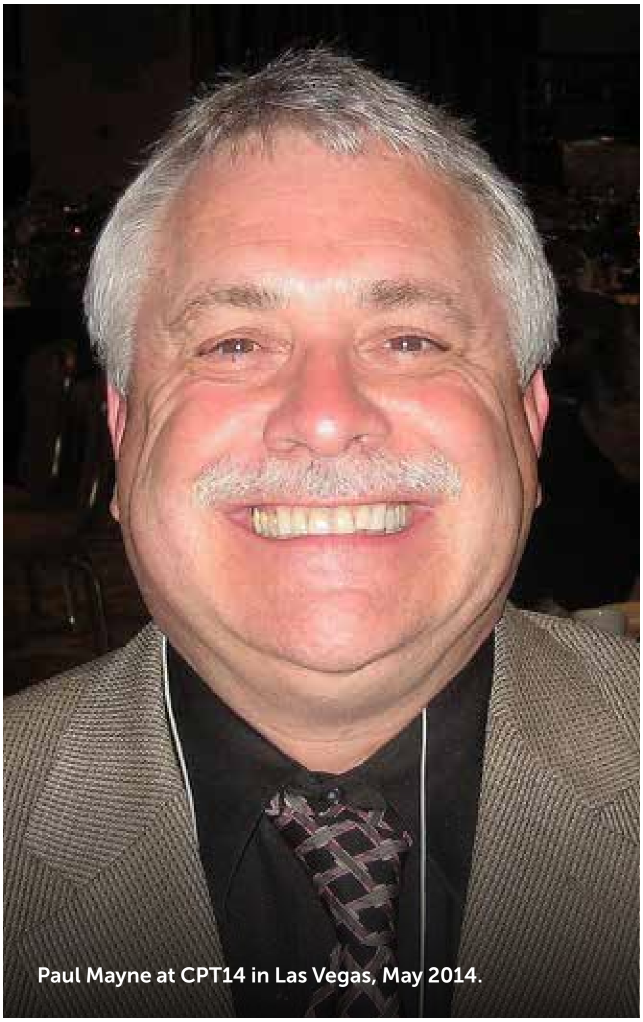
Paul W. Mayne, PhD, PE, M.ASCE

By Md Zahidul Karim, S.M.ASCE, Marta Miletic, S.M.ASCE, Weston Koehn, S.M.ASCE,
Tri Tran, S.M.ASCE, and Steven Halcomb, PE, GE, M.ASCE



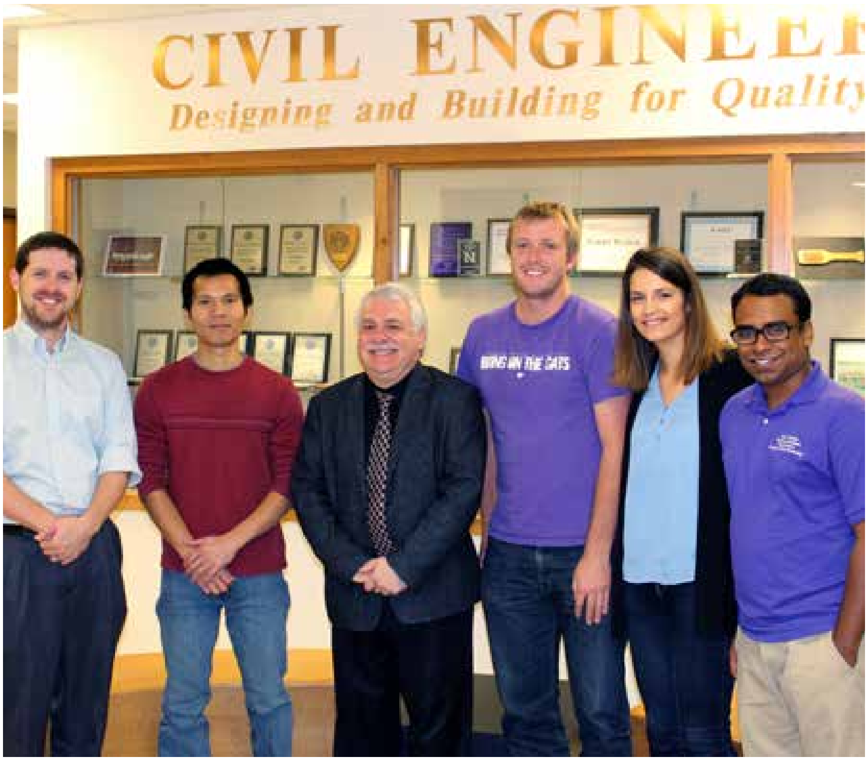
Paul Mayne at CPT14 in Las Vegas, May 2014.

