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Features

24  What’s New in Geo? Sustainable Biogeotechnics
Biogeotechnics will likely become part of mainstream geotechnical engineering in the future.
By Jason T. DeJong

34  New Home for the Maid
Rockfalls, talus, and the race for a dry dock.
By Michael J. Mann, John F. Hubert, and James J. Janora

44  Small Projects Are Big Deals
Collaboration is key, no matter what the size of the project.
By Daniel Mahrt

50  The Leaning Towers of Wilmington, Delaware
Emergency response and retrofit of the I-495 viaduct to address lateral squeeze.
By Paul H. Moffitt and Bruce A. Shelly

56  Innovations in Geosynthetic Rolled Erosion Control Products
From forests to fibers.
By Jennifer L. Smith and Shobha K. Bhatia

62  Geotechnical Risk Management
The five non-technical topics that are crucial for the successful practice of geotechnical engineering.
By Gary S. Brierley

ON THE COVER
The Maid of the Mist tour boats in October 2013, after being lifted out of the Niagara River onto their new winter dry dock. The mist from Niagara Falls can be seen in the background.

GEOSTRATA is seeking eye-catching cover photographs to illustrate upcoming issue covers. We particularly need photos that convey the themes of military geotechnics, retaining walls and earthquake geotechnics. However, we will consider all eye-catching photos. Ideally, photos should be portrait orientation and 3 MB or larger. If we use your photo, appropriate credit will be noted. Send your photos and accompanying photo captions to geostrata@asce.org.

Have you seen GEOSTRATA’s updated website? Please visit geostrata.geoinstitute.org, where you can check out current and past issues of the magazine, learn about recent developments in research and practice within the field of geotechnics, and much more!
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President’s Letter
By Allen Cadden

From the Editorial Board
By R. Jeffrey Dunn

As I See It: Differentiation from the Dark Side
By Kord Wissmann

Lessons Learned from GeoLegends: Joseph P. Welsh
By Amy Getchell and Maria Gabriela Alvarado Calle

The GeoCurmudgeon: The Trouble with STEM
By John P. Bachner

Look Who’s a D.GE
An interview with Mohammed (Mo) Gabr

G-I ORGANIZATIONAL MEMBER NEWS

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Reflections On Our Future

Life changes quickly, even when it takes 18 years to get to a point. Yes, my first child just went off to college. He didn’t choose engineering, yet.

I have served on your Board for five years and have now reached the end of my year as your president. When you take on this responsibility, it sounds like such a long time. Now, I wish I had more. More, because this organization and profession have given me so much happiness. As I look back on what has happened during my tenure, I’m even more excited about the future.

I thank Peter Nicholson and the authors of the last GEOSTRATA issue. This reinforced my belief (as noted in many of my columns) that geoprofessionals are very important. The challenges of our daily efforts help society manage risk. We identify the problems, evaluate the consequences, and mitigate them to the extent possible. When we keep this higher calling in mind, then our profession is not about the number of borings or tests we perform; it’s about the value we bring.

Upon reviewing several GEOSTRATA departing messages from my predecessors, I reflect on the great leaders, the accomplishments, and evolution of this organization. As Larry Jedele noted, participation in ASCE and G-I develops leaders. Craig Benson left us with the importance of providing value in whatever we do. The inscription on Karl Terzaghi’s tombstone, “He lived without compromising, served his chosen profession to the best of his abilities, and died without having anything to regret,” was provided by Phil King. What more can I say?

Billy Camp closed his term with a reminder that the D.GE is not a fundraiser, but an important step toward recognizing the expertise necessary to practice as a modern-day geotechnical engineer.

Reflecting on my columns, I leave you with: “Together we accomplish so much more than we do individually” and “Enjoy what you do.” When we are happy, we learn more, contribute more, accomplish more, and waste less energy on useless frustration. I look forward to the words of wisdom Kord Wissmann will bring to these pages.

Thank you to our members, the profession, and in particular, the G-I staff, board, and committee members with whom I have had the pleasure to work.

I learned a lot and believe I grew a lot along the way. In parting, I’m grateful for the support Schnabel Engineering, and most importantly, my family have given me during many years of professional society service. Without this support, I never would have been able to serve you for the past five years.

Allen Cadden, PE, D.GE, M.ASCE
Geo-Institute President
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Malcolm Drilling has been providing support for our clients for over 50 years. Our innovative technology and extensive equipment fleet uniquely positions Malcolm as a national leader in the deep foundation industry. Find out more about what we can do for you at Malcolmdrilling.com.
Although the majority of articles in each GEOSTRATA issue focus on a common theme, we periodically publish an issue that includes a mix of topics. In the past, we gave this conglomeration the title of “Geo-mélange,” as we do with this issue. That got me to wonder a little more about the specifics of that word – mélange. I already knew that the rock underlying the high-rise building in downtown San Francisco where I work and am writing this piece is known as Franciscan mélange. And, from experience I know that formation fits pretty well with at least one geology definition found on the Internet: a totally disordered mixture of rocks of different shapes, sizes, ages, and origins.

What other information is available about mélange? With the ease of the Internet, plenty of information becomes available in just seconds, and one can quickly find mélange — a mixture of incongruous elements, with origins around 1650 from French or possibly Old French. How about some synonyms? There are plenty of those, too, including assortment, gallimaufry (new to my vocabulary), medley, mish-mash, mixed bag, potpourri, and variety. Interestingly, a lot of food imagery was listed, including alphabet soup, gumbo, jambalaya, ragout, salad, salmagundi, smorgasbord, and stew… a wide variety of delicious meal courses that actually started to make me hungry. So what's on our menu for this issue?

Well, you can’t go wrong by including Star Wars in an article. Kord Wissman, in his “As I See It,” uses the famous movie series and value propositions from the retail clothing industry as metaphors to describe how to fight commoditization in geotechnical consulting (the Bright Side), combined with some lessons learned from the Dark Side of geotechnical contracting.

Two articles provide case histories constrained by time and schedule. Michael Mann, John Hubert, and James Janora describe how a new dry dock for the iconic Maid of the Mist boats at Niagara Falls was designed and built at a difficult site formerly occupied by a power plant. A portion of the site had been destroyed by previous rockfalls, and access was extremely limited. Initial design plans were crafted based on assumed subsurface conditions, but had to be revised as construction revealed the actual subsurface conditions. In the second article, Paul Moffitt and Bruce Shelly describe emergency response and retrofit of an I-495 bridge in Delaware, where support columns were tilting in response to deformations from an adjacent soil stockpile. When an Interstate has to be closed, around-the-clock design and construction to allow reopening are a necessity.

Next, we jump to legal concerns. It’s no surprise that the practice of geotechnical engineering tends to be litigious, but how often can simple changes in project execution prevent a client from later becoming dissatisfied, and possibly even suing? Often small projects lead to big problems, and Daniel Mahrt makes a good case for emphasizing the importance of effective collaboration — common for big projects and important for small projects as well. Gary Brierly, in his article “Geotechnical Risk Management,” discusses risk exposures and key project elements where risk can be controlled or reduced.

Jennifer Smith and Shobha Bhatia describe their studies of innovative erosion control products. After a wildfire, erosion control is critical, and certain natural forest waste products can help. They also discuss the use of polyacrylamide-coated, natural fiber erosion control products for controlling sediment and erosion.

In the second contribution to our new feature “What's New in Geo?”
Jason Delong outlines a new frontier in geotechnics; rather than creating conventional designs around recognized physical and chemical processes, soil bacteria can be utilized to alter properties and provide biogeotechnical solutions that are sustainable.

Finally, Amy Getchell and Maria Gabriela Alvarado Calle from Purdue University present their interview of our latest GeoLegend, Joseph Welsh, an international expert in ground modification.

So there you have our latest Geomélange for your reading enjoyment, with at least a small smorgasbord of articles. Maybe we should have photographed some jambalaya for the front cover?

This message was prepared by R. Jeffrey Dunn, PhD, PE, GE, D.GE, M.ASCE. He can be reached at jeff.dunn@arup.com.

Briaud Elected Technical Region Director

In June, Jean-Louis Briaud, PhD, PE, D.GE, Dist.M.ASCE, was elected director of ASCE’s Technical Region. Briaud is a former president of the G-I and ISSMGE.

The Technical Region is comprised of the members of the eight ASCE Institutes. The Technical Region’s Board of Directors coordinates the interaction between the Society’s Institutes, collectively represents the Technical Region’s interests, and facilitates solutions to issues common to the Institutes. Its responsibilities include recommending nominees for the position of ASCE president-elect and conducting peer reviews of the Institutes.

In his vision statement for his nomination to this office, Briaud wrote that his goal as Technical Region director would be to represent the Institutes “fairly and forcefully... Technical issues are the very solid foundation on which ASCE is built, and the Institutes deserve a lot of credit and respect for the success of ASCE.”

Gribb Becomes Dean

Molly Gribb, PhD, PE, F.ASCE, civil and environmental engineering department head and professor at the South Dakota School of Mines and Technology, assumed the role of dean of the University of Wisconsin-Platteville’s College of Engineering, Mathematics, and Science (EMS) in July 2015. The College of EMS consists of more than 3,300 students in eight academic departments.

Gribb’s research focus has been environmental science and engineering in the areas of soil and ground water contamination. She has secured over $7.5 million in external funding for projects and grants, including National Science Foundation CAREER and Army Research Office Young Investigator Program awards. During her tenure as department head at the School of Mines, she developed a new doctorate program in civil and environmental engineering and facilitated strategic planning in support of research at the school.

Previously, Gribb was professor of civil engineering at Boise State University (BSU) for 10 years. While at BSU, she served as director of the Center of Environmental Sensing and led an interdisciplinary research team in the development of a subsurface contaminant sensor system. Before that, she spent seven years as assistant and then associate professor at the University of South Carolina.

Engler Elected to The Moles

Theresa Engler, executive director of the Deep Foundations Institute (DFI), has been unanimously elected to The Moles, a fraternal organization of individuals now or formerly engaged in the construction of tunnel, subway, sewer, foundation, or other heavy construction projects.

Editor’s Note:
With this issue of GEOSTRATA, we say goodbye and thank you to Beth Gross, who has served with dedication on the magazine’s Editorial Board since January 2012. Beth has been an active and diligent editor, but she is now serving a three-year term with the G-I Board of Governors (BOG). One of her new responsibilities will be serving as the BOG’s liaison to the Editorial Board so she can continue helping make the magazine an outstanding resource for all G-I members.

James L. Withiam
Editor-in-Chief
Check out New Orleans' newest piece of mind. Made from Nucor recycled steel, our steel pile is driven deep into the Louisiana earth, and supports this levee that helps protect millions of the most resilient people in America. Each and every person committed to rebuild New Orleans stronger, safer, and even more prepared for the future. So it can be filled back up with a sea of fun-loving people.

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It’s Our Nature."
Differentiation from the Dark Side

By Kord Wissmann, PhD, PE, D.GE, M.ASCE

Remember the first time you saw the Star Wars Trilogy? Episodes 4, 5, and 6 are where we first met Luke, Han Solo, and Darth Vader. Remember when we learned that Vader was Luke’s dad, and we had to come to grips with a good guy going to the Dark Side? Vader’s story is not so mysterious to me; we both once lived on the Bright Side (of geotechnical consulting), before going over to the Dark Side (of geotechnical contracting). The force is indeed a bit different over here. Living on the Dark Side, you get to look back to where you came from and see things that you didn’t see before.
There’s lots of talk over there on the Bright Side about an evil shadow approaching, a shadow called commoditization. Over here on the Dark Side, we laugh about this shadow because we know it so well. You, on the Bright Side, make us walk in this shadow every day, with your specifications and your endless need for competition. We have adapted to it. We know how to deal with it.

Before we go there, I’ll reveal one of our many secrets. Over here on the Dark Side, we wear costumes to hide our darkness. This costume includes a dress shirt. Our shirts are all made overseas by skilled workers in factories that make many dress shirts for many vendors, a secret practice called private labeling. They ship these dress shirts to different vendors, who aim to sell them to us. Some of us buy them at Target. Those who are looking for a bit more luxury go to Jos. A. Bank. Some even go to Savile Row in London. While the dress shirts are a bit different in each place, it’s not the shirts that make us go to these places. We select these places for something else: the experience. The vendors know something about us that they keep to themselves. It’s called differentiation, and it’s expressed through a value proposition (VP).

Target gives you a low price, always. It’s a good VP, and many people like it. Jos. A. Bank gives you special attention and makes you feel important, and the price is fair (especially when they offer three for the price of one!). And for those of us who have ever visited the tailors of Savile Row, well, they deliver luxury. They give you a shirt and a back massage, hand you a powdered wig…and then steal your wallet.

The secret of the value propositions is that each venue differentiates its services according to the preferences of each customer group. To exercise its VP, Target cannot serve the egos of those who regularly shop at Jos. A. Bank. It would bankrupt them. Likewise, Jos. A. Bank cannot provide its VP at the price offered by Target. Differentiation is a reaction to a market condition, and it is something that takes some skill to exercise. The providers can’t dictate the market—it’s as impossible as dictating the tides. A market that is undifferentiated is called a “commoditized market.” This is the shadow that we are seeing.

This kind of market cannot distinguish between vendors on anything other than ... price.

Dress shirts, from the perspective of the workers overseas, are a commodity. But dress shirt providers are not. They use points of differentiation to create protected markets for themselves.

So how does this relate to us... I mean you... on the Bright Side? In the past, differentiation was upheld because there were only a few players who delivered a product poorly understood by their clients, like a secret
Make no mistake, battling the shadow of commoditization is not easy. Over here on the Dark Side, we’ve learned that we cannot change the market.
But the past mechanisms of differentiation are fading and are no longer enough to hold back the shadow. So perhaps now you are thinking... how is it done on the Dark Side? Some of us do not differentiate on anything other than price. You know who we are.

There are those of us who differentiate with very specialized machines requiring strength and capital. There are others who thrive on innovation, inventing new tools and processes to lower the dollar value of construction – protecting these inventions with proprietary approaches, patents, and trademarks covering the costs of development.

If commoditization is the absence of differentiation, the first step for all of us is to actively decide how we wish to differentiate. Who will be the low price leader? And who will have extended service offerings? The market will demand that somebody is the low-price leader. If we do not differentiate in other ways, we are placed by the market in the low-price group, and to survive, we must be the best at it. Target relentlessly reduces its overhead, uses lean management strategies, and maximizes efficiency on all tiers.

Differentiation can also be achieved by providing a unique customer experience. This is the strategy used by Jos. A. Bank – make customers feel a certain way when they use our services, and charge more for them. This is a good strategy, and it works, though it is easy to replicate. Differentiation can also be achieved with relationships – the Savile Row model. Our customers get an ego boost when we hand-tailor the deliverable. It’s another good strategy, but one that’s difficult to scale up and grow, requiring that those who practice this strategy remain small to execute their VP.

The best differentiators, the ones most secure in their market position, are those who differentiate by understanding knowledge gaps. They then use their acumen to form bridges to the unknown.

These differentiators actively seek to understand what services they provide that are easily understood and replicated, and what knowledge they have that is valued but not easily understood. They create unique bridges across the knowledge gap. Examples of differentiated knowledge on the Bright Side include underground support, dewatering, geotechnical instrumentation, ground improvement, hand-held sensors, Lidar, and management systems such as 6 sigma.

Make no mistake, battling the shadow of commoditization is not easy. Over here on the Dark Side, we’ve learned that we cannot change the market. But we can adapt. And you can, too, if you wish to survive. For my friends still on the Bright Side, if we figure out how to differentiate, the Bright Side will remain brilliant, and the clouds of commoditization will be penetrated by the sun.

KORD WISSMANN, PhD, PE, D.GE, M.ASCE, is president and chief engineer of the Geopier Foundation Company in Davidson, NC, and incoming G-I president. He can be reached at kwissmann@geopier.com.
“I’ll tell you one funny story.”

Joseph P. Welsh, PE, F.ASCE

By Amy Getchell, EIT, S.M.ASCE, and Maria Gabriela Alvarado Calle, S.M.ASCE

Born and raised in Philadelphia, and father of eight children and grandfather of 14 grandchildren, Joseph Welsh is a man with many stories and experiences. He retired as vice president of Hayward Baker, Inc. in 1999, and has more than 60 years of engineering/construction experience. He earned his B.S. in civil engineering from Villanova University and took graduate-level courses at Villanova University, as well as the University of Pennsylvania. Currently, Welsh is president of Joseph P. Welsh & Associates, where he is a consultant to the design and construction industry.

