CARIBBEAN INDUSTRIAL FACILITY

View of CDSM grid prior to construction of mat foundation

Up to three soil mixing rigs worked two shifts to complete the project on time

Project Highlights – Caribbean Industrial Facility

- A soil-cement grid was constructed using CDSM (Cement Deep Soil Mixing) to improve ground stability, control settlement and prevent liquefaction of soils within the foundation areas.
- Over 200,000 cubic yards of loose, silty sand, soft clay, and gravel were improved by CDSM over a period of fifteen months.
- Triple-shaft CDSM equipment was used to improve soils to a depth of 45 feet. Up to three CDSM soil mixing rigs, working double shifts, were used on the project site.
- CDSM construction exceeded unconfined compressive strength and soil mix uniformity design requirements. Design specifications for unconfined compressive strength required an average of 100 psi at 28 days.
- **Project Owner**: Confidential
  General Contractor: Bechtel, Intl.

EXECUTIVE SUMMARY

Caribbean Industrial Facility

Incremental load test in progress

The CDSM (Cement Deep Soil Mixing) method was used to construct a grid pattern of soil-cement columns under two 820-foot by 490-foot critical industrial facilities. The grids were created to prevent the generation of excessive pore water pressure during and after earthquakes and to prevent the liquefaction of soils within the foundation area.

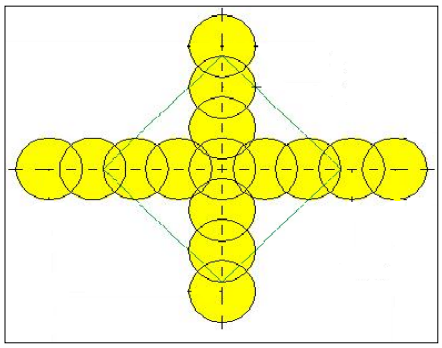
Soil conditions encountered on the project consisted of reclaimed hydraulic fill that resulted in a heterogeneous mixture of loose, silty sands, soft silt and clay and gravel. Underlying the hydraulic fill at depths ranging from eight feet to 28 feet below ground surface was the top of the natural younger marine sediment layer, consisting of primarily loose to medium dense silty sand and sand. Below the younger marine sediment layer was the older marine sediment, consisting of medium stiff to hard clay. Ground water was encountered at three to six feet below the ground surface.

The soil-cement grids were designed to reinforce the liquefiable sandy soils and soft clay lenses. Each soil-cement grid was 13.8 feet by 17.7 feet and was drilled to a maximum depth of 45 feet. The soil-cement grid was formed using 3-foot diameter columns spaced on 2-foot centers.

A CDSM test section was performed prior to full production to verify that the CDSM equipment, procedures, and mix design could produce the required soil improvement. Load tests were also performed during the test section to determine the amount of settlement when loads were applied to soil-cement columns. Results from the test section demonstrated that the CDSM walls would provide a soil-cement grid of adequate strength, satisfying the geometric, strength and uniformity requirements. The test section also demonstrated that the soil-cement columns would limit settlement within the design values.

Over 200,000 cubic yards of CDSM soil improvement was constructed over a period of fifteen months. Triple-shaft CDSM equipment was used for this project to a maximum depth of 45 feet. Drilling depth, penetration/withdrawal speed, shaft rotation and slurry injection rates were monitored in real-time and recorded in 3-foot depth increments to assure accurate mixing control and a uniformly mixed soil-cement product.

Test specimens for unconfined compressive strength were retrieved by a triple barrel coring system, and exceeded the acceptance criteria of an average of 100 psi at 28 days.



Load test layout

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