

TENSAR INTERNATIONAL CORPORATION

LAYING THE GROUNDWORK FOR TOMORROW



Tensar[®]

The Engineered Advantage™

With clear advantages in performance, design and installation, Tensar products and systems offer a proven technology for addressing the most challenging projects. Our entire worldwide distribution team is dedicated to providing the highest quality products and services. For more information, visit TensarCorp.com or call 800-TENSAR-1.



Tensar International Corporation

Tensar delivers engineered systems that combine technology, engineering, design and products. By utilizing Tensar's approach to construction, you can experience the convenience of having a supplier, design services and site support all through one team of qualified sales consultants and engineers. By working with Tensar you not only get our high quality products but also:

SITE ASSESSMENT

We can partner with any member of your team at the beginning of your project to recommend a Tensar Solution that optimizes your budget, financing and construction scheduling.

DESIGN ASSISTANCE/SERVICES

Experienced Tensar design engineers, regional sales managers, and distributors will develop budget estimates and proposals to help you evaluate your best construction options and determine the most cost-effective approach.

SPECIFICATION

Our value-engineered solutions feature stamped drawings with precise construction details. Changing site conditions can be quickly addressed in the field or in our Engineering Department.

SITE SUPPORT

Tensar regional sales managers and our distribution partners can advise your designers, contractors and construction crews to ensure the proper installation of our products and prevent unnecessary scheduling delays.

EXPERIENCE YOU CAN RELY ON

Tensar is the industry leader in soil reinforcement. We have developed products and technologies that have been at the forefront of the geotechnical industry for the past three decades. As a result, you know you can rely on our systems and design expertise. Our products are backed by the most thorough quality assurance practices in the industry. And, we provide comprehensive design assistance for every Tensar system.

For more information about Tensar products and systems, visit TensarCorp.com, e-mail info@tensarcorp.com, or call **800-TENSAR-1**. We are happy to supply you with additional system information, complete installation and design guidelines, system specifications, design details, conceptual designs, preliminary cost estimates, sealed construction drawings, summaries of completed projects, software and much more.



Hawks Prairie Park and Ride – Lacey, Washington

Tensar was able to make effective use out of public land by developing a new park and ride facility on top of a retired landfill. TriAx® Geogrid was used to stabilize the soils in order to offset the effects of differential settlement.



California Gulch – Leadville, Colorado

The flexibility of Triton® Marine Mattresses allowed the contractors to install them without modification – even on tight curves.

For more than 30 years, Tensar has provided economical solutions to common infrastructure and site development needs.



Proven Solutions and Technologies

Tensar International Corporation (Tensar) is the leading developer and manufacturer of high-performance products and engineered solutions for site development and infrastructure. We exceed our customer needs by providing a wide range of geosynthetic solutions for common earthwork challenges.

By providing innovative application technologies and specialized technical services, we supplement our products with value-enhancing alternatives to conventional earthwork and site development solutions. Together, these products, technologies and services constitute engineered systems that serve a variety of transportation, commercial and industrial markets.

We are a full service provider of specialty solutions and engineering services that bring economical solutions to common infrastructure and site development needs. Our commitment to serving our clients' interests, on a global basis, provides innovative solutions based on our more than thirty years of research and development and site work experience.

Our expertise focuses primarily on the following fields of practice:

- ▶ Roadway improvement
- ▶ Railway improvement
- ▶ Retaining walls/reinforced slopes
- ▶ Foundation improvement
- ▶ Coastal/waterway protection
- ▶ Asphalt reinforcement
- ▶ Mining
- ▶ Environmental systems
- ▶ Settlement control for heavy structures
- ▶ Floor slabs
- ▶ Seismic design
- ▶ Slope reinforcement



Inverness Heights Market – Hoover, Alabama

A solution was needed at this retail development to create more usable land. The Mesa® Systems were chosen because of their superior aesthetic and economical capabilities, which ultimately saved the owner \$500,000 in overall project costs.



Interstate H3 – Oahu, Hawaii

When the Hawaii DOT needed a cost-effective solution to the boulder strategy specified in the original plan for slope retention, they chose the Sierra® Slope Retention System. The Hawaii DOT saved millions of dollars and the project received an Outstanding Civil Engineering Achievement award.



Port of Los Angeles – Los Angeles, California

By incorporating TriAx Geogrid, pavement sections that allowed a high level of operational flexibility were achieved for this 230-acre terminal.

Roadway Improvement System



TriAx[®]

Conventional construction practices are presenting new challenges to pavement engineers, contractors and owners due to the volatility of material costs and their availability. Construction budgets are under constant scrutiny to deliver the highest quality end product for the least amount of money. Indeed, the practice of implementing a “typical pavement section” is costing many owners both time and money due to a number of factors:

- ▶ Asphalt and crushed aggregate pricing volatility
- ▶ Reduced construction and maintenance budgets
- ▶ Pavement life span being compromised due to increased trafficking or insufficient pavement structure

These factors have decision makers questioning performance estimates and the conventional strategies they once relied upon to evaluate projects and set priorities.

A growing number of transportation professionals are considering designs that incorporate Tensar TriAx[®] Geogrid.

TriAx, the ground breaking triangular stabilization geogrid, is one of the industry's leading solutions for creating mechanically stabilized pavement structures.

A BREAKTHROUGH TECHNOLOGY

In combination with Tensar's engineering and design services, cost-analysis tools and site assistance, TriAx Geogrid provides a simple, reliable and affordable solution for constructing flexible pavements that deliver both reduced construction cost and long-term value.

TriAx offers a proven performance benefit for paved roads by:

- ▶ Reducing pavement component thickness – asphalt, aggregate base and granular subbase
- ▶ Simplifying construction
- ▶ Lowering long-term maintenance costs

TriAx Geogrid enables you to create durable and cost efficient engineered structures through the product's unique structure and performance properties.



