SPECTRA® RAIL
RAILWAY IMPROVEMENT SYSTEM

RAILWAY
IMPROVEMENT SYSTEM

SYSTEM OVERVIEW

Tensar®

The Spectra® Rail System provides a predictable, cost-effective solution for the reinforcement of ballast and sub-ballast layers.

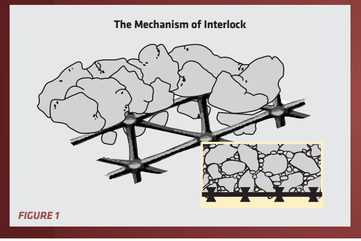


FIGURE 1

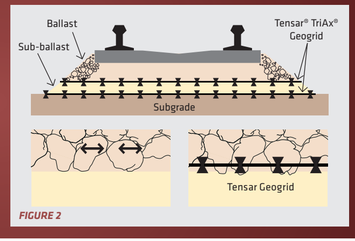


FIGURE 2

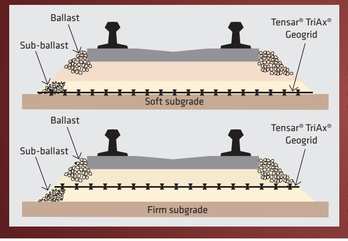


FIGURE 3a: *Sub-ballast stabilization provides improved bearing capacity.*

FIGURE 3b: *Ballast stabilization leads to increased maintenance intervals.*

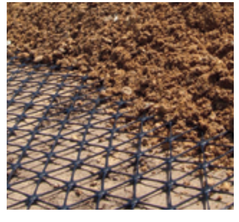

Analyzing local soil conditions

Tensar® TriAx® Geogrid Keeps Rail Performance on Track

For more than two decades, Tensar® Biaxial® (BX) Geogrids have successfully stabilized ballast and sub-ballast layers under a wide range of soil and loading conditions – from light rail to heavy Class 1 rail structures. The American Railway Engineering and Maintenance of Way Association (AREMA), the nation's foremost authority on industry practices, has also recognized the value of geogrid technology for trackbed stabilization by including a chapter on geogrid in its 2010 Manual for Railway Engineering. Indeed, the benefits of using geogrid over soft and firm subgrades have been demonstrated in a number of laboratory and field tests as well as on hundreds of actual installations around the world. And now, with the introduction of Tensar® TriAx® Geogrid, the benefits are even greater.

With its unique triangular structure, TriAx Geogrid is a revolutionary advancement in geogrid technology as it outperforms BX Geogrids. Its multi-directional properties leverage its triangular geometric structure, one of construction's most stable shapes, to provide a new level of in-plane stiffness and aggregate confinement. The transition from a rectangular to a triangular grid aperture, coupled with an increase in rib thickness and junction efficiency, offers the rail industry a better alternative to conventional materials and practices. As part of the Spectra® Rail System, TriAx Geogrid provides a predictable, cost-effective solution for the stabilization of ballast and sub-ballast layers that includes many advantages:

- Lower up-front construction costs – mechanical stabilization of the sub-ballast layer reduces the amount of aggregate required to obtain a particular factor of safety against bearing capacity failure. Typically, savings of approximately $30,000 per linear mile of track can be attained.
- Increase the speed of construction – less aggregate means less construction time.
- Minimize ballast settlement and lateral creep – the period between maintenance cycles can be extended by a factor of three to five times when TriAx Geogrid is used to stabilize the ballast layer.
- Maintain effective drainage of the trackbed – stiff TriAx Geogrids help prevent aggregate and subgrade soil fouling and reduce the generation of fines through particle abrasion.
- Extend the life of mechanical rail line components (rails, ties, joints, etc.) – less vertical deflection during loading results in less wear and tear in the mechanical components of the rail structure.
- Improve performance and operational productivity by eliminating the need for speed restrictions on potentially troublesome sections of rail line.



Applications

HOW TRIAX® GEOGRIDS WORK – MECHANICAL INTERLOCK

Tensar® TriAx® Geogrids stabilize ballast and sub-ballast layers through the principle of "mechanical interlock." When unbound aggregate is compacted over a geogrid, the coarser particles partially penetrate through the geogrid apertures and lock into position (Figure 1). As the aggregate layer stiffens, the load distribution over the underlying subgrade is enhanced, increasing its effective bearing capacity. Shear forces imposed within the aggregate layer as a result of trains passing are thereby partially transferred into the geogrid.

