

THE GEOTECH EVOLUTION

CTL | THOMPSON VICE PRESIDENT MARC CLEVELAND, P.E., AND
FOUNDER BOB THOMPSON, P.E., REFLECT ON 45 YEARS IN THE FIELD.

WHEN BOB THOMPSON, P.E., founded his Denver-based geotechnical engineering firm in 1971, his wife typed up client reports on onionskin with carbon paper using a manual typewriter. Reporting techniques are not the only thing that has changed in the last four and a half decades, and Thompson has been at the forefront of the evolution. Together with his team, he has changed the science of geotechnical engineering in the West, creating a sound foundation for Colorado's explosive growth while mitigating its negative impacts.

Thompson was fortunate to learn from Fu Hua Chen, one of the first engineers to identify expansive soil and its effects during his work on China's Burma Road. Chen was attracted to Denver because of its unique geological conditions — including expansive soils, hidden mines, and dipping bedrock, which can wreak havoc for developers and builders but present an interesting challenge for an ambitious engineer.

Armed with his natural curiosity and a solid foundation of knowledge from Chen, Thompson built what is now Denver's largest geotechnical firm, including one of the only commercial testing labs in the country with unique fly ash and cement analysis and expertise. Over the years, he and his team contributed many of the techniques and construction detailing used today to minimize risk and movement to both residential and commercial structures. Because of his commitment to peer engagement, Thompson also set a consistent standard of practice for engineers practicing in Colorado. These standards raised the overall quality of work and fortified the industry against legal action.

Thompson recently sat down with his longtime colleague, Marc Cleveland, P.E., CTL/Thompson vice president, to discuss his history in the field and what he sees in its future. The two men have worked together since 1975 when Cleveland, still in college, started working for Thompson as a lab/field technician.

Cleveland: *What do you think has been the most impactful change in geotechnical engineering over the last half-century?*

Thompson: In the Rocky Mountain West, the most impactful changes are the advanced testing methodologies and mitigation techniques developed to build in expansive soils. We have a better understanding of depth of wetting, which assists in our estimate and prediction of heave



CTL|Thompson turned a brownfield site littered with environmental hazards and detritus into developable land that now holds Metro State College of Denver's Student Success Building, part of CTL's three-phase brownfield project for Denver's Auraria Campus.

— and because we have better testing results, we can provide more alternatives for mitigating the expansive soil conditions. The overall result is better long-term performance of structures.

Cleveland: *What impact have these changes had on the engineering community and the public?*

Thompson: These advances in testing and soil mitigation have allowed for development in high-risk areas that developers previously would avoid. This development has enabled Denver to grow and become the vibrant region it is today.

For example, in the 1970s and 1980s, residential building just west of Denver in the foothills of the Front Range was severely limited due to the region's expansive soil and dipping bedrock. These issues were resolved in the mid-1990s when we developed deep sub-excavation techniques to mitigate the expansive soils and steeply dipping bedrock,



opening up acres and acres for both residential and commercial development.

Back in the early days of the housing boom, homes built in and around Denver were constructed using drilled pier foundations with slab-on-grade in basements and sometimes in lower-level living areas. This was especially true in the garden level of a bi-level or tri-level residence, which was a popular floor plan at the time. Structural floor systems were used for high-traffic living areas. Though the building systems and floor plans were common, the area's expansive soil conditions led to cracked foundations and poor floor slab performance.

Today, with expansive soil mitigation, we can use a shallow foundation (spread footing or post-tensioned slab), rather than a deep foundation. In addition, slab-on-grade can be

During work on the 31-story One Lincoln Park condominium tower at 20th and Lincoln streets, fuel tanks were found buried on the site. CTL|Thompson recommended abatement strategies and now the iconic tower houses some of the hottest condos on the market.



CTL|Thompson was hired to manage much of the ground work for Gaylord's initial construction phase, but after concrete trucks sunk causing construction delays, the team shored up the ground with chemical stabilization, a solution usually used on permanent roads.

CTL|Thompson is constructing the foundation for Denver's newest office tower, called 1144 Fifteenth. The 42-floor, LEED Gold-certified building is being built on a block that formerly housed a fueling station, nine-story bank, and streetcar loop.

used in basement areas with a low risk of undesirable movement and cracking — far less expensive for the homebuilder and more convenient, safer, and less expensive for the homeowner and those who underwrite the home warranties.

I'd say another impactful change has been brought to our industry by the progression of computers and instantaneous electronic communication. Geotechnical engineering is a science that evaluates materials formed by nature, which are variable. It takes time to properly evaluate conditions for a site, but clients are under much tighter deadlines, causing them to put time pressures on our teams. While our work is very systematic, sound solutions require the thought of highly experienced engineers. Sadly, this creative element is often cut in the time crunch, as is a deeper understanding of both the client and the project. I think we may develop fewer industry-changing solutions because we have lost the time to think.