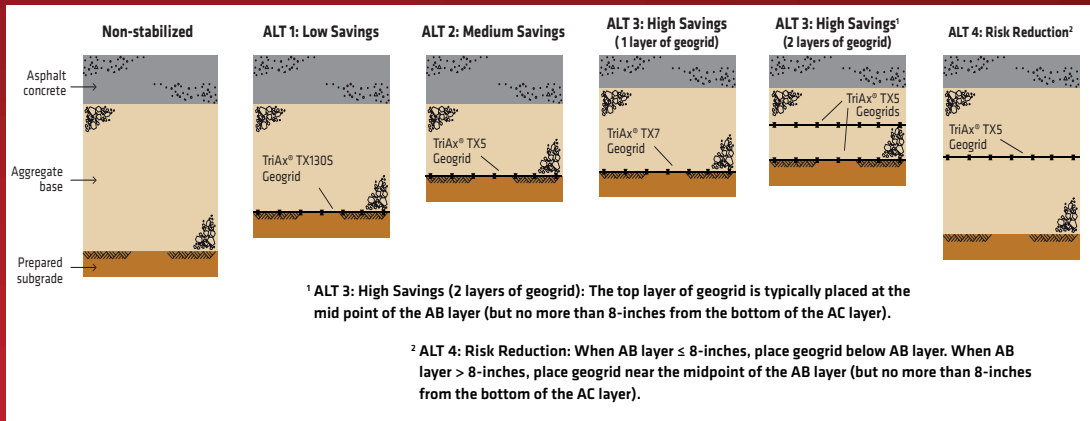
ADOT US Highway 89T – Northern Arizona

A 27-mile bypass road was needed to route the main flow of traffic through northern Arizona. The construction area was located in a very remote part of the state with very few sources of aggregate available and involved long haul distances.



ADOT US Highway 89T (continued)

TriAx[®] Geogrid was used to stabilize the pavement section, reducing the required aggregate base course by 33% and extending the pavement life by 300%. By reducing the aggregate section, more than \$2.2 million were saved in material costs.



1st Avenue – Chula Vista, California

The city of Chula Vista wished to improve 1st Avenue; however, traditional construction methods required deep excavation work. TriAx Geogrid allowed the city to maintain a shallow base and asphalt pavement section without having to relocate existing utility lines, saving the city time and money on the project.



Pleasant Valley Drive – Owensboro, Kentucky

The contractor selected TriAx Geogrid to reduce the amount of ACC, resulting in a constructible pavement section over existing soils that met the required design loading. As a result, it did not force the contractor to increase costs by undercutting and replacing subgrade soils.



Imperial County Airport – El Centro, California

TriAx Geogrid created an affordable option for rehabilitating the taxiway while providing a superior projected design life. This option also allowed for a thinner base layer without the complications associated with chemical stabilization.

Railway Improvement System



The performance of any rail track is directly affected by the ballast and sub-ballast, which together form the roadbed structure. When tracks are built over soft subgrades, regular maintenance of the foundation layers becomes critical. Even routine maintenance requires some disruption to normal operations, resulting in additional expense related to maintenance costs and lost productivity.

Developed to stabilize the ballast and sub-ballast layers, the Spectra® Rail Railway Improvement System is a proven and cost-effective solution that utilizes Tensar® TriAx® Geogrids, the system's key component. The American Railway Engineering and Maintenance-of-Way Association (AREMA) recognizes the use of geogrids in rail designs through inclusion in a chapter of its 2010 Manual for Engineering.

Tensar Geogrids provide a number of benefits when installed over a trackbed's soft subgrades.

- Minimize ballast settlement and lateral spread, reducing the rate of trackbed deterioration. Rates of settlement are

comparable to those of tracks constructed over solid bedrock. This reduces the overall maintenance requirements in terms of maintenance cycles.

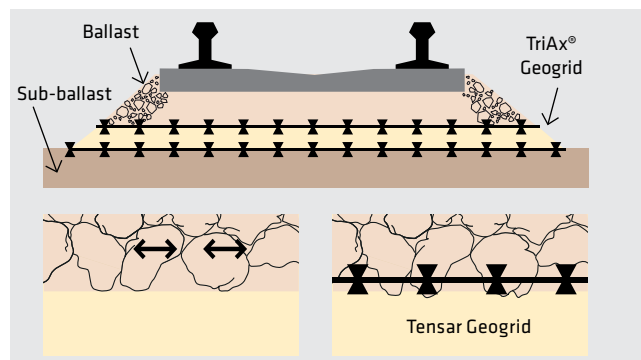
- Stiffen the ballast layer as aggregate and geogrid mechanically interlock. Shear forces from passing trains are transferred from the aggregate to the geogrid, ultimately reducing wear and tear on the track and its associated mechanical components (ties, insulated joints, etc.).
- Reduce the buildup of aggregate fines, thereby helping to maintain good quality drainage within the roadbed structure.

Quick and easy to install, Tensar Geogrids have significantly reduced material and labor costs in hundreds of trackbed stabilization projects around the world. When performance and economy are top priorities, railway maintenance engineers, railway owners and transportation authorities rely on the SpectraRail System.



Sub-ballast Reduced by 50% – Pierre, South Dakota

A six-mile long section of track near Pierre, South Dakota with a long history of settlement issues was subjected to 5 mph speeds. By incorporating TriAx Geogrid into the design, the required sub-ballast was reduced from 12 in. to 6 in. along with a reduction in excavation and construction time.

