

Award Winning Micropile Support

OF HISTORIC BUILDING IN WASHINGTON D.C.

BY RICHARD GUENTHER, PE, BERKEL & COMPANY CONTRACTORS, AND MORGAN NESMITH, PE, DGE

The developers of City Ridge – Roadside Development and North America Sekisui House (NASH) have created an “urban village” at the former Fannie Mae headquarters complex on Wisconsin Ave NW in Washington, D.C. The use of the site, which had been vacant since early 2018, continues a trend of turning to vacant, existing structures to meet these urban areas’ growing needs since available space has become scarcer.

Eight new structures were constructed for this development, centered around the abandoned Fannie Mae building that was left on the site. These structures include a below-grade parking structure under most of the site footprint along with 687 residential units, a 150-room hotel, about 150,000 sq ft (13,935 sq m) of retail space, and about 62,000 sq ft (5,760 sq m) of office space.

The Fannie Mae building was designed and constructed in the Colonial Revival style to mimic the Governor’s Palace in Williamsburg, Virginia. The central portion

of the original structure was built in 1956 on pile caps with small-diameter cast-in-place piles. Two wings were added in 1962 and were supported on belled caissons. All told there were three above-grade and one below-grade level. The current development team requested its inclusion as a local historical landmark for preservation and inclusion in the new development.

A large, commercial grocery store anchors the new development, and the ground level around the existing structure was lowered by approximately 8 feet (2.4 m) to accommodate this facility. Excavation depths for the below-grade parking under the remainder of the site were as much as 40 feet (12.2 m) immediately adjacent to the existing structure and up to 62 feet (18.9 m) at the rearmost portion of the site.

The foundation and earth retention requirements for the project included underpinning the existing building, excavation support for the remainder of the site, and additional deep foundations to support new structures installed around the periphery of the

Aerial view of underpinned Building and Surrounding Excavation

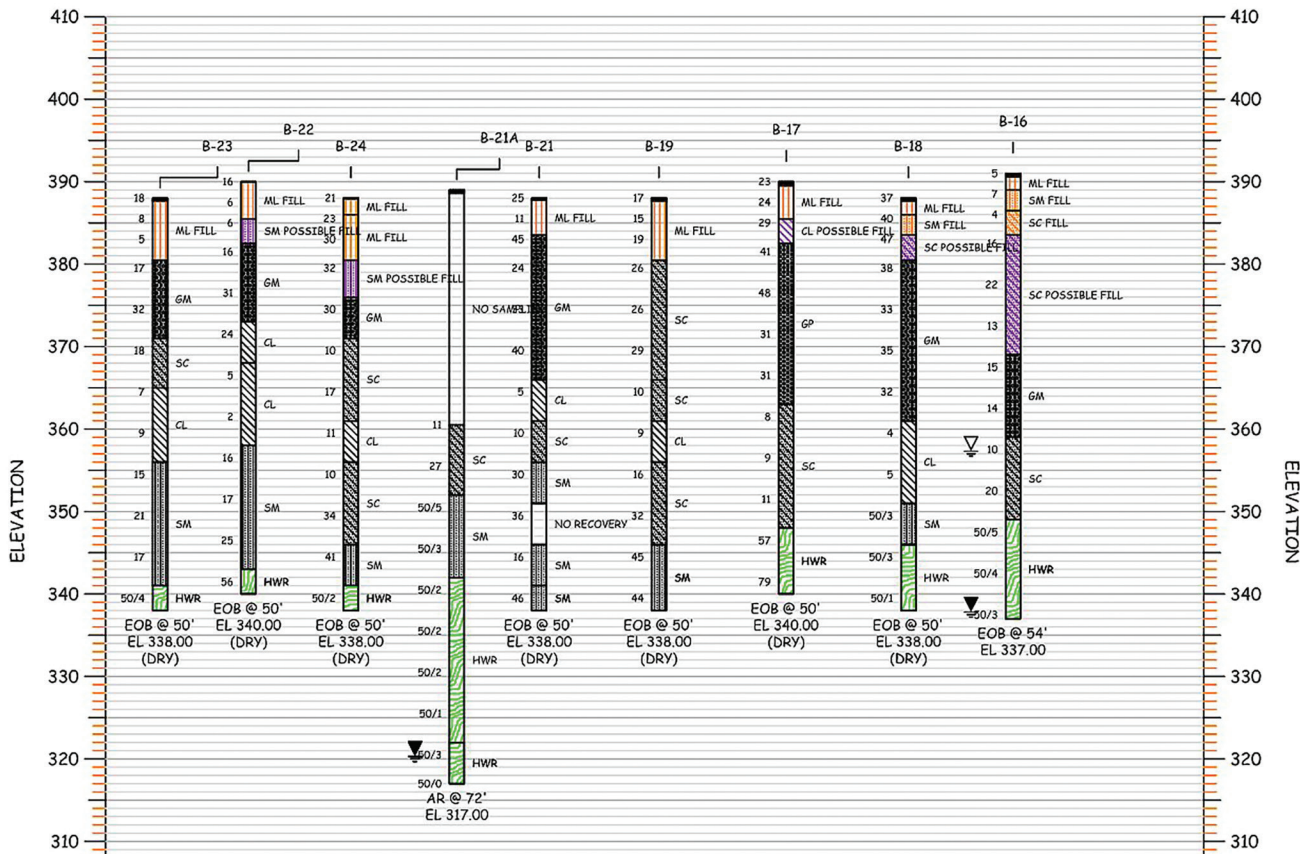
Artist rendering of proposed development