In addition, the geogrid's ability to confine aggregate particles significantly reduces lateral spreading of granular particles, a major cause of ballast and sub-ballast settlement (Figure 2). TriAx Geogrids offer strength at low strain in all directions, preventing large deformations within the aggregate. The rigid triangular apertures of TriAx Geogrids are designed to interact with typical railroad ballast and sub-ballast materials to ensure optimum mechanical interlock. Geogrids with larger apertures (for example, Tensar TX190L) are used to stabilize the coarser aggregates typically used for ballast layers.

BALLAST AND SUB-BALLAST STABILIZATION

Tensar TriAx Geogrids are used to stabilize the trackbed structure in two ways:

- Sub-ballast Stabilization – installed at the bottom of the sub-ballast, TriAx Geogrids help distribute imposed loads more efficiently over the underlying subgrade, leading to a reduction in the required sub-ballast layer thickness (Figure 3a).
- Ballast Stabilization – installed between the ballast and sub-ballast layers, TriAx Geogrids limit lateral particle migration and thereby minimize track settlement. This helps increase the period between maintenance cycles by three to five times (Figure 3b).

INTERMODAL FACILITIES

The loads imposed in the loading/unloading paved areas adjoining rail lines at intermodal facilities generally exceed those applied to the trackbeds themselves. These heavy-duty pavement structures are designed to support loads not only from truck traffic, but from cranes and other cargo transfer equipment.

In addition to thousands of successful installations on heavily trafficked paved and unpaved surfaces, Tensar® Geogrids have provided stabilization solutions at many intermodal facilities. Tensar Geogrids at intermodal facilities have been used to:

- Minimize the required aggregate thickness and the overall cost of pavement structures.
- Increase the speed of construction, reducing labor and equipment costs.
- Eliminate the need for over-excavation, disposal and replacement of poor quality soils.
- Eliminate the need for lime or cement treatment of the subgrade.
- Integrate industry-leading, technology-based design practices.
- Extend the design life of heavy-duty pavements by a factor of three to six times, leading to significant life cycle cost savings.
- Provide an easily installed, sustainable solution that minimizes construction truck traffic and impact to the surrounding public infrastructure.

Cost Benefits

TENSAR® TRIAX® GEOGRIDS SAVE ON IMMEDIATE AND LONG-TERM COSTS

Tensar® TriAx® Geogrids provide both short-term and life cycle cost savings. By significantly reducing the required trackbed thickness (Figure 4), Tensar TriAx Geogrids can typically save up to $30,000 per linear mile of track. The ease of geogrid installation not only accelerates construction schedules, it also eliminates the cost of special labor and equipment. With the option to install Tensar TriAx Geogrids in wet conditions, contractors can maximize their productivity in inclimate weather.

Since Tensar TriAx Geogrids can be installed directly over existing weak subgrade soils, the costs associated with subgrade excavation, disposal, and replacement or chemical treatment (along with the set time for chemical treatment) can be eliminated. With shallower excavation, the potential costs associated with the relocation of utilities can be eliminated as well.

Since track maintenance is a costly and ongoing liability, life cycle cost savings are an additional benefit of using TriAx Geogrids. With the current (and rising) cost of maintenance, railway owners must continuously seek the most cost-effective immediate and long-term maintenance solutions.

Over the long term, Tensar TriAx Geogrids preserve the integrity of the railway structure by confining the ballast and sub-ballast layers. This typically extends the period between maintenance operations by a factor of three to five times (and the design life of heavy-duty pavements at intermodal facilities by three to six times). Finally, in reducing the deflection of the trackbed during loading, Tensar TriAx Geogrids extend the life of mechanical track components including rails, ties and insulated joints.

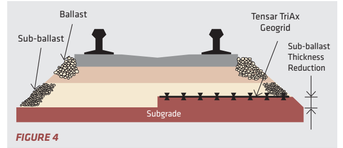


FIGURE 4

DESIGN SUPPORT AND PROJECT ASSISTANCE YOU CAN RELY ON

As the worldwide leader in geogrid technology and design support, Tensar is committed to the success of your rail stabilization project. Our products and technologies are backed by the most thorough quality assurance practices in the industry. We provide comprehensive design and site assistance for every stage of a Spectra® Rail System project. For example, we'll provide support to analyze local soil conditions at no charge. This service delivers a more accurate assessment of in-place soil parameters such as stiffness and strength of near-surface soils, leading to a more reliable and economical design.