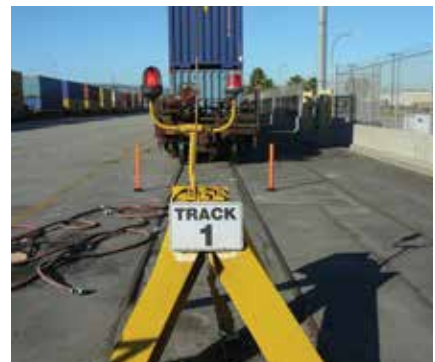


A benefit of using TriAx Geogrid is the confinement of aggregate, which reduces lateral spread, a major cause of ballast and sub-ballast settlement.



Increased Maintenance Intervals Achieved – Captina, Ohio

Reconstruction took place on a 100 year old track constructed over uncompacted clay fill. Track foremen indicated that prior to TriAx Geogrid installation, it was necessary to place ballast in this section on a weekly to biweekly basis for the last 30 years.



Pier A Intermodal Facility – Port of Long Beach, California

The Port of Long Beach (PoLB) used the Spectra® Rail System to improve an intermodal facility. After many successful annual inspections, PoLB staff considers Tensor Geogrid a standard strategy for alleviating settlement issues.

Asphalt Reinforcement System



Reflective cracking in pavements is typically caused by traffic loading, age hardening or temperature cycling of asphalt. Traditional responses have included the application of thicker asphalt overlays – a solution that addresses the problem only at the surface.

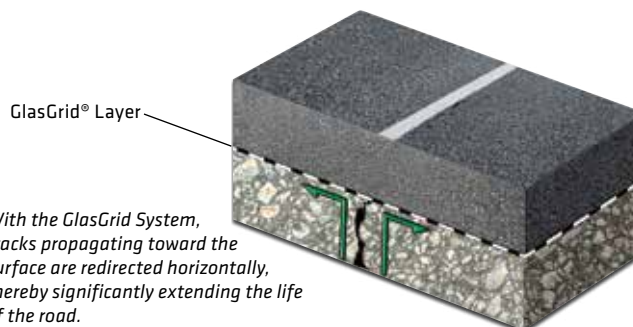
The GlasGrid® Asphalt Reinforcement System provides additional support to resist the migration of reflective cracks in roadway applications, reducing maintenance costs and extending pavement life up to 200%. Manufactured by Saint-Gobain ADFORS and distributed in the Americas exclusively by Tensar, the GlasGrid System has been used on thousands of highways, roadways, parking lots, and airport runways and aprons throughout the world. It has helped address reflective cracking caused by:

- ▶ Longitudinal and transverse concrete pavement joints
- ▶ Thermal loads
- ▶ Lane widening
- ▶ Cement-treated or stabilized layer shrinkage cracks
- ▶ Block cracks
- ▶ Asphalt construction joints



Installed between an asphalt leveling course and the surface course, the GlasGrid System becomes the hidden strength in a road, redirecting reflective crack stresses horizontally to effectively dissipate them.

The GlasGrid System is effective in every geographical area and climate extreme. Installation is easy, and can be provided by Tensar authorized distributors. In addition, since it's made primarily from fiberglass, the GlasGrid product is easily millable and recyclable.



Washington Boulevard - El Cajon, California

City engineers relied on the GlasGrid System to resurface Washington Boulevard in a way that would improve the asphalt overlay's performance while reducing life cycle costs.



U.S. Interstate 40 - New Mexico

Installation of the GlasGrid System saved the New Mexico DOT \$500,000 in repair costs by avoiding full-depth reconstruction. In addition, the maintenance schedule has been extended from four to eight years on the GlasGrid-treated segments.

GlasPave® Paving Mats come in roll lengths ranging from 250 to 1,000 yds and three different roll widths to maximize layout efficiency.



The GlasPave® Asphalt Reinforcement System is among the strongest paving mats available. GlasPave Mats combine fiberglass mesh with high performance polyester mats that deliver the highest tensile strength on the market. Manufactured by St. Gobain ADFORS and distributed in the Americas by Tensar, GlasPave Mats create a longer lasting, better performing pavement while offering a cost-effective solution to tight paving budgets.

The advantages of GlasPave Paving Mats include:

- ▶ **Higher Stiffness** – Their fiberglass mesh offers a high tensile strength compared to other paving fabrics to delay reflective cracking common in asphalt overlays. By delaying the onset of reflective cracking, the design life is also extended, further reducing repair costs.
- ▶ **Moisture Barrier** – Due to GlasPave Paving Mats' non-woven matrix, binder fills voids within the fabric to prevent moisture infiltration into the pavement structure. With minimal water infiltration, the structural integrity of the pavement is maintained and the effects of freeze-thaw cycles are minimized.

- ▶ **Easily Milled** – Fibers are easily disbursed in asphalt millings and will not negatively impact the recycling of asphalt for future projects.

Easy installation is another benefit of GlasPave Mats. The additional stiffness of GlasPave Mats makes them more durable and less prone to on-site installation damage. And because GlasPave Mats come in roll lengths that range from 250 yds to 1,000 yds, installation time is optimized since fewer roll changes are required. Once in place, their distinctive design allows for a strong bond with a variety of tack coats. Due to their thermal stability, hot mix asphalt will not cause GlasPave Mats to shrink, change dimension or lose their bond prematurely.

Complementing the GlasGrid Asphalt Reinforcement System, GlasPave Paving Mats offer less maintenance and easy installation to become an affordable pavement rehabilitation option. As with all Tensar products and systems, design and installation assistance are available.



Due to its high temperature fiberglass matrix, the GlasPave Paving Mat will not shrink or change dimension when it comes into contact with hot mix asphalt. This feature eliminates the risk of premature slippage or loss of bond.



The additional stiffness of the GlasPave Paving Mat makes it more robust than paving fabrics and other paving mats, and less prone to on-site installation damage.