Professor Paul W. Mayne is the enthusiastic bass guitarist who has played a legendary role in geotechnical engineering, focusing on site characterization, in-situ testing, foundation engineering, and evaluation of soil and rock properties. Professor Mayne, who jokingly refers to himself as a "Geomusician," has been successfully working in geotechnical engineering within academia and industry for almost 40 years. He is currently a professor and group coordinator of geosystems engineering at the Georgia Tech School of Civil and Environmental Engineering. His primary research interests are the use, conduct, and interpretation of the cone penetrometer, seismic piezocone, and flat dilatometer, as well as evaluation of shallow and deep foundation systems and ground modification techniques.

Mayne earned his bachelor's, master's, and doctoral degrees from Cornell University. However, his academic life wasn't initially smooth. He temporarily left college during his junior year, but later returned and received his bachelor's degree in civil engineering in 1976, followed by his master's degree a year later. He then joined Law Engineering Associates in Virginia, where he worked in the District of Columbia-Virginia-Maryland region until 1987. When he realized he needed more academic knowledge to better serve the field of geotechnical engineering, Mayne returned to Cornell for his doctoral degree and graduated in 1991. Since then, he has been a faculty member at Georgia Tech, where he has supervised approximately 40 graduate students and post-doctoral fellows. He has served as the chair of the International Society for Soil Mechanics and Geotechnical Engineering (ISSMGE) technical committee on in-situ testing for the past 14 years, and has organized conferences on is-situ testing in Atlanta (1998), Porto (2004), Taipei (2008), Pernambuco (2012), and, most recently, Brisbane (2016). In 2013, he was elected to a four-year term as vice president of the ISSMGE for North America.

Professor Mayne has published more than 295 publications as author or co-author and holds one patent. Some of his nationally significant publications include the National Highway Institute manual on *Subsurface Investigations: Geotechnical Site Characterization* (2002), FHWA *Geotechnical Engineering Circular No. 5: Evaluation of Soil & Rock Properties* (2002), the Electric Power Research Institute (EPRI) manual for *Estimating Soil Properties for Foundation Design* (1990), National Cooperative Highway Research Program (NCHRP) *Synthesis 368* on *Cone Penetration Testing* (2007), and ConeTec *Engineering Design Using the Cone Penetration Test* (2009).

In the keynote arena, Professor Mayne has delivered many prominent lectures, including the James K. Mitchell Lecture (2006), the Mike O'Neill Lecture (2009), SOA-1 at ICSMGE Egypt (2009), the Ardaman Lecture (2012), the 2013 Sowers Lecture, the 2014 Jennings Lecture (South Africa), the DFI Hal Hunt Lecture (2014), and the James Hoover Lecture (2014). He has also received numerous honors and awards for his professional and institutional service, including the Outstanding Professional Education Award from Georgia Tech (2006), an award of appreciation for editorial board service with the *ASTM Geotechnical Testing Journal* (2002), and an award for exemplary contributions from the Transportation Research Board (1995). He will likely be most remembered for his legendary paper (1982), "K_0-OCR Relationships in Soil," in which 170 different soils were used to provide an empirical relationship between K_0 and OCR for loading-unloading-reloading conditions. This paper was selected as a "classic reading reference" and chosen for reprint in ASCE's *GSP 118, A History of Progress: Selected U.S. Papers in Geotechnical Engineering* (2002).



The authors with Professor Mayne. From l to r: S. Halcomb, T. Tran, P. Mayne, W. Koehn, M. Miletic, and Z. Karim.

