2025 Honorable Mention Project

Figs. 1 and 2: Architectural renderings of The United Bldg.

North America's Tallest Façade Retention System

By Mark Reinders, P.Eng.

In the heart of downtown Toronto, ON, Canada, a full city block at 481 University Avenue and 210 Dundas Street West has become the site of one of the most complex heritage preservation efforts ever attempted in North America. The development of the United Bldg. (Figs. 1 and 2), a 50-story mixed-use tower, required the complete in-place retention of the façades of two historically significant heritage sites (Fig. 3):

- A 1928, nine-story Beaux-Arts structure, originally owned by the Maclean Publishing Company, located at 210 Dundas St.
- A 1961, ten-story Modern Classical building, serving as an expansion for the Maclean Publishing Company, located at 481 University Ave.

Due to this designation, all original finishes — brick, stone, concrete, and steel — had to remain undisturbed and fully supported throughout construction. At ten stories tall, the façade retention system (FRS) designed for this project became a monumental engineering and construction marvel, unprecedented in the industry. The complexity of this project was only amplified by the spatial limitations imposed. Dense urban infrastructure — including streetcars, subway tunnels, and congested utilities — restricted the available options for the FRS design and imposed stringent monitoring criteria. The solution needed to restrict ground settlement to less than 3 mm (0.1 in.) and façade movement of 15 mm (0.6 in.). This led to the development of a highly integrated hybrid support system, merging elements of

Fig. 3: 481 University Avenue and 210 Dundas Street West historical façades

Fig. 4: Floor-by-floor demolition operations

the existing structure with the FRS and the support of excavation (SOE) design to allow four levels of underground construction beneath the retained façades and structure.

Green Infrastructure Partners (GIP) is a leading Canadian specialty contractor with over 50 years of experience in deep foundations and shoring works. They were selected as the specialty service subcontractor responsible for delivering the demolition, support of excavation, façade retention system, and ultimately, the integration of all these systems. This included a controlled demolition of the heritage structures, installing deep foundation elements around and within the structures, façade support with structural steel, transferring the façade's weight onto the new deep foundation elements, and finally providing earth retention with lateral supports and shotcrete.

DEMOLITION IN TIGHT QUARTERS

The initial phase of construction required the controlled demolition of the original interiors of 210 Dundas Street West and 481 University Avenue, all while the façades remained in place (Fig. 4). GIP crews used compact machines, hoisted floor-by-floor to surgically dismantle the slabs, beams, and columns, dropping debris to the lower floors.

To ensure stability of the façade, the first bay of columns, slab, and grade beams were left in place and supported with additional structural steel. Combining the existing structure and new reinforcement provide an economical and efficient means of supporting the historic façades throughout the construction phases.

DEEP FOUNDATION ELEMENTS

The largest challenge on this project was re-supporting the FRS — inclusive of the façade, existing structure, and new reinforcement — onto temporary foundations. This would allow the removal of the existing footings and basement walls as well as the installation of new permanent foundations for the future 50-story structure. To facilitate this massive load transfer, two different forms of SOE were installed on the perimeter, to support half the loads transferred to the exterior. Discrete king piles were installed within the building's footprint to support the interior half of the loads.

The primary SOE consisted of a secant pile wall along

Figs. 5 and 6: Cased Kelly drilling of secant piles (LEFT) & drilling of micropiles (RIGHT)

Figs. 7 and 8: King pile drilling and placement near FRS (LEFT), placement of king pile in drilled shaft (RIGHT)

two-thirds of the perimeter, where minimal site restrictions existed. Cased Kelly techniques were used to drill 1.0-m (3.3-ft) diameter shafts in an overlapping manner to create a continuous concrete wall below grade (Fig. 5). The majority of these drilled shafts contained 6 MPa (870 psi) concrete as well as W610x217 wide flange beams. In areas directly supporting the high vertical loads from the FRS, the properties were upsized. The drilled shaft diameter increased to 1.3 m (4.3 ft), the concrete strength increased to as high as 55 MPa (8000 psi), and the steel reinforcement increased to W760x257. This drilling occurred 400 mm (16 in.) off the face of the façade. Minimal vibrational transfer or movement of the FRS were identified during this work.