Foundation Improvement System for Embankments Over Soft Ground



The Prism® Foundation Improvement System meets the needs of site and infrastructure developers by creating reliable embankments over poor soils.

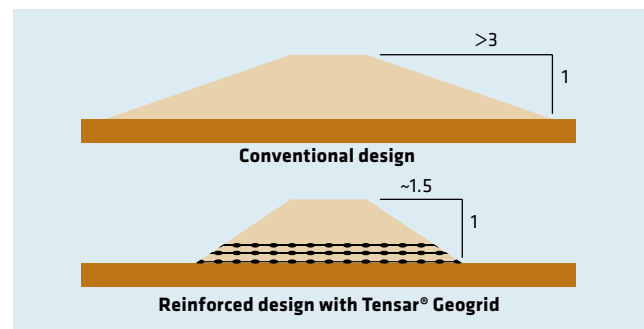
By allowing steeper side slopes and distributing loads more efficiently over weak underlying soils, the Prism System often eliminates the need for undercutting and backfilling. In addition, this system can be used alone or in combination with ground improvement techniques such as Geopier Rammed Aggregate Pier® (RAP) or rigid inclusion systems and even traditional systems like deep foundations, surcharging and chemical stabilization.

When confronted with soft soils or wetlands, the Prism System is optimal for the construction of:

- ▶ Bridge approach fills
- ▶ Causeways
- ▶ Levees
- ▶ Dikes

These projects are expensive and time-consuming when built using traditional means. However, with its composite soil and geogrid structure, the Prism System provides a reliable and cost-effective embankment foundation, either independently or in conjunction with other methods.

By creating an internally reinforced core, the Prism System can minimize the embankment footprint, differential settlement and fill requirements. The result is improved structural integrity with reduced construction schedules and lower project costs.



The Prism System minimizes the footprint of the embankment, as well as its fill requirement and settlement potential.



Westminster Levee – Jefferson Parish, Louisiana

By using the Prism System, the Louisiana DOTD and the U.S. Army Corps of Engineers were able to build a 10 ft (3 m) high hurricane protection levee over weak, marshy soils.



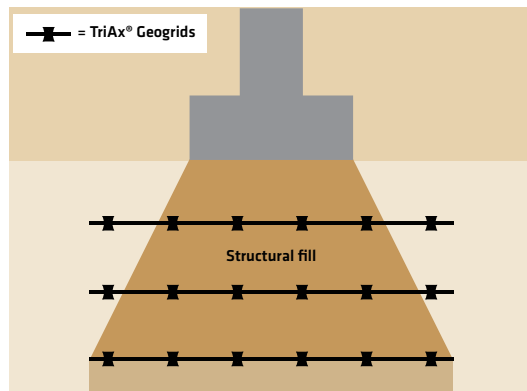
Bridge Approach – State Road 15/US 17, Florida

When soft soils were discovered under the proposed site of a new bridge, the Prism System was used on the bridge approach to reinforce a high-level embankment and to reduce the bridge length by 361 ft (110 m). Total costs were reduced by \$970,000 on this bridge project.

Foundation Improvement System for Shallow Spread Footings



Weak and variable soils pose a major threat to the performance of any structure's foundation. The costs associated with conventional foundation improvement solutions can also be detrimental to a project. In response, Tensar developed the Dimension® Foundation Improvement System to create a firm foundation for engineered structures such as buildings and retaining walls. This lower cost solution provides an improvement over conventional foundation improvement methods such as over excavation/replacement, chemical stabilization and even deep foundations.



The Dimension System consists of aggregate fill and Tensar® Geogrids that interact to form a stiffened structural composite mat over weaker, compressible soils. The system works by distributing the loads more widely and uniformly over underlying compressible soils.

The system can even be combined with other ground modification techniques such as Geopier Rammed Aggregate Pier® systems and/or wick drains to lower overall foundation costs.

The Dimension System:

- ▶ Increases the allowable bearing capacity beneath shallow spread footings
- ▶ Reduces differential settlement
- ▶ Minimizes undercutting and backfilling

The Dimension System is tailored to individual site conditions, so exceptional foundation performance can be achieved with maximum savings relative to conventional foundation improvement techniques.



Cerritos Mall – Cerritos, California

The Dimension System was used as a value engineered (VE) solution to create a stable foundation over weak clay on a site prone to differential settlement.



Broadway Plaza – Chula Vista, California

Using the Dimension System saved an estimated \$1,000,000 versus the original design, which specified a deep foundation system for this shopping center development.

Retaining Wall Systems



Departments of Transportation (DOTs), contractors and engineers have long appreciated the many advantages of Mechanically Stabilized Earth (MSE) panel walls. Their wide range of designs and finishes, combined with their simplicity and speed of construction, make them more appealing when compared to other types of wall systems.

Although panel-faced MSE Walls are commonly tied back with steel reinforcing elements, the questionable durability of these elements and their connection to the concrete panels threatens to restrict their use in the future. As an alternative, ARES® Retaining Wall Systems utilize highly durable, non-corrosive geosynthetic reinforcing elements, therefore providing a cost-effective, functional and aesthetically versatile option.

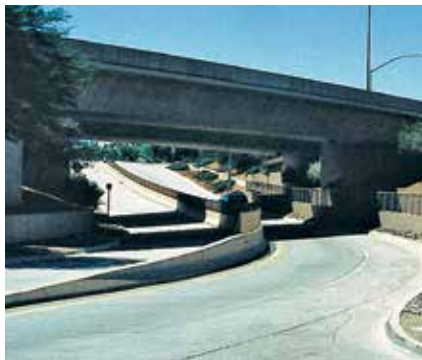
ARES Walls are proven MSE retaining wall solutions. They have been assessed by the Highway Innovative Technology Evaluation Center (HITEC), and millions of square feet have been installed on a variety of transportation and site development projects.

