

Feature Story - Spring 2007

Variable Soil Conditions Don't Stop Roanoke City Fire Station Team

Dual system provides solid foundation for new station and administrative building.

Underground surprises and soft-rock formation presented meant hurdles and opportunities in the design and construction of a dual-foundation system for the Roanoke City Fire Station and Fire Administration Building.



Because for the complexity of the project, masonry and structural iron are place intermittently, a slow but effective solution.

adds Grant Walker, a principal with ECS Mid-Atlantic LLC of Chatilly, Va., the geotechnical engineering firm on the project. Karst can increase the risk of sinkholes or depressions.

ECS brought in ground improvement design-builder GeoStructures Inc. of Leesburg, Va., which came up with a dual-foundation plan that included 142 30-in-diameter, 8- to 17-ft-deep Geopier elements and 42 helical pier foundations drilled to up to 40 ft. deep, says Nyle Hothem, Southeast regional manager for GeoStructures.

Each Geopier element supports 90,000 lb., and the helical piers support 50,000 lbs. each.

"More than 80 percent of the load will be transferred to the Geopier elements," Hothem says. "Geopier works really well on sites with a variable soil profile because you can drill down and penetrate the fills. Length can vary, and construction on top is simple spread footing."

"The mixing of foundation types seemed to be a good solution without having to go to the expense of a higher-dollar deep-foundation system, such as caissons or piles," Walker adds.

Breakell broke ground on the \$4.8 million, 26,800-sq.-ft., three-story building in October 2005. Firefighters moved in to the building in March.

They'll use the first two levels for training, living quarters and apparatus bays. Administrative offices will occupy the top floor, along with training and support spaces.

As crews began excavating, they discovered a building under a thin layer of topsoil. It turned out to be a former laundry and dry cleaners that had collapsed and been covered over 50 years ago.

"There were some problems with the rock seams," says Joe Waldin, project manager for Breakell Inc., Roanoke, the project's general contractor.

"There were solid rock sections about 4 ft wide, then a 4-ft gap between that and another 4 ft of rock. The area between the rock was soft as pudding."

The northern portion of the site primarily contained noncarbonate shale and the other section was a deeply weathered karst, which becomes soft clay with seams extending to significant depths,

"The foundation was there, the shingle roof, the HVAC," Waldin says.

Crews recognized the floor tile as a type that had contained asbestos, so the company stopped work and ordered an inspection. Sure enough, the tile included the fire-retardant substance and required special containment and disposal.

Breakell removed 20 ft. of material on the high side of the site before reaching subgrade. The new building consumes almost the entire parcel, requiring excavation along the property line to erect L-shaped walls with structural footings.

Crews had to avoid undermining the adjacent building's foundation and parking lot. To stabilize it, Breakell installed 25-ft-long screw soil anchors under the parking lot, mounted iron pipes and attached a geomat to the pipes.

The combination structural steel and concrete masonry unit structure also presented challenges. The structural steel sits atop masonry piers, then bar joists run to the block wall.

"What made it difficult was we could not erect all of the steel in one day," Waldin says. "We could only erect up to the point where the masonry was done." He adds that ironworkers had to return for subsequent steel erections.

The building has two roof types—built-up ethylene-propylene-diene-terpolymer membrane roof in several sections and a metal roof on trusses on others—which Waldin says made it tricky to close the building.

Waldin credits cooperation and an amiable working relationship between the owners and design and contracting teams for maintaining the schedule.

"There have been no arguments, shouting matches or finger pointing," he adds. "With all of the insurmountable challenges, this project could not reach its completion without this remarkable working relationship."

Team Box:

Owner: City of Roanoke, Va.

General Contractor: Breakell Inc. General Contractors, Roanoke

Architect and Structural Engineer: Spectrum Design PC, Roanoke

Geotechnical Engineer: ECS Mid-Atlantic LLC, Chantilly, Va.