Designing High-Rise Building Foundations  
  Harry G. Poulos, AM, FAA, FTSE, NAE, DSc Eng  
  Coffey Geotechnics  
  Sponsored by Schnabel Engineering, Consultants, Inc.

- **3:05 PM**  
  **Break** (Exhibit Hall – Virginia EF)  
  Pretzels  
  Sponsored by GeoStructures, Inc.

- **3:30 PM**  
  Seven Months to Dewater a 6,000 yd³ Excavation  
  John H. Schmertmann, PhD, PE, F ASCE, NAE  
  University of Florida

- **4:10 PM**  
  Geotechnical Engineering at Kennedy Space Center  
  George Filz, PhD  
  Virginia Tech

- **4:50 PM**  
  Challenges in Design of Screw-Piles and Helical Anchors in Soils  
  Alan J. Lutenegger, PhD, PE, F ASCE  
  University of Massachusetts

- **5:30 PM to 6:30 PM**  
  **Happy Hour** (Exhibit Hall – Virginia EF)
Wednesday, April 29, 2015

Location: Virginia Rooms ABCD

7:00 AM to 8:00 AM
**Continental Breakfast** (Exhibit Hall – Virginia Rooms EF)
Fruits, pastries, muffins, bagels, yogurts, hard boiled eggs. Juice, coffee, granola bars, trail mix and fruit until noon

8:00 AM
**Geo-Hazards and Critical Infrastructure**
Tom O'Rourke, PhD
Cornell University

8:40 AM
**Recent Case Histories of Confined Access to Shoring and Underpinning Projects**
John R. Wolosick, PE, DGE
Hayward Baker, Inc.

9:20 AM
**The Evolution of the Concrete-Faced Rockfilled Dams (CFRD)**
Alberto Marulanda
INGETEC S.A., Consulting Engineers

10:00 AM
**Break** (Exhibit Hall – Virginia Rooms EF)
Warm cinnamon buns

10:25 AM
**Toppling Failure of Rock Slopes**
Richard E. Goodman, Dr. h.c., Prof. Emeritus
University of California, Berkeley

11:05 AM
**Lessons Learned from a Bridge Abutment Failure**
Raymond A. DeStephen, PE
Schnabel Engineering Consultants, Inc.

12:45 PM
**Geosynthetic Engineering: Lessons From 30 Years of Landfill Performance**
Robert C. Bachus, PhD, PE, DGE
Geosyntec Consultants

12:25 PM
**Closing Remarks**
Roger Failmezger, PE, F ASCE
*Conference Co-Chair*
President, In-situ, Inc.

12:30 PM
**Conference Adjournment**
ORGANIZING COMMITTEE

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Senior Principal Geotechnical Engineer
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JGomez@ecslimited.com

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Golf Outing Chair
Senior Vice President
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ASCE Virginia Section Representative
Vice President/Hampton Roads Regional Manager
ECS Mid-Atlantic, LLC
MGalli@ecslimited.com

Sara B Philips
Marketing
Project Manager
ECS Mid-Atlantic, LLC
SPhilips@ecslimited.com
Some Lessons Learned from Geotechnical Site Investigations
P. K. Robertson, PhD
Professor Emeritus & Technical Advisor
Gregg Drilling & Testing Inc, California, USA

ABSTRACT
It is common in many parts of North America that geotechnical site investigations are performed with limited budgets using basic drilling, sampling and SPT. A simple risk-based approach will be presented that can be used as a guide to determine the appropriate level of sophistication for geotechnical site investigations. Most empirical correlations used in practice to interpret penetration tests are derived from experience and research in ‘ideal’ soils. These are soils with little or no microstructure, where microstructure is caused by physical and chemical processes, such as, aging, cementation, stress and strain history, weathering, etc. This often results in excessive conservatism that can be costly. To improve interpretation and application of penetration tests, it can be important to identify the existence of microstructure in soils. Simple methods to identify if soils have significant microstructure will be presented and discussed.

Dr. Peter Robertson brings more than 40 years experience as an educator, researcher, consultant and practitioner specializing in the areas of in-situ testing and site investigation, earthquake design of geotechnical structures, and soil liquefaction. Peter is recognized as an expert both nationally and internationally in the areas of in-situ testing and soil liquefaction. He has been a consultant to various industrial clients and insurance companies in North America, Asia and Europe for projects involving liquefaction evaluation for major structures, stability of on-shore and off-shore structures, landslides, stability of natural slopes and tailings dams, and use and interpretation of in-situ tests. He is the co-author of the primary reference book on Cone Penetration Testing (CPT). He has also authored or co-authored over 250 publications as well a popular CPT Guide that is freely available via the Gregg website. With support from Gregg Drilling & Testing Inc., Peter has also assisted in the development of several inexpensive CPT-based interpretation software programs and has presented a series of free webinars on the CPT in an effort to enhance education and practice. Peter continues to provide private consulting to a wide range of clients.
Design of Aggregate Pier Groups to Control Settlement
Roy H. Borden, PhD
Professor of Civil, Construction and Environmental Engineering, North Carolina State University

