Drilled Shafts
Cutter Soil Mixing
Metro Exposition Line
Culver City, California

MALCOLM
Deep Foundations

CONSTRUCTION PERIOD
May 2009 to March 2010

CLIENT
Owner: LA County Metropolitan Transportation Authority
Contractor: FCI/Fluor/Parsons

SERVICES
5 EA 15 FT Dia. Drilled Shafts with CSM Stabilization Ring to 112 FT depth

18 EA 11 & 12 FT Dia. Drilled Shafts with Polymer Stabilizing Fluid up to 92 FT depth

Benefits of Cutter Soil Mixing (CSM) Stabilization

- Eliminates the need for shaft stabilization by drilling fluids or steel casing
- Shaft installation in dry possible if groundwater is cut off
- “Mass Concrete” placing requirements can be waved due to reduced ground temperature differentials

CONTACT MALCOLM
This job was managed by our Southern California Division in Irwindale, California.
For a complete list of office locations and technologies, visit **Malcolmdrilling.com**

Project Overview

Phase 1 of the Metro Exposition Line project is an 8.6 mile extension of the 73 station Metro Rail System in Los Angeles. It terminates in West Los Angeles at the Venice/Robertson Aerial Station, which is an aerial structure supported by 11, 12 and 15 feet diameter drilled shafts with depths of up to 112 feet. The 15 feet diameter shafts were constructed by stabilizing the surrounding soil by injecting grout using the Cutter Soil Mixing (CSM) technology. The 11 feet and 12 feet diameter shafts were constructed using polymer drilling fluids for shaft stabilization.

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Construction Details

Eight CSM panels were installed in an octagonal pattern around each 15 ft diameter shaft with the ends overlapping by 3.5 ft to form a compression ring. Each panel was about 9 ft long and 3.3 ft wide and extended to depths of 118 ft below ground surface. The CSM method of soil mixing injects large amount of cement into the ground while shearing off the native soil matrix with counter rotating cutting blades.
An in-Situ, high strength and low permeability soil ring around the perimeter of the shaft was formed. This ring eliminated the risk of caving ground conditions. It also resulted in a much higher temperature than the surrounding native soil, thus reducing the temperature differential between the drilled shaft concrete and the stabilizing ring at the perimeter of the shaft. This lower temperature differential eliminated the requirement to install cooling lines in the drilled shaft, which was a part of the project's Mass Concrete specification.

Since the CSM panels did cut off the natural water table, shaft construction in the dry was possible. This eliminated the need for drilling fluid stabilization or the use of large diameter steel casings.

Ground Conditions

Conditions at the site comprised of alluvial soils, extending to the full depth of the pile foundations. The alluvial soils were comprised of intermittent layers of silty clay, clayey sand, silty sand, and clayey silt. Groundwater was encountered at approximately 25 feet below ground surface.

Quality Control

The integrity of the drilled shafts was determined by both Gamma-Gamma (GGL), and Cross-Hole Sonic Logging (CSL). Polymer slurry was used to stabilize the open shaft excavation for the 11 ft and 12 ft shafts with the slurry meeting quality specifications through carefully controlled slurry exchange procedures. Slurry was not necessary at the 15 ft shafts since they were stabilized with the CSM panels.

The Thermal Control Plan for shafts larger than 14 ft in diameter required a concrete mix with 40% fly ash to minimize concrete curing temperature during hydration in order to control temperature differentials between the shaft and surrounding soil, as well as temperature sensors within the shafts. These requirements were eliminated due to the use of CSM panels.

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