The secondary SOE required the use of micropiles and shotcrete on the remaining third of the site perimeter. This area had considerable limitations imposed, restricting surcharge loading over a below-grade subway station and spatial restrictions due to at-grade streetcars. As such, hollow structural section (HSS) 406 x 14.6 mm (16 x 0.6 in.) diameter micropiles were installed as close as 200 mm (8 in.) to the façade (Fig. 6). These elements allowed flexibility in location and position, ensuring they were spaced at no more than 1.2 m (4 ft) apart. In areas of high FRS loading, they were clustered in groups of 4, 6, or 8, with 100 mm (4 in.) between them. To provide support during excavation, shotcrete and mesh were applied (detailed later in this article). The micropiles were filled with a limestone-based grout, using a water-reducer and viscosity-modifier admixtures to both facilitate placement and to consistently achieve 60 MPa (8700 psi) strengths.

Almost a year after SOE drilling was completed, the interior space was sufficiently demolished to allow for the installation of king piles. Cased Kelly techniques were used again to drill 1.0-m diameter foundation elements that supported the FRS within the new building's footprint (Fig. 7). These king piles consisted of W360x634 beams with a 60 MPa self-consolidating concrete toe to support design loads over 6000 kN (675 tons). The toe of the king piles received 108 Nelson studs and an uplift plate to fully engage the concrete toe (Fig. 8). Only 16 were installed, as close as 75 mm (3 in.) to the edge of the FRS. Position and verticality tolerances were stringent, as many of the king piles were cast into future permanent columns.

TYING THE FRS AND SOE TOGETHER

At grade, multiple retention trusses were built around the existing columns at the main floor elevation. It extended through engineered pockets in the façade to bear on the cap beam that spanned the SOE. The interior side ended at the edge of the in-place slab to facilitate placement of the basement level truss. This basement truss was referred to as the 'transfer truss', and it sat on top of all of the king piles, connecting the 16 of them together. Once the transfer truss was in place, the retention trusses were spliced beyond the in-place slab, to bear directly on top of the transfer truss. Finally, jacking pedestals were installed around all 50 existing columns. Each pedestal had an upper bearing surface secured to the column, while the lower bearing surface was secured to a retention truss. Figs. 9 and 10 provide illustrations of how these elements came together to facilitate the load transfer.

