MICROPILE SUPPORT OF THREE UNDERMINED BUILDINGS IN WASHINGTON, D.C.

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INTRODUCTION:

The American Trucking Association (ATA), owner of three buildings located in the vicinity of the United States Capitol at Capitol Hill, coped for years with limited parking and office space. Two buildings that were constructed in 1893 and 1910 fell under the historic protection act and therefore could not be demolished. The four story building constructed in 1972 was the only building providing usable office space (see Figure 1). City regulations added a unique twist to the improvement plans of the architect. The only building cleared for demolition had one more floor level than a new building permit would have allowed. The two other buildings had to keep the original structure and its façade. To solve this dilemma the architect decided not to demolish the 1972 building and instead designed a 2 ½ story underground parking garage in conjunction with a redesigned floor plan for the existing buildings. The underground parking garage would be build underneath all three existing buildings. The challenge was to design a sufficient support system for all three buildings. Micropiles were selected to provide the vertical support. Forrester Construction Company selected Schnabel Foundation Company to design and built a support of excavation extending the outside perimeter of the foundation wall beyond the existing building foundations with an overall depth of 10.5 meter (35 feet). This work was performed with conventional drilled in soldier beams, tiebacks, underpinning, bracket piles and lagging.

Figure 1: Upper left building was built in 1972; Lower right building was built in 1893

DESIGN CONSIDERATIONS:

SFC designed a micropile support pattern with an average micropile load of 318 KN (71.5 kips) per micropile. 1 ½ meter (five foot) casing lengths were used for the micropile installation based on a 4.3 meter (14 foot) ceiling height and a very narrow approximately 4.6 meter (15 ft) bench. SFC installed a total of 58 micropiles all located underneath the buildings. HP soldier beams were used where unobstructed overhead allowed for the use of conventional drilling equipment. This was the case for all building perimeter piles.
Pertinent details of the design and construction are listed below:

1. FHWA, AISC
2. design load of 318 KN (71.5 kips)
3. total micropile length of 19 meters (or 62ft)
4. micropile casing diameter of 24.45 centimeters ($9^5/_8$“)
5. micropile casing wall thickness of 1.38 centimeter (0.545”)
6. 12.2 meter (40ft) casing per micropile
7. 9.2 meter (30ft) of #11 bar in the bonded length with an overlap of 2.4 m (8ft) to the casing
8. bonded length of 6.7 meter (22 ft).
9. Intermediate lacing to the adjacent micropile cluster.
10. Medium Dense Clayey Sand for the overall depth of the bonded length of all micropiles with blow counts of 22 to 27