ABSTRACT
The use of stone columns and aggregate piers as a substitute for other deep-foundation elements has increased substantially in recent years. For cases in which non-toe bearing columns are used (floating columns), the total ground-surface settlement is potentially made up of two parts; compression of the reinforced zone and compression of the zone beneath the columns. This presentation will present the results of axisymmetric FEM analyses performed using PLAXIS which are compared to simplified approaches for calculating upper- and lower-zone compression.

The upper-zone (reinforced) compression is determined using two methods: the performance ratio (PR) proposed by Poorooshab and Meyerhof, which is defined as the ratio of the settlement of the treated ground to that of the untreated ground under the identical surcharges, and that of Priebe who uses a settlement ratio, n, which is basically the inverse of the PR. Both solutions are presented as a function of area replacement ratio, $A_r$, and column length, as well as the column and surrounding soil properties. Compression in the lower zone (beneath the columns) is shown to be reasonably estimated using an “imaginary footing” approach, with the surface load applied at a depth of 2/3L.

Dr. Roy H. Borden is a Professor of Civil, Construction and Environmental Engineering at North Carolina State University and a licensed professional engineer in North Carolina. He received his B.S. in Civil Engineering from Tufts University and his M.S. and PhD degrees from Northwestern University. His work has focused on the areas of soil and site improvement, the behavior of shallow and deep foundations and retaining structures and the laboratory and insitu characterization of residual soils. Dr. Borden has been a past chair of the ASCE Grouting Committee, a member of the Executive Editorial Board of the Ground Improvement Journal and a member of ISSMFE TC-17, Committee on Ground Improvement, Reinforcement and Grouting and served a 4-yr term as a member of the System Management Board for the National Geotechnical Experimentation Sites Program. At NC State has been awarded the Kimley-Horn Faculty Award for research and teaching, been recognized as an Outstanding Teacher, received a University Outstanding Extension Service Award and been inducted into both the Academy of Outstanding Teachers and the Academy of Outstanding Extension Faculty.
Settlement of Kansai International Airport Islands
Gholamreza Mesri, PhD
Ralph B. Peck Professor Civil Engineering, University of Illinois at Urbana-Champaign

Abstract
The Kansai International Airport was constructed in Osaka Bay in 18- to 20-m-deep seawater to avoid noise pollution and land acquisition disputes. Construction of the 511-ha Island I began in 1987 and Runway I began operation in 1994. Construction of the 545-ha Island II began in 1999, and Runway II began operation in 2007. Using more than 2.2 million vertical sand drains fully penetrating into the 17.3- to 24.1-m-thick Holocene clay layer and 430 million cubic meters of fill material, the project is viewed as an engineering marvel. On the basis of a detailed review of the geology of Osaka Bay, construction of the Airport Islands, and the permeability and compressibility of the Holocene and Pleistocene subseabed deposits that reached a depth of 400 m below the seafloor at the Kansai Airport site, settlement analyses were conducted assuming the uniqueness of end-of-primary void ratio–effective vertical stress relationship and the Ca/Cc law of compressibility. Airport Island I has already settled below the 4-m above sea level surface elevation required by the design specification, and the surface elevation of Island II is predicted to be 4 m above sea level by 2023–2036. Airport Islands I and II will be at sea level, respectively, by 2067 or sooner and by 2058–2100. By the end of the 21st century, Island I and Island II are predicted to settle, respectively, 17.6 and 24.4 m.

Gholamreza Mesri, a world authority on the behavior of soils and a leader in the study of the compressibility and consolidation of soils and ground improvement, is the Ralph B. Peck Professor Civil Engineering at the University of Illinois at Urbana-Champaign. Together with Karl Terzaghi and Ralph B. Peck, he is the co-author of the Third Edition of the widely-used textbook, Soil Mechanics in Engineering Practice.

Professor Mesri has taught short courses in Geotechnical Engineering, attended by large number of engineers, in many countries. He has served as a consultant to government and private organizations in relation to construction projects in various parts of the world, for airports, offshore facilities, tunnels, hydroelectric developments, building foundations, and landslides. He is a member of the International Commission on Restoration of Metropolitan Cathedral of Mexico City, a member of the International Commission on Swelling Rocks, ISSMGE Technical Committee on Soft Soils Foundation Engineering, and a founding member of the International Committee on Coastal Geotechnical Engineering.