Q: What made you choose geotechnical engineering while you were a student?

The U.S. Navy ROTC paid for my college for the first two years. When I went to college, I didn't really know what I wanted to do. I struggled through and wasn't the best student. Ironically, I quit after my junior year and played guitar for a living. Music and all the stage shows were fun, but made my life hectic, so I decided to go back to school. Somehow, I latched onto geotechnical engineering, and this is who I am today.

Q: You had already been a successful engineer in industry for 11 years, so what made you return for a PhD after all that time?

I loved geotechnical engineering. I was 35 by the time you are referring to. Realizing that I wouldn't be able to retire until 65, I asked myself if I had enough education to be as excited about geotechnical engineering over the next 30 years? I thought a PhD would be a good way to help me maintain my enthusiasm.

Q: Why do you think more college students tend to go for other disciplines of civil engineering (e.g., structural or transportation) than geotechnical?

We have failed to make geotechnical engineering interesting to the students as a subject. The way we teach today — using most of the same textbooks

GeoMusicians Paul Mayne (Georgia Tech), Jim Mitchell (Virginia Tech), and Martin Fahey (The University of Western Australia).

at most of the universities — is exactly the same way that we used to teach and think in the 1940s. Unfortunately, we present students with a world made entirely of "soft clay" and expect them to go out, get the samples, and test them all in the lab. But that's not the way anybody does it.

We need to do some sort of field test. The real soil for construction is outside, and that's where you should test them. For example, we teach time rate of consolidation from textbooks, and I agree, as a geotechnical engineer, you need to know it. But if your construction site is in a sandy environment, then time of rate of consolidation is irrelevant, and you must do some in-situ testing. We also make this subject rather difficult by using too many theories and equations. For example, we use limit equilibrium for slope stability, limit plasticity for bearing capacity, and earth pressure theory for walls, so undergrads get totally confused! None of them has any background in plasticity, so why even show them all that?

All these things are statics, and we should just use limit equilibrium to explain them all. Moreover, limit plasticity has nothing in it about the grain-crushing strength. You see these diagrams of N_c, N_q, and N_γ, and they are unbounded; that cannot happen. If you calculate the stresses using these parameters at a friction angle of, say, 45 degrees, the particles are going to crush way before you get that far. People have worked on the crushing strength of particles, but we are too afraid to include these new things in the textbooks. I think we should show undergrads the sunny sides of geotechnical engineering; we should show them the application of geophysics, the seismic piezocone, and seismic dilatometer to get them interested. Once they commit to graduate school in geotechnical [engineering], *then* show them all the complicated stuff like compaction curves, time rate consolidation, and so on.

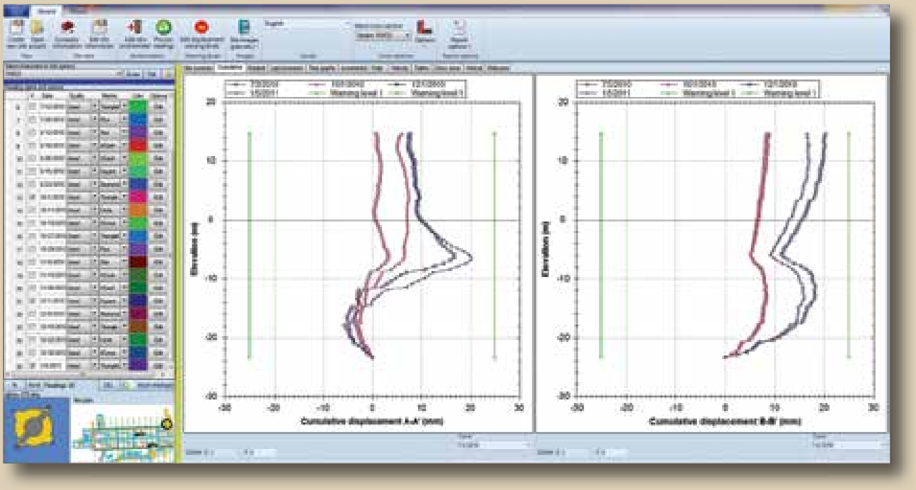
Q: What are the advantages and disadvantages of in-situ soil testing in comparison to laboratory soil testing?

