



Malcolm Drilling Company
Ground Improvement Division

Vibro Replacement Stone Columns

South Layton, Utah Interstate 15

Improvement Overview

Stone columns are a ground improvement method which involves replacing in-situ material with an aggregate such as 3/4 inch crushed rock. This replacement process not only densifies the surrounding material through displacement, but also through settlement due to vibration. During an earthquake, seismic loading is resisted by the combination of stone and densified earth. Additionally, the increase in pore water pressure dissipates through the permeable stone columns, preventing liquefaction.



Ground Conditions

In South Layton the soil beneath the bridge abutments of a new Interstate 15 bridge varied between dense clean sands, clayey silt and weak sensitive fines. Liquefaction analysis determined the soil was susceptible to liquefaction and must be improved. In addition, ground improvement was needed to mitigate lateral spreading due to load.

Owner

Utah Department of Transportation

General Contractor

Ralph L. Wadsworth Construction Company, LLC

Geotechnical Engineer

Terracon Consultants, Inc.



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Design

With such varying conditions Malcolm Drilling chose to perform pre-improvement CPTs in order to facilitate the optimum size of column to be installed. The final design consisted of 2,540 stone columns. Each column was 25 feet deep and approximately 3.3 feet in diameter. The stone columns were laid out in a 6.5 foot square grid pattern in the areas to be improved.

Construction

Six locations involved tight access with existing roadways and rail lines, including one area directly between the North and Southbound traffic of Interstate 15. In some areas, stone columns were safely installed within 10 feet of active UTA and UP rail lines, as well as within 10 feet of Interstate 15 lanes. Increasing the difficulty of the project was the cold and snowy Utah winter. Despite these factors Malcolm Drilling was able to complete their work in all areas on or ahead of schedule.

Quality Assurance

Data acquisition software recorded the stone column installation in real-time. Reports were generated displaying quantity of stone placed, air pressure, and amperage over depth. Utah Department of Transportation required Malcolm Drilling to complete over 20 SPT to verify densification. At the completion of the installation, the engineer of record confirmed N_{160cs} values in liquefiable soils, based on Chinese Criteria, were achieved.



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