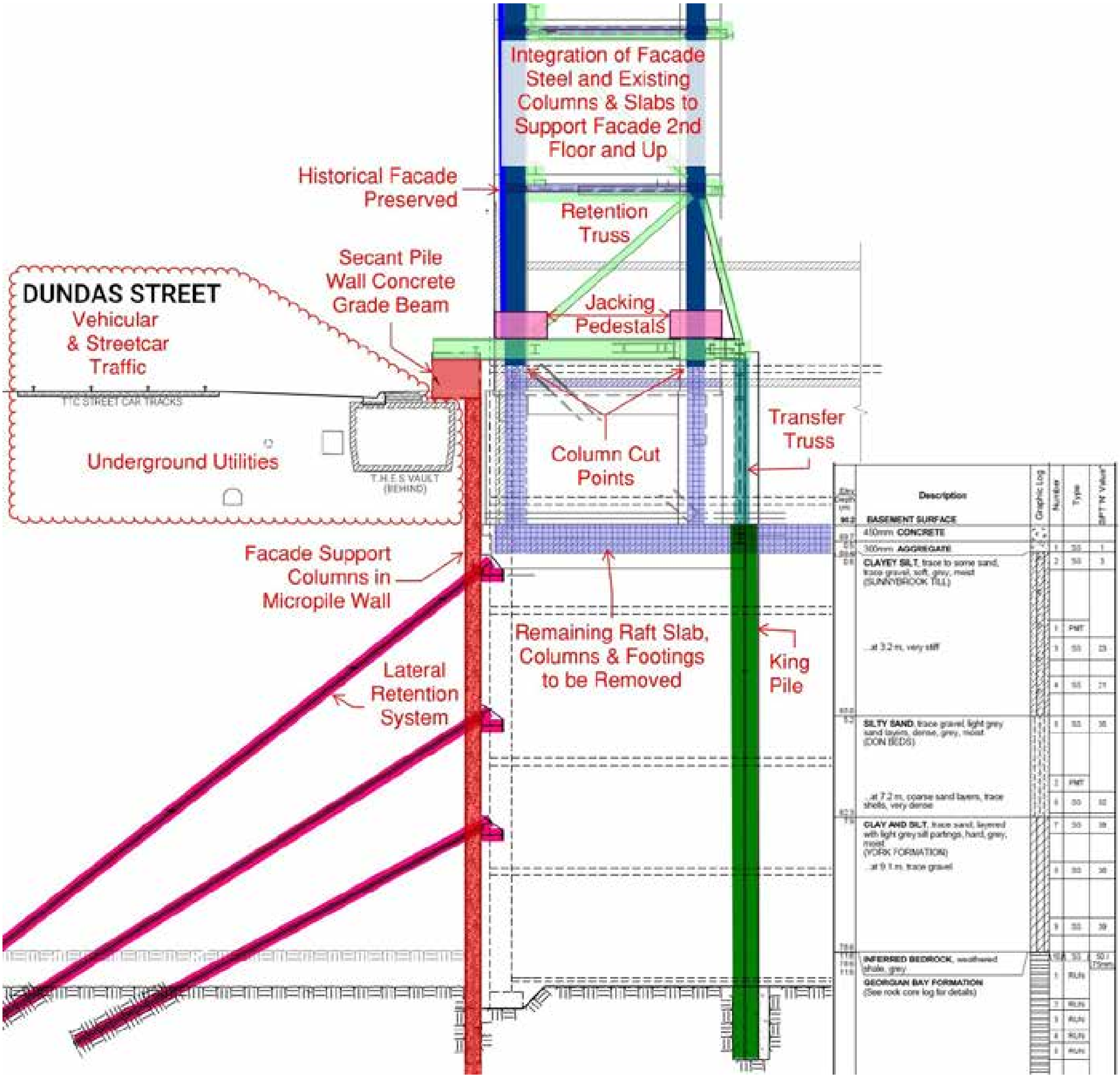

Fig. 9: FRS-SOE Section View

TRANSFERRING THE LOAD

Following the completion of the hybrid SOE-FRS system, the next major milestone was to safely transfer the full weight of the heritage façades from their original footings onto the newly constructed support system (Fig. 11). The weight of the entire system was estimated around 20,000 metric tons (22,000 tons), with a +/- 15% variation. To mitigate excessive movement and manage the load variability, the FRS was divided into 8 segments (1, 2, 3…, 7, 8), and the load transfer process was divided into 5 steps (A, B, C, D, E). This resulted in 40 stages of work to fully transition the load, sequenced as 1A, 2A, 3A…, 6E, 7E, 8E, taking over six weeks to complete. The 5 steps were:

A. Jack to 50% of expected load. Investigate anomalies. Temporarily Shim. Monitor strain.

B. Jack to 75% of expected load. Investigate anomalies. Temporarily Shim. Monitor strain.

C. Sever existing columns below jacks and re-connect to allow compression-only load through column (no tension or movement). Monitor strain. Monitor displacement across compression-only connection.

D. Jack to either 100% of expected load, 100% of expected strain, or displacement across compression-only connection. Temporarily shim. Monitor strain. Monitor displacement.