Among his honors Mesri includes the 1988 and 2004 Norman Medal, the 1992 Thomas A. Middlebrook Award, and the 2015 Karl Terzaghi Award of the ASCE.
I-495 Capital Beltway Express Lanes Challenges, Solutions, and Lessons Learned

J. Christopher Giese, PE
Chief Engineer, ECS Mid-Atlantic, LLC

Abstract

The design and construction of the Express Lanes for the I-495 Capital Beltway was a $1.5B Design/Build undertaking. It included finishing Phase VIII of the I-95/I-395/I-495 Interchange Reconstruction Project and constructing toll express lanes and comprehensive I-495 improvements along I-495 corridor up to and beyond the complex Tysons Corner and Dulles Airport Access Road Area. Overall, the project covered about 12.5 miles of twelve-lane roadways, fifty-five bridges, approximately 200 retaining walls, and several areas of ground improvement.

The project required submission and approval of over 200 design packages over a fifteen-month design period. The design packages were reviewed by a General Engineering Consultant retained by the Virginia Department of Transportation. This presentation focuses on the practices employed by ECS and other consultants to meet the exacting design schedule, including management and staffing, quality assurance practices, working processes with the lead designer, the GEC, and the owners, TransUrban and VDOT.

The technical part of the presentation presents design issues and solutions for the bridge foundations and retaining walls. The presentation includes ground improvement solutions employed at several areas of the project. The technical part of the presentation presents problems encountered during construction and solutions to these problems. The presentation also highlights technical and management lessons learned associated with a large geotechnical project undertaking.

J. Christopher Giese, PE has extensive geotechnical engineering project experience, especially in the state of Virginia. For the last twenty years, Mr. Giese has focused exclusively on transportation projects. His experience includes engineering consultation for over 400 bridge projects.

Mr. Giese is a long-term member of the Fairfax County Geotechnical Review Board, a select group of recognized leaders in the field of geotechnical engineering. His geotechnical engineering expertise includes consultation for design of shallow and deep foundations, analysis and design of various types of retaining walls, ground improvement techniques, landslide control, pavements, and dam design. Mr. Giese is experienced with rock slope design and rockfall mitigation practice. Mr. Giese developed and oversaw the initial five-shaft load test program for the initial phases of the I-95/I-395/I-495 interchange reconstruction project.
Seismic Evaluations for Geotechnical Site Investigations: Successes, Lessons Learned, and the Future
Barbara Luke, PhD, DGE, F ASCE

Professor of Civil Engineering, University of Nevada, Las Vegas

Abstract:
Seismic methods are an extremely useful tool for geotechnical site investigations. They are beneficial whenever a feature or characteristic of interest presents a contrast in mechanical stiffness. Seismic methods have been used successfully to investigate sediment layering, bedrock contacts, faults, saturated zones (potentially transporting contaminants), sinkholes, tunnels, buried treasure or debris, and more. The practice is mature, but there remains much room for advancement, and research intensity in this subject area remains high. Reality has not yet caught up with the scene in the classic film “Jurassic Park” where the dinosaur-fossil image materializes with a shotgun blast and the push of a button. Civil engineering practitioners need to be aware of the capabilities of seismic methods as they exist today, and also what is, for now, still out of reach.

The talk will celebrate the wide range of applications and highlight successes of seismic methods for geotechnical site characterization. It will also address some pitfalls in collecting and interpreting seismic data. What conditions are not yet possible to resolve with current capabilities? And, the likelihood of success is clearly linked to knowledge, experience and diligence of the practitioner. The presenter will draw on personal successes and “disappointments” for illustration. Emphasis will be on Rayleigh wave methods for shear wave velocity profiling, especially as applied to earthquake site response analysis. Direct body wave velocity measurements via refraction and downhole methods will also be addressed.

Barbara Luke directs UNLV’s cross-disciplinary Applied Geophysics Center. Her research emphasis is in seismic site characterization and application of the outcomes to solve engineering problems.

