The preservation of historic buildings is not only essential to the understanding of our national heritage, but it is also environmentally responsible to adapt existing buildings to compatible new uses. With this perspective, the American Enterprise Institute began exploring options to expand the newly acquired Andrew Mellon Building, located at 1785 Massachusetts Ave. NW in Washington, D.C., without causing any harm to the Beaux Arts style limestone façade and its plaster interiors. The building is a National Historical Landmark, but its 72,000 sq ft (6,690 sq m) of usable floor space did not meet the needs of its new owner.

The building perimeter is very near the property line, so horizontal expansion was not possible. Adding height to the building was not an option, as this would have altered the historic nature of the building exterior. The only feasible option that could provide the desired floor space was to add a new floor underneath the existing structure. By adding a level beneath the existing building, an additional 28,000 sq ft (2,601 sq m) of floor space could be produced.

Berkel & Company Contractors was chosen as the deep foundation/shoring contractor tasked with ensuring that the existing structure was stable and remained undamaged during the excavation and construction of the new lower level. To accomplish this, Berkel provided a shoring system that would act as both excavation support and permanent deep foundation elements for the final structure.

Preservation of the existing limestone façade and plaster interiors was critical to the success of the project, as additional foundation settlements could damage these irreplaceable building components. Project specifications, therefore, included very stringent limits for foundation settlements. The maximum allowable total settlement for all existing building walls and columns was ¼ in (6 mm) for the duration of the project.
Soil Conditions and Foundation Selection

The subsurface conditions at the site consisted of 23.5 ft (7.2 m) of fill starting at El. +82 ft (El. +25.0 m) (existing exterior grade). This fill consisted of sandy silt and poorly graded sand with gravel, with SPT blow counts varying in N-value from 3 to 9 blows/ft (blows/0.3 m). Below the fill layer was a 10 ft (3.05 m) deep layer of well-graded gravel and clayey sand with N-values ranging from 36 to 54, which was underlain by a disintegrated rock layer extending downward to El. +20.7 ft (El. +6.3 m).

The existing steel-framed structure, originally built in 1917, consists of five above-grade stories and one basement level. The structure is supported by perimeter wall and column footings in addition to 42 interior spread footings. The existing exterior and interior footings were bearing at about El. +76 ft (El. +23.16 m). The new basement would lower the bottom of the foundations approximately 14 ft (4.3 m) to El. +62 ft (El. +18.9 m). The additional below-grade level was estimated to increase the load on the foundations approximately 15%. Although interior spread footings and exterior wall footings had been used to support the existing structure, the increased building load and stringent settlement requirements precluded the use of shallow foundations. Therefore, the building instead would have to be supported and stabilized by a new deep foundation system, which had to be installed prior to the excavation to the new subgrade elevation.

In addition to supporting the loads of the final structure, the selected deep foundation system would be required to support the structure during excavation. Because of the load demands, stringent settlement requirements, difficult access and installation in low headroom conditions, cased micropiles were selected as the primary deep foundation system. Micropiles with a nominal outside diameter of 7 in (178 mm) were selected to support the exterior walls and columns, and micropiles with a nominal outside diameter of 9-5/8 in (245 mm) were selected to support the interior columns. The use of micropiles would not only meet the service requirements of the project, but would also be amenable to the logistical constraints present at this site.

Along the perimeter of the building, an excavation support system was needed in addition to vertical support of the exterior walls and columns. Underpinning pits were selected, which would provide both the excavation support and the vertical support for the exterior of the existing building. Because of the tight settlement requirements, it was determined that the underpinning pits would need to either extend to bedrock or be supported on piles. It was determined that micropiles would be used to support the pits, which would be faster and more economical.

Access Limitations

The 1785 Massachusetts Avenue project had very challenging logistics. The building was very tight to the property line around the entire perimeter, so exterior staging areas were limited. Staging inside the building was also limited, as material storage would impede construction equipment and workers. It became necessary to establish an offsite staging area a few miles away from the jobsite. Materials were brought to the site on an as-needed basis, unloaded from the street and immediately brought into the building. In addition, the streets and sidewalk adjacent to the building had to remain accessible to the public throughout construction.

Access into the building was initially limited to a single 5 ft x 7 ft (1.5 m x 2.1 m) basement door, which was at the bottom of a 42 in (1,067 mm) wide switch-back ramp. Materials had to be manually carried into the building through this door. There was a short, narrow alley on the east side of the building, and, at the end of this alley, a hole was cut in the side of the building and a ramp was constructed, which provided another point of access. However, the alley was too narrow and the ramp too steep to allow for vehicular traffic. Materials would be placed at the top of the ramp then dragged down the ramp and into the building.