E. Secure all jacking points with permanent shims to lock in load on retention trusses.

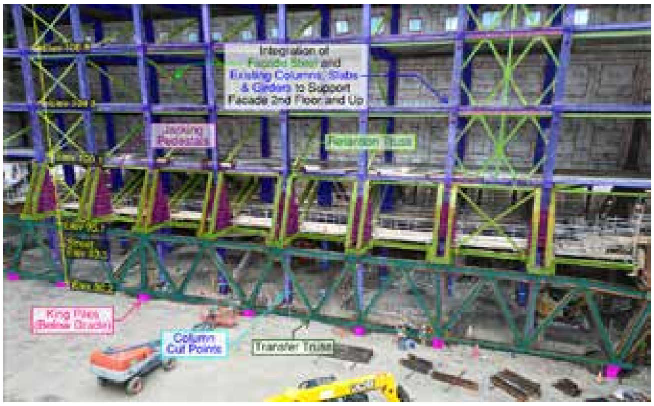

Fig. 10: FRS-SOE Elevation View

Fig. 11: Jacks around existing columns

Fig. 12: Basement wall demolition, exposing micropile wall

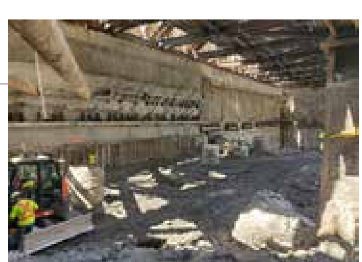

Fig. 13: Micropile-shotcrete and secant pile SOE

LATERAL SUPPORT & SHOTCRETE PLACEMENT

With the façade fully supported, the excavation commenced. The existing footings were demolished as the excavation progressed, however more care needed to be taken with the existing basement walls. When removing these walls, the deep foundation elements were exposed. As mentioned earlier, two-thirds of the site perimeter was a secant pile wall, resulting in a continuous concrete wall that retained the earth and infrastructure behind it. The other third exposed the steel casing of the micropiles, either in clusters or spaced at 1.2 m (Fig. 12). The earth remained exposed, therefore excavation lifts were limited to a height of 1.5 m (5 ft) until shotcrete could be applied.

The wet-mix shotcrete mixture was supplied by Canada Building Materials (CBM) as a 35 MPa (5000 psi), air-entrained mix with a 10 mm (0.4 in.) aggregate and a slump of 60 +/- 20 mm (2.5 +/- 0.75 in.). 75 mm hardline were secured to the secant pile walls at either end of the micropile zone to allow flexibility when placing. Flex line then extended to two points on the site perimeter where a shotcrete pump would be positioned, depending on where the shoot was occurring.

Each 1.5-m lift was prepared by securing studs to the face of the micropile as well as rods in the middle of the 1.2-m bays. These were used to support 2 layers of wire mesh, both being 102x102 MW11.1/11.1 with 75 mm in between. Once the wall was prepared, the concrete was delivered and pumped to the shotcreters at the base of excavation, where it was shotcreted by hand nozzling, without the use of mechanized equipment. The total shotcrete thickness was 150 to 200 mm (6 to 8 in.) deep, ensuring a minimum of 50 mm (2 in.) coverage on the outermost layer of mesh. The surface was left as gun finish, as the permanent wall for the future structure was to be built in front (Fig. 13).

Part of the SOE design required various lateral supports in both the secant pile wall and the micropile-shotcrete wall. They consisted of:

- **Tiebacks:** Anchors drilled and grouted into rock behind the wall, then tensioned to impart lateral load into the SOE
- **Walers:** Horizontal steel beams welded to the face of the vertical support that help distribute tieback loads across multiple vertically drilled elements

At the micropile-shotcrete wall, additional internal walers were required to support the lateral loads at the tieback location (Fig. 14). This required hand excavating and an additional 150 mm between the micropiles and installing a steel beam, field coped and welded tightly against the sides of the micropiles. This process was extremely time consuming, and it became quickly evident that this operation drove the critical path of the job and would delay the schedule.

