Raising the rails

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Temporary soil enforcement supports heavy dynamic loading during construction of grade separation retaining walls.

Railroads have long been important to the economy of Wichita, Kan. Its citizens applauded the merger of the Union Pacific and Southern Pacific Railroads in 1996. However, when the Union Pacific proposed doubling its movements of mile-long coal trains through the heart of the city, local leaders began searching for an alternative solution. With assistance from state and federal agencies and the railroads themselves, they began planning a major construction project—one that would alleviate traffic congestion at dozens of city-center crossings and improve the quality of life for residents.

Construction on the Central Rail Corridor Grade Separation project began in February 2006. An amalgamation of federal, state, and local grants and private railroad financing funded the $98 million endeavor. Its objective was to elevate a pair of side-by-side railroad tracks along the Burlington Northern Santa Fe right-of-way through the downtown traffic corridor. When completed, the project would create new grade separations connecting five new bridges and one rehabilitated bridge along a 1.8-mile strip, allowing both trains and vehicles to flow unimpeded through eight major thoroughfares.

Back-to-back T-Wall retaining walls on both sides of the 70-foot-wide rail right-of-way elevate busy train tracks above Wichita's city streets, eliminating rail crossings and traffic congestion.

Project
Central Rail Corridor Grade Separation, Wichita, Kan.

Design/engineering
Soil Reinforcement Design, Inc., Woodstock, Ga.
HNTB, Overland Park, Kan.

Product application
Geogrid reinforcement supports a temporary retaining wall and keeps trains running in two-stage construction of a rail grade separation

Temporary solution

HNTB's design concept required a temporary reinforced wall as part of the comprehensive plan for erecting permanent, back-to-back T-Wall retaining walls on the east and west sides of the 70-foot-wide right-of-way. Kansas Department of Transportation specifications called for a design/build temporary structure to support the combined seismic and dynamic loading of two fully loaded freight trains passing side by side.

The necessity of maintaining active rail service on the track adjacent to the construction site as well as vehicle crossings between bridge abutments dictated that the project be completed in two stages. First, one rail line would be closed and raised—supported by the west T-Wall and a temporary, geogrid-reinforced wall. Once train service was reestablished along the newly elevated track, the East T-Wall would be erected, the temporary reinforced wall between the two T-Walls buried, and the lower track elevated.

Strata System, Inc.'s StrataSlope system, including Stratagrid temporary wire forms and Microgrid facing, was specified for the project. Strata engineers worked directly with designers from Soil Reinforcement Design, Inc. (SRDI), and project managers from Wildcat Construction, the wall installer. Demolition of the first track began in March 2006.

"This was a single-source, design/build project for us—with no up-front design details provided by the owner," said Strata Systems Vice President David Butchart. "Strata's sales and engineering team, in conjunction with SRDI, immediately took the lead, coordinating preliminary structural designs and providing on-site management services, including installation training for Wildcat Construction crews, as well as ongoing technical support."

The project required coordinated delivery and staging of materials along the 1.8-mile-long job site without impacting train schedules and vehicular traffic. The Wichita Central Rail Corridor project's sheer magnitude and the volume of materials consumed attests to its complexity:

- 1.8-mile-long by 70-foot-wide right-of way;
- 28-foot maximum height;
- 311,000 square yards of high-tenacity, knitted Stratagrid reinforcement material;
- More than 12,000 temporary wire form baskets;
- 104,000 square yards of Microgrid facing wrap; and
- 900,000 cubic yards of 100-percent compacted pit sand back fill.

SRDI, HNTB, Strata, Wildcat Construction, general contractor Dondlinger & Sons, and railroad representatives worked closely together on site management throughout the project's lifecycle.

A temporary retaining wall constructed with wire form baskets and geogrid soil reinforcment withstands heavy dynamic loading from 80,000-pounds-per-axle engines.

Designed for heavy loads

Supporting the dynamic and seismic loads of heavy coal trains with a temporary, reinforced wall is challenging under normal circumstances. But the demands of the Wichita Central Rail Corridor project proved exceptional. Averaging loads of 80,000 pounds per axel, the heavyweight E. Cooper 80 engines used by the Union Pacific Railroad along its Wichita line far surpasses the typical 34,000-pounds-per-axle loading produced by commuter and light rail engines. Consideration of a single engine load is significant; however, the city and the railroad mandated contingency plans requiring the temporary structure to be able to withstand the potential for both rails to be loaded simultaneously, however remote the possibility.

With Wildcat Construction crews installing Stratagrid and turning lengths of Microgrid wrap back into the wall for facing stability, the StrataSlope system demonstrated that it could support the heavy rail loads. Integrated with 100-percent compacted pit sand backfill, the system met design specifications for supporting loads of 900 pounds per square foot (psf), compared with 250-psf loads commonly required for highway/roadway traffic.

"It may be that reinforced walls supporting static buildings are heavier from time to time, but the Central Rail Corridor in Wichita is the heaviest dynamic loading we have ever designed," said Thomas Rainey, SRDI senior geotechnical engineer.

Unique design

Since the temporary reinforced wall would be buried between two permanent T-Wall retaining walls in a relatively short time, soil erosion was not a serious concern, so no thought was given to vegetating the temporary structure. Mechanical support for the heavy loading was achieved by installing horizontal layers of Stratagrid at 18-inch intervals (one layer per wire basket) all the way to the top of the wall. Additional structural stability was provided by a facing of temporary wire baskets. These were backfilled with pit sand and wrapped in a blanket of Microgrid face wrap.

"The wire baskets serve as a construction and compaction form, enabling installers to hold the fill in place while wrapping Microgrid back into the wall, encapsulating the sand-filled baskets. It further allows compaction of the fill to the face of the structure, which means less settlement," said Butchart.

Tracking the outcome

After a regular train schedule began running along the top of the completed grade separation in November 2007, Wildcat Construction monitored the site for several months. Using 80, well-placed monitoring pins, they looked for any possible movement in the track bed. The extensive surveillance validated the fact that even with heavy loading (E. Cooper 80 rail engines), the structure never moved more than 0.5 inch in any direction, including vertical settlement.