Before starting college, Welsh had more than 20 non-engineering jobs, including bible salesman, busboy, Good Humor [ice cream] man, and car parker, to name a few. After college, he considered working for the Delaware River Port Authority until he discovered that one of his duties would be walking on the cables of three major suspension bridges! In 1955, he started working for the Philadelphia District Corps of Engineers as a foundation and materials engineer, project engineer, and safety engineer after obtaining his professional engineering license in Pennsylvania. In 1960, he became a field engineer at Intrusion Prepakt, Inc., and, later on, co-founded Erosion and Soil Technology (EAST). In 1970, Welsh co-founded the SOILTECH Department of Raymond International, Inc. In 1978, he began working at Hayward Baker Company.

During his time as vice president and a member of the Executive Committee of Hayward Baker, his responsibilities included engineering, marketing, estimating, research, contracts, troubleshooting, and general oversight of operations. He’s best known for his work with ground modification. Welsh has worked on more than 2,400 projects throughout the U.S. and overseas and has written more than 60 technical
Everybody’s got good and bad in them. If you look for the good, you find it; and if you look for the bad, you find it. So look for the good!

Articles. He has presented more than 25 short courses in the areas of ground modification, grouting, and synthetic fabrics, and has presented more than 160 lectures to engineering and construction firms, spreading the ‘gospel’ of ground improvement. In 1980, he co-authored with Professor Robert Koerner the first book about synthetic fabrics.

During his career, Welsh helped pioneer developments for the underground design and construction industry in ground modification technologies, grouting, dynamic deep compaction, vibro compaction, stone columns, vibro-concrete columns, deep-soil mixing, synthetic fabrics, erosion control and scour problems, underpinning, and in-situ testing. Additionally, he helped introduce new technologies to the U.S. These included jet grouting, fracture grouting, fine-grain cement, dynamic deep compaction, vibro displacement/vibro replacement, use of fabrics for forming concrete, and deep-soil mixing.

Professional activities for Welsh include being a life member and fellow of ASCE, a member of the American Concrete Institute, and founder of ACI’s Technical Committee 552 on cementitious grouting, emeritus member of The Moles, and member of the advisory board for the civil engineering department at Catholic University between 1996 and 1998. He was also a member of the executive committee of the ASCE’s Geotechnical Engineering Division (the forerunner of the Geo-Institute) and served as chairman from 1991 to 1992.

Welsh received Villanova University Engineering’s Alumni Award for Professional Achievement in 1998. He has also received the U.S. Universities Council on Geotechnical Education and Research’s (USUCGER) Research Investment Award, and was named one of the grouting “G.R.E.A.T.S.” by the ASCE Grouting Committee. In 2005, Welsh received the Wallace Hayward Baker Award from ASCE’s Geo-Institute “in recognition of a 50-year career of inventive landmark contributions to the technical and practical application and development of ground improvement methods.” Most recently, he was one of the five 2014 recipients of the prestigious Outstanding Projects and Leaders (OPAL) Award for his lifetime accomplishments in construction and civil engineering over the past 60 years.

Q: Do you think it is important to have a graduate degree in the field of geotechnical engineering?

Oh, definitely! When Hayward Baker first started, Wally Baker was the only employee with a PhD. But now, Hayward Baker has quite a few PhD’s, and they’re doing such a great job. A master’s degree is essential for any professional that Hayward Baker hires now. I feel that any person joining the geotechnical engineering field now needs to achieve at least the master’s level and should become a professional engineer as well.

Q: What was Wally Baker like?

Wally Baker was a genius and an entrepreneur, but not a great businessman. Wally’s philosophy was to do something different for each job. But I’d say, if it works, keep using it.

Q: You have given many seminars during your career. Do any stand out to you?

I spoke about Dynamic Deep Compaction at the collapsible soil seminar in Albuquerque, NM, sponsored by Ralph Peck. To be on the same program with Ralph Peck was very exciting. He was an engineer I greatly admired. Frequently, he was the key lecturer at the Central Pennsylvania Geotechnical Conference in Hershey, PA. Every year, you could see him aging, but his lectures were always fascinating, frequently citing failures he and his father had made. Few engineers like to mention their failures, but we can learn from failures as well as success.

Q: What was the most notable project you worked on?

My most memorable project was probably Locks and Dam 26 in Alton, IL, on the Mississippi River in the late 1970s. Being the first phase of the possible new lock and dam, in the second toughest labor
Lessons Learned from GeoLegends

market in the U.S., more than 24 business agents from Illinois and Missouri showed up at the preconstruction meeting. At one time, this structure set the Corps of Engineers’ record for the most wood piles under it, but the problem was that floods would rock it back and forth. The Corps had decided to build a new lock and dam, but for political reasons, funds were not available, so the project had to wait a year. The Corps wanted to see if they could chemically grout the soil around the piles to strengthen them. I led a joint-venture contract downstream from it to chemically grout the sand, make it into sand-cement, and then excavate like an archeological dig. It was fascinating.

Another notable project was strengthening the west face of the U.S. Capitol during facade strengthening project. Above: Joe Welsh with geotechnical engineering students from Purdue University. From l to r: Amy Getchell, Joe Welsh, and Maria Gabriela Alvarado Calle.
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Lessons Learned from GeoLegends

Many engineers find it difficult to give talks before an audience. It’s a learned skill that needs to be mastered.

Capitol in Washington, D.C. We had a contract with the office of the architect, and the work required drilling holes through the old walls to strengthen them with anchors to tie them back. Because the building was so old, the drilling operation caused dust to enter nearby structures and led to complaints from senators and house representatives. The solution was to work nights, but we weren’t making any money on the project. So with all of the core samples we had, we cut them into 3-in pieces and were going to sell them on the street! The Architect of the Capitol got wind of it and said, “No, you’re not, Mr. Welsh,” so we ended up giving them to our clients. It was a great marketing tool.

Being involved with the design and construction of many of the U.S. subways was one of the highlights of
my career. These projects included extension of the Philadelphia subway, the Baltimore and Washington subways, Pittsburgh, Los Angeles, Seattle, etc. And being a consultant and then a contractor on the Boston ‘Big Dig’ was most interesting.

Q: Do you have any comments on today’s geotechnical practice?
Today there are really no middle-sized geotechnical engineering firms, only very small and very big ones. Companies are constantly being acquired, so when you walk into the office, you don’t know who’s in charge.

Q: What is the biggest shortcoming in the geotechnical practice right now?
Politics. It decides everything, whether in the academic area or anywhere else. Very few geotechnical engineers involved in politics want to be involved. We do our own thing and are happy.

I remember giving a lecture at one of Professor Jerry Leonards’ classes at Purdue University and was warned by others that Jerry always finished by asking a zinger of a question. When I finished, one of the students asked, “Mr. Welsh, when I get out in the real world, how many decisions will be made by engineering and how many by politics?” When I answered, “about 50-50,” Professor Leonards said, “Great.” That must have been the type of answer Leonards wanted because we then went to lunch!

Recognize that in our society, politics is always prevalent. I remember vividly analyzing hydraulic data on a proposed dam, and when I finished my report, I was told to do it again as “that’s not the answer we want!” Many news sources, the Internet, etc., can be slanted. As engineers, we are trained to deal with facts and figures, not politics.

Q: What is your biggest regret after entering retirement?
The only negative of my retirement is losing my secretary, Rose. I would give her something, and she would do it, which was enormously helpful to me. I also haven’t kept myself current. Things are moving so fast. If you don’t stay current, you cannot keep up.

Q: What do you see for the future of geotechnical engineering?
There are a lot of nuances out there. Keep going to technical meetings like IFCEE 2015 to stay up-to-date on the latest information. You’ll learn that some people are still trying to reinvent the SPT, while others are doing fascinating research. Read the journals,
Lessons Learned from GeoLegends

Many engineers like to expound on their expertise when talking to a client. But we are given two ears and only one mouth for a reason.

figure out what you want to do. Every day you can learn something new.

Q: What are some of your life philosophies?
Everybody’s got good and bad in them. If you look for the good, you find it; and if you look for the bad, you find it. So look for the good! Life is a continual learning experience. Smile and appreciate everyone. Enjoy what you do and appreciate life.

Many engineers like to expound on their expertise when talking to a client. But we are given two ears and only one mouth for a reason.

Q: What advice do you have for students and young engineers today?
For engineering students, learn the fundamentals. If you don’t have the fundamentals, you can’t build on anything. Don’t burn your bridges when you leave a job, and stay active with ASCE. Despite the normal headaches of any position, if you’re not happy or satisfied, find a position that’s more rewarding. I remember one young engineer who attended one of my lectures while in school. When we became reacquainted later on, I learned he was very unhappy because he had worked on a project for 18 months only to have it shelved!

Many engineers find it difficult to give talks before an audience. It’s a learned skill that needs to be mastered.

Another thing I like to advise people is to enjoy the daily challenges of understanding client problems. Remember that while we all want to work on interesting and challenging projects, ultimately we need to understand our client’s needs so we can meet their expectations.

Q: If you had to do it all again, would you do anything differently?
I probably would have gotten a degree in marketing or a degree in history. Marketing alone is a very challenging job; you identify a prospective project, but turn it over to others for its implementation. You then re-enter the project if the client isn’t satisfied or if the project doesn’t meet the client’s or your own expectations.

Q: Any other comments?
Every conversation has a speaker and a listener. Engineers talk too much and tend not to listen.

I had a heart attack in 2008 that made me realize that life is too short. You don’t appreciate something until you don’t have it. The older I get, the more I appreciate my parents.

And, finally, geotechnical construction should be considered by any student as a career opportunity. It’s exciting, challenging, rewarding, and offers opportunities to satisfy all career fields (construction, engineering, management, etc.).

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FEATURES

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Biogeotechnics will likely become part of mainstream geotechnical engineering in the future.

By Jason T. DeJong, PhD, A.M.ASCE
Geotechnical engineering is simultaneously science and art. We use our cognitive abilities to characterize, analyze, and design geotechnical systems; and yet, in all cases, the quantitative analysis is not sufficient. We then perform “geotechnical art” by making assumptions on values, completing stratigraphic contours, predicting future loading conditions, selecting things like recurrence intervals, and finally committing to our decisions by legal oath via our professional licensure stamp. Collectively, this “art” consists of informed and systematic applications of judgment.

The need for judgment in geotechnical engineering is largely due to soil being a natural material, with a variability in properties in situ that far exceeds other civil engineering materials. Every site, and therefore every project, is unique. As a geotechnical engineer then, no two days are the same! This is one reason why we love our profession.

We have, by necessity, always simplified the complexity of soils. For decades, soil properties and behavior were attributed to gravimetric forces and the presence of water. Prof. Mitchell has revealed, and many others have since built on his findings, that chemistry is at work in all soils, and is the scientific basis for clay behavior. As our understanding of the role of chemistry in soils developed, the profession advanced and began harnessing chemical processes to manipulate engineering properties (e.g. lime stabilization and electrokinetics).
BioSoils Are Living Soils... and They Change in Time

Arguably, the next advent for the geotechnical profession is to recognize that the soil is a living ecosystem. For example, the bacterial count in near-surface soils with significant organic content often exceeds $10^9$ bacteria per 1 cm$^3$. More than $10^6$ bacteria are also present in a cubic centimeter of poorly graded quarry sand typically used as backfill or roadway subgrade materials. Our “inert” backfill materials are not so inert after all! Soil is alive!

The living nature of soil can involve biological and chemical changes that challenge our traditional understanding of time-dependent stability in soils. Such changes can improve or degrade soil properties from the as-constructed condition over the service life of a geotechnical system. Often, the net effect of detrimental changes is not sufficient to compromise the conservatism embedded in the design, but they are present nonetheless. In other cases, such as the reduction of hydraulic conductivity of landfill liners and the softening of soil slopes, we acknowledge and account for time-dependent effects.

Figure 2. Biofilms for temporary hydraulic conductivity reduction: (a) test setup, (b) formation, starvation, decay, and re-healing stages.
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Bio-mediated Solutions... Engineering Solutions Mediated by Biological Processes

Over the past 15 years, geotechnical researchers have formed interdisciplinary teams with microbiologists and geochemists in an effort to merge their knowledge and identify bio-mediated processes that may be accelerated in time to induce changes in soil that result in significant improvements in engineering soil properties. While great progress has been made with some promising processes presented herein, we are still in the early days of discovery.

Why is the role of biology critical in this interdisciplinary endeavor? Biological processes directly influence the rate, timing, and location of the geochemical reaction network(s) that induce changes to the soil structure. In some cases, the process creates a permanent inorganic precipitate that could also be solely produced using chemistry in a beaker on the lab bench; by mediating this process, we can control the reaction and enable such processes to occur uniformly within a soil mass. In other cases, an organic polymer may form around bacteria, and its stability is directly coupled to continued bacterial growth; when the bacteria die, the change in engineering properties also reverts.

Microbially mediated calcite precipitation (an inorganic mineral precipitation technique) is the process that has shown the greatest promise and research focus to date. Recent research treating large 2-m-diameter tanks of soil has demonstrated that it is possible to solidify loose, uncedent sand (relative density, $D_r = 40\%$, initial shear wave velocity, $V_s = 120\ m/s$) into a sandstone-like material ($V_s = 970\ m/s$) over a period of 10 days, while controlling the spatial distribution of improvement (Figure 1: note that the final $V_s$ gradient across the tank was produced by design to calibrate a numerical model). Moreover, this process is possible through bio-stimulation, wherein bacteria already present in the sand (native bacteria) are first stimulated with nutrients to increase in population and activity, and then used to mediate the calcite cementation process. Calcite precipitation in the void space and particularly at particle-particle contacts increases soil stiffness, strength, and liquefaction triggering resistance, and decreases
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permeability. The resulting potential applications are wide ranging and include liquefaction mitigation beneath existing structures, stabilization of unsealed roadways, control of groundwater flow, and contaminant immobilization.

The growth of biofilms, or bacterial communities that secrete a gel-like substance known as EPS (extra-cellular polysaccharide), has been shown to coat coarse-grained soil particles and plug voids for short-term modification of soil properties. The generation of EPS within sands can effectively reduce hydraulic conductivity by more than 100 times over a period of about two weeks (Figure 2a). Recent column experiments have demonstrated that this process also can be achieved by stimulating native bacterial populations. Once reduced, the hydraulic conductivity reduction can remain stable for more than 60 days, after which it degrades (Figure 2b). If desired, retreatment can sustain or recover the full reduction, or alternatively, the biofilm could be allowed to degrade, and the hydraulic conductivity can attenuate back to its natural condition. This type of short-term reduction is very attractive for dewatering excavation projects, for example, since the hydraulic conductivity reduction is only temporary.

**Bio-Inspired Solutions… Engineering Solutions Inspired by Biological Analogs**

Ant excavation processes are 100-1,000 times more efficient than current tunnel boring machines. Root systems are 10 times more efficient than current ground reinforcement/foundation systems. Moles advance through soils with amazing efficiencies (Figure 3).

Activities such as these cannot be directly harnessed for geotechnical applications, but the principals and processes they employ, processes that have been optimized by nature over millennia, can be used to inspire new geotechnical solutions.

A majority of geotechnical solutions and their associated construction processes have been driven by the construction industry. Consequently, current technologies are largely feasibility and direct-cost focused; optimization has largely been in the form of incremental improvements.

The goal of bio-inspired geotechnical solutions is to reconsider the performance requirements for a geotechnical system and identify new solutions that leverage, to the extent appropriate, efficiencies optimized in the biological analogs. Biological analogs for excavation, reinforcement, penetration, erosion control, densification, etc., can be readily identified. One example of where this approach may have significant potential is in pile foundations and soil retention systems. Nearly all deep foundation and soil reinforcement systems employ linear, constant, cross-sectional elements to transfer the structural load to the surrounding soil. The biological analog, the tree root system, is 10 times more efficient and highly spatially non-linear. After separating out the physiological role of tree roots (i.e., water and nutrient uptake), it is possible to identify the structural function and associated topology of the root system. The knowledge gained from this type of study enables us to explore the potential performance increase that is possible

![Figure 4. Vision of bio-mediate and bio-inspired solutions along a travel corridor.](image-url)
GeoNet is a battery powered wireless data acquisition network compatible with all of Geokon’s vibrating wire sensors. It uses a cluster tree topology to aggregate data from the entire network to a single device - the network supervisor. GeoNet is especially beneficial for projects where a wired infrastructure would be prohibitively expensive and difficult to employ.