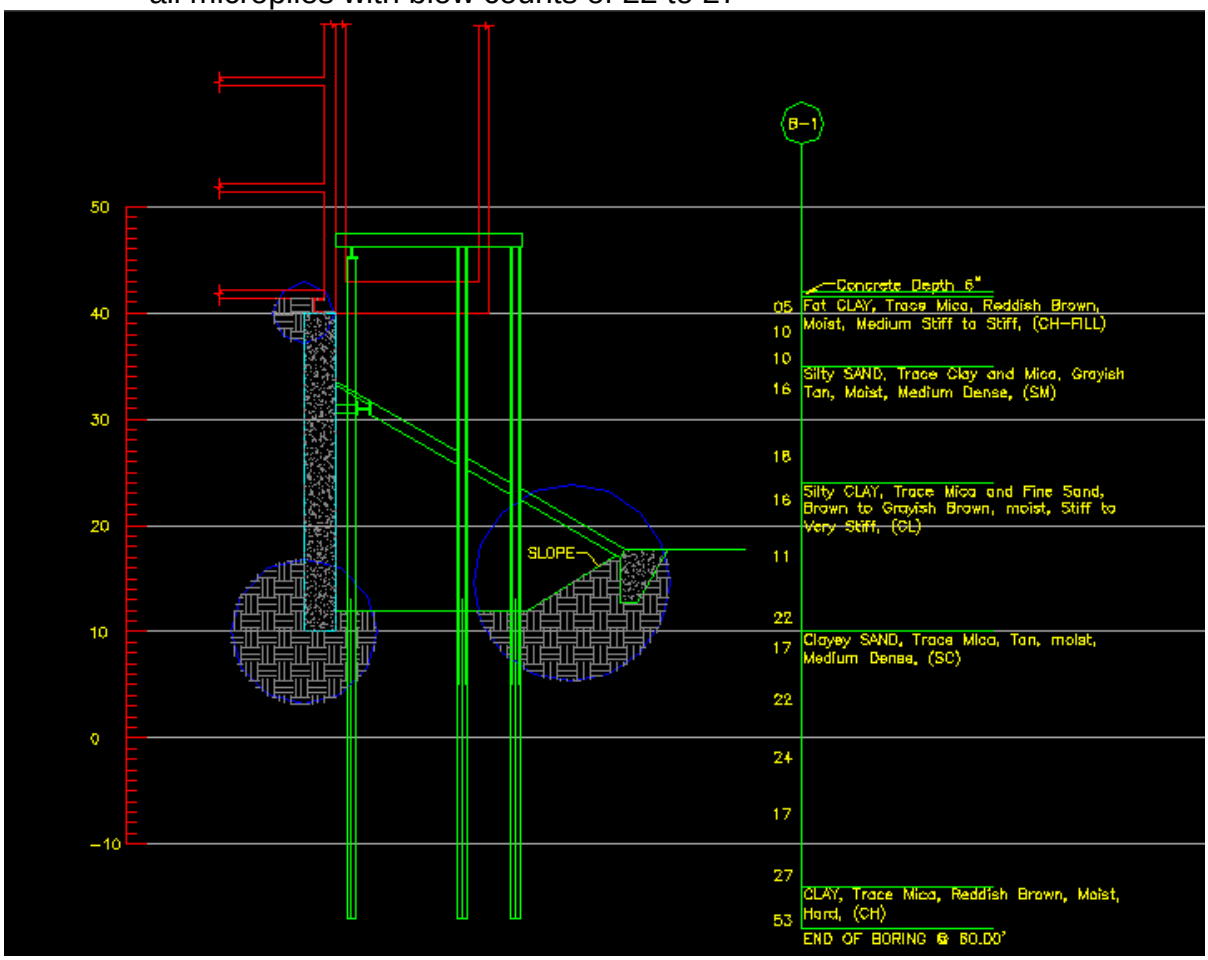

Figure 2

All micropiles shared the same design parameters:
All micropiles were designed to provide lateral stability of up to 11.7 meter when excavated.
SFC installed the majority of micropiles within micropile clusters of two. One cluster of micropiles supported one needle beam to be dry packed to the bottom of the shear wall or column to be supported.
Figure 3 shows the micropile locations and the support of excavation system in plan view.

Figure 3 Overlay of Construction Drawings and a Satellite picture

Legend:

Conventional Underpinning

Heel Block with Brace

Drilled in Soldier Pile

Micropiles

Tiebacks

INSTALLATION METHOD AND LIMITATIONS:

SFC used two different drill rigs, a Kemm KR702 Mini Drill (Figure 4) and a Hutte 202. The Hutte 202 was powered by an electric engine connected to a swivel/ flange adapter allowing the discharge of spoils through a 15 cm hose into a containment box located at the outside perimeter of the buildings. The discharge of spoils into the basement was not possible. All micropiles were tremie grouted.

Figure 4 Micropile Drilling Operation

MICROPILE TESTING

One successful micropile test was performed with an incremental loading up to 200 % of the design load. A HP14x102 beam and the existing shear wall were used to counteract the load imposed on the micropile. (See Figure 5 and 6) Test results are shown in Figure 7.

