

Mass Stabilization Ground Improvement

Fuel Storage Tanks Port Everglades, FL

Eleven new 60-foot-tall fuel storage tanks, with diameters of 125 feet and 100 feet, were planned for construction on ringwall foundations on a former coastal marsh area reclaimed for industrial development in Port Everglades, Florida.

Problem

The site was underlain by soft clayey silt with peat lenses from a depth of 7 to 15 feet. The soft, organic-laden silt layer would experience significant short-term and long-term compression, resulting in excessive settlement of the tanks.

Design Solution

Hayward Baker designed an innovative mass stabilization program that created a stiff soil matrix beneath each tank. The stiff soil matrix transferred the tank compression loads through the improved soils and to the upper limestone formation at a depth of 15 feet. Soil mixing was also more economical compared to the other options of excavate-and-replace, or deep foundations.

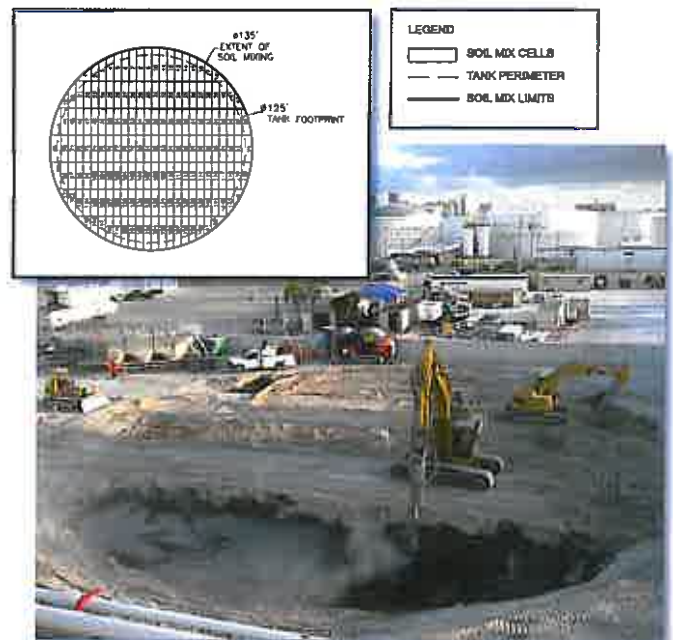
Construction

Each tank pad was divided into strips, which were then subdivided into individual mixing cells. Hayward Baker first used excavators to temporarily remove several feet of overlying granular fill material, which did not require treatment. Hayward Baker used an excavator-mounted mixing tool to complete the blending of the soil mass while special shuttles pneumatically delivered the binder to the head of the mixing tool and into the mix zone.

After mixing, but prior to initial set of the soil-cement mass, a geo-fabric separator was placed and the granular fill material was replaced over the freshly mixed soil mass. Placing of the fill material compressed the freshly treated soil mass and forced out air pockets that may have formed during mixing.



Prior to construction of these 11 fuel storage tanks, underlying soft clayey silt with peat lenses was improved by mass dry soil mixing to control settlement.



Dry soil mixing operations at one of the planned tank pads, and plan view showing soil mix cells.

Owner

Vecenergy, Houston, TX

Contractor

Ranger Construction-South, Pompano Beach, FL

Engineer

Dunkelberger Engineering & Testing, Inc.,
West Palm Beach, FL

Fuel Storage Tanks, *continued...*

Quality Assurance/Quality Control

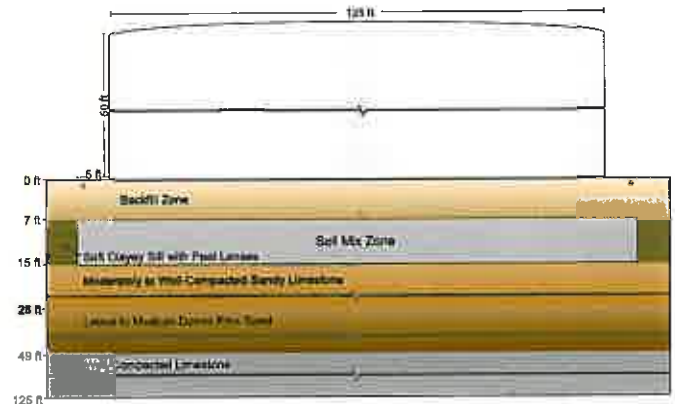
Binder dosage and mix energy were computer controlled, which resulted in a consistent, uniform mix. Core samples of the soil mix were obtained from several pad areas and tested by an independent laboratory, confirming that the design shear strength of 1,875 psf was achieved.