NO METAL – NO CORROSION

With soil reinforcement that is 100% polymeric, ARES Walls eliminate corrosion concerns related to either the reinforcing element, or to the connection of that element to the panel. Tensar Retaining Wall Systems offer the cost advantages of an MSE retaining wall without the long-term consequences of exposure to chlorides, sulfates, low-resistivity soils or stray electrical current potential. Such properties illustrate that ARES Walls are the logical choice for aggressive backfill soils, transformer platform areas and electrified rail projects.

THE ARES SYSTEMS ADVANTAGE

ARES Retaining Wall Systems are inert to chemical and electrical corrosion. These properties permit the use of a wide range of backfills, including recycled concrete, allowing greater economy and a sustainable design.



Tanque Verde Interchange – Tucson, Arizona

Constructed in 1984-85, this was one of the first Tensar Walls ever built. This demonstrates the long-term performance of the ARES Full-Height Panel Retaining Wall System.



Route 7 – Colonie, New York

Bridge abutment wing walls were required to support proposed entrance and exit ramps. The ARES System was chosen because it incorporates the use of HDPE geogrids, which are inert to chemical and electrical corrosion, allowing the system to be used in a wide range of backfills.



King Kamehameha – Oahu, Hawaii

The smooth, uniform face of the ARES Full-Height Panel permits the use of a wide range of architectural finishes.



Memorial Causeway - Clearwater, Florida

The non-corrosive properties of Tensar Geogrids allow the ARES System to be used in salt water applications.



Stoney Trail - Alberta, Canada

ARES® Full-Height Panels were chosen for these bridge abutment walls due to their structural reliability and unique aesthetics.



County Road 124 Overpass - Delaware County, Ohio

The Ohio DOT specified MSE walls to allow County Road 124 to bridge over the existing CSX Railway. The ARES System was chosen in part because of the ability to use locally available aggressive soils with Tensar's non-corrosive HDPE Geogrids.

Retaining Wall Systems



Since 1999, the Mesa® Retaining Wall Systems have been the retaining wall solution of choice for many architects, engineers and DOTs. The first segmental retaining wall (SRW) system to incorporate a positive mechanical connection between the geogrid and the wall face, Mesa Systems offer superior and cost-effective solutions for both structural and landscape retaining wall needs in the transportation, industrial, commercial and residential markets.

With a network of licensed independent block manufacturers throughout the United States, Canada and Latin America, Mesa Systems have become the standard in SRW technology. A truly integrated solution, they are the only SRW system where block, geogrid and connector have been developed by one company; unlike other SRWs, the components of the Mesa Systems have been specifically designed to work together for optimum efficiency and performance. High-strength, low-absorption concrete units, high-shear strength connectors and Tensar®

Geogrids combine to form an MSE system that meets or exceeds industry standards. With Mesa Systems' high connection strength and reliability, core fill* is rarely needed. Using less core fill reduces imported stone and labor requirements, resulting in greater project savings.

For long-term durability, increased structural integrity and simplified construction, all at costs lower than most conventional alternatives, specify Mesa Retaining Wall Systems for your next project.

**Core fill is the aggregate fill within the open void space of a SRW block. Core fill is recommended for wall segments that form convex curves with a radius less than 25 ft (7.6 m) and 90° outside corner units.*



I-25 Founders Meadow – Castle Rock, Colorado

CDOT I-25 was the first major bridge in the United States to be built on footings supported by geogrid-reinforced abutments. This technology eliminates the need for “traditional” deep foundations (piles) altogether. The result – major cost savings.



St. Anthony's Hospital – Denver, Colorado

The Mesa® Ashford™ System was specified at the St. Anthony's Hospital campus for both its aesthetic and its structural merits. The retaining walls created handicap access ramps, detention ponds and supported the Flight for Life helipad. The customized color, dubbed the “St. Anthony Blend,” matched stonework already in place.



Pearl Street – Braintree, Massachusetts

No other segmental retaining wall system can match Mesa Systems' structural integrity, which is why Mesa is the first SRW system to achieve approval for heavy rail loading.

Retaining Wall Systems



Temporary walls are a necessity for many types of staged construction, but the conventional means for installing them are expensive, requiring heavy lifting and pile-driving equipment. Structures such as soldier piles and lagging walls or sheet piling typically require toe penetration equal to or greater than the wall height, and they may also need secondary bracing or deadmen to safely retain the fill. These walls demand the use of expensive equipment and labor, resulting in significantly increased project costs.

Fortunately, there is a proven technology that allows you to build temporary walls without the challenges and expense of traditional techniques. The Tensar® Temporary Retaining Wall

System uses an inexpensive wire-form facing system along with Tensar® Geogrids to reinforce the fill. As a result,

Tensar Temporary Walls can simplify planning and expedite construction for bridge abutments, road widening, surcharge loading, phased or staged projects and more. And Tensar Temporary Walls are both durable and flexible; they may be left in place or easily removed as needed.



State Route 76 – San Diego County, California

A CAT 777 weighing approximately 360,000 lbs is supported by Tensar Temporary Wall bridge abutments.



I-25 – Denver, Colorado

This temporary wall in Denver did not require excavation, was easy to install and offered the lowest cost alternative. It also allowed the contractor to use milled and recycled asphalt for fill.



Ringling Causeway Project – Sarasota, Florida

The system enabled the walls to be left in place, whereas the sheet pile alternative may have required removal.

Retaining Wall Systems



Engineers and architects are under constant pressure to find cost-effective alternatives to traditional wall systems. For a range of applications, the SierraScape® Wire-Formed Retaining Wall System is the ideal solution for appearance, performance and overall value. Backed by decades of engineering experience and with millions of square feet installed worldwide, the SierraScape System is a complete retaining wall solution, which includes materials, design, specifications and technical assistance.