In the laboratory, we have well-controlled boundary conditions and are aware of the dimensions of the specimen. On the other hand, when we push a cone penetrometer or a blade dilatometer in the field, we're not sure what volume of soil we are testing. Although we have a rough idea, different types of experiments and different types of soil make everything nebulous, and we are not quite sure about the volume of the soil. Another thing is we can control the drainage conditions in the laboratory tests, but in the field it can be anywhere in between drained or undrained; we can have a million shades of gray between black and white.

Q: Do you see a decrease in empirical methods and increase in theoretical and computational mechanics in the future?

I think they will go hand-in-hand. If you look at the flat dilatometer, it's had a more or less empirical relationship in the past; but later, when we realized what the device was telling us, engineers could go back and explain them with theories. I think if you look at the history of any discipline, it's a play between the theory and what your experimental data show. You keep

SiteMaster Inclinometer Software

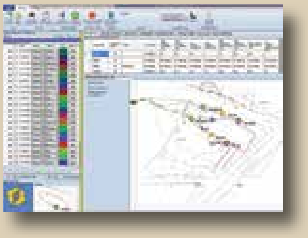


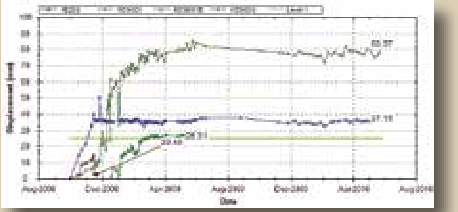
SiteMaster is a comprehensive inclinometer package used for processing and managing inclinometer data.

SiteMaster works with any inclinometer system which produces a text data file. Data are stored systematically in an easy to modify folder, with corresponding displacement graphs organized in a simple and efficient manner.

SiteMaster also features a reporting tool allowing reports to be quickly generated and exported in PDF or MS Word format.

For more information, please visit: **www.geokon.com/SiteMaster**





Digital Inclinometer System / Model GK-604D

***NEW!** with Digital Compass*

The Model GK-604D Digital Inclinometer System consists of a Model 6100D Digital Inclinometer Probe, a cable mounted on a reel, which transmits the probe signals via Bluetooth® to a Handheld Field PC readout. The latest model incorporates a Digital Compass to enable initial spiral surveys to be conducted using the same probe. In addition the pulley wheel, cable-grip assembly grips the cable directly thus taking the load off the cable markers and preserving their spacing.

Applications

- Landslides
- Unstable Slopes
- Dam Embankments
- Landfills
- Slurry Walls
- Caissons
- Piles
- Sheet Piling
- Tunnels