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*Environmental factors also affect battery life.*

**Battery Life Estimates: 60 Minute Scan Rate**

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**Battery Life: 60 minute scan rate**

*Linked by Geokon-Incorporated*
with a root-inspired foundation or reinforcement element. It also allows for examination of the potential methods for constructing such a system.

**Biogeotechnics... A New Emphasis Is Coming to the Mainstream**

Collectively, biogeotechnics, or the development of bio-mediated and bio-inspired geotechnical solutions, constitute a rapidly growing emphasis in geotechnical engineering. In the coming decades, it will likely become part of mainstream geotechnical engineering (Figure 4). This field lies at the confluence of geotechnical engineering and microbiology, geochemistry, zoology, and plant science, as we come to recognize that life sciences are relevant to geotechnical engineering!

The development of biogeotechnical solutions forces a paradigm shift in which we, as geotechnical engineers, must recognize and consider soil as a living ecosystem, and not as a sterile, non-reactive, stable material. As geotechnical engineers, we must be trained — or re-trained — to think and be informed as biogeotechnical engineers.

**Sustainability... Adding to the Bottom Line of Safety + Cost**

The responsibility of the civil engineer is to safely provide essential services to society and the built environment, both to individuals and the community at large. This is the highest priority. In a capitalistic marketplace, a second priority is cost. The desired services are to be provided safely using the most economical solutions. These two criteria (safety and cost) have driven, and continue to drive, final selections. This approach, in combination with an assumption of nearly unlimited materials (e.g., cement) and resources (e.g., fuel), has led to the development of material- and energy-intensive, brute force, geotechnical solutions, and construction procedures.

We have now realized that there is a societal cost to these approaches. Emissions from these conventional construction methodologies are causing air quality degradation, ozone depletion, global warming, and sea level rise. Moreover, the materials and resources that are employed are finite. We cannot continue with business as usual in the decades to come.

As a result, we must re-evaluate how we make decisions. We must add sustainability to the existing criteria of safety and cost. The impact of a given technology can be quantified in terms of carbon footprint, embodied energy, etc. A comparative analysis between alternate solutions, wherein the carbon footprint is assigned a monetary value (e.g., social carbon cost), will help us, as a profession, realize the impact that geotechnical systems have and provide a basis for quantitative comparison between alternate solutions. Preliminary work in this area has shown that the carbon footprint between different ground improvement methods can differ by 10 times, and different earth retaining systems can differ by more than 3 times.

The criteria of safety must be uncompromised, but the cost calculations must include a solution’s sustainability in addition to capital costs. The challenge, of course, is that capital costs are measured in real dollars out of the investor’s wallet, while the sustainable costs are measured in equivalent dollars that everyone will experience, often at a later date. As a result, integration of sustainability and the societal impact into decision making must be led by government and forward thinking private investors.

**The Path Forward**

Bio-mediated and bio-inspired technologies hold promise to provide the sustainable geotechnical solutions that our society requires. There is an opportunity to re-consider, re-define, and re-design geotechnical solutions from this basis. For this to be realized, we must encourage broader exposure in our students’ education curriculum, continue pursuing new ideas through research, and engage with and educate current geotechnical practice of this emerging opportunity.

Be a bio-inspired geotechnical engineer!

**Acknowledgements**

The thoughts and ideas within this article have been inspired by many individuals, particularly my Soil Interactions Laboratory research group, researchers who teamed together to form the NSF Engineering Research Center for Bio-mediated and Bio-inspired Geotechnics (CBBG, biogeotechnics.org) (Ed Kavazanjian, Carlos Santamarina, Rosa Krajmalnik-Brown, Paola Bandini, David Frost, Claudia Zapata), and collaborators who participated in the NSF-funded BioSoils workshops of 2007 and 2011.

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View from Canada of completed dry dock prior to lifting boats – October 2013.
The Maid of the Mist Corporation (MOTMC) has operated the iconic Maid of the Mist boats beneath Niagara Falls since the early 1900s. Traditionally, the company has provided trips from the U.S. and Canadian sides of the Niagara River. For years, a dry dock located on the Canadian side served as the winter storage and maintenance facility for the Maid of the Mist boats. The boats must be stored at least 20 ft above the lower Niagara River to protect them from ice build-up at the base of the falls during the winter.

The MOTMC had recently lost access to the Canadian side, requiring development of a new American dry dock facility. Buildable space at the base of the gorge is limited, and the site of the former Schoellkopf Electric Power Plant (Figure 1), approximately one-half mile downstream of Niagara Falls, was deemed a suitable location. However, that location, combined with the geology and site history, presented several geotechnical challenges that ultimately controlled the design and construction of the dry dock.

Site History
The New York State Office of Parks, Recreation and Historic Preservation (NYSOPRHP) maintains a treasure trove of geologic and historic information at the Discovery Center (Figure 1). Mining this information provided a fascinating glimpse into the past and served as the basis for some of the key decisions regarding the development of the site.

The Schoellkopf Plant was constructed in two parts during the early 1900s. Station 3A was built between 1905 and 1914 and was the first alternating...
current, electric-generating facility in the U.S. Stations 3B and 3C were constructed between 1918 and 1924, using newer and different construction techniques than for Station 3A. A rock slide in 1956 destroyed Stations 3B and 3C, (in part, because of the different construction methods); however, much of Station 3A’s structure survived the rockfall, including a masonry façade covering the 200-ft-high Niagara Gorge face and penstocks, the concrete tail race structure, and an abandoned elevator tower.

Station 3A was repaired after the 1956 failure and generated power until the Robert Moses Plant, located several miles north in Lewiston, NY, was completed in the early 1960s. Station 3A was demolished in 1962. The 200-ft-high stone façade and the elevator tower were largely untouched until the Maid of the Mist development.

**Design Considerations**

The dry dock facility includes a dry dock for winter storage of the Maid of the Mist vessels, a permanent crane to transfer the vessels from the water to the dry dock, a support building, walkways, and an access elevator from the top of the gorge that was constructed inside the abandoned Station 3A elevator tower.

Before the site could be considered as a viable location for the new facility, some fundamental issues had to be evaluated. These included studying the cause of the 1956 rockfall that destroyed Stations 3B and 3C and whether the new facility could be protected from future rockfalls, evaluating the condition and stability of the remnants of the 3A facility, and determining whether a new dry dock could be founded in the unique geologic conditions at the base of the Niagara Gorge.

Other interesting aspects of this project included the extremely tight schedule (work could not commence until April 2013, and the boats had to be out of the water by October 2013), and site access restrictions (there was no vehicular access to the site, so all equipment and materials had to be lowered some 200 ft into the Niagara Gorge by crane). Because of the fast-paced nature of the project and the lack of access to the gorge during the initial design stages, design plans were developed based on assumed subsurface conditions and were revised during construction as subsurface information became available.

**The Rockfall**

A “perfect storm” of conditions combined in 1956 to cause the rockfall that destroyed Stations 3B and 3C. Key factors in the rockfall included the stratigraphy of the Niagara Gorge, the rock structure, the history of development along the gorge, construction methods used to build Stations 3B and 3C, and efforts to stop groundwater from flowing out of the gorge face.

Niagara Falls was formed some 12,000 years ago as glacial ice receded north of the Niagara Escarpment (in what is now Lewiston NY), allowing water that was impounded behind the ice to drain over the escarpment. Since then, the falls has eroded some five miles south to its current location. The 200-ft-deep gorge that the falls created is comprised from the top down of a hard
dolomite “cap rock” (called the Lockport Formation) underlain by weaker shales and siltstones (Rochester Shale). The rock in the region has vertical joints that are oriented in conjugate sets, one roughly parallel to the gorge face and the other generally perpendicular to it. As the shales slake and erode, dolomite overhangs are created. As erosion progresses, the overhangs eventually fail along vertical joints and topple into the gorge. This creates piles of rock debris (talus) at the base of the gorge that eventually build up against the gorge wall and cover the shale. Once the shale is covered, erosion slows, and the gorge walls become stable.

Figure 2 shows the power station when it was in operation. The gorge face is exposed above Stations 3B and 3C, but above Station 3A, it is covered by a 200-ft-high masonry façade. The talus that normally exists at the base of the gorge was removed to build the power stations, leaving the shale exposed and free to erode. During the plant operation, removing weathered shale that accumulated behind Stations 3B and 3C was a continual maintenance operation. Unknown at the time the plant was in operation, there was a vertical joint nearly parallel to and within about 20 ft of the exposed rock face behind Stations 3B and 3C. This joint defined the back side of the slide.

Figure 3 shows that the rock behind Stations 3B and 3C was a series of vertical columns (labeled “A” through “E”). The vertical separations between the rock columns (labeled “Previous Excavations”) were a result of the development that occurred in the late 1800s along the gorge. Back then, the top of the Niagara Gorge was lined with industries that each generated electrical power. Each industry made vertical excavations into the gorge face that served as discharge points for the water after power was generated. The rock columns were bounded on the sides by these industrial excavations and on the back by the vertical joint that was parallel to the gorge face. These conditions rendered the rock columns essentially as free-standing columns with little resistance to toppling. With the support at the base of the columns continually reduced by erosion, failure was only a matter of time.

The Schoellkopf Plant was constructed in two parts during the early 1900s. Station 3A was built between 1905 and 1914 and was the first alternating current, electric-generating facility in the U.S.
Construction and operation of Stations 3B and 3C also contributed to the failure. Water was supplied to Stations 3B and 3C from the Upper Niagara River. The penstocks for Stations 3B and 3C were rock shafts, excavated by blasting down through the dolomite and the underlining rocks and exiting into the power stations at the base of the gorge. Water leaking from the unlined penstocks combined with groundwater, then continually flowed out of the rock face above Stations 3B and 3C, which resulted in a constant maintenance headache for the power plant operators. In 1956, the operators decided to institute a grouting program to reduce the water flow. A line of holes parallel to the gorge face was drilled down through the rock formations to the base of the gorge and grouted.

On June 7, 1956, several weeks after the grouting program was initiated, a massive rockfall occurred. It is likely that the grouting operations blocked drainage paths, causing an increase in hydrostatic pressure behind the rock face, which triggered the rockfall. The rock columns toppled into the gorge beginning from the south and progressing north to Station 3A, completely destroying Stations 3B and 3C (Figure 4). The rockfall was preceded by a large increase in water flowing out of the gorge face, presumably as rock joints opened up and excess water pressure was relieved.

Recent borings drilled at an angle from the top of the gorge and exiting the rock face above the former Station 3B and 3C area, as well as test pits that exposed the rock surface at the top of the gorge, did not reveal open joints such as the one that was a factor in the 1956 rockfall. Although the explorations did not reveal conditions that would lead to large-scale rockfalls, the design team recommended a program of scaling to remove old foundations and loose rock overhangs. The team also designed a rock fence to protect the new dock. A question still remained, however, about the condition of the former Station 3A. All that could be seen was the exposed exterior of the 200-ft-high masonry façade.

The Remnants
Station 3A was built before Stations 3B and 3C and was constructed differently. Instead of exacerbating the natural rockfall mechanism of the gorge (as Stations 3B and 3C did), the penstocks protected and reinforced the rock face. The rock at the top of the gorge was removed to allow construction of a forebay and gatehouse at the top of the gorge. Instead of sinking the penstocks into the rock, the penstocks extended horizontally from the forebay to the edge of the bedrock gorge face, then turned 90° downward and followed along the bedrock face to the powerhouse at the base of the gorge. The penstocks are 9 ft in diameter and consist of steel plates, riveted together and enveloped in concrete that was placed in contact with the bedrock face. A 4-ft-thick, stone masonry façade was built in front of and between the concrete envelopes surrounding the penstocks. Water from the upper
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Niagara River that supplied the plant was contained within the concrete-lined forebay and penstocks, preventing it from flowing into the rock joints (as it did in Stations 3B and 3C).

The space behind the façade, but between the concrete penstock encasements, is open and can be observed from manholes located near the top of the wall. The design team opened each manhole and observed the condition of the rock face, the back side of the façade, and the concrete surrounding the penstocks. Figure 5 is typical of the conditions between two penstocks.

The concrete surrounding the penstocks is in good condition, with only a few tight cracks on the end penstocks. The masonry is also in good condition, with little accumulation of debris at the base of the façade. The inside face of the stone façade is covered with a layer of mortar, and there are no visible cracks at the connection of the masonry and the concrete that covers the penstocks. These observations revealed that the 200-ft-high masonry façade and the rock face behind it are in good condition.

The design team recommended removing loose rocks, repairing the mortar in some areas of the masonry, and completely refurbishing the inside of the elevator tower. However, the investigations did not reveal potential large-scale failures that would preclude the planned development.

**What the Falls Left for a Foundation**

Design and construction of the dry dock facilities presented many challenges. A key issue was how to prepare a proper foundation. The dry dock consists of a retaining wall (about 20 ft high) located next to the river and a reinforced concrete slab constructed on fill behind the wall. In the middle of the dock is a 90-ft-high, permanent Liebherr Crane (requisitioned from Austria) that would be used to lift the 125-ton Maid boats in and out of the water.

While the geology of the gorge walls is well known, much less is known about the rock conditions at the base of the gorge. The bottom of the gorge is covered with talus, but its thickness and specific details about the rock formations underlying the talus were unknown at the site.

The dry dock design progressed without any subsurface information because drill rigs could not access the area until permits were secured. Also, a large crane (a Manitowoc 888 Ringer Crane) had to be erected to lift equipment into and out of the gorge. Preliminary design plans included micropiles to support the retaining wall and the previously mentioned Liebherr Crane. Micropiles were considered an attractive option because the depth of the piles could be varied to suit the geologic conditions.

Subsurface exploration work began in late May 2013 with the knowledge that the boats had to be out of the water by the end of October. The results showed that a hard sandstone layer (Whirlpool Sandstone) existed beneath the planned, permanent crane, but it was covered by about 50 ft of talus, as shown in Figure 6. Fortunately, the Whirlpool Sandstone extended just beyond the crane foundation and was sufficiently thick to provide the required support for the micropiles. However, this was not the case everywhere beneath the dock. Sandstone was absent south of the crane, leaving only...
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While the geology of the gorge walls is well known, much less is known about the rock conditions at the base of the gorge. The bottom of the gorge is covered with talus, but its thickness and specific details about the rock formations underlying the talus were unknown at the site.

The weak, underlying Queenston Shale at depths of more than 100 ft below the new dock.

Plans for the dry dock were modified to accommodate the variable rock conditions. Instead of supporting the retaining wall on piles, the design team decided to move the retaining wall and dock away from the river far enough to meet stability requirements. The retaining wall was founded on a large spread footing supported on the talus. The crane remained in its originally planned location, supported on micropiles founded in the Whirlpool Sandstone.

Forty-eight, 7-in.-diameter micropiles were installed around the circumference of the crane foundation, each with a permanent steel casing and a No. 28, galvanized reinforcing bar. That’s a 3½-in.-diameter steel bar extending the entire length of the pile and grouted 20 ft into the Whirlpool Formation! The piles were installed in two concentric rows, one vertical and one battered. Both the vertical and the battered piles were load tested to 480 k.

Conclusion

The contractor built the dry dock from mid-July through September 2013. It was an amazing feat considering that every ounce of steel, concrete, and equipment had to be lifted into the gorge by crane.

In late October, the Maid boats were lifted out of the water onto the new dry dock. Clearly, the engineering and construction creativity and perseverance exhibited by those who built the power plant in the early 1900s are still relevant to today’s construction challenges.

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SMALL PROJECTS ARE BIG DEALS

Collaboration is key, no matter what the size of the project

By Daniel Mahrt, PE, M.ASCE
Geotechnical engineers work on a wide array of projects, ranging from small retaining walls or pavement projects, to construction of dams, canals, and foundations for bridges and high-rise buildings. On large projects, collaboration is required and expected for a successful project. High-profile megaprojects and design-build projects, among others, require collaboration because many disciplines are working simultaneously, and specific design details may have significant impact on other aspects of the project. On smaller projects though, the collaborative environment is often not as prevalent.