Cleveland: As geotechnical engineering practices were evolving, you joined forces with a few like-minded colleagues to solve some of our bigger problems, ultimately creating the Colorado Association of Geotechnical Engineers (CAGE). What has been the value of this group?

Thompson: I thought it made sense for firms to put down their competitive swords and work together to tackle the myriad issues facing the industry. In the 1990s, developers, builders, and engineers in Colorado were under considerable pressure — the market was demanding growth, but developing on shaky ground led to lawsuits and legislation. The only way I knew how to tackle these issues was to share our experience and work together to address the business and engineering issues facing the region. I had seen CalGeo, the California Geotechnical Engineering Association, do great work, and they agreed to help us develop a similar structure.

CAGE was up and running in 1995, and it remains a forum for companies to share information, experiences, and expertise, changing competitive relationships to collegial support.

Cleveland: *I recently spoke to Craig Colby (a senior engineer at Cesare Inc. of Centennial), who was on the CAGE board of directors for many years. He believes the transparency and shared focus created by CAGE led to higher standards and a better overall quality of practice for the entire construction industry. Do you think that's true? He also called you a "wrangler" of CAGE's members.*

Thompson: Ha! I'm glad Craig thinks we made things better. And we did make substantive changes by working together. We created the standards we still use today for slab-on-grade foundations for residential and low-rise commercial and for drilled pier design. These standards improved quality and safety — and buffered the industry against the legal action that was all too common in the early days of Denver's growth.

The peer-reviewed geotechnical study mounted by CAGE also helped the industry nationally. With CTL's lab testing and the expertise of the group, engineers around the country gained a better understanding of expansive soil and depth-of-wetting issues.

Cleveland: *CTL's materials testing lab today is one of the few labs in the country with its deep understanding of fly ash and cement analysis and expertise. Why did you initially acquire the lab? What has been the value both to clients and the overall field of structural engineering?*

Thompson: I had a desire to bring new thinking to our industry by exploring complementary sciences. While our team performed concrete testing for our clients in the early years, we needed other firms for additional inspections, particularly with commercial work. By acquiring what was then Commercial Testing Labs, Inc., we broadened our capacity to test materials used on both commercial and residential projects.

The lab was originally constructed in 1947, and has had some of the very best minds in the field working there, from Carl Ray, the original owner, to Bud Werner, a national expert who remains with us today, providing singular expertise on fly ash, mixtures, and concrete.

Cleveland: *What attributes were necessary half a century ago to be a successful geotechnical engineer? Which are necessary now?*

Thompson: While the science of geotechnical engineering goes back to about the 1920s, it was still in its infancy when I got started in the '60s. Most of the guys — and they were all guys — came out of schools as either civil or structural engineers with maybe a class on geotechnical properties. At that time, geologists would tell people where and where not to build.

The understanding of soil properties and strengthening gained momentum as the U.S. started to build larger and larger structures, primarily by the Army Corps of Engineers, which developed many of the early geotechnical solutions. Universities and the private sector helped fuel advanced testing because of the need to understand soil properties underneath planned developments.

As we gained more knowledge, engineers began specializing in geotech, taking over for the geologists formerly on our exploratory teams. To truly replace geologists, however, engineers needed a deeper background in science, both geology and the scientific process. Today's engineers also should be proficient in the wide range of technological tools we use in the field and back at the office. As your intro states, we started out typing reports with a manual typewriter. Clearly technology has changed!

Though more knowledge is demanded of today's engineer, more is also available. The number of completed projects has grown, obviously, so we have more background to inform our decisions. With the internet, much of this past work is also quickly and easily accessible.

Cleveland: *Looking back at our 45 years in business, what are you most proud of?*

Thompson: My goal was to help the construction industry build safe and long-lasting structures. We've helped an estimated 100,000 projects get off the ground, which is quite a body of work, and I'm proud of each one, whether it was a single-family home or landmark projects like Denver International Airport, the Lowry Air Force Base redevelopment, and the Pueblo Levee repair. I'm also proud of all the work your team is now doing to change Denver's skyline. When we started in 1971 we could only dream of working on the types of foundations needed for these high rises.

Which leads me to *my* question, Marc. You've been doing this nearly as long as I have, what are *you* most proud of?

Cleveland: Thanks Bob! I am humbled to have been on the ground floor, literally, of some of the state's most notable projects. But I'd say the most interesting part of the job is working with our team of experts to solve the engineering challenges brought to us by our clients. Finding a smart, budget-friendly way to get any job done gives me the most satisfaction.

BOB THOMPSON, P.E., founded CTLThompson (www.cctl.com), a full-service geotechnical, structural, environmental, and materials engineering firm, in 1971. Today it is the largest locally owned geotechnical engineering firm headquartered in Denver, with 230 employees in nine offices across Colorado and Wyoming. Half of CTL's leadership team has been with the company more than 20 years, including **MARC CLEVELAND, P.E.**, who is vice president.