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Spring Conference
April 20-22, 2023

Sawgrass Marriott
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Do What You Have to Do. I Trust You!

Kelby Williams, P.E.

**GEOPROFESSIONAL
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**CASE
HISTORY** **93**

NUMBER

PROJECT MANAGEMENT

The Client
A prominent regional developer of commercial properties

The Project
A five-city block cluster of high-profile, mixed-use, high-rise buildings designed to transform an abandoned industrial district into a lively urban neighborhood and destination shopping district

Assignment of the GBA-Member Firm
Perform a geotechnical-engineering study to support design of high-rise foundation systems; recommend earth pressures for shoring, basement walls, and permanent dewatering systems; and serve as the client's representative for earthwork operations.

Background
The GBA-Member Firm's CEO and the developer's CEO had worked together successfully on numerous projects for more than 15 years, establishing a relationship based on mutual respect and trust. This project was the developer's most ambitious to date, by virtue of its size, local prominence, and complexity. Among other things, the project plan called for four levels of parking beneath 2½ city blocks and adjoining streets.

The Member Firm's CEO joined as his company's project manager. A geotechnical engineer with 20 years' experience, he thoroughly understood subsurface conditions in the area of the site. He designed a comprehensive exploration program that the firm executed without incident. Soil conditions were what he anticipated; his recommendations were consistent with his expectations.

The shoring contractor hired for the project worked on a design-build basis, retaining its own engineer who designed a tied-back, soldier pile, excavation support system. The developer retained the Member Firm to review the shoring system's design and observe its implementation.

Construction began with installation of soldier piles for the perimeter shoring system, designed to consist of steel H-sections embedded in a 24-inch-diameter drilled hole and backfilled with structural concrete to the excavation level. From the excavation sub-grade to the ground surface, the remainder of this hole was to be backfilled with a "lean-mix concrete" that allowed it to be easily chipped away during lagging and anchor installation. Curiously, the shoring designer failed to delineate structural-concrete and lean-mix concrete requirements in the construction documents, and—because the lean-mix concrete was temporary—the city building department did not require it to be tested.

The shoring contractor asked the Member Firm's CEO/project manager to give the contractor "permission" to "lean-tilt" the lean-mix concrete instead of using tremie methods. Without asking for clarification, the CEO said that free-falling would be acceptable as long as the contractor directed the "lean-mix" into the H-section web, to reduce the risk of soil being incoated from the drilled excavation. Installation of the soldier piles took about 5 months. The contractor tipped the piles in the very dense-gravel formation underlying the project site.

The shoring contractor installed three rows of tied-back anchors to support the soldier piles as the basement excavation was advanced below street level and the surrounding city right-of-way. In compliance with the shoring contractor installed three rows of tied-back anchors to support the soldier piles.

Problems and Outcomes
As the excavation was nearing completion, three soldier piles in the northeast corner of the excavation plunged downward between 12 and 18 inches and rotated about