Our Duty as Engineers
All projects have unique challenges, and as engineers, it’s our duty to provide our clients and the public with safe, reliable, and sustainable solutions. Collaboration is required to evaluate different solutions that will impact other members of the design and construction teams. The most appropriate solution may change as the project design develops. What seems to be the most appropriate, cost-efficient solution during early stages of the project (such as a consolidation surcharge program), may later become impractical due to tighter construction schedules, construction staging, or other project requirements that develop over the course of design. As geotechnical engineers, we owe it to our clients to stay engaged on the project, continually asking questions, and seeking feedback.

On large projects, it’s common and expected for several parties (structural engineer, civil engineer, contractor, and others) to review the details. However, on small projects, a geotechnical report is often issued without any subsequent interaction by the geotechnical engineer with members of the design team. Remember that even on small projects, your client trusts you to provide an effective solution, no matter what it takes.

Why Collaborate?
Many of us went to engineering school because we like technical challenges. The engineering field tends to attract introverts who find comfort in numbers and calculations, who sometimes have difficulty initiating and maintaining effective communication. However, a vital part of engineering is communicating your findings effectively. After all, you can have the most incredible ideas in the world, but if no one understands the concepts you’re promoting, clients will never hire you, and your company will not grow. Many rewards can be reaped by collaborative engineering:

- **Dedicated Clients** — A vital part of engineering is understanding the people you are working for and with, and meeting their needs. When clients realize you are looking out for their best interest, your relationship will transform; you will no longer be a commodity, but a trusted advisor. Of course, this takes time and won’t happen over the course of
Fast-track projects are becoming more common. What was once a linear process of obtaining geotechnical information before the design is finalized is now a constantly changing scenario. Stay engaged in the project, or report recommendations may be misinterpreted as the design changes.

one small project. But as a client realizes that there are fewer surprises when you are on the team, or their projects remain within budget, they will realize the value that you provide. One way to speed up this process is to stay in constant communication with the client. Don't be afraid to “toot your own horn.” Did you just suggest a change or alternative that will save the client's budget or schedule? Take credit for it!

**Reduced Risk** — Within our company, we've noted that risk of litigation is inversely proportional to project size and complexity. A collaborative environment can significantly reduce risks on small projects by identifying potential conflicts and solutions early in the process, without impacting construction schedule or budget. Identifying these things early also helps you win dedicated clients.

**More Work/Better Scope** — Collaboration takes time. It may require you to revisit your original assumptions, reassess your calculations, or perhaps change your recommendations based on your improved understanding of site conditions or project requirements. If you have done your work properly and your clients realize your value, they will be more likely to compensate you for these additional services. Of course, it may take time for them to realize this value, but persistence in collaborating with clients is a highly effective business development tool that will win over customers and reduce risk. This is a win-win approach for everyone!

**Example** — At a recent preconstruction meeting for renovation of a car dealership, a collaborative team of the contractor, structural engineer, and geotechnical engineer were able to develop a foundation solution for a difficult area of the project. The design called for shallow foundations supported on the existing site soils. At the preconstruction meeting, the contractor noted an area inside the existing building where construction of the new footing would require significant removal and subsequent replacement of the floor slab, and was discussing the removals with a subcontractor. Being on site to see the actual conditions, I suggested that helical piers could easily be installed in this location, and would require only minimal removals. The structural engineer was able to make a quick design modification, and the small change saved significant time and cost, while still allowing the business to operate. While this is a small, relatively basic example, it is easy to imagine how many times easy, simple things like this can be overlooked if engineers are not present at critical points of the project.

**Challenges**

There may be roadblocks on the path to collaboration. By identifying these obstacles, we can be better prepared to work through them. Some common challenges are as follows:

**Information Flow** — Geotechnical engineers are often the first engineering specialty to be on a site. In the best cases,
we have access to a detailed site plan and survey from which, coupled with a field reconnaissance, we can develop an adequate scope of services. In other cases, we will have a general concept plan, and boring locations can be evaluated based on specific site features and the conceptual project. Often these plans will change before construction. Many times these things change after a geotechnical report has been finalized, or change while the geotechnical work is being completed.

Schedule — Fast-track projects are becoming more common. What was once a linear process of obtaining geotechnical information before the design is finalized is now a constantly changing scenario. Building sizes, layout, loadings, and other design details can change, even during construction. A geotechnical engineer must stay engaged in the project, or report recommendations may be misinterpreted as the design changes.

Communication — Cultural and technological changes have strained the collaborative environment. We live in an age of nearly instantaneous emails and text messages. Gone are the days of “snail mailed” documents, hard copies, and fax machines. We no longer have to deal with the time delays that are associated with these forms of communication. However, E-communication is not without its own set of problems. E-communications are not always subject to the same level of internal review and deliberation that more formal reports or letters are, yet e-communications pose the same risk as signed and sealed documents. Interpersonal cues, reactions, and hot buttons are often missed with e-communications. Moreover, misinterpretation of e-communication is also common. While we try to stay on top of the information flow and schedule by firing off mass emails, we may miss the important reactions or cues of our clients and fellow members of the design team.

Client/Design Team — We all know that various clients and teams work on many different sizes of projects. While large projects and clients often have a team of geotechnical engineers to review submittals, small projects may have a single designer or a smaller design team that does not have geotechnical expertise. While many clients and team members may be considered “educated clients,” there is a greater percentage of “under-educated clients” associated with small projects. These clients may not be involved in many projects, or may not have the background or formal education to understand the intricacies of geotechnical engineering.

Low-Bid Environments — Low-bid environments aren’t usually conducive to collaboration. Collaborative clients appreciate working with a collaborative team, and expect value, not the lowest cost. We don’t have to race to the bottom to win projects in environments that do not mesh with our values.
Effective Collaboration
Balancing all of these challenges is not an easy task, but did you go to engineering school because it was easy? No! Step up to the challenge, and reap the rewards! Collaboration is the tool to balance all of these challenges and excel as an engineer. Here are some tips for establishing and improving collaboration on small projects:

- **Get to Know Your Client** — In this age of immediate and electronic delivery, we sometimes lose the personal touch. There seems to be less and less follow up on services. Try hand delivering a proposal or deliverable to your client. You may be surprised to find that this provides a great opportunity to discuss your approach and get immediate feedback on any scope or design changes that may be impacted. When working with clients and firms around the world, personal meetings are obviously not practical, but a follow-up phone call promptly after transmitting the document can also be effective.

- **Identify Collaborative Partners** — As geotechnical engineers, our collaborative team should include the owner/client, structural engineer, civil engineer, architect, and contractor/specialty contractor. Input from other individuals may also be needed. Each of these parties will have unique perspectives and varying needs at different times in the project process.

  - Develop relationships with contractors and specialty contractors, and hold discussions about projects with them prior to recommending or specifying a proprietary technique. Specialty contractors may be able to recommend newer technologies, or different systems.
  
  - Develop your own internal project teams, or pair up with a co-worker to feed off of each other’s strengths. Are you an introverted perfectionist? Team up with an extroverted promoter. One of you may be more effective at initiating the collaboration, while another will know all the important details of the project.

- **Step Up and Lead** — The collaborative process can be difficult to begin if the design team has not worked together before. Often, on small projects, there is no one taking the lead to initiate collaboration. As upstanding professionals, geotechnical engineers can initiate this collaboration, and in the process prove their worth to their clients and team. Developing this collaboration can be as simple as suggesting
a face-to-face or an Internet meeting rather than creating and accumulating an endless string of emails.

Effective Communication — There are numerous times within a project where communications can, and should, occur. More frequent communications can cut through most potential roadblocks. All projects vary and will have different intricacies and checkpoints where collaboration and communication can occur. At a minimum, communication should take place during preparation of the scope of services, upon authorization and scheduling of the work, prior to and following completion of the field work, prior to and after completion of the deliverable, and during construction. Most projects will have even more opportunities. To be collaborative, these communications must move two ways. Questions must be asked, and answers and confirmations must be given. One-way communication is not collaborative. Two-way communication is easier with a phone call or personal visit, or, if the parties are a distance away from each other, via Skype or a similar program. Emails often end up as one-way, non-collaborative communication, but some people may not respond to phone calls or voice mails, and this sort of communication is necessary.

With face-to-face meetings losing their popularity in our electronic age, significant value is being lost. For example, during a meeting with the design team, a savvy professional will be able to interpret non-verbal cues, reactions, or items of the most interest for the design team. More often than not, there are intricacies to a project that aren’t communicated via e-communications.

During a personal meeting, you are more apt to ask detailed, clarifying questions you may not otherwise notice in an email. Web meetings and conference calls can be effective as well, and should take precedence over emails.

No Surprises!  
Check in with the team shortly after completion of field work. What were the findings? Discuss with the team both expected and perhaps unexpected findings and go over how they may impact the project. In particular, will the unexpected findings require a change of the proposed scope and/or project schedule? Anything that is unexpected should be promptly communicated. If your report or your invoice has surprises in it, your client relationship could become strained.

Attend the Preconstruction Meeting  
As contractors and subcontractors come on board a project, there is added potential for collaboration. Different contractors may have different approaches that can impact the final geotechnical solution. Listen to the contractors, and work with them to find mutually agreeable alternatives to the original plans. Visit the site during construction to check on the progress.

Collaborate Your Way to Success  
Collaboration on projects is not always easy, and can be difficult to initiate. The challenges are worth overcoming, and will help to elevate you, your clients and partners, your company, and our profession. Collaboration can lead to more successful projects with fewer surprises, not only helping make your job easier, but also helping your clients and partners succeed. Through these successes, the collaborative team builds trust and respect for each other, paving the way for a stronger, more prosperous working relationship.

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On a sunny, summer afternoon last June, the project manager for AECOM’s open-end bridge design contract with the Delaware Department of Transportation (DelDOT) received an urgent call from DelDOT’s assistant chief bridge engineer. He learned that during a recent field visit to the banks of the Christina River in Wilmington, DE, a local geotechnical consultant had observed that a few of the 60-ft-high concrete columns that support the bridge carrying I-495 over the Christina River were tilting toward the east and obviously out of plumb.

The geotechnical engineer had been on-site to investigate potential impacts to an underground petroleum pipeline that runs parallel to the I-495 bridge just to the east of the structure. The reason for his site visit was to determine whether a soil stockpile (Figure 1) that had been placed on the privately-owned land between the pipeline and the I-495 bridge had caused any damage to the pipeline. But while investigating, the observant engineer inadvertently discovered a much more significant impact to the adjacent viaduct bridge structure. His timely observation and subsequent report to the DOT set into motion the around-the-clock design and construction efforts that comprised the emergency response and retrofit of the bridge.

THE LEANING TOWERS OF WILMINGTON, DELAWARE

EMERGENCY RESPONSE AND RETROFIT OF THE I-495 VIADUCT TO ADDRESS LATERAL SQUEEZE

By Paul H. Moffitt, PE, M.ASCE, and Bruce A. Shelly, PE, M.ASCE

Figure 1. Impacted bridge piers with soil stockpile in foreground, looking north.
Background

The existing I-495 bridge was constructed in 1973 and is supported on deep foundations that vary from tapered, steel shell piles inland from the shoreline of the Christina River to steel H-piles within the river’s floodplain. The impacted section of the bridge was located within the floodplain and consists of parallel structures supported by pairs of single shaft, hammerhead pier columns founded on groups of battered and plumb steel H-piles, approximately 140 ft long (Figure 2). The piles were driven through 100 ft of soft alluvial clay to a competent stratum of decomposed bedrock. Since the last biannual inspection of the bridge in 2012, a soil stockpile had been placed immediately adjacent to four of the piers on the northbound side, causing significant lateral deformation to the piers and bridge deck. The soil stockpile acted as a surcharge load on the soft compressible alluvium, and had induced enough lateral deformation on the subsoil to apply excessive lateral load on the pile groups. The resulting lateral squeeze deformed the H-pile groups and cracked the pile cap (Figure 3), causing the bridge piers to tilt and displace laterally.

On June 2, 2014, DelDOT closed I-495 through this corridor to traffic and engaged the design team to help develop a remediation strategy and design a retrofit to re-open the bridge as soon as possible. This closure directly impacted over 90,000 daily users, based on average daily traffic data. That same day, the project team confirmed that the soil stockpile should be promptly removed to unload the surcharge on the compressible clay layer and to stop any additional movement. DelDOT then coordinated with the owner of the soil stockpile to begin its removal on the first day of the emergency response. Stockpile removal continued around-the-clock until all of the soil had been transported offsite and the area had been restored to its original grade. In total, over 50,000 tons of soil were removed in 10 days without interruption while other site activities were underway. The four affected bridge piers were instrumented with tiltmeters to monitor their movements. The tiltmeter instrumentation was connected to a data logging hub that uploaded real-time readings to a centralized website.

Response

While a remediation strategy and initial design efforts were underway, a geotechnical subsurface investigation was developed by the geotechnical contingent of the project team. The subsurface investigation was performed within the affected area to map the extent and measure the magnitude of soil disturbance, confirm foundation conditions, and define a competent bearing stratum for the impacted pier foundations. The investigation consisted of explorations and instrumentation at four potentially damaged pier foundations along the length of the bridge (Figure 4). This included: 10 test pit excavations at pier footing locations; 12 cone penetrometer test (CPTu) soundings; 6 conventional Standard Penetration Test (SPT) borings with rock coring; 4 open-standpipe piezometers fitted with transducers; 3 inclinometers with in-place probes; and 1 groundwater monitoring well for sampling and analysis of potential hazardous contaminants. Similar to the tiltmeters, all of the subsurface instrumentation was linked to a data-logging hub and uploaded to a centralized website for real-time monitoring.

During the initial phase of the subsurface investigation, one of the most significant findings was the excess pore water pressures measured during the CPTu soundings. The measured pore pressures exceeded a 1.0 psi/ft threshold in numerous locations throughout the entire soft clay layer under Piers 11 through 14, which is indicative of ground disturbance in the clay soil. The pore water pressure values were correlated to an equivalent overburden height of 35 to 40 ft, which corresponded very well to the actual height of the soil stockpile.

Significant cracking in the concrete pile caps was found during the test pit investigations at each of the pile cap locations where pier deformation and displacement had occurred. Exposing the pile caps also revealed that the column foundations were compromised at four pier line locations (Nos. 11 through 14), consisting of eight separate pile caps. Therefore, it was obvious that the existing H-pile foundations were significantly impacted at these pier locations and would necessitate installation of new deep foundations to underpin and/or reconstruct the piers to restore the bridge to service.
The project team worked around-the-clock during the first few days of the response effort to formulate a plan to support the impacted structure. Ultimately, the team chose new deep foundations consisting of drilled shafts bearing on bedrock due to their superior lateral and axial capacity, as compared to relatively flexible H-piles. The drilled shafts were designed as end bearing on competent bedrock at a depth of about 150 ft below grade.

Once the retrofit plan was in place, the design of the substructure and superstructure began. All of this happened during that first week of June. Two of the four pier lines (Nos. 12 and 13) were damaged beyond repair and therefore required complete reconstruction. This reconstruction consisted of a pair of reinforced, concrete grade beams founded on groups of four drilled shafts, for a total of eight drilled shafts per pier line. The grade beams would serve two purposes: to support the temporary jacking towers to realign the bridge deck in a temporary condition, and to function as the final substructure to receive new three-column bent piers for the permanent viaduct. For the pier lines immediately adjacent to Pier Nos. 11 and 14 (Pier No. 11 to the south and Pier No. 14 to the north), the translation of the existing pier columns was not significant enough to warrant complete reconstruction, but the existing H-pile groups and pile caps were damaged enough that underpinning of those pier columns was necessary. The underpinning at Pier Nos. 11 and 14 consisted of four drilled shafts per pier column, for a total of eight drilled shafts per pier line, and a new post-tensioned pile cap built on top of the existing cap to transfer the load (Figure 4).

