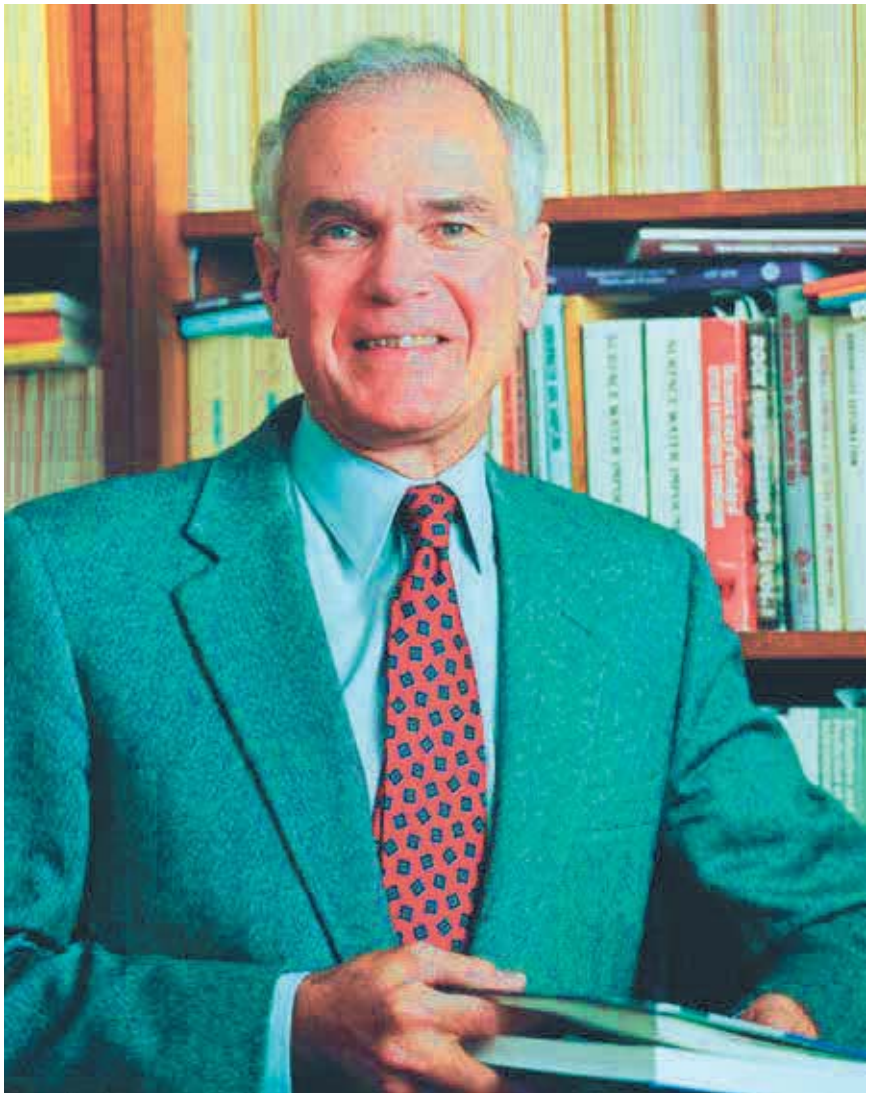
Norbert R. Morgenstern, PhD, PEng, FCAE, NAE, F.ASCE

By Shelley L. Rodriguez, S.M.ASCE, and John Stapleton, EIT, S.M.ASCE



Norbert R. Morgenstern. (Photo courtesy of the Alberta Order of Excellence.)

Norbert R. Morgenstern is a distinguished civil and geotechnical engineer. He has received some of the highest honors in his field, including the Walter Huber Engineering Research Prize (1971), the Terzaghi Lecture (1992) and the Seed Medal (2011) (both from ASCE), the Rankine Lecture (1981) from the British Geotechnical Society, the Legget Medal, the highest award of the Canadian Geotechnical Society (1979), and election as a foreign associate to the U.S. National Academy of Engineering (1992). He has helped agencies and owners all over the world to design dams subjected to difficult conditions and to evaluate and remediate slopes subjected to landsliding. For the latter, he is recognized as "Mr. Landslide" in Hong Kong.

Morgenstern was born in Toronto, Ontario, Canada. He graduated from the University of Toronto in 1956 with a bachelor of applied science degree in civil engineering. He was awarded the Athlone Fellowship for post-graduate studies in the United Kingdom and departed for London to study soil mechanics at the Imperial College of Science and Technology at the University of London. He received his PhD in soil mechanics from that institution in 1964. He soon advanced to a faculty member, starting as research assistant in 1958 and then lecturer two years later. He stayed

at the Imperial College for another eight years, teaching, researching, and sharpening the skills that would eventually lead to an outstanding career as a consultant in applied earth science.

