



# ON SOLID GROUND



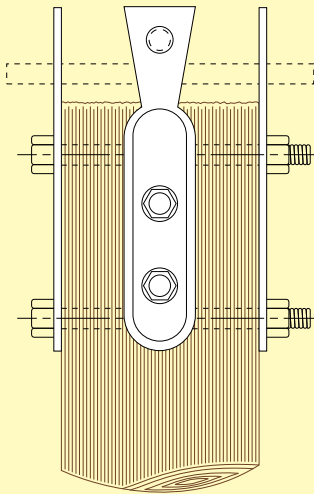
By Lisa Gordon

**P**rofessor Magued Iskander has always been excited by scientific discovery and its potential to impact engineering practice.

As a geotechnical engineering educator and Chair of the Civil & Urban Engineering Department at the New York University Tandon School of Engineering, he has made a name for himself during an accomplished career that spans more than 25 years.

In particular, Iskander, 54, is recognized for his teaching, research and consulting in the analysis, design and construction of deep foundations. His geotechnical research has been accepted as the leading authority in the use of recycled polymeric piling as a replacement for conventional piling, especially in waterfront environments, as well as physical modelling of soil-structure interaction using transparent soils.

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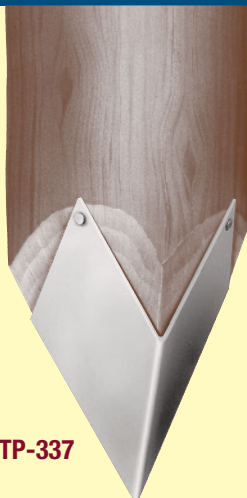
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Torpedo anchor after installation in a transparent soil model.

He has authored five books, edited 11 books and published more than 175 papers and reports, including over 80 journal articles covering a range of geotechnical subjects. Born in Egypt, Iskander got his start in that country's air force, where he supervised the construction of roads, runways and reinforced concrete structures.

"I became a civil engineer shortly after being drafted into the Egyptian armed forces, where I supervised the construction of 73 buildings comprising a beach front recreational resort for the Air Force, including a house for President Mubarak," he said. "Then, I started my master's degree over there and I was exposed to geotechnical engineering and research on slope stability. I went to work at my master's advisor's consulting firm, where I started as a structural engineer. After designing a few tall buildings, I quickly became disenchanted by the monotony of following the structural code, so he advised that I should switch to the geotechnical division. I realized I enjoyed the consulting business and I decided to pursue a PhD so that I could practice at the highest level."

As a doctoral student at the University of Texas at Austin, Iskander was fortunate to work with some of the giants of the foundation engineering world, including Roy Olson, his doctoral advisor. His dissertation committee also included Lymon C. Reese, well known in the field of lateral capacity of piles, and Don Murff, who played a key leadership role in writing the API pile design standard.

"My doctoral research dealt with the axial capacity of pipe piles," he said. "I was the first to demonstrate that when you drive a pile into sand, it creates a mini earthquake that generates a bit of pore water pressure that reduces the strength of the soil and causes the pile to advance faster. That mechanism is well understood in clay and is credited with pile setup, but I was the first to show that setup also occurs in sand, albeit at a much faster rate."



Plastic piling at Iskander's research site.

Also, with Olson, Iskander worked on comparing measured and predicted pile capacities, and helped him formulate design approaches and later improve the design parameters.

"Following my doctoral degree, I recognized the limitations of existing knowledge, so I chose a career in academia," said Iskander.

He went to Polytechnic University, which has since merged with New York University (NYU), and has been there for 23 years. His earlier research at Polytechnic focused on piling made from recycled polymers, evaluating its durability, driveability, capacity, creep and load testing, among other characteristics.

Today, Iskander is focused on visualizing soil behavior and soil-structure interaction in a range of important applications. "We do this in a number of ways; for example, you can drive a pile next to a glass wall and track the motion of individual soil particles. But mostly, we've been using synthetic soils made of transparent substances that behave at the macroscopic level like natural soils. Snow is white, but it's made of water, which is transparent. But snow is white because it's full of air and air refracts light differently.

"If I am able to fill in between the particles with a liquid that has the same refractive index, then I can see through the material," he said. "I can now study flow; I can show you how contaminants travel in soils. For example, the effects of viscosity, velocity and gradient on in situ remediation can be studied. I can also shine a laser through a lens and make it a sheet of light. When the laser sheet interacts with the soil, it produces a speckle pattern. You can see and measure its displacements with a camera. Once you have the displacements, you can compute local strains. These techniques empower us to study the stress distribution around piles and other structures. My students wrote an open source software called MAGICgeo that allows interested researchers to achieve some of these tasks. You can download MAGICgeo from our website."

Iskander and his graduate students have also conducted research for the U.S. Department of Defense, examining how

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projectiles – as fast-moving objects – travel through soil. Most recently, they focused on modeling the behavior of torpedo anchors used for tethering offshore oil platforms in deep waters, using transparent soils.

In the last few years, Iskander returned to an area that he explored decades ago during his doctoral work, but with a twist. Together with his students, he is adapting methods from computer science for predicting pile capacity. They hope to employ artificial intelligence (AI) to better predict the capacity of driven piles.

“It’s still preliminary, but we have created a Pile Capacity Data Warehouse by importing several databases of pile load tests and associated soil information into a state-of-the-art relational database that can be queried, similar to an airline reservation system. We have also programmed the most widely used pile design methods. Currently, we are exploring how various popular design standards perform against load test data by using several advanced data analytics techniques. In the next few years, we will look into AI approaches to improve established design methods, but also predict the capacity of piles using AI rather than calculating it using conventional approaches.”