**Geotechnical Considerations**

Once an approach and substructure type were selected, the design effort had to begin immediately without waiting for the subsurface investigation or testing to be completed. Therefore, initial soil and bedrock parameters could only be based on presumptive values from published references, subsurface profiles from the existing plans, correlated values from the in-situ testing, and relevant testing from adjacent structure foundation investigations performed on similar soil and bedrock. There was significant correlation and corroboration of the various sources of data. This included recent laboratory test results on similar soil and bedrock from an adjacent DOT bridge project then under design (the Wilmington Waterfront Christina River Bridge project west of the I-495 site). The availability of this data was extremely helpful in allowing for the timely confirmation of the assumed parameters used in the preliminary design of the foundations.

Based on information obtained from the existing plans’ subsurface profile sheets, a generalized soil profile was created for the drilled shaft design at the impacted piers. Soil and rock parameters were assigned very conservatively based on published references. The assigned parameters were eventually refined as new boring and in-situ testing information became available, and then finalized after laboratory testing had been completed.

For simplification, a generalized stratigraphic column was created to provide a worst-case model for each of the four pier locations. The drilled shafts were designed as end bearing on bedrock (without rock sockets), and lateral resistance was

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**Figure 3. Cracking in Pier No. 14E pile cap.**
developed in the soft marine clay layer that comprised the upper 100 ft of the soil profile. A conservative undrained shear strength ($S_u$) profile was developed ($S_u$ increasing with depth) based on correlations with the CPT sounding data.

The $S_u$ values were subsequently corroborated by results from unconsolidated, undrained (UU) triaxial laboratory testing of undisturbed, Shelby tube samples collected from the borings. The significant layer of soft, compressible clay was assigned very minimal $S_u$ values (0 to 7 psi, increasing with depth). Excess pore water pressure was accounted for as additional axial load (downdrag) on the drilled shafts from correlated pore pressure readings taken during CPT sounding when the soil surcharge was still in place, representing a worst-case condition. Actually, because the soil stockpile was removed within the first 10 days of the emergency response, the pore pressures dissipated significantly by the time the drilled shafts were constructed. But to maintain a conservative approach, the initial excess pore water pressure caused by the soil stockpile was used to calculate the equivalent downdrag load (300 kips), which was applied to each shaft.

A single, static analysis was performed using the method from the AASHTO LRFD Bridge Design Specifications (6th Ed. 2012), which follows the method in the Canadian Foundation Engineering Manual (1985). The Canadian method accounts for spacing and aperture of discontinuities in the rock-bearing stratum, in addition to using representative, unconfined, compressive strength values from rock core recovered from the project. A bearing resistance reduction factor of 0.50 was used because no confirmatory load testing would be performed on the drilled shafts. Final design analysis determined that the shafts could develop over 4,000 kips of axial capacity, thereby exceeding the required axial loading of 3,000+ kips per shaft. The capacity of the shafts was controlled by the geotechnical capacity of the bedrock using the Canadian Method and assuming the use of 4,500 psi concrete. All axial capacity was developed from end bearing, and any contribution from side resistance was ignored. Single shaft lateral analysis was performed with LPILE version 6.0, and group analysis was performed with GROUP_v8.0.

**Foundation Construction**

A major milestone in the emergency response occurred on June 12, when the prime contractor’s drilled shaft subcontractor arrived at the site. On its first day of mobilization, the subcontractor immediately began setting casing and drilling. With 32 drilled shafts to install, there was no time to waste. Initially, casing oscillators were used to limit vibrations and prevent additional damage to the existing pile groups. The use of the casing oscillator was effective, but very slow, so to meet the aggressive schedule, the contractor asked if it could switch to vibrating the casing using a vibro-hammer. Because the bridge piers were already instrumented with tiltmeters, the drilled shaft subcontractor decided to try vibrating the casing while monitoring for any movements. Because no movements of the bridge superstructure were observed, the remaining casing was vibrated into place to expedite the work. The oscillator was still used on subsequent drilled shafts to start the casing installation, which helped maintain production.

![Figure 4. Elevation of underpinning and new foundations for Pier Nos. 11-14.](image-url)
Foundation construction also benefited from the availability of pre-assembled reinforcement cages from the Tappen Zee replacement bridge project north of New York City. Through an agreement between DelDOT, the prime contractor, and the Tappen Zee contractor, pre-assembled reinforcement cages were shipped directly to the I-495 site where they were spliced and lifted into place through access holes cut in the bridge deck. This entire procedure — from procurement, to assembly, to installation — allowed the foundations to be installed in weeks instead of months. The drilled shafts were fully-cased for their entire depth, and excavation was handled with low head, fixed-lead rigs using bentonite slurry.

The design team worked with the drilled shaft subcontractor to develop termination criteria for each shaft based on the depth to competent bedrock (Brandywine Blue Gneiss), as determined from the existing subsurface profiles and the new borings. The drilled shaft contractor’s construction methods verified the subsurface conditions by drilling through a weathered rock zone prior to encountering the competent gneiss bedrock. Drilled shafts of 4 ft diameter were installed with an average shaft length of 150 ft. The deepest shaft was over 165 ft, a feat previously considered impossible with conventional, low-head drill rigs and tooling. Permanent steel casing was installed for the entire depth to bedrock to eliminate soil loss during drilling and to minimize localized bridge settlement. The last drilled shaft was completed on July 16, just 32 days after the drilling began. That equated to a production of one shaft/day with an average length of shaft of 150 ft. This duration included integrity testing and acceptance of each shaft with crosshole sonic logging (CSL). Figure 5 presents a photo of the completed piers.

**A True Success Story**

Real-time monitoring of the piers and subsurface was conducted during the entire construction process. Low head clearance under the bridge presented challenges during excavation and installation of the drilled shafts, but this was overcome by the contractor’s innovative means and methods. This case history involving significant lateral loads imposed by a surcharge on deep foundations provides a real-life example of lateral squeeze effects on pile groups and the innovative methods employed to construct new foundations in these conditions. However, the true success of this story starts with the valuable lessons we learned about compressible soils and the vulnerabilities they can create around bridge structures. Even more importantly, the fact that the problem was noticed and acted upon so quickly, and in a collaborative manner, helped to save serious potential damage — or even possible life-safety concerns — from occurring. From an engineering perspective, the story of the remediation efforts on the I-495 bridge over the Christina River should be remembered as a true achievement for the betterment of the motoring public.

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INNOVATIONS IN GEOSYNTHETIC ROLLED EROSION CONTROL PRODUCTS

From Forests to Fibers

By Jennifer L. Smith, PhD, PE, M.ASCE, and Shobha K. Bhatia, PhD, M.ASCE

Over the last 50 years, many different types of geosynthetic rolled erosion control products (RECPs) have emerged, ranging from different structure types to different fiber types. Natural-fiber RECPs were developed to provide temporary protection to bare soils and assist in the growth and establishment of vegetation. Synthetic-fiber RECPs were developed to provide long-term protection in applications where longevity and relatively high tensile strengths were required. Because of their versatility, ease of installation, relatively low cost, and effectiveness in addressing soil erosion problems, RECPs have been used extensively around the world. In 2004, it was estimated that 59 million m² (Mm²) of RECPs were employed worldwide, with 42 percent used in North America, 34 percent in Europe, 15 percent in Asia and the Pacific, and 9 percent elsewhere. In each region, natural-fiber RECPs made up approximately 55 to 60 percent of the total RECPs used.
Figure 1. Photograph of a spruce needle RECP manufactured by hand for the study.
History of RECP Use

The early RECPs were natural-fiber, open weave textiles (OWTs) made from jute and coir, stemming from the first use of jute mats for erosion control in the 1950s. These were followed in the 1960s by erosion control blankets (ECBs) made of curled wood excelsior. Since that time, many different fibers have been used in ECBs, ranging from straw in the 1970s to recycled fibers in the 2000s. Other natural fibers, such as kenaf and sisal, have also been explored for ECBs. However, they may not gain traction in the established market without economic or technical advantages over the existing natural-fiber RECPs. Another feasible option is innovative natural fibers, such as transesterified jute, which has an enhanced durability. Synthetic fibers are also used, but their use is primarily in turf-reinforcement mats (TRMs) for long-term applications.

Based on a survey of RECP manufacturers, natural-fiber RECPs — primarily native straw and wood excelsior — have been more popular than synthetic-fiber RECPs in the U.S. Straw and wood excelsior have also been the most popular natural-fiber RECPs around the world: in 2004 they made up 47 percent of the natural fibers used, followed by coir (38 percent) and jute (15 percent). It’s believed that these trends in the use of straw, wood excelsior, coir, and jute natural-fiber RECPs will continue because they are resources that are low cost, effective at reducing soil losses, and renewable. With the continued expansion and enforcement of the U.S. Environmental Protection Agency’s (USEPA’s) National Pollutant Discharge Elimination System (NPDES) program and other regulations that limit sediment discharge, it is expected that the RECP industry will continue to grow.

There’s still a need for the continued development of value-added natural fibers for erosion control applications. SUNY-ESF/Syracuse University recently undertook two research initiatives in this direction: (1) development of low-value residuals (LVRs) for post-fire applications, and (2) development of polyacrylamide (PAM)-coated, natural-fiber RECPs for erosion and sediment control.

Low-Value Residuals for Post-Fire Applications

Soil erosion is a significant issue in the management of forests, particularly in areas that have been disturbed by wildfires. Studies have shown that erosion rates and runoff after wildfires can increase by one to three orders of magnitude. In 2012, more than 3.8 million hectares burned in the U.S.; this number is expected to double by 2050. In recent years, there has been an increase in the use of RECPs as ground cover on post-fire slopes. The U.S. Forest Service uses 100 percent biodegradable RECPs to minimize erosion inside and near the boundaries of Yellowstone National Park.

Mulching with dry straw or wet hydromulch has been used to protect post-fire soil slopes from erosion. Mulch is typically either applied by hand or by breaking apart bales suspended from helicopters. While mulching has proven to be more effective than seeding, many mulches, such as straw, introduce noxious weeds and other non-native plants to the forest ecosystems.

Although many different RECPs exist, none are based on forest waste products, such as pine needles or wood chips, even though these products have been found to be effective. In a decade-old laboratory study on the use of pine needles in RECPs, researchers who applied simulated rainfall learned that a 50 percent ground cover by Douglas-fir and Ponderosa pine needles reduced rainsplash erosion on post-fire soil by 80 percent and 60 percent, respectively.

In the SUNY-ESF/Syracuse University study, RECPs were manufactured from three different forest LVRs: leaf litter, willow chips, and spruce needles. Mixed leaf litter containing a variety of leaf shapes and sizes was collected from a stand of black maples in Syracuse, NY. The willow chips were obtained from a plantation in Tully, NY, and were found to be highly variable in terms of size, shape, and mass. Spruce needles were collected from a Norway spruce stand in Tully, NY. The average needle length was 15.1 mm. The LVR RECPs were designed to have properties similar to commercially
available ECBs. They were manufactured by hand-stitching materials between nets typically used for the manufacture of commercial RECPs. Figure 1 shows a spruce needle RECP.

Burned soil samples were developed for the fire simulations. Topsoil was compacted in stainless steel containers (20 cm in diameter by 10 cm deep) to 90±3 percent of standard Proctor maximum dry density at a moisture content of ±2 percent of optimum. The containers were then placed on top of a layer of sand in a burn barrel made from a 0.21-m$^3$ drum sliced in half lengthwise. The halves were joined together to create a single, long section that could hold up to seven containers along its centerline. Once the containers were in place, 5 to 10 cm of detritus leaf litter was placed on top of the containers. Then loose leaves were placed on top of the sand and around the containers to the same height as the detritus on the soil containers. The additional leaves around the containers helped simulate a natural forest floor and allowed for a more complete burn. The leaves were ignited in the direction of the wind using a handheld gas lighter. The burn barrel during a controlled burn is shown in Figure 2.

The burned soil containers were placed at the base of a rainsplash simulator, which had been constructed in the laboratory in accordance with ASTM D7101, Standard Index Test Method for Determination of Unvegetated RECP Ability to Protect Soil from Rain Splash and Associated Runoff under Bench-Scale Conditions. The simulator is approximately 2-m tall and produces 2.2-mm-diameter raindrops that fall onto a 3 horizontal to 1 vertical (3H:1V) slope table, simulating a 15-cm/hr rainfall intensity. The slope table consists of three channels 89-cm long by 25-cm wide, with recessed holes at the base to hold the soil containers. Tests were conducted with the LVR RECPs placed along the length of the channels to cover the burned soil containers and with uncovered burned soil containers as the control. Runoff and eroded sediment were collected in buckets at the base of the channels. The mass of eroded soil and turbidity were measured every 5 minutes through 30 minutes and at 45 and 60 minutes for each rainsplash test. Five specimens were tested for each LVR RECP. A 30-ml grab sample of the runoff water was collected for each time increment and measured for turbidity using a laboratory turbidity meter.

Average soil loss results at 60 minutes for the burned soil with and without the LVR RECPs are shown on Figure 3. As shown, the LVR RECPs were effective in reducing soil losses in comparison to burned soil alone. The leaf litter and spruce needle LVR RECPs were more effective than the willow chips in reducing soil losses. This was most likely due to the heterogeneous nature of the wood chips. Similar trends were found with respect to turbidity. Overall, the forest-based LVRs show promise for use as RECPs, particularly for use in burned areas.

Innovative PAM-Coated Natural Fibers

Although RECPs can be effective at providing erosion and sediment control, RECPs are typically more effective at reducing soil losses, while soil binders, such as PAMs, are more effective in minimizing turbidity. Limited work has been done that integrates the two different technologies. One study that considered the application of

![Figure 3. Comparison of average soil losses at 60 minutes for burned soil with and without LVR RECPs.](image-url)
Following the preparation of the solution, 29-cm-wide by 89-cm-long RECP specimens were submerged in the solution for approximately one hour. The coated specimens were then cured using a UV irradiator (Figure 4.) Specimens were irradiated for two, 30-second intervals on both sides.

The performance of the PAM-coated RECPs was evaluated using the same laboratory rainsplash simulator and procedure described above, except that the control was bare soil rather than burned soil. In addition to turbidity measurements, residual polymer concentrations in the rainsplash runoff water were measured using the Streaming Current Detection (SCD) method and a MUTEK-2 detector. The SCD method measures the charge in a sample of effluent.

In terms of soil losses, both the PAM-coated coir and wood excelsior RECPs performed similarly. The PAM-coated coir and wood RECPs decreased cumulative soil losses by 93 percent and 94 percent, respectively, compared to bare soil conditions. The PAM-coated coir and wood RECPs were also 21 percent and 18 percent, respectively, more effective in reducing cumulative soil losses than untreated RECPs. In terms of turbidity, the PAM-coated coir was slightly more effective (91 percent) than the PAM-coated wood RECP (84 percent) when compared against bare soil conditions (Figure 5). The PAM-coated coir and wood RECPs were also 28 percent and 10 percent, respectively, more effective in reducing turbidity than untreated RECPs. Overall, coating RECPs with PAM increases the effectiveness of RECPs in terms of reducing soil erosion and turbidity from bare soil slopes. SCD results indicate that PAM was released incrementally from the treated fibers during the rainsplash tests at environmentally safe levels.

**Importance of RECPs and Innovation**

Soil erosion is a serious issue that must be addressed on nearly every project. RECPs are tremendous tools in our ability to effectively minimize soil losses and protect water quality. The demand for RECPs is only going to increase. To keep up with increasingly stringent regulatory requirements, site constraints, and environmental challenges, it is important that we continue to innovate and improve RECPs to adapt to meet these new challenges.

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It is fair to state that the aspects of civil design and construction referred to as “geotechnical engineering” can be characterized as inherently risky. Geologic processes are complex, and the manner in which the resulting soil, rock, and groundwater conditions interact with construction operations is equally complicated. Hence, the process of investigating the ground and preparing geotechnical engineering reports, drawings, and specifications is fraught with risk at many levels.

Geotechnical professionals are generally familiar with the risks that technical issues can pose on a project, but what about the non-technical issues? Five non-technical topics that are crucial for the successful practice of geotechnical engineering include:

- **Risk Exposure** – How do geotechnical professionals become involved with problematic situations?
- **Assignment Selection** – What can geotechnical professionals do to avoid projects with unacceptable risk profiles?
- **Contract Negotiation** – What issues and potential problems are associated with professional service negotiations?
- **Scope of Services** – How can the project scope of services be managed so as to minimize potential problems?
- **Project Management** – How can the firm and its personnel be managed to help ensure that non-technical issues are considered in a proper manner?