excavation. Berkel was selected by the design team for this unique project, in part, due to its background in underpinning and earth-retention required for the lowering of similar below-grade structures.

SITE GEOLOGY

The project sits at the intersection of the Coastal Plain and Piedmont Physiographic provinces with alluvial soils overlying residual soil and rock. The subsurface profile can be generalized into five strata: (I) fill, (II) natural alluvial soils, (III) natural residual soils, (IV) weathered rock, and (V) less-weathered rock. The weathered (IV) and less-weathered rock (V) were generally the target bearing strata for deep foundations for the new construction.

- ▶ Stratum I: Fill soils at the site ranged from 4.5 to 22 feet (1.37 to 6.7 m) below existing grades with varying Standard Penetration Test (SPT) N values from 2 to 58 blows per 1 foot (300 mm), however the higher SPT N values were attributed to the presence of gravel and other debris.
- ▶ Stratum II: Natural alluvial soils were encountered from 22 to 47 feet (6.7 to 14.3 m)
- ▶ Stratum III: Natural residual soils were encountered below Stratum II or directly beneath Stratum I where some deeper fills were present. These soils were generally sand and silt with some clay. SPT N values ranged from 3 blows per foot to 50 blows over three inches (75 mm). Rock fragments found in core samples were the likely cause of the high SPT N values in this layer.
- ▶ Stratum IV: Weathered rock was encountered below Stratum III to depths of 50 to 72 feet (15.2 to 21.9 m) below the existing grade. SPT N values typically exceeded 50 blows per foot.
- ▶ Stratum V: Boring refusal occurred at multiple boring locations on less weathered rock that ranged in depth from 52.5 to 72 feet (16 to 21.9 m) below existing grade.



▲ Generalized subsurface profile



DESIGN/BUILD: DEEP FOUNDATIONS SHORING - GROUND IMPROVEMENT



**AUGER PRESSURE GROUTED PILES
DISPLACEMENT PILES
DRIVEN PILES • H BEAMS & LAGGING
SECANT WALLS • SHEET PILES • HELICAL PILES
PRESSURE GROUTING • SOIL NAILS
RIGID INCLUSIONS / STONE COLUMNS
UNDERPINNING • TIEBACKS • MICRO PILES**

BerkelandCompany.com

info@BerkelandCompany.com

100% EMPLOYEE OWNED | An ESOP Company

FOUNDATION CHOICE AND CONSTRUCTION

The project geotechnical engineer of record, ECS Mid-Atlantic (ECS), provided recommendations for shallow foundations, micropiles, and drilled shafts for the new facility as part of the initial geotechnical site characterization in 2016. Shallow foundations were planned for the below-grade parking structure while new deep foundations were recommended to permanently support the existing structure during the grade-lowering and below-grade excavation and beyond the completion of construction.

The following factors were considered in the selection of the deep foundation system for the existing structure: load demands on the piles, very tight settlement limits, extremely limited access, and low-headroom installation conditions. Short-segmented, steel-cased micropiles were selected to meet the service requirements of the project and also in light of the logistical constraints at the site.