Dr. Luke is a past recipient of NSF’s Faculty Early Career Development award. The award supported research toward detection and delineation of high-velocity inclusions in soil profiles using seismic surface waves. Current research builds upon that foundation, with new developments in data processing and interpretation. The CAREER award also supported development of an on-campus engineering/geophysics test site which is in regular use for teaching and research. Dr. Luke is active in academic, professional and community service. She has participated in governance of the ASCE’s Geo-Institute and also the Environmental and Engineering Geophysical Society. She holds a bachelor’s degree with highest honors from University of Texas at Austin, master’s degree from University of California, Berkeley, and doctorate degree from University of Texas at Austin; all in civil engineering.
Lessons Learned from Designing High-Rise Building Foundations
Harry G. Poulos, AM, FAAA, FTSE, NAE, DSc Eng
Senior Principal, Coffey Geotechnics and Emeritus Professor, University of Sydney, Australia

ABSTRACT
The design of tall building foundations involves a systematic process which incorporates the following components: Ground investigation; ground characterization; preliminary design of the foundation system for the anticipated structural loads; detailed foundation design, involving close interaction between the structural and geotechnical engineers; load testing of the proposed foundations; modification of the foundation design, if appropriate; monitoring of the foundation performance as construction proceed.
This lecture will discuss the application of this process to a number of high-rise towers including: The Emirates twin towers in Dubai; The Burj Khalifa in Dubai; The Incheon 151 Tower in South Korea; A high-rise tower in Jeddah, Saudi Arabia.
In each case, lessons were learned during the design process, and from the settlements measured during construction. Such lessons have influenced the approaches adopted for subsequent projects. Some of the lessons learned include:
1. The importance of ground investigations – obvious
2. The importance of proper ground characterization. Beware not to over-simplify ground conditions below the foundation level (Emirates). Take account of the non-linear behaviour via strain/stress-dependent modulus values.
3. The importance of simple preliminary design calculations – Emirates experience, transferred to Burj Khalifa and Incheon.
4. The vital importance of early pile load testing – Emirates, Burj, Incheon – all had load tests which either confirmed the design or provided data for upgraded performance predictions or even re-design.
5. Successful prediction of pile load test results will not necessarily lead to an accurate prediction of overall foundation performance – Emirates experience.
6. Cavities may not be as influential or catastrophic as may be feared – Jeddah Tower.

Professor Harry Poulos, has been involved in a large number of major projects in Australia and overseas including the Egnatia Odos highway project in Greece, the Burj Khalifa tower in Dubai, and the Dubai tower in Doha, Qatar. He was elected a Fellow of the Australian Academy of Science in 1988 and a Fellow of The Australian Academy of Technological Sciences and Engineering in 1996. He has received a number of awards and prizes, including the Kevin Nash Gold Medal of the International Society of Soil Mechanics and Geotechnical Engineering in 2005. He was the Rankine Lecturer in 1989 and the Terzaghi Lecturer in 2004, and was selected as the Australian Civil Engineer of the Year for 2003 by the Institution of Engineers Australia. In 1993, he was made a Member of the Order of Australia for his services to engineering, and in 2010, he was elected a Distinguished Member of the American Society of Civil Engineers. In 2014, he was elected as a Foreign Associate of the US National Academy of Engineering.
Seven Months to Dewater a 6,000 yd\(^3\) Excavation.

John H. Schmertmann, PhD, PE, F ASCE, NAE
Professor Emeritus, University of Florida

Abstract

The presentation will describe an old case history of a small Corps of Engineers foundation dewatering problem in sand that proved difficult for all concerned. It involved an initial wellpoint installation, boils, the installation of piezometers, well pumping tests, the design and construction of an inverted gravel filter blanket, and finally a unique use for wellpoints. The contractor expected the dewatering to take 2 weeks. Instead it required using the observational method and took 30 weeks. The contractor had to have faith, the engineers curiosity, and the consultant the courage to scale up the laboratory quicksand tank test. All parties contributed to a happy ending and learned something in the process.

Professor John Schmertmann is perhaps most widely known to students of geotechnical engineering around the world for his method to estimate settlements of shallow foundations. He is professor emeritus of the University of Florida. Earlier, he was a principal with Schmertmann & Crapps, Inc. and a director at LOADTEST, Inc. He has received numerous honors and awards, including: ASCE’s: Collingworth Prize, the Norman Medal, State-of-the-art Award, the Middlebrooks Award, and the Terzaghi Lecture. In 2008, ASCE published Special Geotechnical Publication No. 180 – From Research to Practice in Geotechnical Engineering – to honor his contributions to civil engineering. He was elected to the National Academy of Engineering in 1984.

Over his more than 60-year long and distinguished career, Professor Schmertmann has contributed immensely in furthering the theoretical and practical knowledge in geotechnical engineering in such varied areas as consolidation testing, settlement analysis methods, seepage and piping, shear strength of soils, insitu testing, and soil ageing.