FIGURE 1

INTRODUCTION

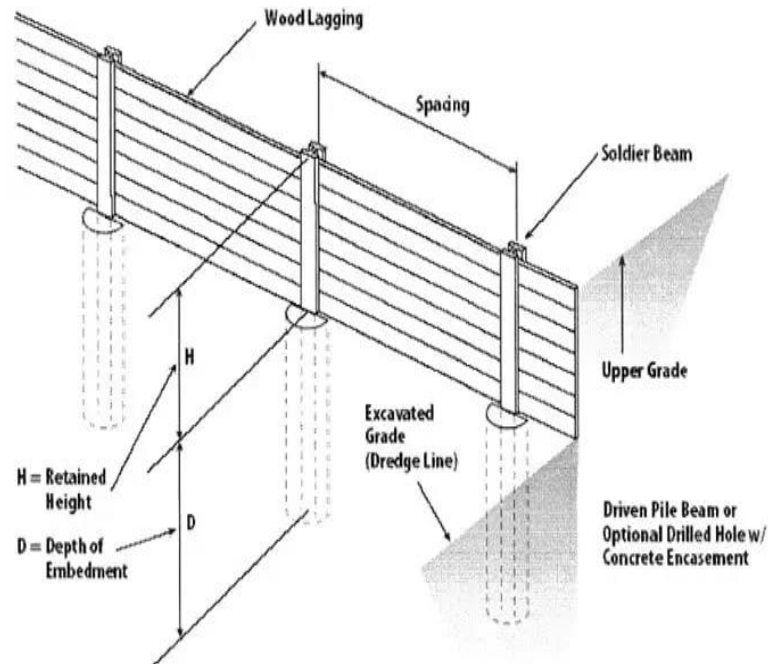
- Client – A prominent regional developer of commercial properties. Member Firm's CEO, a Geotechnical Engineer, and Developer's CEO have long-standing relationship.
- Project – A five-city-block cluster of high-profile, mixed-use, high-rise buildings designed to transform an abandoned industrial district into a lively urban neighborhood and destination-shopping district.
- Member Firm Assignment – Perform a geotechnical-engineering study to support design of high-rise foundation systems; recommend earth pressures for shoring, basement walls, and permanent dewatering systems; and serve as the client's representative for earthwork operations.

BACKGROUND

- Member Firm oversaw initial subsurface exploration which encountered typical conditions, consistent with expectations
- Project plan calls for four levels of parking beneath 2 ½ city blocks
- The shoring contractor worked on design-build basis
 - Their own engineer designed a tied-back, soldier-pile excavation support system for the basement excavation

SHORING SYSTEM FOR SUBSURFACE

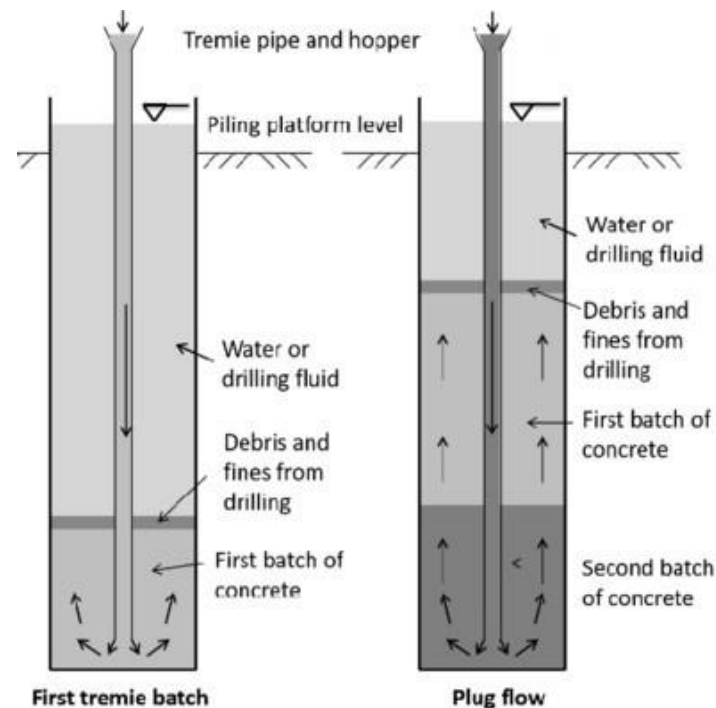
- Steel H-sections placed in 24-in diameter drilled hole
- Tips of piles embedded into underlying very dense gravel
- Backfilled with structural concrete to excavation level
- From excavation level to ground surface, backfilled with “lean-mix” concrete