Iskander has also done noteworthy research on earth pressure against rigidly framed earth structures, nondestructive testing of drilled shafts and seismic earth pressure. Notably, an interactive online seismic earth pressure calculator that he developed with students can be used to compute earth pressure during an earthquake for a variety of frictional or cohesive backfill, considering wall inclination, backfill slope, ground water and layered systems.

While Iskander teaches mostly at the graduate level, he also instructs undergraduates in soil mechanics and foundation engineering.

“I teach two courses with some regularity: Instrumentation Monitoring and Condition Assessment of Structures, which introduces students to the various sensors used to monitor foundations and structures. I also teach Advanced Foundation Design. About 25 percent of that course deals with shallow foundations and 75 percent with deep foundations, with piles representing about a third of the course. It’s probably one of the most comprehensive deep foundation courses out there, at least in the U.S.”

An abridged version of Iskander’s instrumentation course is offered as a continuing education course. His ASCE Instrumentation and Monitoring Boot Camp and other continuing education courses have been taken by over 600 practicing engineers.

As Chair of the Civil & Urban Engineering Department, Iskander oversees over 20 full-time and 50 adjunct faculty members and a number of staff and graduate student employees.

The department is a thriving organization that carries out \$3 to \$5 million of research annually. It is home to a total of 550 students, studying in a variety of civil, construction, transportation or environmental fields and has an annual operating budget of just over \$5 million, in addition to research expenditures.

Iskander’s time is divided between teaching, research and administration – although he joked that administrative duties tend to absorb more than their fair share of the day.

Paperwork is not the most rewarding part of his job. Iskander saves that accolade for working with young people, including elementary school students who have been involved in the NYU Tandon School of Engineering K-12 STEM (science, technology, engineering and mathematics) outreach program.

“Our first idea was to introduce some of the modern sensors that engineers use to high school physics, chemistry and biology

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labs because students don't see the connection between modern tools, such as cell phones and gaming platforms, and the science and math they take in high school," he said.

"We wanted to excite K-12 students by making science more 'techy' and we used sensors, similar to those used by engineers, to inspire K-12 students about science. After finishing our first project, funded by the National Science Foundation and a number of philanthropic organizations, we realized that by the time students reach high school, they will have already formed a self-image with respect to their STEM abilities. We went down two steps and started as early as the second grade to spark their interest in STEM early on. For example, we did authentic geotechnical engineering in a second-grade classroom."

Iskander explained that the program seeks out schools where kids don't necessarily have a lot of opportunities.

"We find that their self-image changes quite a bit over the year. When we measure their improvement in terms of participation in and grades on standardized exams, we do see a perceptible increase in performance."

Teachers are now being trained to incorporate these lessons in their classrooms. "If we train 25 teachers a year and each is working with a minimum of 50 kids per year, that's a very large impact."

The program also takes in highly recommended high school students and puts them in labs, where they work as apprentices under doctoral students.

"Some of the work is breadth, where we reach a large number of students, and some of the work is depth with really talented students."

Iskander has been an active member of the American Society of Civil Engineers (ASCE) Geo-Institute Deep Foundations



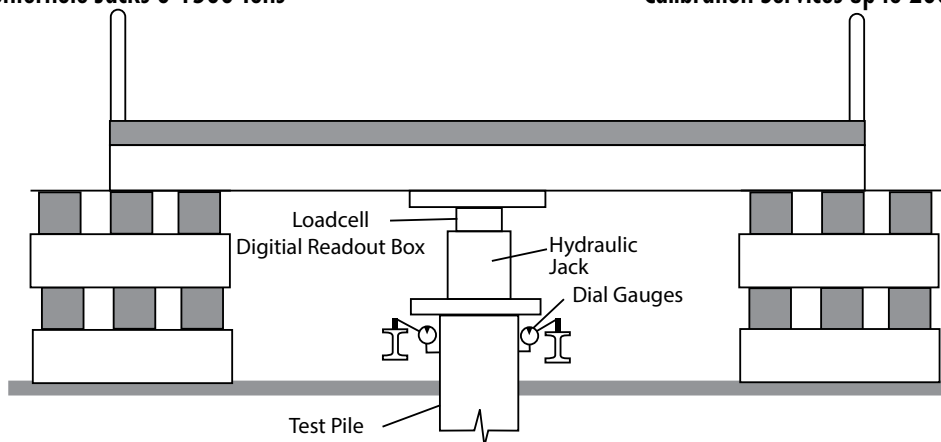
Second graders conducting a permeability experiment.

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**“I am very proud of all the students we graduate at NYU; they end up with a good balance of theory and practical skills that gives them a competitive advantage.”**

*– Professor Magued Iskander*



Committee for over 20 years, contributing to the association in several ways, including editing the proceedings of two International Foundation Congress and Equipment Expos (IFCEE) in 2009 and 2015, which were conducted in collaboration with PDCA, as well as other professional foundations groups.

Iskander has also received a number of teaching awards, including Chi Epsilon James Robbins District Excellence in Teaching Award (2000), Polytechnic University Distinguished Teacher Award (2002) and Jacobs Excellence in Education Award

(2006, 2009). He also received the National Science Foundation CAREER Award. Iskander graduated 12 doctoral and 35 master’s students. He has also served on the dissertation committees of 21 doctoral candidates from four universities. He is presently working with four doctoral students at NYU.

“I am very proud of all the students we graduate at NYU; they end up with a good balance of theory and practical skills that gives them a competitive advantage. Our alumni have succeeded immensely, which is very gratifying,” he said. ▼

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