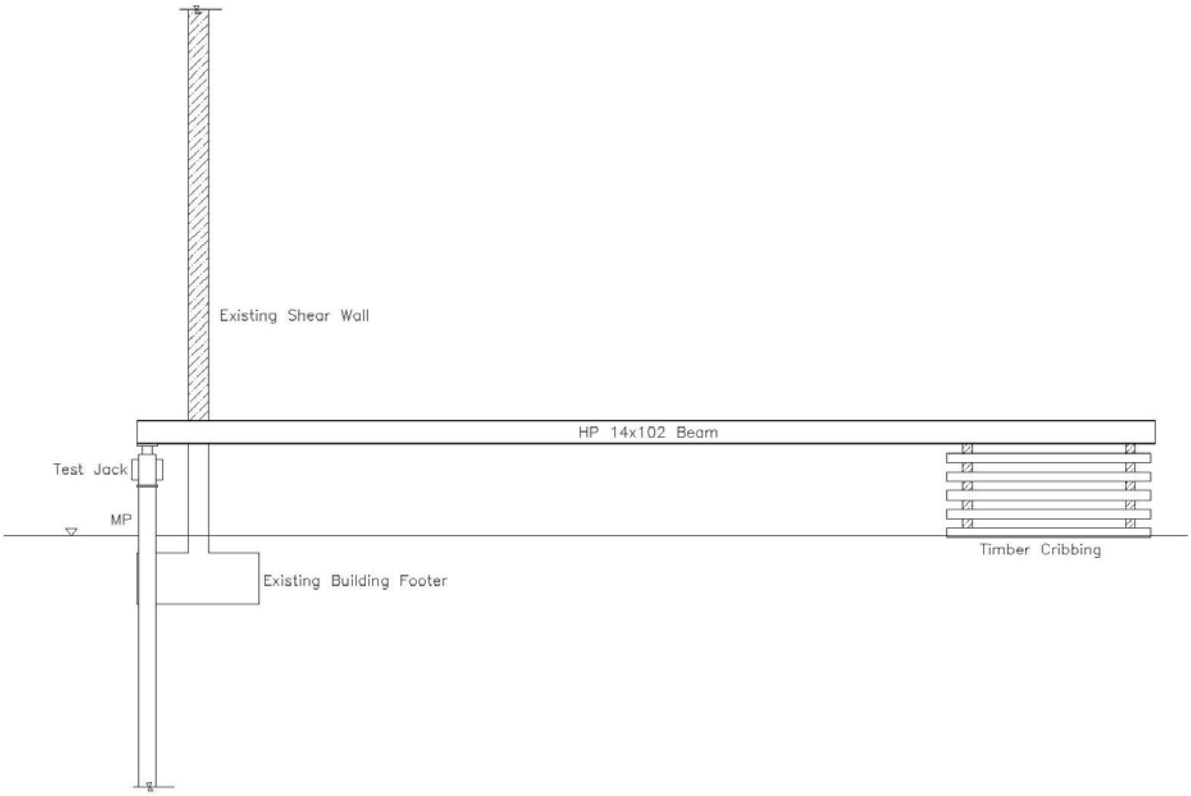

Figure 5 Micropile Test Setup

Figure 6

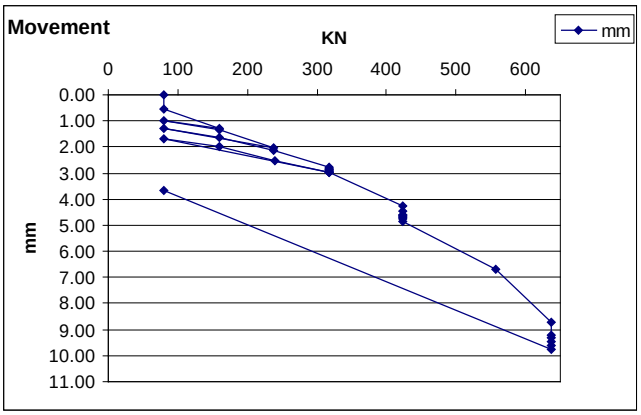

Figure 7

CONCLUSION

The installation of the micropiles was finished within a time frame of 1.5 months. The work was carefully phased in conjunction with the proposed excavation sequence. HP soldier beams were used for building perimeter soldier beams. Virtually no settlement was recorded at the foundation level of all buildings.

The multipurpose use of micropiles functioning as a foundation support as well as a free standing column provides a new dimension to the constructability of complicated projects like the American Trucking Association. Other support systems might have increased the installation time as well as decreased the available space for the construction of the proposed structure. Interference with formwork and new concrete columns was minimized through the successful use of micropiles as the vertical support system for the three existing buildings.

Figure 8

Figure 9