Morgenstern returned to Canada in 1968 as a professor of civil engineering at the University of Alberta, where he taught and supervised many graduate students until 1994. Although currently retired from active teaching, he continues to stay involved in the geotechnical graduate and research programs at the University. His former colleagues and students remember him as a great teacher who was always available, and always ready to listen and help.

Q: How did you first discover your interest in soil mechanics?

I was earning my undergraduate degree in civil engineering at the University of Toronto. I hated it because much of civil engineering at that time was dominated by structural engineering and steel design, which was based on a lot of handbook work with detailed stuff like designing riveted connections. I wondered how I would get out of civil engineering. Between my third and fourth year, I was working as a construction engineer on a large hospital project in Northern Ontario during the long summer vacation. It was primarily survey work. I would go to the local library to get some books to read, and on one occasion I came across a book called *Foundation Engineering* by Peck, Hanson, and Thornburn. I thought, "Wow! This is engineering, and it has geology in it!" I really liked geology. Because I was anxious to get away from structural engineering, that book encouraged me when I went back for my final year. We took soil mechanics and foundation engineering that year, which allowed me to develop my passion. I also did a little extra work in the laboratory that strengthened my interest in the connection between geology and civil engineering. It was all, shall I say, fortuitous, having had good luck in the library on a summer vacation!

Q: Which lessons did you learn as a student that most directly influenced your success? As a professional?

That came at the graduate-school level because I went off to the Imperial College of Science in London for my graduate degree. I was much influenced at that time by Alan Bishop, one of the leaders of the graduate program in soil mechanics. Also, when I joined the staff as a research assistant, I shared an office with Bob Gibson, who went on to make enormous contributions to consolidation theory.

What struck me at that time was the enthusiasm of all the senior people that I encountered. There were remarkable conversations among all of our mentors. Everybody came to work with a sense of joy in the morning; clearly they felt they were breaking new ground – whether it was in teaching, research, or an interesting consulting project. They would share their enthusiasm with all of us over coffee in the lab in the morning. There was a sort of joy about our activities that differed enormously from my vision of the horror of being a structural detailer in a long row of drawing boards. That was the environment I matured in. I felt a special pleasure when integrating our geological world with our more geomechanical world and putting it to practice. Those things have lingered with me through my career: the pleasures we had with the subject and the opportunity to work with the complexity of nature and the productivity of engineering performance.

Delivering the Presidential Address at the 13th International Conference on Soil Mechanics and Foundation Engineering in New Delhi, India, January 1994. (Photo: Taylor and Francis, *Proceedings XIII ISSMFE*, Vol. 6.)

Q: How did you discover your research interest? What made you want to get into slope stability research or learn about dams?

That again was very much Alan Bishop. I was looking for a research topic, and the Bishop slip circle analysis was new and making its impact in practice. In fact, the whole concept of effective stress analysis, which we take for granted now, was just making its impact in practice. There was

Delivering the H. Bolton Seed Lecture, "Risk and Reward — Geotechnical Engineering and the Alberta Oil Sands," at Geo-Frontiers 2011 in Dallas, TX.

Morgenstern chaired the Independent Expert Engineering Investigation and Review Panel for the Mount Polley tailings storage facility after the August 4, 2014, failure in British Columbia. (Photo: Reuters.)

a need to go beyond the limitations of the slip circle. It was driven very much by guidance from Bishop, who had been developing work on expansions to the Bishop Method. He was my mentor and my supervisor. Another interesting challenge at the time was to develop computer programs for what we did. Those were pioneering days. It was computing originally with machine language and things like that, all well before we had the easy coding systems that we have today.

Q: What advice would you give to someone who is currently doing research?

I believe that passion should dominate things you want to do. It's much more important to love the field you're in rather than do something just because you're directed to do it, or doing it because the money is good. There's no question that curiosity is the key and sparks all the work you do in geotechnical engineering research. Curiosity is where the passion comes from. That's the very critical issue. I think that all the people who have been interviewed for this GeoLegend series reflect a curious mind and passion. Anybody who has that is blessed.

Q: How important are graduate studies and research in becoming a geotechnical engineer?

It depends on where one goes as a geotechnical engineer; if you're going into design in the consulting world, it's absolutely essential. I've often thought it useful to come back and get the graduate degree after a year or two of practice, because you can then

make choices about what you care about, but that's not always necessary. If you are heading toward earthwork construction, then the specialization of the geotechnical degree is perhaps not so critical. I can't think of any leader in geotechnical practice today who hasn't gotten a graduate degree at one time or another. It doesn't need to be a PhD, of course, but a good master's degree will often suffice.