The work area was effectively an enclosed space, which necessitated constant mechanical ventilation and electric lighting. Electric and water lines needed for construction had to be run overhead to not impede the construction activities.

Perimeter Support

To support the 25 perimeter columns and exterior walls, and to provide support of excavation for the project, underpinning pits were dug to a depth of approximately 17 ft (5.2 m). Each underpinning pit was supported by battered micropiles, which were installed prior to digging the pits. The micropiles had a nominal outside diameter of 7 in (178 mm) and reduced the potential for differential settlements between the interior and perimeter columns. At the top of each underpinning pit, three 8 in (203 mm) deep channels were formed to create a space for 150 ton (1,335 kN) flat-body hydraulic jacks, which could be used to adjust the elevation of the perimeter columns, if necessary.
Fortunately, differential and total settlements never exceeded the project limit of ¼ in (6 mm), and the hydraulic jacks were never needed outside of the initial loading and final unloading sequences.

The lateral earth pressure acting on the existing basement walls and footings had to be supported prior to excavation. Temporary tiebacks were installed in the existing basement walls to allow crews to demolish the slab-on-grade. Rebar dowels were installed into the underside of the existing footings from inside the underpinning pits using epoxy adhesive. These dowels were used to transfer the lateral earth pressure acting on the existing basement walls above to the underpinning pits. The total lateral load acting on the existing basement and new excavation support was resisted by two levels of temporary tiebacks extending approximately 45 ft (13.7 m) outside the building.

**Interior Column Supports**

These 9-5/8 in (245 mm) diameter micropiles were designed with an allowable compression load of 100 tons (890 kN) and were installed from the existing basement slab through the existing footings using modified tieback rigs. Each of the 25 existing interior columns and 5 new columns were supported by at least 4 micropiles. Before the existing footings were demolished, steel brackets were welded to the existing columns, and a grillage of steel transfer beams was erected on top of the micropiles. This allowed for the service loads in each column to be transferred to the micropile towers before excavation began.

Estimated settlements of the micropiles exceeded the project limit of ¼ in (6 mm). To compensate, column loads were incrementally transferred from the existing spread footings to the new micropiles using hydraulic jacks. By preloading the micropiles, the immediate pile settlements and deflections of the steel transfer beams would occur before the column was directly supported by the micropiles. The column was thus held in place as the new piles were loaded and deflected, which prevented any column movement due to the initial pile settlements and elastic deflections.

Columns were instrumented and monitored for movement. When upward movement of the columns exceeded 0.005 in (0.13 mm), it was considered that most or all of the column load had been transferred to the new micropiles and, thus, the jacking process was halted. Once the column load had been transferred to
the micropiles, the jacks were locked off but kept on site so adjustments could be made as construction progressed and conditions warranted. Settlements were monitored constantly throughout construction. Column movements during the load transfer process did not exceed 1/16 in (1.5 mm). Overall column movements for the duration of the project did not exceed the specified limit of ¼ in (6 mm), with most column movements less than 1/8 in (3 mm).

With the building load transferred from the existing spread footings and now supported by the new shoring system, the existing foundations could be demolished and the excavation could proceed. As the excavation progressed, steel angles were added between the micropile supports creating a trussed tower. Once the new subgrade of the new basement level was reached, pile caps were poured around the micropiles. Headed shear studs were welded to the micropiles to transfer the future column load from the new pile caps to the micropiles.

The new concrete columns were constructed inside the truss towers, from the tops of the new pile caps to the underside of the existing columns. Once the columns were completed, a high-strength, non-shrink, early-set grout was placed between the concrete column and the steel base plate. After two days of set time, the columns were ready to support the building loads once again. The hydraulic jacks were used to relieve the stresses on the micropiles and transfer the building loads back to the columns. The micropiles were then cut down to the top of the new pile caps and the process was complete.

**Concluding Remarks**

Ensuring the preservation of our national landmarks by repurposing them to meet changing needs can be a complex yet rewarding undertaking. Throughout the course of this project, there was constant communication and collaboration between the design and construction professionals. All members of the construction team worked in concert to ensure the project met the needs of the owner while preserving the historic nature of the building. Without this cooperative team approach, and the hard work and determination of the field personnel, a successful outcome for this project would not have been possible.

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