The World Leader in Vibrating Wire Technology™

www.geokon.com/GK-604D

☎ 1·603·448·1562
info@geokon.com
www.geokon.com

Geokon is
ISO 9001:2008
registered

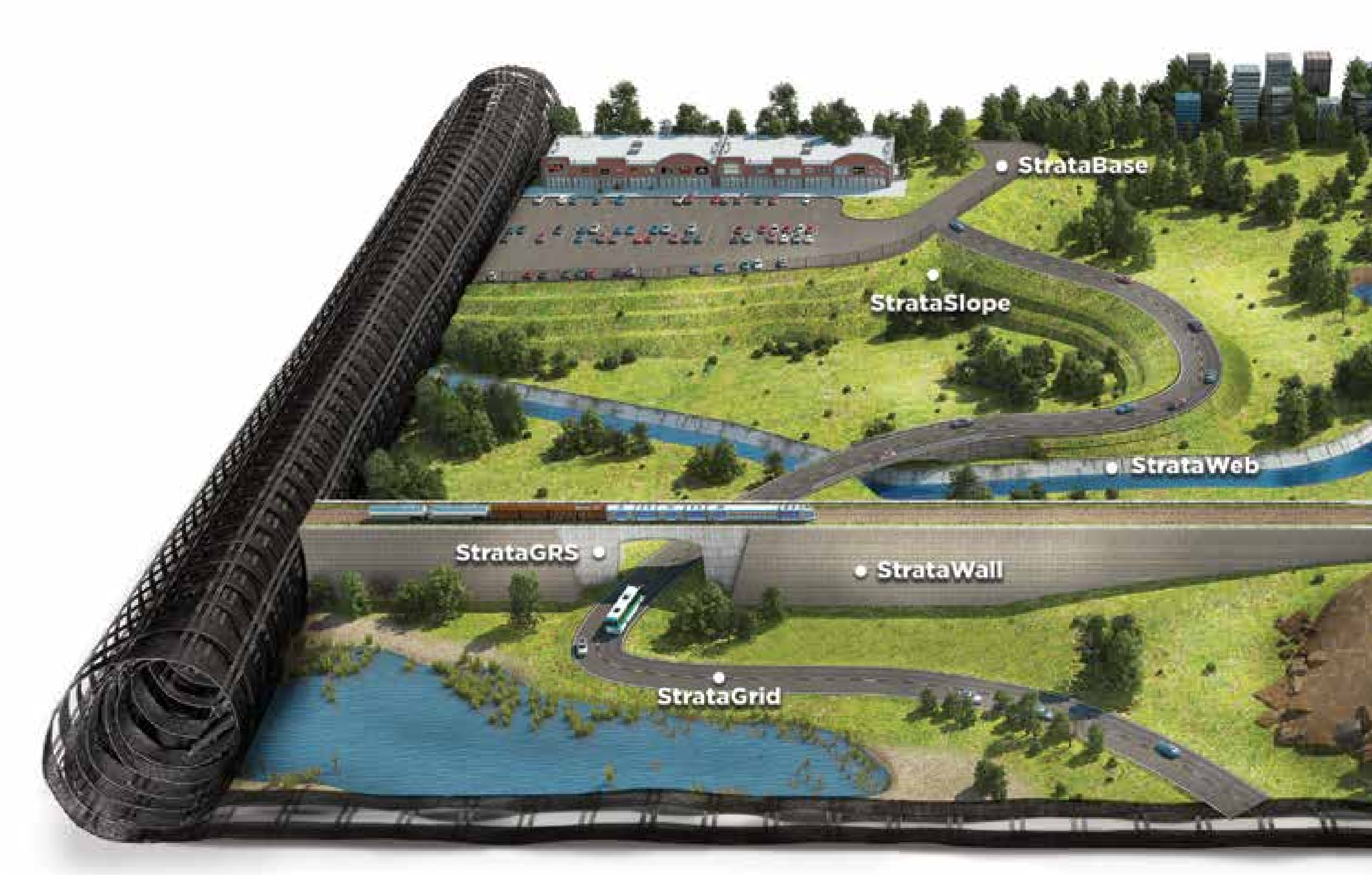
adjusting the theory until they get some sort of compatibility between them. It’s actually a back and forth play, otherwise sometimes we will miss some of the key parameters.

Q: What is some upcoming research in geotechnical engineering?

The National Science Foundation (NSF) has recently funded for the establishment of the Engineering Research Center for Bio-mediated and Bio-inspired Geotechnics (CBBG), and experts from different universities, including Georgia Tech, are in it. They are looking at bioengineering, where you can use biological processes to help solve geotechnical engineering problems. As an example, say we want to fix loose, liquefiable sand. One solution is to use vibroflotation or dynamic compaction to compact the sand. But instead, these researchers are saying, “Let’s introduce bacteria into the sand and let the bacteria grow in mass quantity to fill the sand voids so that it cannot liquefy.” Of course calcification can be used to introduce calcium carbonate that will bond the sand particles together to prevent liquefaction, but the research that is cutting edge right now is all about biological processes. What if you need to put an underground pipeline in your project site using a biological process? It’s like training big ants to go in there and do it for you rather than using big excavators!

Q: In your opinion, should we be approaching acceptance of true effective stress analysis or continue with total stress analysis in soil mechanics?

