Cutter Soil Mixing

San Joaquin Delta, California

MALCOLM
Retention Systems

CONSTRUCTION PERIOD
January to June 2009

CLIENT
Owner: Contra Costa Water District
General Contractor: Ranger Pipeline

SERVICES
Design and Install CSM Microtunnel Access Shafts

- Jacking Shaft 27'ID x 90' deep
- Receiving Shaft 20' ID x 51' deep

Benefits of Cutter Soil Mix System

- In-situ soil is used as a construction material.
- High compressive strengths can be achieved.
- Vibration-free construction method.

Project Overview

In 2008, the Contra Costa Water District started construction of a new Alternative Intake Project (AIP) near its existing pumping facilities in the San Joaquin Delta region of California, east of the San Francisco Bay. The new AIP project was designed to divert raw water from the new intake pumping plant through a new 72 inch pipeline. An approximate 900 ft section of this new pipeline crosses under the Old River. Construction of the crossing required the installation of a 96 inch steel casing using microtunnel pipe-jacking techniques. The microtunneling operation required a 90ft deep jacking shaft and a 70ft deep receiving shaft. Malcolm Drilling designed and built these access shafts utilizing the Cutter Soil Mix (CSM) Method.

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

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Construction Details

Malcolm installed the CSM panels at the receiving shaft first and then moved over to the jacking shaft. Slurry from the CSM process was pumped to a temporary storage basin and then relocated to the final on-site disposal site. Wet grab samples were obtained from each panel during construction to allow compressive strength testing. Excavation and shotcrete proceeded on an approximate 3-day cycle for each 5ft lift. When the bottom of the shaft elevation was reached, a reinforced concrete seal slab was installed followed by more heavily reinforced shotcrete structures accommodate the tunnel penetrations and the MTBM jacking forces.

Ground Conditions

In general, the site soils consist of thin deposits of peat and organic soils underlain by older alluvial soils to great depth. The alluvial soils include silt and clays (flood plain deposits) interbedded with sands.

Design Details

The Contract documents required that the shafts be watertight with a maximum permissible inflow of 10 gpm. Large scale dewatering of the site was not permitted due to concerns about consolidation settlement that would

occur as a result of reduction in pore pressure caused by the dewatering. Malcolm Drilling proposed that the primary support for both shafts consist of a series of overlapping soil-cement panels to form a pre-installed compression ring designed to resist a combination of at-rest soil pressure, groundwater pressure and construction surcharge loading. Due to the fact that this was the first project in the United States where unreinforced CSM panels were being used to create a compression ring structure, Malcolm installed supplemental ground support in the form of wire-mesh reinforced high early strength shotcrete over the lower 50 ft in a top-down sequence. The shotcrete lining also served to hold down the cast-in-place reinforced concrete seal slabs that were constructed at the base of each shaft.

The CSM Method

The CSM system is a modified trench cutter “Hydro Mill” type machine. Unlike conventional soil mixing techniques that utilize end mixing mechanical tools (depending on mechanical mixing between shear blades in axial motion), the CSM system utilizes a set of milling wheels working in the vertical plane. This mechanical action shears the soil into small particles and blends it with injected grout or other cutting fluids into a homogeneous mix. The CSM machine has a very stiff non-rotating Kelly bar attached to a base machine. The stiff Kelly, coupled with inclinometers in the “cutter head” allow the cutter head to be steered in the “X” axis by altering wheel speed and in the “Y” axis by the base machines parallelogram.