Professor Schmertmann received his undergraduate degree in Civil Engineering from MIT and MS and PhD degrees from Northwestern University.
Geotechnical Engineering at Kennedy Space Center
George Filz, PhD
Charles E. Via Professor of Civil and Environmental Engineering
Virginia Tech

Abstract
NASA is renovating the infrastructure at Kennedy Space Center to accommodate a new generation of heavy lift space vehicles that will exceed the capacity of some existing infrastructure components. This presentation focuses on overall stability of the transporter that carries heavy lift vehicles along the crawlerway from the Vehicle Assembly Building to Launch Pad A, crawlerway surface treatment for track-mounted and rubber-tired transporters, Vehicle Assembly Building foundations, and stabilization of slope protection slabs at Launch Pad A to resist shaking from rocket blasts.

Professor George Filz received his BSCE and MSCE degrees from Oregon State University and his PhD from Virginia Tech. He worked in private engineering practice for seven years between his MS and PhD degrees. He now serves as the Charles E. Via Professor of Civil and Environmental Engineering at Virginia Tech, where his teaching, research, and professional practice interests include foundation engineering, soil improvement and reinforcement, levees, dams, and seepage barriers. He various awards and honors include the ASCE Middlebrooks Award, the ASCE Croes Medal the ASCE Florida Project-of-the-Year Award, and the TRB Best Practice-Ready Paper Award.
Challenges in the Design of Screw-Piles and Helical Anchors in Soils
GeoVirginia - 2015
Alan J. Lutenegger, PhD, PE, F ASCE
Professor of Civil & Environmental Engineering
University of Massachusetts

ABSTRACT
Screw-Piles and Helical Anchors have been in use throughout the world to support a variety of structures for the past 180 years, and have seen a dramatic increase in use in Civil Engineering practice during the past 20 years. Screw-Piles and Helical Anchors consist of a manufactured foundation/anchor element with a central steel shaft and one or more helical plates welded to the shaft. Like all foundations, Screw-Piles and Helical Anchors present a number of challenges to Geotechnical Engineers in the design process. The unique geometry and installation process associated with Screw-Piles and Helical Anchors presents a challenge to engineers to develop appropriate soil properties and to use appropriate models of behavior in order to obtain reliable estimates of load-displacement behavior and capacity. The challenges facing engineers in the design of Screw-Piles and Helical Anchors in soils will be described and illustrated with specific examples. Unlike other foundations and anchor systems, these challenges relate to the specific geometry of the helical pile/anchor, i.e., number, size, and spacing of helical plates; size and shape of the central shaft; the failure mode in compression or tension; and site characterization to determine design soil properties. In addition, the influence of soil disturbance produced by rotation during installation on the behavior will be described, and the importance of high quality installation, controlled largely by the Contractor, will also be discussed. A brief discussion of installation quality control and torque-to-capacity relationships will be also presented.

Alan J. Lutenegger is Professor of Civil and Environmental Engineering at the University of Massachusetts-Amherst where he has been a member of the faculty since 1989. He received his B.S. degree in Construction Engineering in 1975 from Iowa State University and his M.S. (1977) and Ph.D. (1979) degrees in Geotechnical Engineering, also from Iowa State University.

Dr. Lutenegger’s area of interest is primarily focused on in-situ testing of soils, physical-chemical behavior of clays, lime modification of clays, behavior of driven piles. Over the past 10 years, his research work has largely been focused on the design and behavior of Screw-Piles and Helical Anchors which has included over 400 full-scale load tests. He has authored or coauthored over 180 technical papers related to Geotechnical Engineering and has advised 55 graduate students in his 31 years as a faculty member. He is a Registered Professional Engineer and a Fellow of the American Society of Engineers. In 2011 he founded the International Society for Helical Foundations (ISHF) and is currently serving as its Executive Director.
ABSTRACT
Geotechnical engineers play a critical role in managing the performance of large geographically distributed systems that are affected by geohazards such as earthquakes, floods, hurricanes, and landslides. Systems, such as water supplies, levees, and gas and liquid fuel supply networks, cover thousands of km\(^2\) and are subject to many different ground response and geotechnical failure mechanisms. The geotechnical factors affecting system behavior have broad implications for life safety and regional economic stability. The lecture will explore the geotechnical aspects of large system behavior during extreme natural events, starting with the performance of system components under extreme conditions of soil-structure interaction. The impact of the Canterbury Earthquake Sequence on the underground infrastructure in Christchurch, NZ is explored with the use of an extraordinary GIS and high resolution LiDAR data set to evaluate the regional characteristics of liquefaction-induced ground deformation and its effects on water, wastewater, and gas distribution systems. The geotechnical factors affecting regional system response to geohazards will be examined with reference to earthquake effects on the Los Angeles and San Francisco water distribution networks as well as hurricane effects on critical infrastructure in New York City. Recent advances in designing and testing a new generation of hazard-resilient pipelines are described. The lecture will explore the implications of recent earthquakes and hurricanes with respect to low probability/high consequence events and the need to improve the protection of critical infrastructure.