We should definitely go for effective stress analysis. In the first lecture of any graduate course, I cover effective stress analysis, and I’ve developed a model titled “Critical State Soil Mechanics for Dummies” because most of the books do not cover critical state soil mechanics. I’m not saying that critical state soil mechanics is the only way to look at the soil, but it links the terms “consolidation” and “shear strength.” In the



beginning of an undergraduate course, we teach consolidation, and then cover shear strength or Mohr circles for the next few weeks. After that, we move onto another topic, like permeability. But wait a minute! Consolidation and shear strength are linked together; it is critical state soil mechanics that links them, and it is based on effective stress analysis. We have a notion that clay will always show undrained behavior and sand will show drained behavior, but that's not true. Another thing is we take pore pressure as zero where it hits the groundwater table and then goes down at a constant gradient of unit weight of water, but that's not true either. There are a lot of capillary rises and weather changes, and it depends on the type of the soil. I agree these are very difficult to measure. This is the reason why I say there is a lot of room for improvement.

Q: Who was your role model or "GeoLegend"?

Jim Mitchell is still one of my big legends. This man is awesome; he's 85 now and still participates in conferences, writes papers, gives presentations, and plays saxophone. I am a geomusician: I play bass guitars mostly. I had a chance to play with him at a conference in Portugal where he played saxophone and I played bass. There were also keyboardists and guitarists at that conference: all of them were geotechnical engineers. I also want to mention Julio Valdes from San Diego State University. He plays drums, keyboards, guitars, and basses; he also writes songs and sings, and recently released an album.

Q: What advice do you have for young geotechnical engineers who want to work in the industry?

Every project you get involved in is interesting and has some unusual aspects. Some people want to codify geotechnical engineering, but I don't think we can ever do that. Mother Nature doesn't always show you all her

secrets. To deal with some complicated projects is sometimes frustrating, but exciting at the same time. Geotechnical engineering is a puzzle. My wife likes crossword puzzles, some people like sudoku, and I like geotechnical engineering: it's always a big puzzle. Sometimes you just can't figure it out, and that is what makes it interesting. There's so much room for improvement. If you look at what we are doing and how we do it, there are so many things that we can do to make it better. GS

▸ **MD ZAHIDUL KARIM, S.M.ASCE**, is a master's student in the Department of Civil Engineering at Kansas State University (KSU). He holds a bachelor's degree in civil engineering from Bangladesh University of Engineering and Technology. His master's research focuses on characterizing soil erosion potential using electrical resistivity. Zahidul is the treasurer of the G-I student chapter at KSU. He can be contacted at *mdzahidulkarim@ksu.edu*.

▸ **MARTA MILETIC, S.M.ASCE**, is a PhD candidate in the Department of Civil Engineering at KSU. She holds both a bachelor's and master's degree in civil engineering from the University of Zagreb in Croatia. Her PhD research focuses on strain localization in fiber-reinforced, pressure-sensitive materials. She is the current KSU representative for the G-I Student Leadership Council and can be contacted at *mmiletic@ksu.edu*.

▸ **WESTON KOEHN, S.M.ASCE**, holds a bachelor's degree from the Department of Civil Engineering at KSU, where he is also studying for his master's in the same field. Weston's master's research focuses on characterizing riverbed hydrogeologic properties and processes using electrical resistivity. He can be contacted at *koehnweston@gmail.com*.

▸ **TRI TRAN, S.M.ASCE**, is a PhD student in the Department of Civil Engineering at KSU. He holds a master's degree in civil engineering from KSU and a bachelor's in civil engineering from CanTho University in Vietnam. His PhD research focuses on fine-grained soil erodibility. Tri is currently the president of the G-I student chapter at KSU. He can be contacted at *tritran@ksu.edu*.

▸ **STEVEN HALCOMB, PE, GE, M.ASCE**, is a distance PhD student in the Department of Civil Engineering at KSU. He holds a BS, MCE, and MS in arctic engineering, and a graduate certificate in earthquake engineering from the University of Alaska, Anchorage. Steven currently works in Anchorage, AK, as a senior geotechnical engineer and is researching applied unsaturated soil mechanics in slope stability. He can be contacted at *shalcomb@ksu.edu*.

2015 ground modification fieldtrip to Juniper Street in Atlanta, GA; Paul Mayne and John Wolosick in front of group.