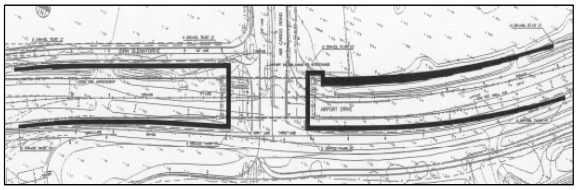
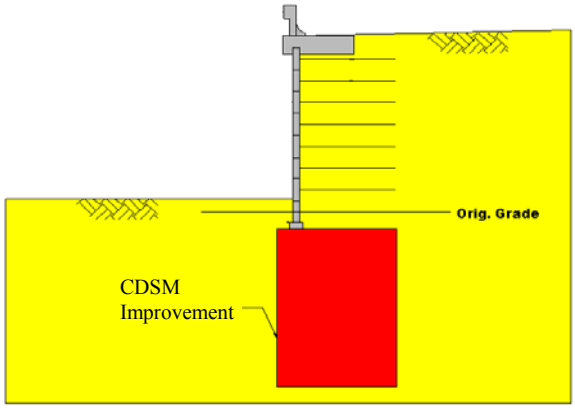
OAKLAND INTERNATIONAL AIRPORT ROADWAY PROJECT

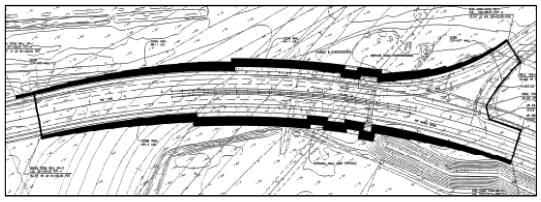
Completed CDSM panel exposed for viewing



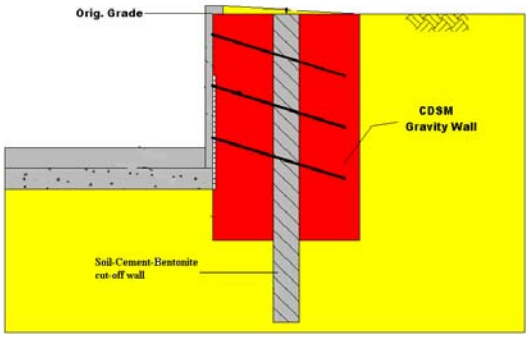
CDSM improvement at Airport Dr. over-crossing



CDSM provides ground stability for MSE wall and embankment



CDSM walls at Taxiway B under-crossing



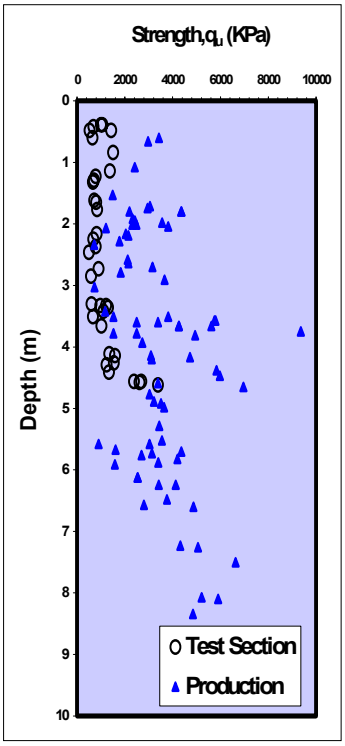
CDSM provides excavation support & groundwater control

Project Highlights

- A soil-cement gravity retaining wall, a soil cement foundation, and a soil-cement-bentonite cutoff wall were constructed for two roadway under-crossings and one over-crossing.
- Over 68,000 cubic yards of loose, sandy fill and Bay Mud were improved by CDSM soil improvement methods.
- Triple-shaft CDSM equipment was used to improve soils to a depth of 43 feet.
- CDSM construction exceeded all geometric, strength, and hydraulic conductivity design requirements.
- **Project Owner**: Port of Oakland, Oakland, CA
  Geotechnical Engineer: Geomatrix, Oakland, CA

EXECUTIVE SUMMARY

Airport Roadway Project, contracts 'A' & 'B', Oakland International Airport



The construction of the Oakland International Airport Roadway Project for the airport expansion required the stabilization of subsurface soils for the construction of three grade separation structures - two roadway interchanges and one intersection of a roadway and taxiway serving the airport. Loose, sandy fill and soft Bay Mud were improved by Cement Deep Soil Mixing (CDSM) for the construction of a soil-cement foundation under MSE (Mechanically Stabilized Earth) walls for a roadway over-crossing, a soil-cement gravity retaining wall to maintain stability of a roadway under-crossing during and after a major earthquake, and a soil-cement-bentonite cutoff wall for groundwater control.

A test section was performed prior to full production to verify that the CDSM equipment, installation procedures, and mix designs would produce soil-cement and soil-cement-bentonite with sufficient strength, uniformity, and permeability to meet the design intent. Additional test sections were performed for the confirmation or modification of the mix design and installation procedures to cope with the complex subsurface soil conditions resulting from the historical development of the site. Test section results revealed that the CDSM cutoff wall, retaining wall, and foundation could be constructed to satisfy the design criteria and that the supplemental test sections would alleviate the impact of the varying subsurface soil conditions.

Over 60,000 cubic yards of CDSM ground improvement and over 8,500 cubic yards of CDSM cutoff wall were constructed over a period of eleven months.

Triple-shaft CDSM equipment was used for ground stabilization and cutoff wall installation to a maximum depth of 43 feet. Drilling depth, penetration/ withdrawal speed, shaft rotation and slurry injection rates were monitored on a real-time basis for accurate mixing control and a uniform mixed product.

Core samples were retrieved from the hardened soil-cement foundation and gravity retaining walls for strength testing. Test specimens from the soil-cement-bentonite cutoff wall for strength and permeability testing were retrieved by wet sampling. Acceptance criteria for unconfined compressive strength required an average of 150 psi at 28 days for ground stabilization and an average of 80 psi at 28 days for the cutoff wall. Hydraulic conductivity of the cutoff wall required a maximum coefficient of $1x10^{-6}$ cm/sec.

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