Tom O’Rourke is the Thomas R. Briggs Professor of Engineering in the School of Civil and Environmental Engineering at Cornell University. He is a member of the US National Academy of Engineering, International Fellow of the Royal Academy of Engineering, Distinguished Member of ASCE, and Fellow of American Association for the Advancement of Science. He received a number of distinctions for his research and teaching, some of which include ASTM C.A. Hogentogler Award, ASCE Collingwood, Huber Research, C. Martin Duke, LeVal Lund, Stephen D. Bechtel Pipeline Engineering, and Ralph B. Peck Awards, and the British ICE Trevithick Prize. He gave the 2009 Rankine Lecture and has been selected to give the 2016 Terzaghi Lecture. He served as President of the Earthquake Engineering Research Institute and as the chair or member of many professional society committees. He has authored or co-authored over 360 technical publications. His research interests cover geotechnical engineering, earthquake engineering, underground construction technologies, engineering for large, geographically distributed systems, and geographic information technologies and database management. He has served on numerous government advisory boards, as well as the consulting boards or peer reviews for many projects associated with highway, rapid transit, water supply, and energy distribution systems.
Recent Case Histories of Confined Access Shoring and Underpinning Projects
John R. Wolosick, PE, DGE
Director, Hayward Baker Inc.

Abstract
Two recent shoring and underpinning case histories are presented that illustrate the use of modern drilling and grouting equipment to reliably support soils for temporary shoring and to underpin existing building foundations. The projects include a museum and a manufacturing facility for confidential clients. The projects utilized micropile underpinning, soil nailing and shotcrete, resistance piers and steel pipe struts to accomplish the work. Deep excavations, up to 25 ft deep were performed indoors, with low headroom and confined space limitations.

John R. Wolosick is Director of Engineering for Hayward Baker Inc., Atlanta, Georgia where he covers projects nationwide and specializes in micropiling and underpinning, anchors, earth retention and landslide stabilization, and all types of grouting.

He holds B.S. and M.S. degrees in Civil Engineering from the University of Illinois at Urbana-Champaign, and has more than 35 years of experience in Geotechnical Engineering and Contracting. Mr. Wolosick is the author of more than 30 technical papers. He is a Registered Professional Engineer in ten Southeastern and Mid-Atlantic states.

Mr. Wolosick is the President of the Deep Foundations Institute (DFI) for 2015-2016. He was the recipient of the 2008 ASCE/Geo-Institute Martin S. Kapp Foundation Engineering Award. He is former Co-Chair the ADSC/DFI Micropile committee (2004-2007). He is also a member of the ASCE Earth Retaining Structures committee and Past-Chair of the ASCE Georgia Section Geotechnical Committee (2003-2005).
THE EVOLUTION OF THE Concrete-Faced Rockfill Dams (CFRD)
Alberto Marulanda
Chief Executive Officer, INGETEC SA, Colombia

ABSTRACT
The construction of Concrete-Faced Rockfill Dams (hereafter referred to as CFRD) has increased in the last decades. This enthusiasm for CFRDs has its origin in both its inherent stability characteristics and its construction and schedule features. In addition, its foundation requirements and treatments that are less strict and more straightforward to carry out, particularly when compared to gravity or arch dams, have made this type of dam a very attractive solution. Therefore, the CFRD is currently a very common type of dam with several projects recently finished or under construction, with heights well above 180 m. The design and development of CFRD dams have been based primarily on precedent and empiricism. However, recent incidents have shown that the extrapolation of precedents with the current procedures can have serious consequences. There is a need to improve the current design approaches and evolve beyond empiricism, including the development of analytical methodologies to analyze the behavior of this type of dam. Recent problems in some dams in Brazil, Lesotho and China, where the face has suffered considerable cracking, are also presented.

The main problem in the dams that have behaved adversely was the characteristics of the rockfill, which confirmed that a “good” rockfill is not defined by just the hardness of fill particles but by the fill’s gradation. This issue was well recognized several decades ago. However, it is likely that due to the pressure to further reduce costs and compress schedules, this fundamental knowledge on rockfill behavior was overlooked. The adequate processing of rockfill, including gradation, sluicing and compaction are essential to obtain an adequate behavior of a rockfill dam.

The framework described in this paper provides a rational and systematic approach for evaluating the rockfill properties for these dams. Examples of very recent and successful dams illustrate the capability to adapt to different design requirements because of variability in materials and foundation conditions.