Cone Penetrometer Testing and in situ shear strength measurement using the Column Penetration Tool were performed within the first 14 days of curing, to confirm uniformity of the mix.

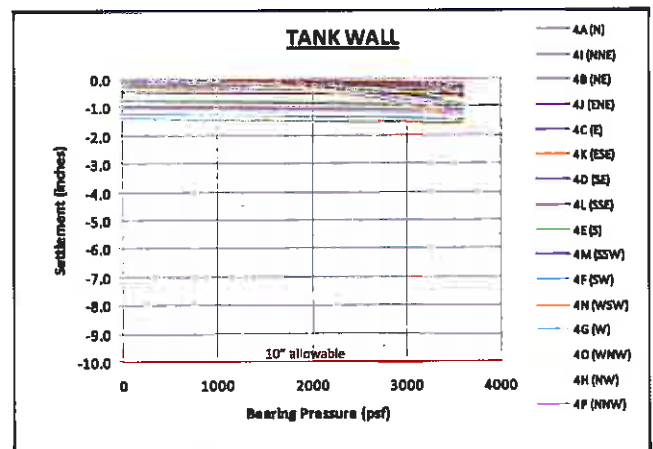
Post-construction, full-scale hydrostatic testing of the tanks served as full-scale load testing of the mass stabilization system. The planar tilt of the tanks was less than 1.2 inches, much less than the allowable 10 inches. The out of plane differential settlement was less than 0.2 inches in 30 feet of arc length, about one-half of the allowable 0.375 inches in 30 feet.

Conclusions

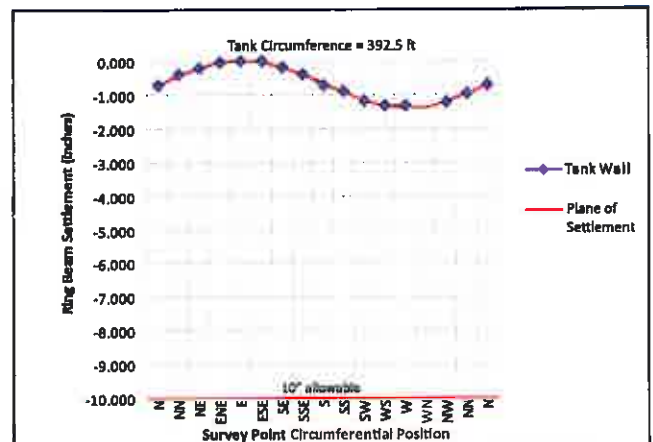
Hayward Baker's design/build mass stabilization provided the owner with an economical foundation completed ahead of schedule. Since construction, the tank foundations over the improved soils have performed well.



Section view of improvement zones.



Tank settlement measurements at tank #4, resulting from hydrostatic testing.



Ring beam settlement measurements at tank #4, resulting from hydrostatic testing.

Hayward Baker Locations

Atlanta 770-442-1801	Houston 281-668-1870	Providence 401-334-2565	Syracuse 315-834-6603
Baltimore 410-551-1980	Kansas City 913-390-0085	San Diego 760-839-2870	Tampa 813-884-3441
Chicago 630-339-4300	Knoxville 865-583-8212	San Francisco 925-825-5056	Vancouver 604-294-4845
Dallas/Fort Worth 817-753-7000	Los Angeles 805-933-1331	Seattle 206-223-1732	HB Subsidiary: Craig Olden, Inc. 800-422-4667
Denver 303-469-1136	Minneapolis 952-851-5500	St. Louis 314-802-2920	
Fort Lauderdale 954-977-8117	Nashville 615-883-6445		
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