PHILLIPS EXETER ACADEMY BUILDING EXPANSION

Location: Exeter, NH

Project Type: School

DUROTERRA™

DUCTILE IRON PILE ADVANTAGES

- Low vibrations
- Rapid installation compared with micropiles
- Capacity in end-bearing or friction
- Work adjacent to shoring on active, constrained site
- Modular system to minimize space for laydown

PROJECT DESCRIPTION

The renovation of the Academy Building on the Phillips Exeter Academy campus will create 45 refurbished classrooms, a new design lab, and a 1,300 seat Assembly Hall. As part of the renovation, two new 19-ft by 27-ft shear wall mat foundations connected with grade beams were required. Static bearing pressures on the mat were generally around 3,000 psf but seismic overturning resulted in pressures exceeding 7,000 psf.

GEOTECHNICAL CONDITIONS

Soil conditions consisted of up to 7 feet of loose sand fill underlain by loose to medium dense silt and fine sand extending to about 30 feet below grade. A thick deposit of soft to stiff silty clay and silt was encountered from about 30 feet to 80 feet where silty sand (glacial till) was encountered. The glacial till was initially medium dense and increased in density with depth. Groundwater was encountered at 16 feet below grade.

PROJECT CHALLENGES

Provide a low vibration, cost-effective foundation solution to support the high mat pressures on a constrained site.

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DESIGN AND CONSTRUCTION SOLUTION

A deep foundation solution was needed to support the two mats subjected to the high overturning pressures. The piles needed to be installed within the shored-excavation which was adjacent to the existing Assembly Building undergoing renovations. HUB Foundation was performing underpinning and shoring work for the project and discussed the option of installing Ductile Iron Piles for foundation support with the project team.

The project was ongoing and developing, testing and installing the deep foundation solution was critical for schedule. The team initially considered a dry installation with a Series 118/9.0 pile driven to terminate in glacial till / rock. While this approach would result in a high capacity, pile lengths would approach 90 feet. The pile designer for the project considered an alternative approach using exterior grouted Ductile Iron Piles to develop capacity in friction in the upper soils to create a piled raft foundation. The friction pile consisted of a 220 mm grout shoe driven with the Series 118/9.0 pile.

Load testing was performed on both pile options as the design team worked to develop a solution. The dry pile was driven to a depth of 90 feet where it achieved a set of 50 seconds/1 inch. The test was performed to 200 kips (200% of a maximum design load of 50 tons). The response showed about 0.7 inches of deflection at the design load and about 1.5 inches of movement at the maximum test load with linear behavior for both the loading and unloading cycles. The exterior grouted pile was installed with 2 sticks (32 feet) and included a centerbar which was wet-set into the grout so the pile could be tested in tension. The tension test performed well and confirmed the friction pile design capacity.

With performance data for both end-bearing and exterior grouted friction Ductile Iron Piles, the design team analyzed the mat foundations. A design approach was developed featuring 32 friction piles with lengths of 50 feet for support of each mat for a total of 64 piles. The exterior grouted piles were installed with an Epiroc EC140T (Atlas Copco MB1700) hammer mounted on a John Deere 210G LC excavator. Following installation, centerbars were wet-set into the piles to provide both compression and tension capacity.

PROJECT TEAM

DIP Installer: HUB Foundation
DIP Designer: McPhail & Associates, LLC
Geotechnical Engineer: S.W. Cole Engineering, Inc.
Structural Engineer: Thornton Tomasetti
General Contractor: Consigli Construction