Q: Do you believe that today's universities place enough emphasis on fundamentals?

It's difficult to have a whole lot of material in the undergraduate program because the scope of the subject is now so diverse – slope stability, rock mechanics, engineering geology, computation, geomechanics, and all of that. I think an undergraduate program should provide grounding, principles, and an interest for the future. But you can't expect to come out of an undergraduate program and instantly have confidence for the workplace. Ultimately, that confidence will come at the graduate level after being coupled with some practice. When I review undergraduate academic programs, I look for their clarity of principles. What are they? Why are they important? The other essential is enthusiasm! Try to maintain a connection with geology like we do at the University of Alberta. Without that fundamental, you don't have the tools to deal with the complexity of the geological world. But that's hard to get because undergraduate programs are limited in this regard.

Q: What advice do you have for young geotechnical engineers?

First, get a mentor – there's no question about that. But you want to make sure that the environment at your first job doesn't consume you with routine work. To get from where you are now to a successful career, it's important to place great emphasis on the mentoring environment. After all, we can all learn a lot from each other.

Visit to field site in northern Alberta oil sands with former students and colleagues. From l to r: John Sobkowicz, Ed McRoberts, Norbert Morgenstern, and James Obermeyer. (Photo courtesy of John Sobkowicz.)

Q: How did your research interest change over time?

I lived in England for about 12 years when I was at Imperial College. My research interests were mainly analytical and computational at that time. Then, after engaging in some consulting work, I became interested in more diverse problems of dam design. When I returned to Canada, I encountered areas that had not been adequately researched before, such as permafrost engineering for arctic development, unsaturated soil mechanics, and mining geotechnics. I was able to build on many challenging regional problems. Moreover, working on research areas provided me access to interesting projects and people who were doing interesting practical work themselves. These relationships have always offered very good synergy in that regard here at the University of Alberta.

Q: If you want to be a professor, is it important to have some practical work experience in the profession?

Yes. There's no question that if you want to discover the important problems, it's hard to find them in a purely academic environment. How you get that experience is a critical issue in the early stages of your academic career. Young professors are often pressured to publish and things like that, which can interfere with getting experience. It's a difficult challenge to resolve, but without it, you'll miss out on opportunities to enrich your teaching and mentoring students.

Authors Shelley L. Rodriguez and John Stapleton.

A 2010 photo of Morgenstern with his wife, Patty, and Paul Mayne in Vancouver, British Columbia. (Photo courtesy of Paul Mayne.)

Q: During your career, which project was most challenging?

I've been very fortunate. In the 1970s and 1980s, I worked in the Arctic. Permafrost engineering was an area of great challenges and opportunities, and interesting projects. I've also been engaged for several decades in the development of the Alberta oil sands, which have posed major geological, hydrogeological, geotechnical, stability, and environmental questions. This work has been a source of great satisfaction for me. More recently, much of my academic and professional practice has focused on tailing dams in the mining industry. In all, my greatest satisfactions have been tied to the extractive industries – oil and gas, mining, and so on.

Q: Is there an area of geotechnical engineering that needs more research?

There's a reassessment of risks that will require more thought. For years we have used the observational method to overcome the many uncertainties we face in geotechnical practice, but that's not enough. We must improve our awareness of where uncertainty comes from and how it can be managed safely. It's something I spend a lot of time thinking about. Our understanding and quantification of risk and its management will be aided by ever-improving analytical tools, but it's clearly important to understand the sources of uncertainty in a sufficiently detailed manner.

As a profession, we are involved in a riskier part of engineering than many other fields. I've investigated some major failures in the last few years, and I've found the experience discouraging. I'm quite concerned about our sometimes limited understanding of the risk involved in some of our major projects, coupled with the very substantial responsibilities that we unknowingly take.

Q: What's the future of geotechnical engineering?

There are certainly lots of interesting new tools emerging that relate to advancing our computational abilities and our monitoring of performance. I see a coupling of these two things for real-time optimization of the design, construction, and operation of projects as being very exciting developments that are coming along quickly. These new tools will integrate total project inputs, from site characterization, formulation of material behavior, design criteria, safety assessment, and so on. It will all be very exciting, but will require high levels of education, training, and practice.

Q: What's your best achievement?

My best achievement is my students. I get enormous pleasure out of the success of the many bright and talented students that I've had the pleasure to work with. As an aging professor, to keep running into the success of enthusiastic students is a lasting pleasure for me. GS

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