

# Deep Soil Mixing

Portland Avenue  
Tacoma, WA



# MALCOLM

Ground Improvement

## CONSTRUCTION PERIOD

April to October 2015

## CLIENT

Owner: WSDOT

General Contractor: Hamilton Construction

## SERVICES

349 Ea. 7 Ft. Dia. Deep Soil Mixing Columns

9,000 Cu. Yd. of 5 and 7 Ft. Dia. Jet Grouting Columns

1,298 Ea. 3-4 Ft. Dia. Stone Columns

9,800 Gal. Permeation Grouting

## BENEFITS OF GROUND IMPROVEMENT SYSTEMS

- **Stone columns reduced static and seismic settlement of future highway embankments and retaining walls**
- **Jet grouting reduced static settlement of utilities and was performed beneath existing highway bridges, reducing overall project impact and schedule**
- **Soil mixing reduced static settlement of future retaining walls and mitigated seismic lateral spreading hazards around drilled shafts on slopes**
- **Permeation grouting stabilized loose soil beneath active railroad tracks and above the crown of a jacked bore tunnel**

## 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](http://malcolmdrilling.com)

## Project Overview

Expansion of I-5 through Tacoma will improve safety and add capacity to one of the busiest highways in the region. The project included the replacement of bridges, overpasses, ramps, and embankments, as well as improvements to associated utilities and local roads. Malcolm was selected by Hamilton Construction to perform drilled shaft and ground improvement work on this major Washington State Department of Transportation project. The scope of the ground improvement work included deep soil mixing, jet grouting, vibro-replacement stone columns, and permeation grouting.



# Deep Soil Mixing

Portland Avenue  
Tacoma, WA



**MALCOLM**  
Ground Improvement

## Construction Details

For the soil mixing, Malcolm utilized an RG23 drill rig to install 7 foot diameter columns to depths up to 89 feet. An extension was added to the Kelly bar to achieve the required depths on the project, which are the deepest single-axis columns constructed by Malcolm to date. Grout mix design parameters were adjusted as work progressed through different areas of the project to ensure that strength parameters were consistently achieved in the varying soil conditions. For jet grouting, Malcolm utilized a Bauer BG15 drill rig for work in areas of unlimited headroom and a specially modified low headroom drill rig for work beneath existing highway bridges. Column diameters of 5 feet and 7 feet were utilized to achieve the high area replacement ratios (up to 80%) within the specified treatment areas. For the installation of stone columns, Malcolm utilized three cranes: one equipped with an auger on swinging leads for pre-drilling on slopes which were difficult to access, and two outfitted with B27 electric vibrators. All stone columns were installed using the dry bottom-feed method. Permeation grouting was performed by installing sleeve port pipes, then injecting grout in a highly controlled manner to target the specified treatment zone. Various grout mixes containing bentonite, Portland cement and microfine cement were strategically utilized to permeate soil pore spaces and achieve full coverage of the specified treatment zone.

## Ground Conditions

The subsurface conditions varied across the project site and included very soft cohesive silts and clays, loose liquefiable silty sand and layers of decomposing organic material. Undocumented fill and obstructions including abandoned timber piles were also encountered at numerous locations. Ground water depths were typically shallow, ranging from about 2–10 feet below working grade.



## Quality Control

Strength of jet grout and soil mix columns was confirmed by taking wet grab samples from various depths within freshly completed columns and casting cylinders. 28-day UCS tests performed on cylinders taken from silty, clayey and organic soils showed strength generally on the order of 100–300 psi, while cylinders taken from sandy soils showed strength of about 500–700 psi. Electronic data acquisition systems were utilized on all stone column, soil mixing and jet grouting installation rigs to provide real time display and recording of key installation parameters to ensure that all ground improvement elements were installed in accordance with the project requirements.

This job was managed by our Ground Improvement Division. For a complete list of Malcolm's locations and services, visit our website at [malcolmdrilling.com](http://malcolmdrilling.com).

Look to the blue at [malcolmdrilling.com](http://malcolmdrilling.com)

