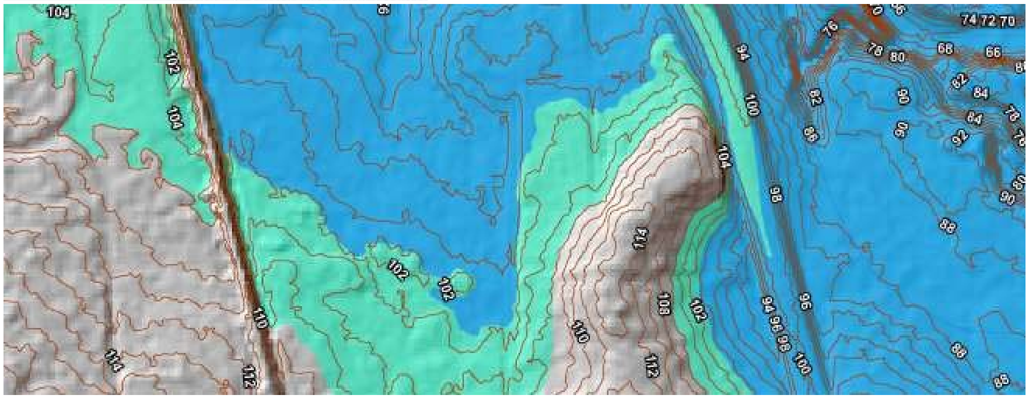

Project Case Study: Construction on loose fill

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A site with irregular, potentially unstable fill materials, required a multi-pronged solution that involved a combination of ground improvement technology and a design/build effort.

By Mike Cowell, P.E.

Soil-improvement strategy sets school on a firm foundation.

Project
St. Coletta Special Education School ground improvement, Washington, D.C.

Design-build firms
Whiting-Turner (general contractor)
GeoStructures (ground improvement)

Product application
Ground-improvement technology and rammed aggregate piers enable construction on loose fill above rail transit tunnels.

When the site was a jail, loose fill soil underneath was a great idea to deter prisoners with visions of tunnels. But when the time came to turn the site into the St. Coletta Special Education School in Washington, D.C., the builder had the benefit of a geotechnical investigation and found just how loose those soils were, and how much of a problem they were for supporting a new structure.

Known as Reservation 13 on the original L'Enfant Plan of 1791, the site has been home to a variety of government buildings over the years, including the 19th century Washington Asylum for indigent patients and people convicted of minor crimes, and the 20th century DC General Hospital that closed in 2001 but still hosts some health clinics. In the section of Reservation 13 specifically designated for St. Coletta School, geotechnical borings encountered as much as 22 feet of undocumented fill in some spots. This had to be addressed before construction could begin because of the fill's irregularity, potential instability, and its close proximity to a tunnel on the Orange line of the Metrorail transit system.

Geopier rammed aggregate piers were installed beneath spread footings in areas away from the Metro tunnel.

General contractor Whiting-Turner was faced with only a couple of options. If it did a typical design/bid/build job, a likely outcome would be a time-consuming over-excavation of the undocumented fill, which would have to be trucked to a suitable landfill and replaced by engineered material. In these situations, delays and costly change orders can come into play as problems are encountered.

Knowing that the depth of the support system had to be relatively shallow because of the Metro tunnel, and because the expected load of the structures would be relatively light, Whiting-Turner accepted the recommendation to forego caissons and instead agreed to a multi-pronged solution that involved a combination of ground improvement technology and a design-build effort. For the slab section, which would need to support only 75 pounds per square foot, the Rapid Impact Compaction (RIC) technique was used to treat the soil with a 7.5-ton weight that rises and drops at a rate of 40 times per minute onto a 5-foot-diameter area.

In addition to the financial benefits of stiffening and keeping the old fill in place, RIC had a serendipitous finding. Using resistance readings from the on-board RIC computer, the operators saw the soil stiffen as expected, but in some areas, a pattern emerged where soil deformation was quite small and the weight bounced, which indicated an obstruction. After further investigation, Whiting-Turner uncovered a slab and foundation wall from the old city jail dating back to the 1870s, along with additional loose fill, toilets, and other remnants from the period, all of which had to be removed before final tamping would make the sections suitable.

Plans also called for installation of Geopier elements for reinforcement of the spread footings in areas away from the Metro tunnel. Averaging 11 feet in length, these rammed aggregate piers were situated beneath the column footings as designated by the architect. Underneath 84 footings were a total of 230 Geopier elements, which function by removing weak soil from a drilled hole, and ramming well-graded aggregate into compacted, 1-foot-thick layers using a beveled tamper. The beveled tamper forces the aggregate into the sidewall of the cavity, stiffening the surrounding soil and supporting the spread footings enough to carry the load above, which in this case was as much as 4,000 pounds per square foot.

Because of the safety implications of construction on top of or near a Metrorail tunnel, a third solution of extra-large spread footings was used for areas closer to the underground passageway. Designed in accordance with the Adjacent Construction Design Manual of the Washington Metro Area Transit Authority, these provided a better measure of protection.

With Geopier elements and RIC-based ground improvement completed on the 99,000-square-foot area, construction proceeded in a condensed, 14-month time frame and concluded in time for the school year that began in early August 2006. Designed as a series of small "houses" within a larger complex connected by a public space called the Village Green, St. Coletta continues to add to the history of Reservation 13 as a national model for delivery of special education services, and for a unique design-build approach that incorporated ground stabilization in tight city quarters.

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