This article is not intended to provide legal advice or to address the risks associated with environmental remediation projects. In addition, the term "client" in this article refers to several parties, such as project owners, architects, and prime designers working on a design-bid-build project. A completely different set of nontechnical issues would need to be evaluated relative to working for a contractor on a design-build project.

**Risk Exposure**

The number of risks associated with geotechnical engineering is long and contains numerous legal interpretations that are convoluted and highly variable among the different state and federal jurisdictions. The bottom line, however, is that geotechnical design professionals acquire liability on a project as a result of disappointed project outcomes and/or unrealized project expectations.

Owners and other project participants have a right to expect that the geotechnical professional’s design will result in a completed facility that is adequate for its intended purpose and functions as anticipated. Imagine, for a moment, that your completed facility is magically placed into the ground exactly in accordance with your recommendations.
That being the case, will the owners and/or end users of that facility be pleased with the finished product? If the answer to this question is no, then the geotechnical design professional could become “liable” for any actual and/or perceived shortcomings of the finished facility. But the problem is much more complicated than just that. For instance:

- Did the project cost more or take longer to construct than anticipated?
- Were third parties damaged in various ways as a result of construction-related activities?
- Did the problem cause delays which resulted in ripple effects throughout the remainder of the project?
- Did the problem result in serious embarrassment and/or “bad press” for project participants?
- How much did it cost to fix any “problems?”

Obviously, it is beyond the scope of a single article to discuss all of the ways that a geotechnical design professional can generate liability and exposure on a project. However, there are precautionary steps that can be taken to minimize and control project exposures, as follows.

**Assignment Selection**

How do you evaluate the potential for positive client interactions? Start by asking yourself the following questions:

- Is this a good client? Is this someone that you’ve worked with in the past and want to work for in the future? If not, then what can you learn from the experience of others?
- Does this client have the financial resources to accomplish the project?
- Does this client have a history of being fair and reasonable with consultants and with contractors?
- Does this client understand the risks and exposures associated with subsurface projects, and is the client prepared to address those risks and exposures in a fair and equitable manner?

Numerous studies have shown that the answer to many of the above questions is “no.” For instance, developers, homeowners, condominium owners, small municipalities, and school districts have relatively bad reputations as clients. In addition, be suspicious of clients who focus solely on the cost of your services. Good clients recognize that geotechnical services are an essential investment in the success of a project. Good clients will, therefore, support the cost of a geotechnical scope of services that is both adequate and necessary to meet the project’s design requirements. Good clients also value partnering with someone who possesses the adequate knowledge, experience, and judgment (based on real-world project completions) to be working on their projects.

Of course, it is not only the client that must be selected, but also the project. Here, the backgrounds and experience of both the client and your firm come into play. Suppose, for instance, that one of your good clients becomes involved with a project for which it has no prior experience. Clearly, this raises a red flag about that owner’s ability to authorize everything that is required to do a good job. Moreover, if your firm also lacks experience for that type of project, then you may end up with a blind-leading-the-blind situation that is inherently risky and which has a high probability for bad outcomes and unrealized expectations.

The bottom line is that you must be honest about client characteristics and your own experience and capacity for accomplishing a given task. Do not HOPE for a good outcome, because hope is not a plan! Your company should have a well-developed go/no-go decision-making process. Equally important, accept the fact that not every phone call represents a good project opportunity. A good rule-of-thumb is that if you are trying way too hard to make something happen, then JUST STOP — because it is probably not worth it. “Bite the bullet” up front and save yourself many sleepless nights.

**Negotiations**

Contract negotiations can help limit your liability and control your risk exposures. While all contract provisions can be important, the following provisions must be addressed during contract negotiations for geotechnical services:

- **Standard of Care/Negligence** – Geotechnical service contracts should only require performance in accordance with the standard of care of other professionals providing similar services. Professional negligence, by definition, means that your services failed to meet the current state of geotechnical engineering practice in the locale and at the time the services were provided. Contracts that obligate
Geotechnical design professionals acquire liability on a project as a result of disappointed project outcomes and/or unrealized project expectations.

performance to the “highest” standard of care or that assign responsibility for “all” acts and omissions should be avoided. These terms increase your risk and potentially negate your errors and omissions insurance policy.

Insurance Requirements – It is rare for any type of adjudicated settlement to exceed the limits of your professional liability insurance policy. Although it is possible for someone to try to obtain control over your personal assets, that course of action is difficult, expensive, and unlikely to succeed. So, to some degree, insurance limits do, in fact, represent a form of limitation of liability. Therefore, do not provide more insurance in the contract than is commensurate with your level of effort and/or your degree of responsibility for the project outcome.

Duty to Defend – Do not agree to pay to defend anyone associated with your project. The only entity that you are obligated to defend is your own firm and then only for allegations of negligence related to your specific scope of services. Any reference in your contract to a “duty to defend” your client or other parties associated with the project must be rejected.

Flow-Down Requirements – Your best bet, by far, is to sign a contract directly with the project owner. If you do, then there should be no question about your level of responsibility. But, if you do sign a contract with another party such as a design professional or a contractor, then you will likely be asked to assume all of that party’s contractual responsibilities as described in their prime agreement. If that is the case, then you must carefully review the prime agreement and make a conscious decision about how your scope of services relates to those responsibilities.

Indemnification – Unless you agree to a greater degree of indemnification in your contract, you are only required to indemnify your client for your own negligent performance. Therefore, be very careful when reviewing the indemnity obligations in any contract. Additionally, be careful not to assume indemnity obligations as a result of “flow-down” requirements.

Limitation of Liability – Including a Limitation of Liability (LOL) paragraph in your contract is advisable and has been shown to withstand legal challenges in numerous court decisions. However, overly aggressive LOL language that goes so far as to disclaim your own negligence is illegal in some states and could result in the entire clause being declared null and void. Simply establishing the monetary limit of liability for your professional services as described in your scope of services is all that is required. The LOL section of a contract should also be used to include language that limits your responsibility for consequential damages.

Scope of Services
One of the most important parts of a professional services contract is the scope of services, especially because it provides an additional opportunity to limit your liability and control your risk exposure. Despite what is written in the “contract,” the scope of services portion of your contract should explicitly state which professional activities are included and which are not included. For instance, if your firm is asked only to provide design criteria for the finished facility, then both the proposal and the final contract should be emphatic in that regard. The scope of services provided in the contract should also clearly define the subsurface investigation required to accomplish that design in a proper manner. Finally, the scope of services should include a specific list of project deliverables to be provided as part of the contracted services.

In addition to listing and describing the items and deliverables to be provided as part of the contracted services, the scope of services section of a contract should be equally definitive about which items are excluded. For instance, if appropriate, a proposal should exclude responsibility for site safety, for ground contamination, or for locating existing underground utilities. In the absence of such a list, it is easy for a plaintiff’s expert to state that the...
“standard of care” obligated you to perform services that were not proposed and were never intended.

Two items of particular concern in this regard are third-party impacts and construction monitoring. There is a huge difference between a project in the middle of nowhere (a so-called “green” site) and that same project in the center of a major city. If damages occur to nearby existing facilities, then the geotechnical engineer could be blamed for those damages by entities with which he/she does not have a contractual relationship. So when agreeing to work on a project, be highly sensitive to the potential for negative third-party impacts and act accordingly.

An additional item that is commonly included in scopes of services is construction monitoring. All geotechnical engineers know how important it is to have trained professionals in the field observing construction activities. If the client refuses to authorize construction monitoring in the contractual scope of services, then it is important to make clear to that client that he or she is assuming additional risk by excluding those services. Without geotechnical professionals in the field observing construction activities, it is impossible for the geotechnical engineer to avoid negative third-party impacts, to document the occurrence of differing site conditions, and/or to avoid inappropriate construction procedures.

As you can see, a well-prepared scope of services can and should be used to limit your risk exposure. The proposed contractual scope of services should state what will and what will not be performed. Clients who refuse to authorize an adequate scope of services should be avoided.

**Risk Management Culture**

Proactive risk management should be a centerpiece of the corporate culture for all geotechnical engineering firms. For instance, consider designating a specific managing principal like a Risk Management Officer (RMO) who is tasked with reviewing business practices on a regular basis. This individual should be readily available to all project managers for the purpose of evaluating all but the most routine project assignments. In addition, the RMO must be thoroughly versed in all of the latest case histories associated with risk exposure and have ready access to individuals who can assist with risk exposure evaluations. The RMO should also be an educational resource who conducts internal seminars for the purpose of reviewing risk management practices and summarizing problematic case histories so that all staff personnel are fully informed about risk exposures on a regular basis.

When it comes to project assignments, geotechnical engineers must be clear-headed, objective, and proactive. Do not go outside your comfort zone with respect to prospective clients and/or unusual projects. Control your scope of services and have a well-developed go/no-go negotiating strategy for your company. Do not be lulled into a false sense of security about uncomfortable project “opportunities.” Sometimes, the best project decisions you make are those associated with clients and/or projects that you avoid.

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The Trouble with STEM

By John P. Bachner

Let’s talk about science, technology, engineering, and mathematics – STEM – and Presidents Bush’s and Obama’s efforts to make it a national priority. And with good reason: The United States is not graduating enough scientists, technologists, engineers, and mathematicians at a time when the nation’s need for these professionals increases dramatically every day. I’m not in a position to address the shortages associated with STM, but I do have an opinion or two when it comes to E.

First, this thought: Two U.S. presidents have on more than one occasion told the nation about the importance of E. And as proof of the pudding, each has put how many engineers into his cabinet? Not one. And how many engineers have received public attention and praise for their service on the President's Commission to Achieve a Secure Future through Engineering? Not one, because no such commission exists. And how often has a U.S.
president hosted a National Academy of Engineering awards ceremony and insisted that the event be broadcast at least on C-SPAN? Never.

My question: If engineering is so important, why is it that no one important seems to treat it that way? Far more evidently, evidently, is the annual White House Correspondents’ Association Dinner, where politicians and movie stars bask in their own vapid celebrity, and the news media glom onto it like it actually means something.

But let’s get real: It’s not U.S. presidents’ job to carry engineers on their shoulders. Like opportunity, the presidents knocked on the door… but no one answered. It seems to me that engineers by and large prefer to remain in the shadows, out of sight, whispering suggestions about this and opinions about that into the ears of people who have enough courage – or ego – to seek public office. Where are the engineers who seek the spotlight to create the impression that being an engineer is cool; that being an engineer can take you to the most enviable of places? They’re not there, because they’re so few and far between; because STEM initiatives of the last 50 years have failed to attract them to engineering. Why? Because STEM initiatives have focused on the coolness of engineering, not on the coolness of being an engineer.

So far as I can tell, engineering does not now meet young peoples’ definition of cool (or “chill,” as cool is now being called), because the youngsters who seem to like it the most — who are also STEM targets — are not, generally speaking, what most might regard as cool. The cool people — the high-school leaders — don’t do E, and they avoid STM as well. Sure, 20 years after graduating, some of those high-school leaders may be pushing a broom at a Taco Bell, but by then, it’s too late: They’ve lost their chance… and so has engineering. So has the United States, for that matter, because STEM initiatives are designed to attract people who love or learn to love science, technology, engineering, and math. Few of them are part of the nation’s general leadership community.

Not all U.S. engineers get off on engineering, to be sure. Just look at the CEOs of some of the larger U.S. engineering firms. They tend to be gregarious leaders who, for the most part, have attitudes far different from those possessed by those they lead. So, how do we get more folks like that involved in engineering, because — clearly — engineering needs more of them: people who don’t like the shadows; people who respond eagerly to opportunity’s knock; even people who are unafraid to open closed doors and demand that opportunity show itself.

Clearly, we are not going to get more of “them” by telling them as youngsters that engineering is cool, when they believe it isn’t, or that engineers are cool when, for the most part, engineers seem to be in hiding. As such, if the nation is serious about encouraging more STEM involvement, especially among the leadership types who do not respond to current STEM initiatives, it needs to take a different approach. I offer a three-step plan.

**Step one:** Conduct a credible national survey to learn why people become engineers in the first place. While many are attracted by the lure of the technical challenge championed by STEM outreach, my own admittedly limited sampling suggests that many choose an engineering career because someone they loved, respected, or admired growing up was an engineer or was somehow involved in engineering or a related discipline. Assuming that to be the case, we need to get more engineers involved in their communities, especially by working with kids, and not necessarily by telling the kids how great it is to be an engineer. All engineers really need to do is make an effort to be mentors to kids and let the kids know they’re engineers, so those kids come to love, respect, or admire the engineers who teach them about life.

The engineers can surely mention that an engineering degree is more valuable than just about any other, because it’s the only degree that permits a person to do just about anything. They can mention that many engineers do continually less engineering once they achieve a management position, often within five years of starting their engineering careers. And they can tell them how important engineering is; how the seven wonders of the ancient world were each an engineer-led design/build project. And the kids engineers mentor may just be able to teach the engineers a thing or two in return.

**Step two:** Establish a multipronged effort to make engineering cool. TV advertising would be part of it, because TV advertising is so powerful. (For goodness sake, cigarette companies are banned from advertising their products on TV because TV advertising could once again make attractive a habit that everyone knows makes people smell bad and then die.) Who would pay for the ads and the collateral programs, materials, and communication? Uncle Sam, of course, because we’re talking about a

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All engineers really need to do is make an effort to be mentors to kids and let the kids know they’re engineers, so those kids come to love, respect, or admire the engineers who teach them about life.

Step three: Do something to heighten engineers’ knowledge of and appreciation for their own profession. I am so tired of hearing, “I’m just an engineer.” Right: How much more important it is to be a Kardashian. Give me a break! Engineers make the world work. If Earth is capable of supporting life 50 years from now, our progeny will have engineers to thank. When more engineers realize that; when more engineers take pride in the fact that they really are the most important professionals of all, we may kindle new attitudes so powerful, that even the most leadership-averse engineers regard themselves as cool… and when that happens, watch out! The STEM initiative will finally take off.

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Dr. Gabr is the recipient of several teaching, research, and service awards, including the Edmund Friedman Professional Recognition award by ASCE. He currently serves as the editor-in-chief of the *ASCE Journal of Geotechnical and Geoenvironmental Engineering*. In 2000, he was elected as a Fellow of ASCE, and in 2015 was inducted as a Diplomate of the Geo-Institute Academy of Geo-Professionals. He is a registered professional engineer in five states.

Dr. Gabr’s areas of expertise include soil improvement techniques, soil-structure interaction, in-situ testing for characterization of geologic materials, and probabilistic assessment of earth structures’ limit states. Throughout his 24 years of academic career, Professor Gabr has served as chair, co-chair, and primary advisor of 94 graduate students at the master’s and PhD levels.
I believe that certification is a testimony to attaining a unique level of experiential knowledge in our field. When I stand in front of my students in the classroom, or if I’m engaged in a consulting or research project, certification demonstrates to my audience a vote of confidence by my peers regarding the breadth and depth of knowledge of my technical background.

Where did you spend most of your childhood, and what was it like for you growing up there?

I was born in Egypt, on the banks of the Suez Canal in the City of Port Said. My parents hail from this city where they have extensive family. We moved to Cairo two years after I was born, and we lived in an apartment on the banks of the Nile River, which is also about a 10-minute drive from the Great Pyramids of Giza. So, as you can see, I grew up in the shadow of great civil infrastructure. My school years were spent in Cairo, and the summer months were spent in Port Said, mainly in social clubs at the shore of the Mediterranean Sea. We had a multinational group of friends whose families were working for the Suez Canal Company. This was always the best time of the year for me, and from these days, I still remember many colorful phrases in Greek, Italian, French, and Armenian. You can say that in very specific situations, I’m able to speak six languages.

When did you realize that you wanted to study civil engineering?

What were the key factors in your decision to become a civil engineer?

My maternal grandfather was one of the first Egyptian nationals to work for the Suez Canal Company as a mechanical engineer. He was responsible for maintaining the ferry system in the canal. He owned a couple of high-rise buildings in the city, and he converted one of the floors into a well-equipped workshop. At this time, it was all manual tools, as I recall. He liked doing woodwork, and I would help him build various things. He would tell me I needed to become a civil engineer and build a bridge linking the east and west banks of the Suez Canal so he could spend more time on his hobby. Fate was sealed then and, incidentally, such a bridge was built nearly 25 years later, but I had nothing to do with it.