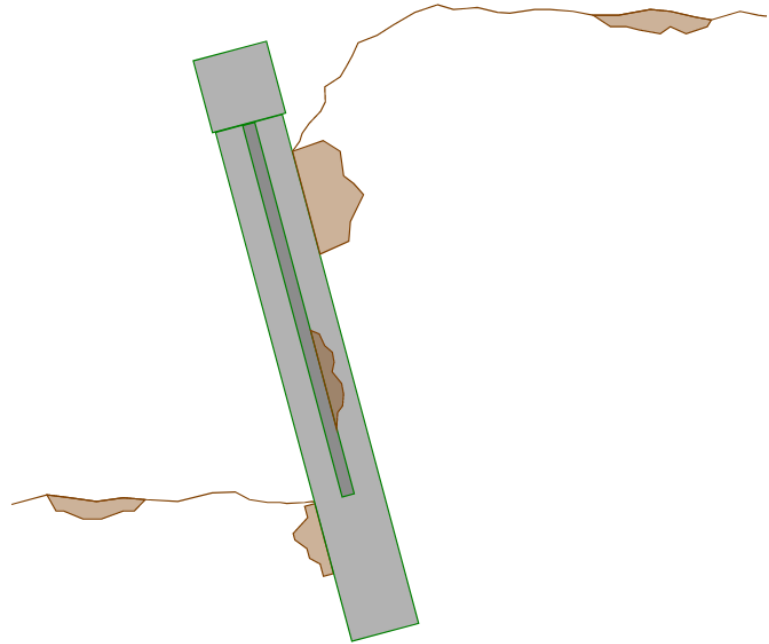
CONSTRUCTION BEGINS

- Shoring contractor contacted Member Firm CEO for “permission” to free fall concrete while encasing H-piles rather than using a tremie
- CEO approved change to method



PROBLEMS BEGIN

- Three soldier piles settled and rotated
- GC opted to push soil stockpile up against failed portion of wall, and installed additional anchors and micropiles to prevent collapse



WORST FEARS COME TRUE



WORST FEARS COME TRUE

- Five days later!
 - Entire north wall of shoring (700 ft) plunged downward and rotated
 - Earth movement led to rupture of 8-inch, high-pressure water line which blew out 30-feet of lagging and flooded excavation
- Damage to adjacent streets, sidewalks, and historic buildings
- \$4.5-million*, which includes construction delays, repairs to adjacent improvements, shoring repairs, and consulting costs

*Reported in 2020 dollars

REACTIONS TO THE ISSUES

- Shoring contractor claimed “changed conditions” which would relieve them of responsibility
 - Hired their own Geotech engineer to do an investigation
 - 3rd party firm did not find blame, but suggested structural concrete should have been used to embed piles
- Member Firm’s CEO undertook their own \$150k investigation
 - Diagonal borings to evaluate strength of lean-mix concrete and soil beneath tips of soldier piles

SO WHAT WAS THE ISSUE?

- Failure occurred when H-piles plunged through 25-psi lean-mix at tips
 - There was no failure where the strength reflected 800+ psi
 - Concrete supplier indicated shoring contractor directed them to remove fly ash and double water:cement ratio
 - Contractor installed failed piles on the days when the supplier delivered weaker mix
- Shoring contractor indicated that since project was design-build, he didn't need a submittal for change to mix
 - Since piles are temporary, City did not require testing

MOVING FORWARD

- Over the following weeks, shoring contractor installed additional tie-back anchors and micropiles under all failed soldier piles
- Constructor-in-charge absorbed cost of delays and redesign of walls
- Client's project insurance covered cost to repair damaged buildings and infrastructure
- Client's CEO insisted that shoring contractor reimburse GBA Member Firm for their costs of forensic investigation

LESSONS LEARNED

- Use Root-Cause Analysis
- Safety First
- Words Matter
- Consider the Risks and Consequences
- ***If It Isn't in Writing, It Didn't Happen!!!!!!***

Comments of GBA Member Firm CEO

“What was really important during this nail biting crisis was that no one was hurt, my client relationship was preserved and even strengthened, my fledging company survived, and the development project was a success. I was personally gratified when the client said, in essence, ***“Do what you have to do. I trust you,”*** and, again, when he insisted that our firm be paid for its investigation. We were also reminded of the potential consequences of straying beyond our scope of service and into the constructor’s means and methods. Constructors are all-too-willing to share their responsibility, and liability, with others.”

Case History 93

- Check out the recent Podcast release of Case History 93 where Elizabeth Brown and Ryan White break it down
- Don't forget to stop by the Emerging Leaders booth before you leave for some interactive fun!