



# TENSAR® GRADE SEPARATION SOLUTIONS FOR HEAVY RAIL AND MASS TRANSIT

APPLICATION BULLETIN

## Sierra® Slope Retention System: Installation in Service Since 1982

### CANADIAN PACIFIC RAILWAY WATERDOWN, ONTARIO (CANADA)

Tensar® Geogrid reinforcement is well suited to the repair of railway embankment landslips. The speed of installation often minimizes service disruption and repair expenses resulting from track closures.

**Application:** A grade separation solution was to address cracks in an embankment shoulder adjacent to railroad tracks located along the Niagara Escarpment in Waterdown (now part of Hamilton), Ontario.

**The Challenge:** Canadian Pacific Railway (CPR) is a Class 1 North American railway that provides freight transportation services over a 14,000-mile network in Canada and the U.S. In 1982, the railway needed a quick and cost-effective repair to a heavy rail embankment landslip. The embankment, located below the ballast and railway subgrade, needed to withstand the sizeable surcharge of a locomotive.

**Site Conditions:** In 1958, high groundwater pressure had caused a slope failure. At that time, ballast fill was placed over the glacial till to reinstate the track; however, problems of track disturbance continued, and surface run-off periodically activated movement along the old shear surface. Following an exceptional thaw in December 1982, rail traffic was completely suspended when cracks were discovered within the embankment shoulder.

**The Solution:** Site topography, repair costs and the need for a speedy repair advanced the use of a reinforced soil structure. A Sierra® Slope System reinforced with Tensar Uniaxial (UX) Geogrid was specified to repair the embankment cracks. The till placed 24 years earlier was excavated down to the bedrock, with benched steps cut into the undisturbed soil. Granular fill was installed to promote slope drainage and help avoid surface frost heave as it lowered the water table. Also, the reinforced granular fill helped CPR achieve a higher factor of safety.

The geogrid's open structure enabled soil particles to interlock through the apertures, mobilizing the high strength of the grid and achieving efficient anchorage. To ensure local surface stability, each layer of geogrid was wrapped up the slope face, turned back and secured into the fill. Finally, the slope face was topsoiled and hydroseeded. The repair was successfully completed in 12 days.

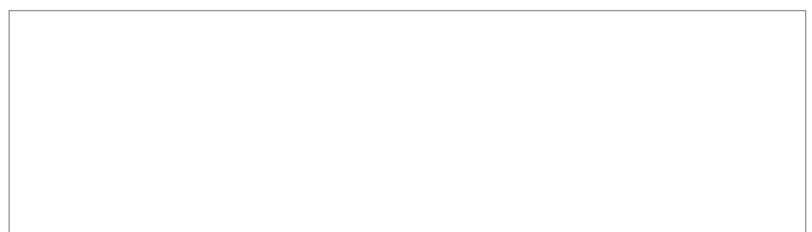
**Follow-up:** A visual site inspection conducted in 2008 by representatives of Canadian Pacific Railway and Tensar revealed no evidence of subsequent failure. Conversations with long-term CPR track maintenance employees indicated no prior events as well.

# Tensar®

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# Tensar®





## Tensar International Corporation Offers Rail Engineers a Wide Variety of Solutions for Railway Applications

For more than three decades, Tensar International Corporation (Tensar) has been providing single-source mechanically stabilized earth (MSE) systems to railway companies in both the mass transit and heavy rail markets.

MSE systems by Tensar are superior to many other grade separation systems because our MSE systems feature reinforcement with strong and durable Tensar® Uniaxial (UX) Geogrids. Made of high-density polyethylene (HDPE), UX Geogrids have proven resistant to chemical, biological and environmental degradation, including hydrolysis. Tensar HDPE Geogrids do not degrade from long-term exposure to water, can be installed in high or low pH soils and can resist attack from most chemicals that may enter the backfill soils that support rail lines. In addition to the geogrids' durability, their open aperture structure promotes excellent soil drainage with no buildup of pore water pressure from clogging.

Additional assurance in the durability of Tensar Geogrids, an extensible reinforcement element, can be found in the "American Railway Engineering and Maintenance-of-Way Association (AREMA) Manual for Railway Engineering."

When considering grade separations for rail applications, safety and long-term performance are at the forefront. Tensar Grade Separation Systems are provided by, and come from, one source – Tensar. The specifier can be assured they are getting a complete system, not pieces and parts brought together by the low bid contractor. There is security in knowing that our systems are engineered to work together in a variety of rail applications.