Do you have a message about specialty certification that you’d like professional engineers to be aware of?

I’m an advocate for specialty certification. I also feel that if one is to call herself/himself a geotechnical engineer, for example, then a master’s degree or some other form of formal continuing education is needed. In our program, an undergraduate student typically takes one course in geotechnical engineering. We all know that this was not sufficient 30 years ago, and certainly it is not sufficient today to be given primary responsibility for geotechnical work.

Why are you certified as a D.GE, and what made you choose to become a Diplomate in the Academy?

I believe that certification is a testimony to attaining a unique level of experiential knowledge in our field. When I stand in front of my students in the classroom, or if I’m engaged in a consulting or research project, certification demonstrates to my audience a vote of confidence by my peers regarding the breadth and depth of knowledge of my technical background. This is important for building the initial trust that is needed for credibility, and places my background in perspective for my stakeholders.

What are some of your personal hobbies and interests?

I used to play soccer, but have now switched to squash to lower the probability of injury. I also played guitar in a band while I was an undergraduate student, but now only my wife suffers through it. I love to fish and troll the Gulf Stream every chance I have. For the complete interview, please visit geoprofessionals.org.
G-I ORGANIZATIONAL MEMBER NEWS

Terracon Adds Two Locations in Upper Midwest Region

Terracon, a leading provider of environmental, geotechnical, materials, and facilities services, is pleased to announce the ownership of two soils testing and materials laboratories in the Upper Midwest. The offices, located in Vernon Hills, IL, and Green Bay, WI, were most recently operated by AECOM, and previously owned by STS Consultants, Ltd. Terracon will retain three employees currently working in the offices.

The acquisition allows the company to further expand its services and geographic presence in the region, which includes offices in Naperville and Chicago, IL, and Milwaukee, WI.

“These laboratories have completed testing on thousands of projects, many under the supervision of the former STS Consultants, Ltd.,” says Matt Catlin, PE, division manager of the Naperville/Chicago offices. “Many of these projects were highly complex and included a number of iconic structures. Gaining that experience will help us to provide faster and more cost-effective consulting to our clients.”

The Vernon Hills facility is one of the few commercial laboratories that offers rock mechanics testing capabilities. The laboratory is accredited by the National Voluntary Laboratory Accreditation program (NVLAP), AASHTO Materials Reference Laboratory (AMRL), and is validated with the U.S. Army Corps of Engineers (USACE).

“These two offices have an excellent regional history and reputation,” said David Gaboury, PE, Terracon’s president and chief executive officer. “We are excited to offer our clients solid, experienced services which align seamlessly with our expertise.”

In other news, Terracon acquired Argus Pacific of Seattle. Terracon is retaining Argus Pacific’s 16 employees. Founded in 1997, Argus Pacific offers industrial hygiene consultation and training related to asbestos, lead, mold, hazardous waste, emergency response, and numerous other occupational health and safety topics.

GZA GeoEnvironmental, Inc. announces Promotion and New Hires

GZA GeoEnvironmental, Inc., a leading environmental and geotechnical consulting firm, announces that Matthew Page of Warwick, RI, has been promoted to senior project manager in the Providence office.

Page joined GZA more than 10 years ago after earning his master’s in geotechnical engineering from the University of Rhode Island, where he also received his bachelor’s degree in ocean engineering. A professional engineer in Rhode Island and New York, Page has extensive experience in waterfront and geotechnical engineering. His areas of specialization include subsurface investigations, shallow and deep foundation engineering, earth support structures, waterfront structures, and construction oversight of marine and land based structures.

“I am very pleased to announce Matt’s promotion to senior project manager,” said William Hadge, president and CEO of GZA GeoEnvironmental, Inc. “He’s an outstanding engineer and project manager, and has served our clients successfully on a multitude of challenging projects, both from a technical and logistical standpoint.”

GZA GeoEnvironmental, Inc. announces that Thomas C. Sexton of Scituate, MA, has joined the company as a senior project manager operating from the Norwood and Hingham offices.

Sexton brings more than 30 years of municipal engineering experience, as well as a full range of support services to his post at GZA. He has served as a consultant to municipalities throughout Massachusetts, Rhode Island, and Connecticut.

Sexton’s areas of specialization include water supply and stormwater infrastructure engineering, resource protection, and coastal engineering. He has also provided more than 400 engineering peer reviews of residential, commercial, and industrial developments on behalf of a diverse group of municipalities, agencies, and associations.

“Tom is a great addition to GZA,” said William Hadge, president and CEO of GZA GeoEnvironmental, Inc. “His expertise in the municipal client sector allows us to further expand our relationships and services to cities and towns throughout Southern New England.”

GZA GeoEnvironmental, Inc. announces that Rodney Van Deusen of Fairfield, CT, has been named a senior consultant in the Fairfield office. Van Deusen brings 32 years of construction management and structural design experience with a concentration in waterfront projects to his post at GZA. Prior to joining GZA, he was a senior project manager with ARGE.
Consulting LLC.

In his role as senior consultant, Van Deusen will provide support to architects, contractors, developers, and other professionals in crafting solutions to upgrade and redevelop the coastlines along the Long Island Sound and the rivers that discharge into it.

Van Deusen received a bachelor’s degree in architectural engineering from the Wentworth Institute of Technology. He is a member of the Fairfield Town Facilities Commission and Parks Advisory Group for the Frist Taxing District in Norwalk. He is also a sitting board member for the Cranbury Chapel in Norwalk and is a regional director for PONY Baseball.

Van Deusen has been recognized by the Port Authority of New York and New Jersey, and the New York City Department of Design and Construction for his service after September 11, 2001.

“We are very excited that Rod has decided to join GZA,” said William Hadge, president and CEO of GZA GeoEnvironmental, Inc. “His experience and leadership will be valuable assets to our clients on projects throughout the region, and his technical versatility allows us to continue to expand our engineering services in Connecticut.

Stantec Announces Nashville Principal, Susan Marlow

Susan Marlow has joined Stantec as a principal in the firm’s Nashville, TN office. Marlow brings 25 years of experience as a leading geospatial expert. She is considered a thought leader in the GIS industry, having served on numerous national panels and committees, and testifying before Congress to address geospatial issues.

Marlow will focus on collaborating on GIS-related activities across Stantec’s multifaceted disciplines across 250 offices in the U.S. and Canada. She will enhance the core values of the company by putting people first and bringing teams together.

Marc Pearson, a principal in Stantec’s Nashville office, said, “Susan’s reputation and knowledge are notable. She’s a proven leader in the GIS community, from her experience growing her own geospatial firm, to her current leadership roles in several national organizations. Her resume, skills, and ability to provide clients with cutting-edge information management solutions will grow Stantec’s GIS presence regionally and nationally.”

Marlow’s previous role was founder and CEO of Smart Data Strategies. She attended the University of Tennessee and holds leadership positions in several professional organizations, including Management Association for Private Photogrammetric Surveyors (MAPPS) (president-elect and chairman of the Federal Cadastral Task Force) and the Institute of GIS Studies (chairman).

GeoStabilization Names New Canada Division Operations Manager

Graeme Quickfall, NZCE (Civil), RPSurv, is the new Canada division operations manager for GeoStabilization. Quickfall has worked for more than 30 years in the civil/geotechnical construction industry, including the United Kingdom, Australia, and throughout the Pacific Islands. For the last 17 years, he served as the general manager for a New Zealand leading specialist geotechnical contractor, where he introduced new technologies such as deep soil mixing, mass stabilization, and soil nailing to New Zealand and Australia. Quickfall also helped develop the New Zealand national specification on ground improvement and has received multiple awards from Transit NZ for innovations in roadway landslide repair.

Strata Systems, Inc. Hires Director of Engineering

Strata Systems, Inc., a leading global manufacturer of soil reinforcement products, is pleased to announce that it has hired Michael Bernardi, PE, as its new director of engineering.

With more than 30 years of soil reinforcement experience, Bernardi has been at the center of the mechanically stabilized earth structures industry since its beginnings. He has significantly contributed to industry design manuals, including serving as the primary technical editor for the 3rd Edition of the National Concrete Masonry Association’s “Design Manual for Segmental Retaining Walls.” Additionally, he has designed more than 10 million sq ft of geosynthetically-reinforced retaining walls, steep slopes, and embankments.

Bernardi holds a bachelor's degree in civil engineering and a master’s degree in geotechnical engineering from McGill University, Montreal, Canada. He is a regular participant in industry organizations at the committee, subcommittee and task group levels, and currently serves on the Board of Directors of the North American
Geosynthetics Society. He is also chairman of an ASTM D35 subcommittee on connection testing. During his career, he has helped to establish numerous design standards, developed advanced design software, and has been at the forefront of new product and systems innovation utilizing geosynthetics. He will lead the technical team at Strata USA, as well as participate in technical leadership at Strata India and Geo Solucoes (Strata Brazil).

Schnabel Engineering Welcomes New Associate

Schnabel Engineering, Inc. (Schnabel), Rockville, MD, is pleased to welcome Rabi Shankar Singh Yadava, PhD, PE, PMP, as an associate. Rabi has 18 years of experience in analysis and design of various types of super- and sub-structures. He received his BT in civil engineering at the Indian Institute of Technology along with his master's and his doctorate in structure engineering.

Yadava’s experience includes work from geo-structural engineering, fossil and nuclear power plants, petrochemical complexes, buildings, offshore jacket structures, highway structures, structural condition assessment, and rehabilitation. His expertise ranges from finite element analysis to structural and geotechnical instrumentation and web-based monitoring.

Rabi is the recipient of the "Best Engineering Design Work" awarded by Bechtel for the design of Stacker and Reclaimer Foundation for Millmerran Power Project. He was also awarded the Dr. K.S. Krishnan Fellowship award from the Department of Atomic Energy by the Government of India.

Rabi is a registered professional engineer in Washington DC, Maryland, and Virginia.

Glen Cherry Joins Shannon & Wilson, Inc.

Shannon & Wilson, Inc. is pleased to announce the addition of Glen Cherry as an associate and the manager of business development and marketing activities for the St. Louis office. Bringing valuable marketing and communications experience to the firm, Cherry states, “I am committed to maintaining Shannon & Wilson’s...”
The Geo-Institute Organizational Member Council (OMC) invites your organization to join us. Enjoy the numerous benefits that G-I organizational membership offers, including the following:

• Up to a 50 percent discount on the G-I annual Geo-Congress for one person.

• A 5 percent discount for advertising in GEOSTRATA magazine.

• Forty percent ($400) of your annual G-I OM dues goes directly to fund G-I student activities. A portion of that money finances student travel to the annual Geo-Congress and the OM/Student Career Fair.

• Each year during the annual Geo-Congress, the OMC hosts an OM Career Fair/Reception. Two OM members from each OM firm are invited to participate, along with 45-50 students carefully chosen by the OMC.

• Opportunity to publish news about your company, including awards, new staff and promotions, company projects, awards, etc.

• Your company logo posted on the G-I website at www.asce.org/geotechnical-engineering/organizational-members.

• Your company name listed in Organizational Member News in each issue of GEOSTRATA magazine.

• Opportunity to display the G-I logo on your website and on printed materials.

• Opportunity to display a G-I Organizational Member placard at your exhibit booth.

• For more information, visit the G-I website at www.asce.org/geotechnical-engineering/organizational-members, where you can download the Organizational Membership application.

Please join us at the upcoming standard course in the Boston area (Burlington MA). This three-day course consists of a well-balanced mix of presentations and hands-on PLAXIS 2D sessions. A variety of geo-engineering applications are covered with ample time for evaluating input parameters and results, and discussing other modeling considerations.

Kurt Amidon Joins Subsurface Constructors, Inc.

Subsurface Constructors, Inc. is pleased to announce that Kurt Amidon, PE, has joined its team as business development manager for the Northeast Region and lead of the recently opened office in Massachusetts. The company is very excited about the opportunity to serve its clients with a full-time presence in the Northeast.

Kurt is a professional engineer with a B.S. in civil engineering from Utah State University and an M.S. concentrating on geotechnical engineering from the University of Massachusetts – Amherst. Amidon has more than 18 years of experience as a geotechnical consultant as part of some of the most successful and respected geotechnical firms in New England, including serving as director of the Geotechnical Service for a group of 20 geotechnical engineers for the past few years.

Subsurface Constructors has served the construction industry for more than 100 years in Missouri and adjacent states, bringing innovative, cost-conscious, and practical approaches to design and construction of deep foundations, earth retention systems, and ground improvement. Over the last 10 years, Subsurface has become a leader in ground improvement and has completed over 400 aggregate pier projects in 31 states, including MA, NH, ME, and NY. Subsurface ground improvement systems include aggregate piers (vibro stone columns), vibro concrete columns (VCC), vibro-compaction, and wick drains. Subsurface has evolved over a century from a traditional deep foundation contractor to a full-service geotechnical designer and contractor.
The American Society of Civil Engineers (ASCE) is currently searching for a dynamic, geotechnical or civil engineer to be the staff lead for its Geo-Institute with full responsibility for managing all strategy, operations, activities, and growth.

**RESPONSIBILITIES INCLUDE:**

- Direct and manage overall administrative operations of Institute (manage and develop staff, establish budget, reconcile finances) consistent with the policies of ASCE
- Develop and implement programs in collaboration with Institute leadership and other appropriate elements of the Society including: conferences, publications, standards
- Manage technical, educational, professional and standards activities; facilitate the advancement of Institute committee activities in those areas
- Network with other similarly aligned organizations and identify opportunities to partner with them and respond appropriately to potential challenges
- Respond to various inquiries of Institute membership and determine appropriate resources
- Identify government affairs issues of potential interest to the Institute
- Create, edit, revise detailed or technical letters, reports, proposals, and contracts

**IDEAL CANDIDATES WILL HAVE:**

- A 4-year degree in geotechnical or civil engineering (advanced degree a plus)
- 10-15 years of progressively responsible experience and demonstrated success managing people and programs
- Association management and/or volunteer management experience a plus

ASCE is a nonprofit professional membership association dedicated to the advancement of civil engineering in order to serve the public good. For consideration, submissions of interest must contain resume and cover letter with salary history and requirements.

**To submit resume and cover letter go to:**
https://asce.applicantpro.com/jobs/109684.html

EOE M/F/D/V
Jim Collin to Join G-I Board of Governors

Jim Collin, PhD, PE, D.GE, F.ASCE, will begin a three-year term on the G-I Board of Governors at the close of the October Board meeting. Collin has been a member of the Geo-Institute since its inception and has served as the chair of the Geosynthetics Technical Committee since 2009. He was the recipient of the Wallace Hayward Baker Award in 2010 and was inducted as a Diplomate in Geotechnical Engineering in 2013.

G-I Welcomes New Senior Technical Manager

In May, Michael Koutsourais, PE, became the G-I’s first senior technical manager. His role will be to grow the G-I’s technical offerings by facilitating and developing continuing education programs and by assisting technical committees to develop projects and activities developing their technical areas.

Koutsourais is a professional engineer with 25 years of experience in geotechnical design and construction. He earned his bachelor’s degree in civil engineering from North Carolina State University and his master’s degree from the Georgia Institute of Technology.

Geotechnical & Structural Engineering Congress 2016 Technical Program

The Program Committee for this joint congress of the Geo-Institute and Structural Engineering Institute have completed the technical program. To learn more about the congress or to register, go to: www.geo-structures.org. Technical, business, and professional tracks running throughout the congress include the topics below. Additionally, there will be a “lightning” round featuring many other technical topics.

- Soil-Structure Interaction
- Earth Retaining Structures
- Foundations
- Codes and Buildings
- Business and Professional Practice I and II
- Emerging Topics
- Pavements
- Bridges
- Seismic and Geo-Hazards
- Sustainability and Resilience
- Nonbuilding Structures, Nonstructural Components & Their Foundations
- Site Characterization
- Ground Improvement

New from ASCE Press

Engineering for Sustainable Human Development
A Guide to Successful Small-Scale Community Projects
Bernard Amadei, Ph.D., Dist.M.ASCE, NAE

- Introducing a multidisciplinary approach to sustainable engineering
- Addressing the role of engineering in poverty reduction & human development
- Providing practical guidelines for conducting engineering projects in developing communities

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Click the “Subscribe” button on the www.YouTube/user/GeoInstituteASCE.com
and turn on “get notifications.”

