Cutter Soil Mixing MEGA-Jet Grouting

Alaskan Way Viaduct Seattle, WA

MALCOLM
Ground Improvement

CONSTRUCTION PERIOD
January 2011 to May 2012

CLIENT
Owner: Washington State Department of Transportation
General Contractor: Skanska USA

SERVICES

291 EA CSM Panels up to 106 FT depth

70 EA MEGA-Jet Columns up to 8 FT Dia.

30 EA Drilled Shafts 10 FT Dia.

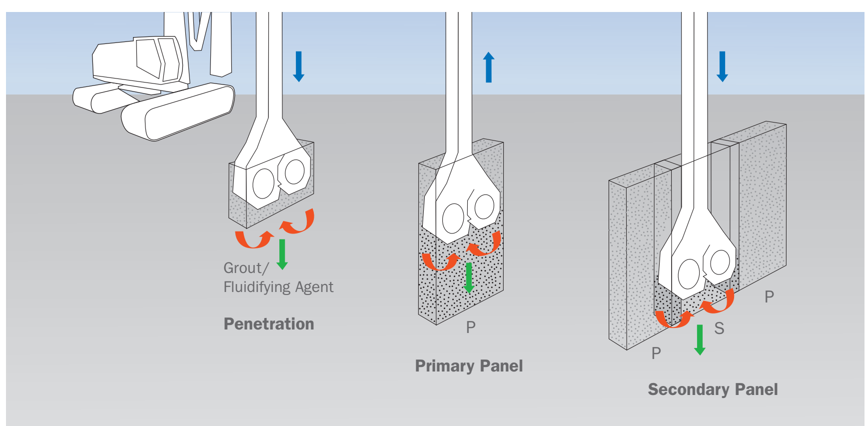
Benefits of Cutter Soil Mixing

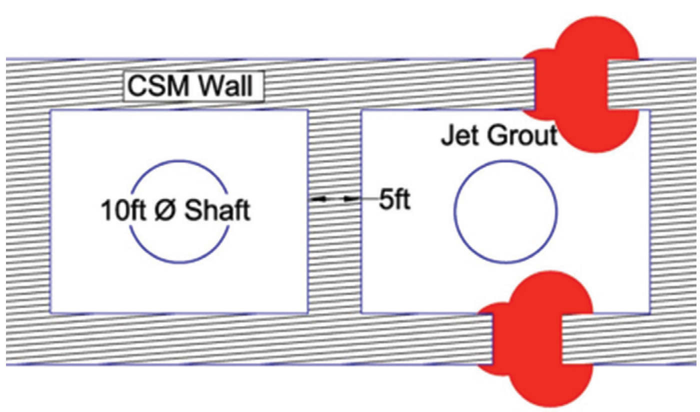
- Counter rotating cutter heads can cut and mix through difficult soils
- Closely spaced shear blades ensure a homogeneous soil-cement mixture
- Rectangular panels are ideally suited for constructing straight walls
- Instrumentation inside the cutting heads monitors x, y and z coordinates in real-time
- Ability to key into underlying bedrock

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

Project Overview

Seattle's Alaskan Way Viaduct carries thousands of vehicles to and from downtown, two major stadiums, and the Port of Seattle each day. Its increasing age and vulnerability was apparent by crumbling concrete, exposed rebar, weakening column connections and deteriorated railings. This section of the Viaduct between South Holgate and South King streets was built on unstable soil that could liquefy in an earthquake and its foundation piles did not penetrate deep enough into solid ground. Consequently, the Viaduct's south end was vulnerable to an earthquake and needed to be replaced. The southern mile of the Alaskan Way Viaduct was replaced with two new side-by-side bridges that meet current earthquake standards, have wider lanes and improve mobility for people and goods in the south of downtown area. These new bridges are supported on a hybrid foundation system consisting of drilled shafts encompassed by deep cement soil mixed confinement cells. The combined system of drilled shafts and ground improved confinement cells helps mitigate against the effects of soil liquefaction down-drag during seismic activity and protects the drilled shafts from global lateral spreading,





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Construction Details

Cutter Soil Mixing (CSM) panels were installed to depths of 106 ft to ensure confinement of the new drilled shafts and protect against soil liquefaction. The design required that the outer wall thickness be a minimum of 5 ft. In order to meet the wall thickness requirement with a single mixing pass a custom set of 5 ft wide cutter wheels were designed and fabricated specifically for this project. This width of CSM panel had never been attempted and established new criteria with respect to what is achievable with modern equipment. A modified two-phase cutting technique was used to complete installation of the deep panels while conventional single phase cutting was used for all shallow panels.

Demolition of the viaduct and construction of the new bridges was performed in two phases in order to maintain existing traffic patterns. Joining the two phases of CSM confinement cells together would have resulted in a construction cold joint. Upon completion of the phased CSM work, MEGA-Jet Grouting was employed to mate the two phases of work together. At the phased joint jet grout columns were installed in a ball-joint or knuckle configuration to fully encapsulate the phase interface and provide a robust continuous wall without any structural deficiencies.

This project established a new benchmark and parameters for CSM panel construction to widths of 5 ft and depths exceeding 100 ft. Ground conditions were ideal for the modified large cutter head's maiden trial. Installation sequence and panel layout were optimized; the quality of the soil-cement was second to none. Malcolm's unique ability to employ state-of-the-art CSM, MEGA-Jet and Oscillator technology on the Alaskan Way Viaduct ensured the commercial and technical success of this critical project.

Ground Conditions

The south Seattle waterfront sits upon reclaimed lands comprised of decades of undocumented fills, debris, and various organic deposits. Within the upper reaches of the soil profile, numerous timber piles and buried trestles or railroad ties were encountered. The various fill deposits overlay soft and loose marine sediments that bear on glacial till at depths that ranged from 51 ft below grade at the north end of the project to 106 ft at the south end. Depth to groundwater was subject to tidal influence and was as shallow as 6 ft below working grade.

Quality Control

The combination of MEGA-Jet Grouting with CSM panel installation provided a means of overcoming buried obstructions when encountered that would otherwise be difficult with CSM techniques alone. Similarly, panel installation around an existing and active rail spur was not possible with CSM without decommissioning and removing the spur, while jet grouting provided a means to drill from an angle at either side of the rail line to create a continuous containment wall beneath it. Continuous cores and in-situ wet grab samples provided verification of the wall strength and continuity throughout its depth.