Our in-house engineering department has worldwide experience designing challenging railway applications in North America, Europe, Latin America and Asia. Tensar has designed grade separation solutions under a variety of soil, loading and environmental conditions.

The solution is simple – if you are looking for a cost-effective grade separation system with a proven track record, Tensar has a system to meet your needs. Tensar Grade Separation solutions for railway applications offer a variety of opportunities to support the rail trackbeds, trestle abutments, bridges and, in the event of a derailment, the deflector walls.

**NOTE:** AREMA Manual for Railway Engineering, - Part 7 – Mechanically Stabilized Embankments, Pg. 8-7-2, 2002.

## Benefits of Using Railway Site Solutions by Tensar®

Safety is always a concern when constructing a new railway or making repairs to an existing one. Our rigorously tested and patented earth retaining systems for railway applications take into consideration a variety of safety factors, including:

- ▶ **Corrosion and Electrochemical Requirements** – Tensar® UX Geogrids are made of high-density polyethylene (HDPE) that resists chemical, biological and environmental degradation. In fact, this same polymer is used to protect other traditional steel reinforced systems.
- ▶ **Drainage and Hydrostatic Pressure** – The open aperture structure of Tensar UX Geogrid promotes excellent soil drainage.
- ▶ **Railway Loads** – Tensar MSE solutions can be designed for rail applications accommodating a Cooper E-80 or greater railway loading distribution.
- ▶ **Stray Currents** – Tensar Grade Separation solutions are reinforced with a polymer material, which is not affected by stray currents from an electrified rapid-transit system.

- ▶ **Vibrations** – Tensar UX Geogrid's open aperture structure and high junction strength provide high resistance to pullout while allowing for strong mechanical connection to the facing materials. This assures no loss in structural integrity due to vibrations, which is possible for systems that depend on friction.
- ▶ **Seismic Considerations** – As with vibrations associated with heavy rail surcharges, pullout resistance and mechanical face connections are increased to accommodate seismic events. Tensar Grade Separation solutions for railway support structures have a record for withstanding seismic events.

There are many reasons to choose Tensar Grade Separation solutions for railway applications for challenging grade changes. Our fully integrated structures are engineered for site and design versatility, long-term durability, increased structural reliability and simplified construction.

With a network of licensed manufacturers throughout the world, rail applications utilizing Tensar Geogrid can be found in almost every major city and country.

## Proven Systems, Endless Facings



**Mesa® Retaining Wall Systems**

The Mesa Systems combine geogrid-reinforcement with high compression blocks and a patented mechanical connector to create a unified system. The performance of every component is integrated to reduce cost and increase structural reliability.



**ARES® Retaining Wall Systems**

A concrete panel wall system, ARES Systems are a cost-effective alternative to metallic reinforced walls. Used on their own or in conjunction with other Tensar® Systems, the ARES Systems can offer dependable wall solutions with long-term durability.



**Sierra® Slope Retention System**

The Sierra System, a reinforced soil slope (RSS) solution, provides a structural, naturally appealing alternative to precast MSE and cast-in-place retaining walls. The vegetative solution can also be combined with other Tensar Systems, such as this Massachusetts Bay Transit Authority (MBTA) project.



**SierraScape® Retaining Wall System**

The SierraScape System provides a welded wire basket system that mechanically connects the polymer geogrid to a galvanized steel and a stone aggregate veneer, giving you a durable and cost-effective retaining wall.



### Tensar® Systems Components for Railway Reinforced Systems

COMPONENTS	FUNCTION
<b>Tensar Uniaxial (UX) and Biaxial (BX) Geogrids</b>	Primary reinforcement that internally stabilizes the structure and fill materials. Secondary reinforcement, in the form of Biaxial (BX) geogrids can be used to provide surficial stability on slope and welded wire basket forms.
<b>Site-Specific Facing System</b>	Provides aesthetic facing in a variety of options including half and full-sized cast-in-place panels, standard concrete block wall, ashlar retaining wall, vegetated, architectural and stone.
<b>Mechanical Connection</b>	Each system has a proven, mechanical connection to offer superior and cost-effective solutions for your mechanically stabilized embankment. Connectors are highly tested and made from high-density polymers to ensure a secure connection at the face of the chosen system.
<b>Engineering Services</b>	Engineering services, design drawings and initial site assistance available upon written contract.

For additional information on grade separation solutions for rail applications or reinforced rail foundations, ballast and sub-ballast layers, call **800-TENSAR-1**, visit [www.tensarcorp.com](http://www.tensarcorp.com) or e-mail [info@tensarcorp.com](mailto:info@tensarcorp.com).