Alberto Marulanda has over 40 years of professional experience and heads a 2,000-person company. He graduated from the University of Los Andes, and obtained his MS from the University of Illinois, Urbana-Champaign. Mr. Marulanda has led the design of hydropower, water supply and infrastructure projects in Central and South America and Turkey. He has worked as an independent consultant and has been a member of the panel of experts in several major dams, and tunnel projects around the world.

He has authored more than 50 technical papers on geotechnical engineering, dams and tunnels. He is the Past Chairman of the technical committee of materials for fill dams of the), a former president of the Colombian Association of Seismic Engineering and past vice president of International Commission on Large Dams. In 2009, he was listed by the Water Power and Dam Construction magazine (London) as one of the “60 most influential people in the 100 year history of hydroelectricity in the world."
Toppling Failure of Rock Slopes
Richard E. Goodman, Dr. h.c., Prof. Emeritus
Department of Civil Engineering, University of California, Berkeley

ABSTRACT
Toppling of rock blocks, individually, or in rock masses of great volume, is now understood to be an important potential mode of failure for rock slopes. Toppling can also occur in foundations, tunnels and underground chambers and on a small scale in any rocky landscape where frost, creep, or water forces are at play. Toppling failures can develop slowly as an expression of creep, or they can occur suddenly and powerfully.

General recognition of toppling by engineers as an important mode of failure for jointed and fractured rocks developed only in the late 20th century. While geologists much earlier noted and mapped regions of overturned bedding and foliation in sedimentary rocks, schists, and slates of steep mountains – they tended to attribute their origin to sustained, slow creep of mountain slopes. Engineers seemed to have eyes principally for hazards of rock sliding on planar bedding, joints or fault surfaces. Rock engineers and geologists are now attributing to toppling (rather than to recent tectonics) some structural lineaments of vast scale in the flanks of mountains.

This presentation will discuss the features of toppled rock masses in nature, and in base friction models – distinguishing between primary and secondary toppling, and block-toppling versus flexural toppling. Methodology for calculating the potential hazard, and necessary strengthening of rock masses capable of toppling, will be discussed in the context of design of excavations. Three instructive California cases will be reviewed in brief.

Richard E. Goodman, a consulting geological engineer was a Professor of Geological Engineering at University of California, Berkeley from 1964 to 1994. His consulting activities mainly focus on rock mechanics and engineering geology of dams, power projects, and rock slope issues. He has served on consulting and several review boards for dams and underground power projects. Professor Goodman is the author of numerous technical papers and five books: Methods of Geological Engineering; Intro. To Rock Mechanics; Block Theory and its Application to Geological Engineering (co-author: Gen-hua Shi); Engineering Geology – Rock in Engineering Construction; and The Engineer as Artist – biography of Karl Terzaghi.

Professor Goodman has received various honors and awards over the years, including: Basic Research Award (U.S. National Committee for Rock Mechanics); Elected to the National Academy of Engineering; The Rankine Lecturer; and The H. Bolton Seed Medal (ASCE) (2000). He obtained his undergraduate degree from Cornell and his PhD from University of California, Berkeley.
Lessons Learned from a Bridge Abutment Failure
Raymond A. DeStephen, PE
President, Schnabel Engineering Consultants, Inc.

ABSTRACT
Thirty-five ft high approach embankments for a railroad and highway bridge overpass were constructed over 40 ft of soft organic clay, resulting in post-construction abutment settlements of 3 ft. These settlements resulted in complete tension failure of abutment piles and damage to the bridge structure, all of which could have been avoided.

Although both consolidation testing and dilatometer testing (DMT) were performed, settlement and time-of-settlement predictions were based on the less conservative DMT results. Eighty percent of primary consolidation was expected in only three months with total predicted settlements of 2.5 ft to 3.5 ft. Instead, total settlements exceeding 5.5 ft have occurred, and the abutments are still experiencing settlement 22 years later.

Excellent field performance data was obtained during construction including excess pore water pressures via piezometers, horizontal slope movements via slope indicators, and vertical settlement in profile across each abutment via horizontal indicators. This data showed horizontal and vertical movements were continuing and pore pressures were well in excess of static levels one year after start of embankment construction. Remarkably, these results were ignored and the embankments were “released to the contractor” for bridge construction.

Remediation included partial reconstruction of the abutments using 16 inch diameter pipe piles driven through holes cut into the bridge deck. Future down drag was minimized by providing pile sleeves through the embankment soil and upper geologic strata, and a friction reducer (bituminous coating) was used to limit negative drag within the clay.

Ray Desstephen received his Master of Science degree in geotechnical engineering from Ohio State University. He is a registered professional engineer in four states. He has been with Schnabel Engineering for the past 40 years, and currently serves as President of Schnabel Engineering Consultants, Inc. which represents the geo-practice within the firm.