THE POSITIVE CONNECTION™

The SierraScape System combines Tensar® Geogrids with a positive mechanical connection between the geogrid and the wire-form for a dependable, cost-effective solution to the most challenging grade change projects. This connection better withstands differential settlement, offers exceptional performance in areas where seismic activity or heavy external loads are a concern and eliminates surficial stability problems often associated with other structures. It also provides a visual construction quality control check during installation.

EASE OF INSTALLATION KEEPS COSTS DOWN

Integrating SierraScape components create durable, yet simple-to-build structures. With a small number of components, project assembly moves quickly and without specialized equipment or labor. Welded-wire forms stack easily to create a uniform wall face, and unlike geotextile wrap walls, stiff Tensar Geogrids and the unique SierraScape Locking Tail Strut help maintain facing alignment. The system can be backfilled with general embankment fills or on-site soils, reducing both fill materials and disposal costs.

INSIDE AND OUT – NO OTHER WALL SYSTEM COMPARES

When it comes to structural stability, no other wire-formed retaining wall compares. The SierraScape System adapts to a variety of conditions, design requirements and aesthetic options.

Compared to concrete, the system is a more cost-effective solution. Its unique wire forms ease installation and minimize construction time. The SierraScape System's low maintenance, design versatility and resistance to environmental degradation make it the right choice for numerous retaining wall applications.



The Outlook – Vancouver, Canada

This residential community was looking for a green alternative to traditional concrete retaining walls. SierraScape vegetated walls were the ideal solution, providing both aesthetics and structural stability.



TXI Facility – Oro Grande, California

Concerns about the chemical properties of the on-site fill led the cement manufacturing facility to choose the SierraScape stone-filled walls because of the non-corrosive properties of Tensar Geogrid.



Brentwood Towne Square – Pittsburgh, Pennsylvania

To eliminate lateral soil loads, a SierraScape Pressure Relief Wall was selected as a cost-effective alternative to traditional below-grade construction.



Vulcan Materials Plant – Columbia, South Carolina

The SierraScape® Wall and superspan structure allow heavy trucks filled with aggregate easy and stable passage to and from the quarry.



Blackstone Valley – Millbury, Massachusetts

The SierraScape® System was chosen because it met the aesthetic demands of the owner as well as the engineer's space limitations, all while saving time and money with the use of on-site soils.



Webb Gin – Gwinnett County, Georgia

A multi-system design combined a Mesa Wall with both vegetated and stone faced SierraScape Walls, providing a unique and aesthetic solution.

Slope Retention System



The Sierra® Slope Retention System is a complete and fully integrated MSE solution. Each component has been designed to work together for optimum efficiency in a variety of challenging site and loading conditions. The Sierra System's cost effectiveness, coupled with its natural aesthetic appeal, provides a reliable solution routinely specified by government agencies, developers, engineers and architects for a variety of applications, including:

- ▶ Transportation infrastructure
- ▶ Commercial
- ▶ Industrial
- ▶ Retail
- ▶ Recreation facilities
- ▶ Municipal water and storm water management
- ▶ Single- and multi-family residential housing

The Sierra System significantly reduces material and installation costs by eliminating many limitations imposed by soil conditions, minimizing fill requirements and allowing the use of on-site fills. The primary cost benefit introduced by the Sierra Slope System is the elimination of more costly concrete facing elements, in favor of less costly, more aesthetically pleasing green elements. The economic benefits of Sierra Slopes have led cost-conscious transportation agencies around the world to specify them for landslide repairs, overpasses and roadway widenings. These same cost advantages have encouraged site developers to specify the Sierra System to enhance property values and preserve the natural beauty of their sites. Sierra Slopes can be graded so that the appearance of these reinforced earth retention structures blend well with native topography and vegetation.



Spanish Hills – Camarillo, California (Before)



Spanish Hills – Camarillo, California (After)

The two pictures above depict slope construction and the final result at a residential development. The Sierra System was used in place of retaining walls to create 29 slopes that were variably graded and landscaped to be indistinguishable from the naturally hilly terrain.



Bridge Street – Irwin, Pennsylvania

This project demonstrates how DOTs can use the Sierra System to stay within a restricted right-of-way while maximizing land use and curb appeal.

Environmental Systems



ADD³

CAPACITY IMPROVEMENT SYSTEMS

ADD³® Capacity Improvement Systems are performance-based designs customized to meet owners' economic needs by reconfiguring waste containment facilities based on site specific conditions. The ADD³ Systems' integrated approach to waste containment structure construction maximizes the economy, life span and security of both municipal and industrial facilities by reducing unit airspace costs and providing a higher level of environmental security.

Even within tight boundary constraints, ADD³ Systems allow efficient expansion of waste containment facilities, thereby increasing the waste capacity and extending service life. ADD³ Systems can be used to:

- ▶ Build safer, structurally stable, steeper slopes to reduce land requirements and increase capacity
- ▶ Construct landfills over marginal foundations
- ▶ Structurally support new landfills built on top of existing landfill cells
- ▶ Reinforce the lining system to create new, usable airspace via vertical or horizontal expansion of an existing cell

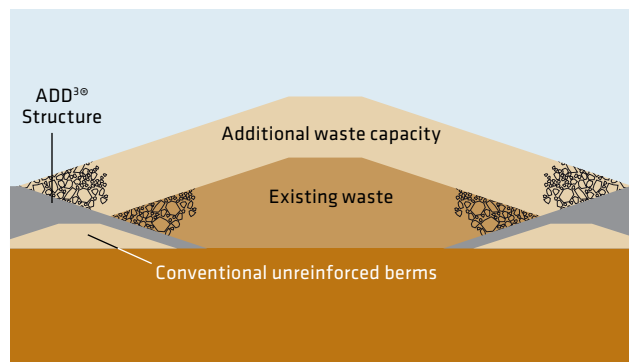


LG&E Trimble County Power Plant - Bedford, Kentucky

Ash Pond Expansion: The ADD³® System provided significant cost savings over the standard solution and blended with the natural landscape.