GIP worked closely with the SOE designer, Grounded Engineering, to replace this internal waler with a shotcrete panel (Fig. 15). The shotcrete was achieving design strength after 24 hours, meaning it could adequately support the tieback loads the day after shooting. A solution was developed to install a 1 m tall rebar panel, consisting of #10M (#3) rebar at a spacing of 125 mm x 125 mm (5 x 5 in.), welded to the edge of the micropiles. This was installed in addition to the two layers of mesh. The depth of the shotcrete was increased to 250 mm (10 in.) at these locations, and great care was taken to ensure it encapsulated the 3 layers of reinforcement and stacked well. This adjustment greatly improved productivity and put the schedule back on track.

PROJECT COMPLETION INSIGHTS

The complexity and constraints of the United Bldg. project demanded early and continuous coordination between all stakeholders. Regular communication and coordination

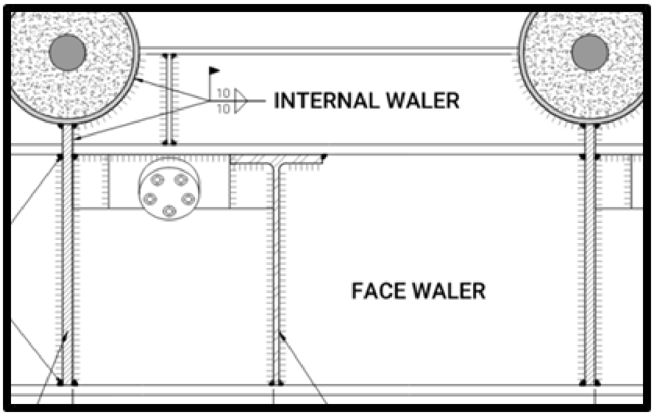

Fig. 14: Micropile Internal Waler Detail

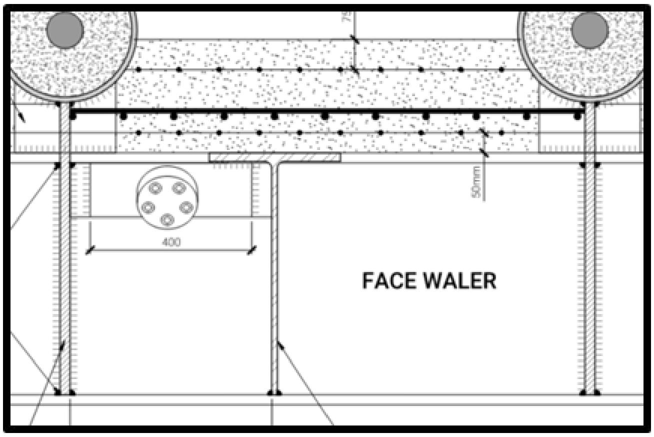

Fig. 15: Revised Micropile Internal Shotcrete Panel

Figure 16: North America's Tallest Façade Retention System

between the owner, architects, designers, consultants, constructors, inspectors and vendors ensured that shifting site conditions were accounted for in real time. This team-first approach was maintained from early in the design process through to the completion of the four-story below-grade excavation. Insights from each party were respected and integrated to improve quality, safety, and efficiency across all phases. The result was the successful delivery of one of Toronto's most complex foundation systems, and the construction of North America's tallest façade retention system (Fig. 16).

ACKNOWLEDGEMENTS

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***Mark Reinders**, P.Eng., is a senior project manager at Green Infrastructure Partners based in Markham, ON, Canada. With over 15 years of experience in the deep foundation industry with widely varying expertise, he prides himself at finding efficient and constructable solutions to a client's subsurface challenges, as well as growing young professionals in the industry.*

2025 HONORABLE MENTION PROJECT

Project:
North America's Tallest Retained Façade

Project Location:
Toronto, ON, Canada

Shotcrete Contractor Company:
Green Infrastructure Partners Inc.*

Engineer Company:
Grounded Engineering

Materials Supplier Company:
Canadian Building Materials

General Contractor:
EllisDon Residential

Owner:
481 Uni Investments Inc

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