He is the author of more than a dozen papers on geo-environmental and geotechnical engineering.
Geosynthetic Engineering: Lessons from 30 Years of Landfill Performance
Robert C. Bachus, PhD, PE, DGE
Geosyntec Consultants, Georgia, USA

Abstract
In keeping with the geosynthetic engineering theme presented at the previous two GeoVirginia Conferences by Dr Bob Koerner and Dr. Bob Holtz, this presentation will highlight the numerous “lessons learned” regarding the behavior and performance of geosynthetic materials as gleaned from the design, construction, and operation of municipal solid waste landfills. Specifically, the promulgation of the Subtitle D regulations nearly 30 years ago has had a profound effect on the municipal solid waste disposal industry and dramatically altered the design, construction, and operation of modern landfills. One of the primary changes (and opportunities) related to design and construction of these modern facilities was the literal explosion regarding the use of geosynthetic materials to solve engineering problems posed by these new regulatory demands on this industry. Over the intervening years, significant advances have been made to the geosynthetic products themselves, some of which were designed and fabricated to address specific technical challenges faced by the designers, contractors, and owners. Advances have also been made regarding design methods that incorporate these unique materials. Sufficient time has passed to allow an assessment of the performance of systems that incorporated geosynthetic materials. This paper and presentation will highlight many of the products and applications regarding the use of geosynthetic materials in the landfill industry. Most notable, the presentation will address the lessons that have been recognized over recent years. Typical applications that involve geosynthetic materials include liquids and solid containment, filtration, drainage, and reinforcement. Examples will include regulatory concerns and feedback, performance documentation, and potential long-term operational issues that may challenge the consideration of geosynthetic materials in the future.

Dr. Bachus is a Principal with Geosyntec Consultants and is based in Kennesaw, Georgia. He has more than 35 years of engineering analysis and design experience, focusing on geotechnical engineering, solid waste containment and engineering, geosynthetic engineering, waste by-product characterization, instrumentation, and geotechnical data management. He has provided design, analysis, forensic investigation and expert testimony for more than 200 projects related to these practice areas.

Dr. Bachus received his B.S. and M.S. from the University of Illinois at Chicago and holds a Ph.D. in geotechnical engineering from Stanford University, as well as degrees. Prior to joining Geosyntec some 24 years ago, he was on the geotechnical engineering faculty at the Georgia Institute of Technology for eleven years and is currently an Adjunct Professor at Georgia Tech. He remains active in teaching through University Extension programs related to landfill design, geosynthetics engineering, geotechnical slope stability, settlement, and seepage. He also teaches courses and workshops for FHWA related to soils and foundation systems design and load and resistance factor design (LRFD). He has authored or co-authored more than 100 technical publications, including several technical design guidance documents on behalf of FHWA and geosynthetic manufacturers.
LIST OF SPEAKERS

Robert Bachus, PhD, PE, DGE, Geosyntec Consultants, Georgia, USA
Roy H. Borden, PhD, Professor of Civil, Construction and Environmental Engineering, North Carolina State University
Raymond A. DeStephen, PE, President, Schnabel Engineering Consultants, Inc.
George Filz, PhD, Charles E. Via Professor of Civil and Environmental Engineering, Virginia Tech
J. Christopher Geise, PE, Chief Engineer, ECS Mid-Atlantic, LLC
Richard E. Goodman, Dr. h.c., Prof. Emeritus, Department of Civil Engineering, Univ. of California, Berkeley, CA
Barbara Luke, PhD, DGE, F ASCE, Professor of Civil Engineering, University of Nevada, Las Vegas
Alan J. Lutenegger, PhD, PE, F ASCE, Professor of Civil & Environmental Engineering, University of Massachusetts
Alberto Marulanda
Chief Executive Officer, INGETEC SA, Colombia
Gholamreza Mesri, PhD, Ralph B. Peck Professor Civil Engineering, University of Illinois at Urbana-Champaign
P. K. Robertson, PhD, Professor Emeritus Technical Advisor, Gregg Drilling & Testing Inc, California, USA
Tom O'Rourke, PhD, Dist ASCE, Thomas R. Briggs Professor of Engineering, Cornell University, Ithaca, NY, USA
Harry G. Poulos, AM, FAA, FTSE, NAE, DSc Eng, Senior Principal, Coffey Geotechnics and Emeritus Professor, University of Sydney, Australia – Keynote Speaker
John H. Schmertmann, PhD, PE, F ASCE, NAE, Professor Emeritus, University of Florida
John R. Wolosick, PE, DGE, Director, Hayward Baker Inc.
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