Tensor Environmental Systems have also been used to build containment facilities for ash and tailing ponds and as foundation reinforcement for heap leaching projects. Additionally, they have been utilized to construct berm expansions that increase the capacity and extend the life of ash or environmental containment ponds.

ADD³ Systems not only lengthen the life of a landfill, but can also simplify the closure of waste impoundments. Even when all other conventional technologies have failed, Tensor ADD³ Capacity Improvement Systems have been able to successfully and securely close sites while reducing costs.



Perimeter Berm

A Tensor® Perimeter Berm with steepened slopes adds capacity, resulting in additional revenue and extended service life.

Coastal and Waterway Systems



Triton® Coastal and Waterway Systems are a family of marine structures used for a broad range of construction and protection applications in and around the water. They provide durable, cost-effective solutions and are typically used for:

- ▶ Foundations for coastal structures and underwater utilities
- ▶ Scour protection for bridge abutments, piers, culverts, utilities, and other structures
- ▶ Erosion protection for stream banks and channels, shorelines and dunes
- ▶ Protective cover for subaqueous utilities/pipelines
- ▶ Grid composite material used as an underlayer for riprap in submerged and soft soil conditions

Triton® Systems various marine structures are also used together with conventional solutions to enhance overall performance.

Triton Systems were specifically developed to counter some of the common difficulties associated with construction in coastal areas. By employing some unique deployment techniques, Triton Systems can be significantly less expensive than conventional solutions. A high degree of flexibility allows Triton Systems to conform to land contours and irregular subgrade conditions far better than conventional solutions. Since Tensar® Geogrids enable Triton Systems to resist virtually all forms of chemical and environmental degradation, the system is often specified for aggressive conditions where other types of materials would deteriorate rapidly.



Living Shoreline – Hilton Head, South Carolina

The Triton Marine Mattress System provides foundation support, filtration and scour protection for breakwaters, groins, jetties, and living shoreline structures.



Triton Marine Mattress Foundation – Palm Beach, Florida

Handling and installation time was approximately five minutes per Triton Mattress, which allowed the contractor to finish construction 37 days early.



Triton Grid Composite

On this project, armor stone was placed directly on Triton Grid Composite, eliminating the standard layer of bedding stone.

Mining Systems



Tensor Mining Systems offer a wide range of cost-saving solutions to meet the needs and objectives of mining operations. Among the proven applications are roof and rib control, long-wall shield recovery screens as well as soft bottom and haul road stabilization.

ROOF AND RIB CONTROL

Tensor Geogrid, teamed with Minex™ Rock Mesh, provides effective roof and rib control for soft minerals as well as the most demanding hard rock and tunneling applications. Tensor Mining Grid meshes are impervious to acidic environments and have very similar strength characteristics to steel, but at a fraction of steel's weight. These properties add up to a drastic reduction in back, hand and facial installation injuries, due to product weight and flexibility. Lightweight, easy-to-handle Tensor Mining Systems easily reduce installation and material handling time by up to 75%.

LONG-WALL SCREENING

Moves that traditionally took weeks several years ago have been reduced to days, enabling customers to save



thousands of dollars working in the most brutal of conditions. Flame-retardant Minex Rock Mesh maintains similar weight characteristics to Tensor Mining Grid, yet is over eight times stronger with increased flexibility.

RESISTIVE UNROLLING TENSAR® TRIAX® GEOGRID

Resistive unrolling allows Tensor TriAx® Mining Grid to be installed from miner/bolters and bolting machines without the need for brackets that cause downtime and needless maintenance.

TriAx Mining Grid rolls are injected with expandable foam or secured with cable ties that allow the roll to be suspended from a bolter or miner/bolter and installed with a predetermined amount of resistance. The resistance prevents the roll from undoing itself during installation as well as keeping TriAx Mining Grid tight against the roof. The benefits include:

- ▶ Reduction of entry development time
- ▶ Increased driveage
- ▶ Reduction of worker injuries and material handling
- ▶ Elimination of the need for screen rehabilitation



Tensor BX and UX Mining Geogrids provide effective roof and rib control for soft minerals as well as the most demanding hard rock and tunneling applications.



Tensor TriAx® Geogrid can be installed without brackets, thus eliminating unnecessary downtime.

› Software for Road Design, Retaining Walls, and Shallow Foundations

Design Technology

SPECTRAPAVE™ SOFTWARE

Tensor provides unique design capabilities to our customers with our industry leading SpectraPave™ Software. The software helps design engineers accurately predict the performance of both conventional and geogrid-stabilized roads. SpectraPave Software includes three design modules for Tensar TriAx Geogrids:

- ▶ Flexible Pavement Optimization using AASHTO design methodology
- ▶ Subgrade Stabilization using the Giroud-Han design method
- ▶ Pavement Foundation Improvement using a modulus-based design approach

SpectraPave also allows the user to conduct Subgrade Stabilization and Flexible Pavement analyses for punched and drawn biaxial geogrids and includes comprehensive cost analysis capabilities for all design modules.



The SpectraPave Paved Application module can compare the thickness of a conventional pavement section to one that is optimized with Tensar TriAx Geogrid and show cost saving results.

DIMENSION® SOLUTION SOFTWARE

Dimension® Solution Software is a foundation design tool that can be used to improve performance and reduce cost of a wide range of shallow foundations. The use of Dimension software can result in substantial building foundation cost savings by facilitating economical design of geogrid-reinforced composite raft foundations. Unlike some design programs, Dimension Software is empirically based, using extensive field and laboratory research conducted with Tensar® Geogrids.