Here are just some of the videos that are now available:

FULL-LENGTH LECTURES
- 2012, 2013, 2014 Peck Lectures
- 2012 & 2013 Seed Lectures
- 2012, 2013, 2014 Terzaghi Lectures
- 2012 Monismith Lecture

WORKSHOPS & SPECIAL PRESENTATIONS
- Ethics Workshop
- Student Professional Development
- Diversity and Inclusion Workshops
- Geotechnical Hero Award & Interview

GEO-CONGRESS HIGHLIGHTS
- 2014 Geo-Congress Highlights
- 2013 Geo-Congress Highlights
- Remember when? Highlights from past Congresses.

The Geo-Channel “Knowledge in Motion”
Become a subscriber today.
Visit the GeoChannel to learn more: YouTube/user/GeoInstituteASCE
Announcing the GBA 2015 Fall Conference

GBA announces the 2015 Fall Conference in Dana Point, CA, October 8-10, 2015. The theme of the conference is “Confronting Risk for Our Firms and Our Clients: The ROI of Engagement.”

Glenn Rix Appointed to Committee on Geological and Geotechnical Engineering
Glenn Rix, PhD, a principal geotechnical engineer with Geosyntec Consultants, has been appointed to the National Research Council’s (NRC) Committee on Geological and Geotechnical Engineering (COGGE). As a focal point within the Board on Earth Sciences and Resources (BESR), the committee’s scope encompasses Earth processes and materials, including the mechanics of rock and soil, and focuses on safe and responsible human development, risk assessment, and mitigation of natural and anthropogenic hazards.

At Geosyntec, Glenn specializes in seismic hazard assessment and mitigation for civil infrastructure projects, including dams, power plants, and ports and harbors, at the component and system scales, as well as advanced near-surface geophysics investigations and interpretations across a range of applications.

University of Florida Commemorates Panama Canal Centennial
The Panama Canal is now on full display at the University of Florida. The University’s Smathers Libraries, which houses the Panama Canal Museum collection, recently constructed the Panama Canal Centennial Trail – a 1/100th scale transit of the canal.

The $15,000 exhibit commemorates the canal’s recent centennial anniversary, as well as showcases the transformational expansion of the channel, which is scheduled for completion in 2016.

A series of seven informational plaques corresponding to landmarks along the channel explain the history, engineering, and construction of the Panama Canal.

To display the length and significant landmarks of the Panama Canal, Frank C. Townsend, FASCE, of Jones Edmunds and a UF professor, suggested bringing the watercourse to life in a small-scale model where visitors can take the trip of ships passing through the channel.

GBA Announces New Executive Director, President, and Secretary/Treasurer
Joel G. Carson has been selected to serve as executive director of the Geoprofessional Business Association (GBA), succeeding John P. Bachner. Bachner’s firm, Bachner Communications, Inc., has managed GBA since May 1973. Bachner has served as GBA’s chief of staff during that span. GBA will become a fully self-managed entity in November 2015. Carson will be tasked with assembling the new management team that he will lead to achieve GBA’s long-term strategic vision.

Laura R. Reinbold, PE (Terracon) is the new president-elect of the Geoprofessional Business Association (GBA), succeeding Joel G. Carson, who resigned the position after being chosen to serve as GBA’s executive director. Charles L. “Charlie” Head, PE, PG (Sanborn, Head & Associates, Inc.) has been named GBA’s new secretary/treasurer, filling the position that Reinbold vacated.
Keynetix and BGS to Develop BIM for the Subsurface

A cloud-based database of U.K. geological and geotechnical data and 3D ground models could soon become a reality, thanks to new research led by geotechnical data company Keynetix and the British Geological Survey (BGS).

"Unforeseen ground conditions continue to be a major cause of project delays and construction programmes overruns," explained Gary Morin, technical director, Keynetix, who is leading the research team. "A big problem is the limited availability of high-quality geotechnical data, which is stored mainly in project archives. If this was publicly-available, construction teams could access better data, site investigations would be more focused, and ground risk would be reduced, saving time and money."

He continued: "Including 3D interpretative models in the cloud will also make it possible to plan investigations in 3D. An added benefit is that the use of geotechnical data in Building Information Modelling should also grow."

"One of the biggest sticking points of incorporating geotechnical data in BIM is that many geotechnical teams are reluctant to share interpreted data with the wider project team, because they are worried it will be misused," Morin said.

"We hope this research will help alleviate those concerns, improving collaboration and data sharing. This will lead to a more complete understanding of the ground, resulting in more informed decision-making throughout the lifetime of a project."

An article about this project will be published in the November/December issue of GEOSTRATA.

DFI Announces Conference Speaker and 2015 Awards

Professor Kenji Ishihara, a world-renowned expert on earthquake geotechnology, will deliver a featured presentation at DFI’s 40th Annual Conference on Deep Foundations, scheduled for October 12-15 in Oakland, CA. It will be titled, “Destruction of Seawalls and Coastal Dikes by Tsunami During the 2011 East-Japan Earthquake and their Restoration.”

Also during the Conference, representatives from T.Y. Lin International/ Moffatt & Nichol Joint Venture will be presented with the 2015 Outstanding Project Award for the San Francisco-Oakland Bay Bridge New East Span.
The 2.2-mile San Francisco-Oakland Bay Bridge New East Span was completed and opened to traffic on September 2, 2013, and carries 300,000 vehicles each day. The East Span is the world’s longest, single-tower, self-anchored suspension span (SAS) and the world’s widest bridge at 259 ft. It is located in a high seismic zone, situated between two major faults that are capable of producing large earthquakes. Anchoring of the SAS tower foundation was accomplished by the T.Y. Lin International/ Moffatt & Nichol Joint Venture using the rock socketing process. The lower, heavily reinforced concrete portion of each pile was cast in rock sockets in bedrock. The upper, permanent steel shell was filled with more heavily reinforced concrete and welded to the concrete-encased steel footing box of the tower foundation at water level. Bay Area geology, which varies along the length of the bridge, also presented immense challenges for the design and construction of the foundations.

In addition, the 2015 C. William Bermingham Innovation Award will be presented to the SFI Joint Venture team, including Shimmick Construction, FCC Construction, and Salini Impregilo, for its Gerald Desmond Bridge “Cast-in-Drilled-Hole (CIDH) Grout Delivery System.”

The innovative design for the bridge foundation used a new grout delivery system that reduced costs and risk. To take into account the design loading of the bridge on active oil-pumping grounds, the team field-designed and tested an innovative Cast-in-Drilled-Hole (CIDH) grout delivery system and grout plate that would be able to utilize the base resistance of the shaft along with the side resistance. The project design required 351 CIDH piles, ranging in size from 5-8 ft in diameter and reaching depths of 102-185 ft. To drill the CIDH piles, the foundation team used casing oscillators and rotators to advance temporary steel casing through the many soil types found at the job site.
Cornell Tech Celebrates Start of Construction on Roosevelt Island

Cornell Tech and partners celebrated the start of construction of the Roosevelt Island campus on June 16, 2015. The first phase of the innovative new campus is scheduled to open in the summer of 2017, combining academia and industry to launch new companies and products.

Cornell Tech is a revolutionary model for graduate tech education, developing pioneering leaders and technologies for the digital age. When fully completed, the campus will span 12 acres on Roosevelt Island and house approximately 2,000 graduate students and hundreds of faculty and staff. Cornell Tech has been up and running since 2013 at a temporary campus at the Google building in Chelsea, and now has nearly 100 graduates.

ASDSO Marks 20th Anniversary of Fatal Virginia Dam Failure

Twenty years ago this past summer, tragedy struck in southwest Virginia when Timberlake Dam failed during an extreme summer rainfall event. On June 22, 1995, between 4:00 pm and 11:00 pm, portions of southwest Virginia received 8.7 to 11 inches of rain, greatly surpassing the six-hour “100-year flood” event total of 4.9 inches. The downpour caused the failure of the Timberlake Dam at 10:30 pm, which released about 528 million gallons of water — enough to fill about 58,000 semi-trailer tanker trucks.

The dam failure took two lives. Rescue worker Carter Martin was swept from a bridge over Buffalo Creek between Bedford and Campbell counties while assisting stranded motorists. The second victim, Doris Stanley, perished after her car was washed from the road between Forest and Richmond.

The dam failure washed out VA-683 in three places and caused extensive damage to three properties along Troublesome Creek near Evington. Workers at Georgia Pacific’s Big Island paper mill scrambled to save equipment as floodwaters encroached, but most businesses in the floodpath sustained only low to moderate damage.

The dam failure raised questions about the safety regulation of Virginia’s dams. The Virginia Division of Dam Safety and Floodplain Management had determined that the dam did not meet modern safety standards. Although the dam was subject to an annual inspection, the State lacked authority at that time to require upgrades to the dam as an exemption was in place for dams built prior to promulgation of some dam safety laws. That specific exemption in the law is no longer in place.

“The 20th anniversary of the Timberlake failure serves as a reminder of the importance of stringent safety regulations for dams,” said Lori Spragens, executive director of the Association of State Dam Safety Officials (ASDSO). “The failure provides a clear example of the need for all dams to meet current design and safety requirements, regardless of when they were constructed. Inspections alone do not make dams safe. It is essential that regulators charged with ensuring public safety have the necessary authorities in place.”
COREBITS CAREER

ASCE/G-I Co-Sponsored Online Webinars
Note: All posted webinars offer 1.5 professional development hours (PDHs).

- Load and Resistance Factor Design (LRFD) for Geotechnical Engineering Features: Deep Foundations: Lateral Analysis
  September 14, 2015, 11:30 AM – 1:00 PM (ET)
- Earthwork 101
  September 17, 2015, 12:00 PM – 1:00 PM (ET)
- NEW – Tactical Asset Management Plans
  September 21, 2015, 11:30 AM – 1:00 PM (ET)
- Geosynthetic Reinforced Mechanically Stabilized Earth Walls
  September 24, 2015, 11:30 AM – 1:00 PM (ET)

OR, CONSIDER BROADENING YOUR HORIZONS!

- The Five Habits of Highly-Effective Marketers
  September 1, 2015, 11:30 AM – 1:00 PM (ET)
- Verification of Computer Calculations by Approximate Methods
  September 16, 2015, 11:30 AM – 1:00 PM (ET)
- NEW – Engineer Your Goals: Three Steps to Setting Clear Goals that Will Give You an Engineering Career and Life Plan
  September 30, 2015, 12:00 PM – 1:00 PM (ET)

Internships Available
Are you looking for an internship? Explore the positions listed on the ASCE website to help you obtain the experience you need to further your career path. New opportunities are added all the time, so start your search today: careers.asce.org/jobs.

ASCE/G-I Seminars
Note: All posted seminars offer continuing education units (CEUs).

- Design and Installation of Buried Pipes
  September 10–11, 2015, San Diego, CA
- Seismic Hazard Evaluation and Mitigation Using Simple Methods
  September 10–11, 2015, Secaucus, NJ
  December 5–6, 2015, Long Beach, CA
  September 21–22, 2015, Las Vegas, NV
  December 10–11, 2015, Scottsdale, AZ
- Dam Breach Analysis Using HEC-RAS
  September 23–25, 2015, Itasca, IL
- Earthquake-Induced Ground Motions
  September 24–25, 2015, Las Vegas, NV
  December 5–6, 2015, Chicago Metro Area, IL
- Soil and Rock Slope Stability
  September 24–25, 2015, Las Vegas, NV
  November 5–6, 2015, Seattle, WA
- Deep Foundations: Design, Construction, and Quality Control
  November 19–20, 2015, Boston Metro Area, MA
- Instrumentation and Monitoring Bootcamp: Planning, Execution, and Measurement Uncertainty for Structural and Geotechnical Construction Projects
  December 5–6, 2015, Washington, DC

For more information about webinars, seminars, and on-demand learning, visit the ASCE Continuing Education website: www.asce.org/continuing_education.

COREBITS CHAPTERS

The Florida Section Annual Conference, held from July 16–18, presented a geotechnical tract at the ASCE event in Orlando. The Geotechnical Tract included a panel discussion on “The Role of the Geotechnical Engineer on Design/Build,” as well as lectures entitled “Determination of Unknown Foundation Lengths for Bridges Using Parallel Seismic Testing” and “Deep Cutoff Wall Construction in an Active Fragile Dam.”

The Georgia G-I Chapter was active at the May 28th Georgia Engineers’ Summer Conference, where an “Introduction to Geosynthetics for Civil Engineering Construction Applications” seminar was presented.

The St. Louis Chapter of the Geo-Institute is finalizing the planning for its annual GeoConfluence Conference, to be held November 6, 2015, at the St. Charles Convention Center, MO. Jointly hosted by the ASCE St. Louis Chapter of the Geo-Institute, the University of Missouri-Columbia, and the Missouri University of Science and Technology, this one-day conference will focus on geotechnical engineering and geo-environmental topics and case histories.

The East Central Florida Branch (Orlando) has resurfaced as a viable active branch, with monthly technical lunch meetings in April (MERIT Geophysical Testing Technology), June (Press-In Piling Methods), July (High Rebound Soils Based on CPT Data), and August (Helical Piles).
INDUSTRY CALENDAR

14th Multidisciplinary Conference on Sinkholes and the Engineering and Environmental Impacts of Karst
October 5-9, 2015
Rochester, MN
sinkholeconference.com

28th Central Pennsylvania Geotechnical Conference
November 4-6, 2015
Hershey, PA
central-pa-asce-geotech.org

Geotechnical & Structural Engineering Congress 2016
February 14-17, 2016
Phoenix, AZ
geo-structures.org

Geo-Chicago 2016: Sustainability, Energy and the Geoenvironment
August 14-18, 2016
Chicago, IL
goenvironmentconference.org

4th GeoChina International Conference
July 25-27, 2016
Shandong, China
gochina2016.geoconf.org

Geotechnical Frontiers
March 12-15, 2017
Orlando, FL
gotechnicalfrontiers.com

For more seminar information:
www.asce.org/Continuing-Education/Seminars/Face-to-Face-Seminars
Geo-Mélange

As a good geotech, I try to respect
All soils equally,
Regardless of their unit weight,
Shear strength, plasticity.
But when faced with mixed grain sizes
I will sigh in great dismay,
For there’s nothing more confounding
Than soil with 40 percent clay.

The primary dilemma:
What samples should I take?
Should I bother with my Shelby tubes
Or will the soil structure break?
It’s likely I’ll be stuck with split spoon
Samples stuffed in jars.
Gradation tests and N-values
Will take me just so far.
(Enter here the expert
Who says each soil property
Could be obtained without a sample!
Just perform some CPTs.)

But I digress. I study limits,
Water contents, percent fines
To correlate with things like
Unit weights and drainage times.
Relationships exist,
But the big question remains:
How to represent the shear strength,
For the short-term case, and drained?

For my trusty correlations
With N-values crumble when
The clayey matrix dominates.
What’s the phi-prime then?
Do I use the plastic index,
Pretend that all the grains are clay,
Regardless of the sand
That is surely in the way?

I guess I’ll be conservative
And choose the lower one,
Then fret over each and every
Analysis I run.
When the safety factors all turn out to be
One-tenth too low.
Maybe ninety pounds per square foot
Was the better way to go?

By the time I get to undrained strength
I just throw up my hands.
Whatever Dr. Peck suggests
Will be my final plan...
Blowcounts over eight, in ksf
Sounds fairly sane,
Ignoring any friction
Between the sandy grains.

With every soil, it’s a challenge
To select your properties
Using judgment, taking risks
To just the right degree.
But these widely-graded mixes fall
In an area so gray
I must admit I’d favor
Just a sand, or just a clay.

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The flexible, high-strength Fortrac® geogrid boasts a 20-year-plus track record in soil reinforcement applications. The geogrids are made from high-modulus, low-creep synthetic materials enclosed in a protective polymer coating. Moreover, they are manufactured in such a way as to guarantee high stability at the intersections.

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<th>Excellent long-term performance</th>
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<td>Simple installation</td>
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