Rotator/Oscillator

Benicia Martinez Bridge

Carquinez Strait, CA

MALCOLM
Deep Foundations

CONSTRUCTION PERIOD
August 2003 to November 2004

CLIENT
Owner: California
Department of Transportation (CALTRANS)
General Contractor: Peter Kiewit and Sons

SERVICES
Drilled Shafts

99 EA 7 ft Dia. Rock Sockets with depths of over 200 ft

Project Overview

Construction of this bridge to carry I-680 over the San Francisco Bay at the Carquinez Strait between the cities of Benicia and Martinez, CA was delayed for more than a year due to constructability challenges relative to the specified rock socket excavation techniques.

Permanent Steel Casings were installed through the water (depths over 60 ft), and soil into bedrock. The sedimentary bedrock underlying the project location consisted of zones of intensely fractured rock with very steep fracture angles along with zones of fresh more competent rock with unconfined compressive strengths in excess of 5,000 psi.

The contract specified the use of polymer drill slurry to stabilize the sidewalls of the rock socket but this technique proved ineffective in the highly fractured rock zones. “Drill and Fill” shaft construction (technique of replacing voids created by rock socket cave-ins with concrete) did not facilitate completion of the rock sockets.

Benefits of Rotator Oscillator System

Vibration-free installation of temporary or permanent casing

Enables shaft construction in caving or unstable soil and rock to depths exceeding 200 ft

Fully-cased construction enhances shaft quality and reduces risk on non-conformities

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

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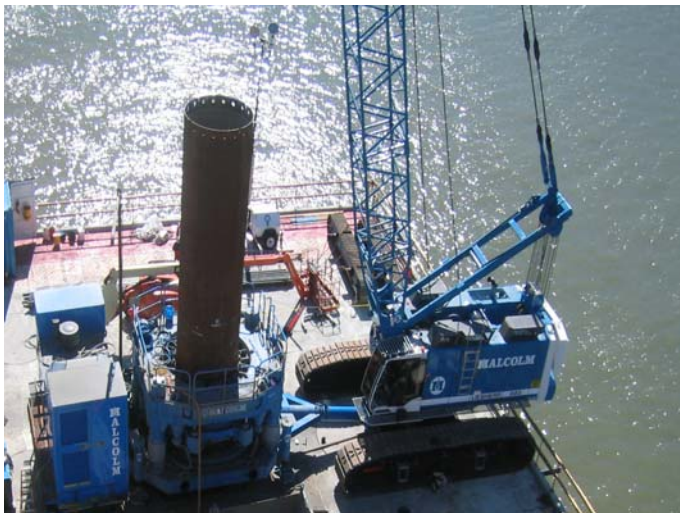
Construction Details

Malcolm Drilling was added to the project team based on their unparalleled experience in Oscillator / Rotator construction and state of the art equipment fleet in order to advance the construction of the bridge.

Work platforms were installed on top of the 8 permanent casings located at each bridge pier location. Two equipment spreads each comprised of a duty cycle dig crane and a 3.0 meter Leffer Rotator worked simultaneously for 22 to 24 hours a day in order to prevent further delays to the construction schedule.

Fully cased excavation of the rock sockets was made possible by the tremendous amount of torque (3 million ft-lbs) and down pressure supplied by the rotator. Carbide drill teeth installed at the tip of the temporary casing permitted the casing to remain ahead of the socket excavation at all times during construction.

The drilled shaft rebar cages were constructed with an internal support system making them free standing allowing for easier concrete placement while extracting temporary casing. Concrete for the drilled shafts was delivered to the work platform by barge.



With over 1 million pounds of extraction force, the rotator was able to remove the temporary casing while maintaining as much as 40’ of concrete above the bottom of the casing.

Ground Conditions

The soils overlying the bedrock unit consisted of loose fine sands and silty clays. The bedrock unit was comprised of a interlayered zones of siltstones and sandstones. The weathering of this material ranged intermittently from intensely weathered to decomposed to fresh with a maximum unconfined compressive strength of approximately 9,000 psi. RQD values ranged from 0-100%. Full length temporary casing was ultimately required to successfully complete large diameter drilled shafts in this material

Quality Control

The shaft integrity was tested using Gamma-Gamma Logging and detected no anomalies within the rock sockets.

An Osterberg load cell confirmed the capacity of the rock sockets. The results of this load test demonstrated that the shafts performed well within industry standards in this type of bedrock. (Katzenbach 2004)