TENCATE
Mirafi®

SOIL REINFORCEMENT

Case Study

application	Steepened Slopes (MSE Structure)
location	Mississauga, ON Canada
product	Miragrid® 3XT
job owner	CN Rail
contractor	Dufferin Construction
wall engineer	Alston Associates/Armtec Ltd.
engineering consultant	Hatch Mott Macdonald

TenCate™ develops and produces materials that function to increase performance, reduce costs and deliver measurable results by working with our customers to provide advanced solutions.

THE CHALLENGE

GO Transit is Canada's first and Ontario's only, interregional public transit system, linking Toronto with the surrounding regions of the Greater Toronto Area (GTA). The combined rail and bus transit system first began operating in May of 1967. Since that time, GO Transit has grown into one of North America's premier public transportation systems with annual ridership of over 48 million passengers per year. Go Transit is currently undertaking an extensive expansion of its facilities, budgeted at some $750 million. Included in this expansion is the construction of numerous additional rail lines throughout the existing rail network. A key component of this rail line expansion is the addition of a third line to improve the current rush-hour only rail service between Hamilton at the western end of Lake Ontario and Toronto, some 50 km (30 miles) to the east. Site constraints played a large role in determining which type of Mechanically Stabilized Earth System (MSE) that would be employed. Access to the various locations that required an MSE had to be achieved via access roads located parrallel and adjacent to the track. There was no direct street access. The clearance between the proposed third track and the property line was minimal. In the case of larger offsets from the track, MSE structures would invariably be located in a creek valley. In many cases the MSE system would have to support a sizeable railway embankment, which in turn would support the new third track. However in some cases, the track would sit virtually on top of the MSE structure.

THE DESIGN

Initially the consultants had specified an Armtec Bin-Wall® Gravity Retaining wall for the entire project. It was determined after the contract was awarded to Dufferin Construction, that an MSE type retaining wall would be easier to construct and therefore, more cost effective. After consultation between the owner, contractor, consultant and retaining wall supplier, it was agreed that a combination of two Bin-Walls® and five MSE walls, utilizing Miragrid® geogrids as the soil reinforcement and Bin-Wall® fascia, would be constructed. The MSE walls have a maximum length of 283m (928ft) and maximum height of 6.6m (21.5ft) and two of the walls have pipes penetrating the fascia on a skew. Bin-Wall® retaining walls are just as the name suggests: steel bins. Manufactured for the most part from corrugated steel sheets, these 3m wide modular walls bolt together in the field and are infilled with well draining granular material. The depth of the bin varies with the loading condition and wall height. In MSE Bin-Wall®, the steel fascia is employed, and the remaining three sides of the bin are replaced with layers of Miragrid® geogrids. With the exception of Miragrid®, all the components used in the fascia and the Miragrid® to fascia connection are standard Bin-Wall® components. The vertical spacing of the Miragrid® geogrids utilized the standard Bin-Wall® Spacer dimension spacing of 406mm (16in). In the interest of simplicity, the design of the reinforcement was kept relatively simple. One type of uni-axial geogrid (Miragrid® 3XT) and three embedment lengths were employed on the project. The fascia to Miragrid® 3XT connection was accomplished via a simple wrapping of Miragrid® 3XT around a stringer stiffener bolted to the columns of the Bin-Wall® fascia. Mirafi® 3XT geogrid used on this project has a published Long Term Design Strength of 28 kN/m (1918 lb/ft). Mirafi® 3XT is manufactured from high tenacity polyester yarns and coated with PVC for additional protection and dimensional stability.


Miragrid®/Bin Wall® connector with 1m (39in) wrap back.


Pipe protrusions from wall.

View along face of Bin Wall®.

THE CONSTRUCTION

The walls were founded on a well compacted granular base. The initial components to be erected were two columns and a stringer which connects the columns. After propping the above into position for line, grade and batter, a third column and corresponding stringer were erected. Mirafi® 3XT was then unrolled and cut to the embedment wrap length specified. The geogrid was installed with the tensile strength direction (Machine Direction) perpendicular to the wall face. The product was then lightly tensioned to remove any slack or creases. Care was taken not to drive tracked equipment on the exposed geogrid. Once the first two layers of stringers and Miragrid® 3XT were placed, backfilled and compacted, the bracing could be removed. The general construction sequence was to erect the wall one or two stringers high, the full length of the wall. This allowed construction efficiency with regards to placement and construction of backfill. Backfill was specified as an Ontario Provincial Standard Specification (OPSS) Granular B Type 1, compacted to 95% Standard Proctor Dry Density. Construction was carried on throughout the winner of 2009, despite low temperatures, precipitation and restricted working time due to rail traffic.

THE PERFORMANCE

This wall (Bin-Wall® fascia + Miragrid® reinforcement) was a prototype wall system that was developed out of necessity from two pre-existing and highly successful retaining wall systems. The knocked-down aspect of the wall components makes them ideal for shipping and assembly in highly restricted sites such along side rail lines. Given the success of this project, it is expected that this retaining wall system will be utilized on future projects with similar constraints.

Grading of backfill behind wall.

Tensioning of 1m (39in) geogrid wrap back at fascia connector.

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