Micropiles with an outside diameter of 7 in (17.8 cm) and 9 5/8 in (24.4 cm) were used to support gravity-only column locations and columns at braced frame locations respectively. Both piles were designed to provide an allowable compression load of 100 tons (890 kN) and all micropiles were installed adjacent to the existing footings from the existing basement slab inside the building using modified Comacchio MC4D and MC8D drilling platforms. Each of the 94 existing columns was supported by a minimum of four micropiles. Typically, each rig installed 2 to 3 piles per day. A grout batch plant was erected on-site to ensure grout was available on demand. Steel casing and bulk cement delivery had to be coordinated for near-immediate use due to the limited space available for material handling on-site. A total of 385 piles were installed to support the existing structure.

COLUMN LOAD TRANSFER

Prior to the demolition of the existing footings and excavation commencement, a load path needed to be created for the service loads in each column to be transferred to the new micropiles. Steel brackets were welded to the existing columns and a grillage of steel transfer beams was erected on top of the micropiles. Design column loads ranging from 280 to 720 kips were incrementally transferred from the existing foundations to the new micropiles using

hydraulic jacks until separation between the column and existing footing was observed.

Once excavation commenced, 7 in micropiles were braced with 3-inch x 3-inch steel angles to prevent buckling. At locations with shear, 3 in x 3 in tubes were used in between the 9 5/8 inch micropiles to transfer the shear load to the base of excavation. Headed shear studs were welded to the micropiles



▲ Steel brackets welded to columns



▲ Micropiles with shear studs



ENGINEERED for PERFORMANCE

CZM is the leader in the North American foundation drilling industry. Since 2013, we've invested significant resources to better serve the needs of the market. Our team of highly skilled engineers offers intelligent solutions for development and improvement of the finest and broadest product line made in the US. We have machines to cover every foundation application, with a robust fleet of rental machines available nationwide. We're continuing our commitment to North America by expanding our headquarters in early 2023 which will increase output and allow us to bring new and innovative drill rigs to the market faster.



PRODUCTION

Our machines are manufactured and designed in the US by our team of highly skilled engineers.



AFTER SALES

CZM Field Technicians are the best in the industry providing a level of unsurpassed expertise. Our commitment to the market includes service locations across North America that quickly provide our customers support to reduce downtime.



APPLICATIONS

- Standard Mast
- Short Mast
- Ultra Short Mast
- Long Reach
- Cable Crowd
- CFA
- Displacement Piles
- Soilmixing
- Pile Driving
- Micropiles
- Jet Grouting
- Cased CFA

SCAN THE
QR CODE
to view our
product line
catalog.



US HEADQUARTERS
912-200-7661
962 Interstate Centre Blvd.
Ellabell, GA 31308

AFTER SALES
912-200-7656
145 E. Industrial Blvd.
Pembroke, GA 31321

TEXAS
817-232-8053
2501 Blue Mound Rd. W
Haslet, TX 76052

WEST COAST
805-667-8416
1720 N. Ventura Ave.
Ventura, CA 93001

to transfer the future column load from the new pile caps to the micropiles. Upon excavation to the new final subgrade, pile caps were constructed around the micropiles.

The original building columns were steel wide-flange sections encased in concrete. The as-built orientation of the wide flange did not always match the original structural drawings and was not known until the concrete was removed. As this orientation only became apparent just before installation of the steel lifting frames, the frames were designed to both match the orientation of the original construction documents but also to be readily adjusted upon concrete removal so as not to delay the project schedule. The columns were extended to the new foundation level by splicing a structural steel section of the same size and reinforcing the entire height with side steel cover plates.

Additionally, when the existing foundations beneath the exterior masonry walls were demolished, no structural members would remain to resist the lateral forces from these walls. BERKEL designed and installed new braced frames to provide a path for these loads from the masonry walls to the new micropiles. These frames had to be carefully modeled to miss, or become incorporated with, the steel lifting frames at each column. BIM coordination was essential to ensure the micropile installation and column support were fully integrated with the new construction components and the excavation support system.

EXCAVATION SUPPORT

In addition to the deep foundations installed at the project site, Berkel provided design-build services for support of excavation. A temporary soil nail wall was used to support the 8-foot cut along the front wall of the existing structure. A soldier-pile-and-lagging wall was installed around the perimeter of the remainder of the site behind the main building to facilitate the construction of the underground parking structure.

Four hundred and sixty seven soldier piles up to 70 feet in length were drilled and installed around the site. A Bauer BG 15 and BG18 were used to drill the pilot holes in which the soldier piles were set at a total rate of about 15 per day.



