TOBIN SCHOOL & VASSAL LANE UPPER SCHOOLS

Location: Cambridge, MA

Project Type: School

DUROTERRA™

DUCTILE IRON PILE ADVANTAGES

- Easily adjust to variable termination depths
- Driven system to penetrate landfill materials
- Displacement process with no spoils to minimize impacts of contamination
- Compatible settlement with ground improvement
- Low vibrations for installation near shoring

PROJECT DESCRIPTION

Following demolition of an existing school, new construction consisted of a 4-story, 359,000 square foot state-of-the-art, consolidated school campus. The project features two gymnasiums, a 400-seat auditorium, classrooms and administrative offices. The project is a Net Zero Ready building offering one of the most sustainable and energy-efficient schools in Massachusetts. A basement level required shoring where layback areas were not possible.

GEOTECHNICAL CONDITIONS

Soil conditions consisted of up to 12 feet of granular fill followed by up to 30 feet of waste fill (former landfill with sand, including bricks, cinders, ash, coal, slag, metal, glass, wood and other debris) and up to 5 feet of organic soils. The fill and organics were then underlain by very soft to hard marine clay and silt. Glacial till and rock (Argillite) were encountered below the clay at depths of up to 82 feet below grade.

PROJECT CHALLENGES

Provide a rapid, low vibration displacement pile to penetrate the landfill and develop capacity in the deeper glacial till and/or rock zones, while maintaining settlement compatibility with the ground improvement system.

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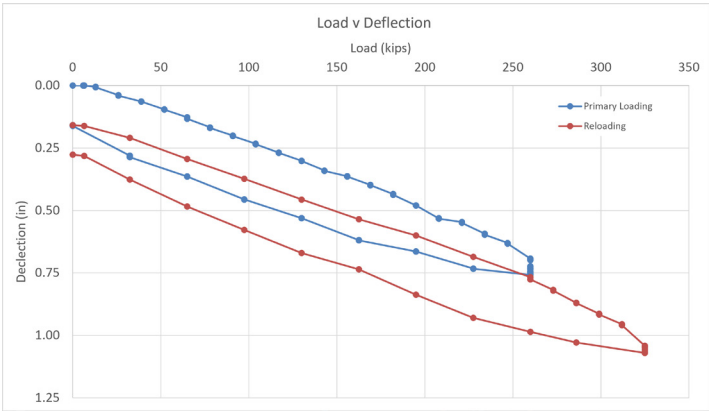
DESIGN AND CONSTRUCTION SOLUTION

Original plans featured shallow foundations designed for ground improvement support using rigid inclusions. Due to the significant depths to penetrate the fill, organics and soft clay, an alternative foundation support solution was needed in a portion of the site where the competent glacial till / rock extended the deepest. It was critical that the pile foundation maintain settlement compatibility with the ground improvement system to reduce differential settlement between the areas.

A Ductile Iron Pile solution was selected because the piles could be driven through the landfill material without generating any contaminated spoils. In addition, the DIPs could be installed using an exterior grouted approach to develop grout encapsulation around the piles for enhanced corrosion protection and mitigate contaminant transport along the pile while also providing greater tension resistance. The deflection characteristics of the DIPs would also be similar to the rigid inclusion system being used elsewhere on the project.



A Series 170/9.0 Ductile Iron Pile was designed with a 270 mm (10.6") diameter grout shoe. A #8 (Grade 75) centerbar was wet-set into the pile after installation. Each DIP was designed to resist 65 tons (compression), 20 tons (tension) and 2 tons (lateral). A 52 ft long DIP test pile and DIP reaction piles were installed for load testing. Results of the test showed approximately 0.3 inches at the design load. The test was loaded up to 260 kips (200%), unloaded and then reloaded up to 325 kips (250%) to observe performance at higher loads. The pile response was nearly linear with a maximum deflection of 1.07 inches and a net deflection of only 0.28 inches after unloading.

With the successful load test complete, Helical Drilling, Inc. installed production piles with the Montabert V1800 hammer. A total of 217 piles were installed in 27 work days, averaging over 500 LF/day. Pile lengths ranged from 39 to 123 feet as glacial till and rock dipped across the area. A number of the piles were installed in close proximity to the shoring system without any issues from vibrations.

PROJECT TEAM

DIP Design/Build Installer: Helical Drilling, Inc.
DIP Designer: GZA GeoEnvironmental
Geotechnical Engineer: CDM Smith
CM-at-Risk: W.T. Rich
Structural Engineer: FBRA
Architect: Perkins Eastman