ENTERGY SUBSTATION UPGRADES

Location: Rolling Fork, MS

Project Type: Industrial

DUROTERRA™

DUCTILE IRON PILE ADVANTAGES

- Cost savings compared with helical piles
- High capacity compression and tension load resistance
- Innovative combination with ground improvement to limit foundation costs
- Rapid turn-key operation (design through installation)

PROJECT DESCRIPTION

Upgrades to the existing Entergy Services 115kV Substation included foundations for new transformers, transmission line towers and other supporting structures. Many foundations were isolated, lightly-loaded foundations, while others included larger mat foundations.

GEOTECHNICAL CONDITIONS

Subsurface conditions consisted of soft to medium stiff silty clay and loose silt extending up to 11 feet below grade followed by very soft highly-plastic clay extending up to 46 feet below grade. The clay was underlain by medium dense sand to the maximum explored depth of 50 feet. Groundwater was about 10 feet below grade.

PROJECT CHALLENGES

Provide a cost-effective solution for support of both compression and tension loads for heavily-loaded mat foundations.

DESIGN AND CONSTRUCTION SOLUTION

Loading demands on many of the foundations required compression, tension and lateral resistance. The project was originally specified for pile caps supported by helical piles. Inadequate field performance during load testing combined with a high foundation cost steered the design team toward alternative options.

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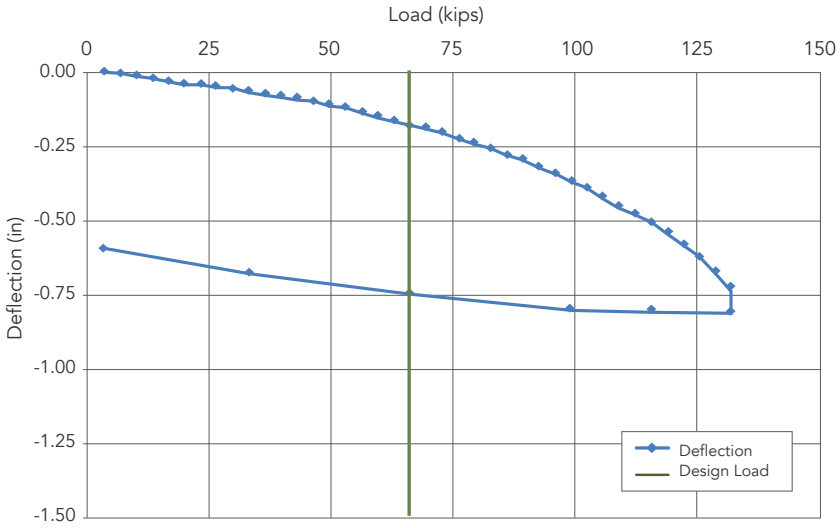
Representatives of Geopier Foundation Company worked with the project team to develop an approach featuring Geopier® Ground Improvement combined with Ductile Iron Piles for foundation support. The Geopier Impact™ system was planned to control settlements of isolated, lightly-loaded foundations, while Ductile Iron Piles were designed to support the more heavily-loaded mat foundations by providing compression, tension and lateral load resistance.

The Ductile Iron Pile design featured Series 118/7.5 piles (118 mm diameter with wall thicknesses of 7.5 mm) with an oversized 220 mm conical end cap. During pile driving, the oversized end cap creates an annular space that is filled with sand cement grout by pumping grout through the pile and grout ports in the bottom cap. The end result is a fully-grouted pile that develops substantial grout-to-ground bonding for friction capacity. Piles were driven to completely penetrate the very soft clay and extend into the medium dense sand a minimum of 15 feet to develop sufficient frictional capacity in the sand layer. Following installation, a high strength 1" Grade 150 ksi threadbar was inserted into the full length of pile to resist tension loads. The Ductile Iron Piles were designed for working loads of 66 kips (compression), 37 kips (tension) and 5 kips (lateral).

Peterson Contractors, Inc. initially performed load testing at the site to confirm the design performance of the friction Ductile Iron Pile solution. The compression load test showed deflections of 0.18 inches at the 100% design load of 66 kips and 0.81 inches at the 200% design load of 132 kips. Monitoring of the tension reactions during the test showed about 0.05 inches of movement at the 100% tension design load of 37 kips and about 0.10 inches at 175% of the tension design load. Following successful load testing, a total of 94 production piles were installed with lengths on the order of 65 feet in less than 2 weeks on the site.

The use of the DIPs provided an economical approach to supporting the large substation foundations with compression, tension and lateral demands. Combined with the Geopier Ground Improvement for the lighter foundations, the design build solution resulted in substantial value to the project.



PROJECT TEAM

DIP Installation Partner: Peterson Contractors, Inc.
DIP Design Partner: Geopier Foundation Company, Inc.
Geotechnical Engineer: SoilTech Consultants
General Contractor: Harvey Construction Company
Structural Engineer: Ampirical Services, Inc.