▲ Load transfer from column to new micropiles



▲ Micropiles braced as site excavated



▲ Micropiles supporting existing masonry wall



NOT ALL ROCK DRILLING TOOLS ARE THE SAME NEVER SETTLE FOR LESS THAN NUMA.

Stop playing games with inferior tools. Numa's dependable, Made in the USA DTH and HDD hammers, bits, and accessories deliver performance and dependability, all without sacrificing tool life. With a drilling range of 3½" to 50½" (89 - 1283 mm), we have the right rock tools for you. Contact Numa today.



NUMA
HAMMERS AND BITS



www.numahammers.com • 800.356.NUMA



▲ Soldier pile and lagging wall with underpinned building

◀ Installation of tieback anchors

Excavation depths varied from about 40 feet immediately adjacent to the existing structure up to 62 feet at the rearmost portion of the site. Multiple excavation support methods were employed to maximize system efficiency. The primary method of lateral support was tieback anchors with up to five rows at the deepest excavations. About 16 anchors were installed per day using Klemm 806 drilling rigs.

Drilling beyond the property boundaries was not possible on all portions of the site. Where it was not, internal bracing and rakers with heel blocks were employed to resist lateral earth pressures. In total 110,000 square feet of support was supported by 601 tiebacks and over 180 tons of internal steel bracing.

TESTING & MONITORING

To confirm the axial capacity of the micropiles, one sacrificial pile was installed and tested in compression to 250% of the design load (250-ton maximum load) in general accordance with ASTM D1143, Procedure A: Quick Load Test. Following

this compression test, shear studs were attached to the sacrificial pile and a concrete cap was poured around it. Load was then incrementally applied to the cap up to the design pile capacity of 100 tons to ensure that the shear stud connections to the micropile had sufficient capacity for the required load transfer.

ECS provided 24-hour, continuous monitoring to ensure project-movement limits were not exceeded. Prisms were placed on top of each of the supported columns inside the building and on every third soldier pile. Multiple total-station survey instruments were set up around the site. The total stations were programmed to turn to each prism on a regular basis, survey the point in question and automatically upload data for review by the project team.

RECOGNITION

The work described in the article was recognized as a 2020 Craftsmanship Award winner in the Sitework category for Underpinning, Foundations,

and Excavations by the Washington Building Congress (WBC). The WBC was established in 1937 as a commercial trade association that emphasizes cooperative efforts to solve common problems. It includes businesses from the real estate, design, and construction community. The Craftsmanship Awards Program was created to honor exceptional workmanship on buildings throughout the Washington D.C. area and awards are made for a wide range of skills. It is the only program in the D.C. region that recognizes the outstanding skills and achievements of individual craftsmen in the commercial construction community. The awards, in their current format, have been presented since 1956.

CONCLUDING REMARKS

The efficacious implementation of the proposed foundation and excavation support system was only possible because of constant communication and collaboration between all of the design and construction professionals comprising the project team who worked together to ensure the project met the needs of the owner while preserving the

historic nature of the existing Fannie Mae building. The unique challenges of the project were met with a cooperative team design approach along with the craftsmanship of the field personnel, which led to a successful project outcome. ▲

AUTHORS

Richard Guenther is an engineer in Berkel's structural engineering office. He has over 10 years of experience designing deep foundation and shoring systems.

Morgan NeSmith is Berkel's Director of Engineering with over 20 years in the geotechnical design and foundation construction industry.

PROJECT TEAM MEMBERS

Developer/Owner: Roadside Development and North America Sekisui House (NASH)

Architect: Shalom Baranes Associates

General Contractor: The Whiting-Turner Contracting Company

Structural Engineer: Tadjer Cohen Edelson Associates

Geotechnical Engineer: ECS Mid-Atlantic, LLC

WWW.TECTONICENGINEERING.COM
TEL. 800-829-6531

Corporate: Mountville, NY
Metro NYC: Forest Hills, NY



- GEOTECHNICAL ENGINEERING
- SUBSURFACE INVESTIGATION
- SOIL & ROCK MECHANICS
- PILE LOAD TESTING & INSPECTION
- VIBRATION MONITORING
- CONSTRUCTION MATERIALS TESTING
- THIRD PARTY INSPECTIONS
- SURVEY LAYOUT
- GROUND PENETRATING RADAR (GPR) FOR UTILITY LOCATIONS

Tectonic

PRACTICAL SOLUTIONS. EXCEPTIONAL SERVICE.
NY | NJ | CT | PA | VA | FL | AZ | CA