Given a specific set of soil and proposed loading conditions, a full design section can be developed by Tensar to include a trackbed section in full compliance with AREMA guidelines. Pavement sections for intermodal facilities can also be developed using our state-of-the-art design software. In addition, we can provide case studies, system specifications, technical notes, installation guidelines, preliminary cost estimates as well as additional supporting documentation.

Altogether, Tensar's engineers and technical support staff, regional managers and national distribution network strive to keep our systems at the forefront of today's design technology and customer needs. Rely on the experience, resources and expertise that have set the industry standard for nearly three decades. For more information on the Spectra Rail System, call **800-TENSAR-1**, e-mail **info@tensarcorp.com** or visit **www.tensarcorp.com**.

Featured Projects

RAIL SPUR
CLANTON, AL

The Challenge: Building and Earth Sciences, Inc., was approached by Irondale Industrial Contractors for advice on bridging a section of very weak subgrade soils under a proposed rail spur in Clanton, AL.

"We had completed a geotechnical study of the site and reported CBR values of approximately 0.5 percent or less," says Richard Brown, P.E. of Building and Earth Sciences, Inc. "When the contractor's workers tried to clear the site for the embankment, their trackhoe sank up to its axles."

The narrowness of the spur corridor next to an existing line meant that traditional removal strategies were not an option. Initially, the contractor tried using riprap to create a construction platform and base, but this material simply sank into the boggy soils when trucks and other construction equipment drove on it. Brown suggested using geogrid to create a working platform to support the embankment.

The Solution: Because the general contractor was not familiar with geogrid, Bryan Gee, P.E., Tensar Southeast Regional Manager provided a roll of TX160 for a test strip at the site.

"We unrolled it in the area that had bogged down the trackhoe and covered it with two to three feet of aggregate," says Gee. "The contractor's crew was able to bridge that section immediately with their equipment. It was impressive." Based on the success of the test section, a two-layer geogrid solution was implemented to support the rail spur.

The simple installation process enabled the contractor to complete the platform quickly and resume construction of the embankment.

"I was very pleased with the result and so was Irondale's representative," says Brown. "He was impressed that a fully loaded off-road truck could cross the working platform with no issues." Brown says he was equally amazed by the performance of Tensar® TriAx® Geogrid. In this situation, it was the only option for crossing some very challenging soil conditions.

PIER A INTERMODAL FACILITY
PORT OF LONG BEACH, CALIFORNIA

The Challenge: In 1998 the Port of Long Beach (PoLB) used the Spectra® Rail Railway Improvement System to help expand and improve one of its intermodal facilities. The expansion included the construction of eight new rail lines for a total length of 14,000 linear feet. The facility's rail tracks are used by the PoLB Marine Terminal for heavy Class 1 rail traffic. To ensure a long service life with minimum maintenance costs, the PoLB wanted a stabilization solution that could provide effective distribution of the applied loads onto the underlying subgrade soils. Soils throughout the port facility are highly variable. Relatively competent sands and gravels occur in some areas while other areas are underlain by silts and weathered coral deposits. The weaker soils often contribute to high maintenance costs and premature track failure.

The Solution: To accommodate the Pier A rail corridor's variable soils, engineers from DMJM Harris specified five different cross sections. Four of these sections used one layer of Tensar® Geogrid for sub-ballast stabilization. In this application, it increased the strength of the construction platform while reducing excavation and ballast requirements. Because annual inspections had revealed that the stabilized sections were continuing to deliver high rigidity under load, PoLB transportation staff began to consider specifying geogrid as a standard strategy for alleviating settlement in areas with soft soils.

"After 10 years we generally find settlement or track-structure problems due to rail facilities near the water table," says Carlo Luzzi, PoLB manager of rail transportation. "So we are asking our engineering consultants to determine how geogrids change track performance. We think using geogrid could extend track service life by an additional 20 years before we see significant issues."

"Anyone who visually inspects the track is really surprised," says Tensar Regional Manager Lars Nelson. "They assume the track is brand new because the geogrid is doing such a good job supporting the structure."

Tensar®

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