Dimension Solution Software is used to calculate the bearing capacity and projected settlement beneath shallow foundations, which helps reduce costs and improve foundation performance.



TENSARSOIL-PRO™ AND TENSARSLOPE™ SOFTWARE

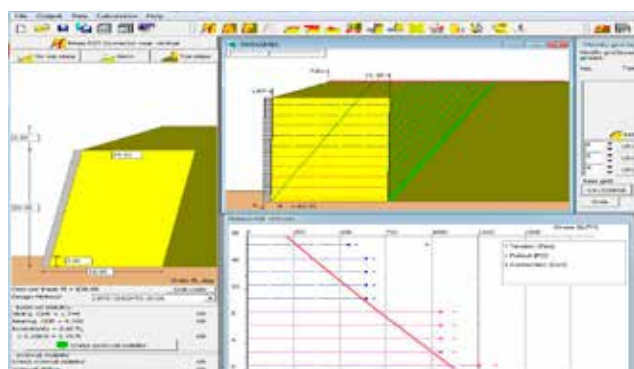
TensarSoil-PRO™ and TensarSlope™ Software are unique tools that make the design of Tensar grade separation systems simpler, faster, as well as more cost-efficient. TensarSoil-PRO Software has been expanded to evaluate the feasibility, potential performance and cost benefits of each of our geogrid-reinforced systems, including:

- ▶ ARES® Retaining Wall Systems
- ▶ Mesa® Retaining Wall Systems
- ▶ SierraScape® Retaining Wall Systems
- ▶ Sierra® Slope Retention System
- ▶ Tensar® Temporary Retaining Walls

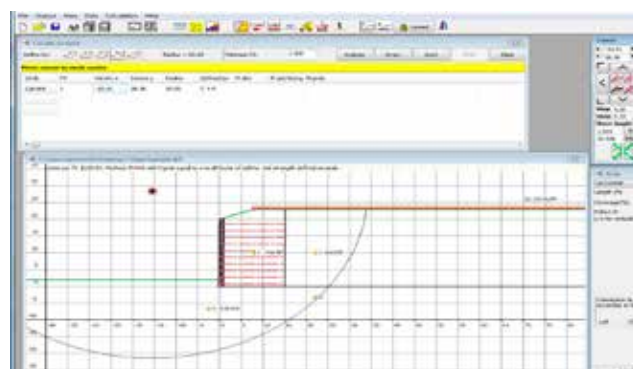
In addition, it may be used with large precast block systems that incorporate Tensar Uniaxial Geogrid into their design. It is also compatible with all major design methodologies to enable you to design projects using various Tensar Systems and meet all major industry-standard protocols including:

- ▶ National Concrete Masonry Association (NCMA) 1997
- ▶ Federal Highway Administration – Demonstration Project 82 (1997)
- ▶ Federal Highway Administration – National Highway Institute (FHWA NHI 043) 2001 (AASHTO ASD 2002)
- ▶ American Association of State Highway and Transportation Officials – Load and Resistance Factor Design (AASHTO LRFD) 2010

TensarSoil-PRO Software is programmed with data from all of the Tensar wall and slope systems. Fully interactive, the software allows the user to input and easily alter wall/slope geometry, geogrid grade or layout, surcharge load and/or soil characteristics – *all on a single screen image* – to determine stability data and material costs instantaneously. Once internal and external stability parameters have been determined, design data can be exported to TensarSlope Software, our slope stability application, for comprehensive, compound and global stability analyses.



TensarSoil-PRO Software allows the user to design prototypes and compare costs of different grade separation solutions.



TensarSlope Software is an effective tool for analyzing slope stability using different types of global soil conditions.

Geopier® Foundations and Floor Slabs



Geopier Foundation Company®, a subsidiary of Tensar Corporation, provides ground improvement technologies for the support of structures. Our Rammed Aggregate Pier® and rigid inclusion systems replace traditional deep foundations, such as auger-cast piles and drilled shafts, and eliminates the need for massive over-excavation of poor soils.

Geopier Rammed Aggregate Pier® (RAP) elements are used in nearly all soil types to economically increase the strength and stiffness of the soil prior to the construction of shallow foundations, retaining walls, and floor slabs. Geopier's RAP systems include GP3®, Impact®, Rampact®, and X1® systems. RAPs are constructed by drilling out or displacing soft/loose bearing soils and replacing them with very stiff columns of aggregate. The piers are constructed with a high energy tamper that not only creates a very dense pier element, but also densifies the surrounding bearing soils, creating a composite soil mass with a greatly increased stiffness.

Geopier's rigid inclusions are used in very soft cohesive and organic soils that require additional strength and stiffness prior to the construction of shallow foundations, retaining walls, and floor slabs. Geopier's rigid inclusion systems include Armorpack®, Grouted Impact® and GeoConcrete® Columns, each tailored for specific soil types and loading conditions. There is virtually no soil profile that Geopier cannot improve.

FOUNDATIONS

For more than 25 years, structural designers have been using Geopier ground improvement systems to provide Intermediate Foundation® support for their projects. Thousands of projects bear on Geopier-reinforced soils, supporting loads as high as 3,000 kips, bearing pressures up to 10,000 psf, and at settlements that conform to the building's structural requirements.

Geopier systems provide foundation support for a wide range of structures, including:

- ▶ Hospitals
- ▶ Office buildings
- ▶ Parking garages
- ▶ Multi-family housing
- ▶ Schools and universities
- ▶ Storage tanks
- ▶ Grain bins

FLOOR SLABS

Geopier systems provide economical solutions for the support of conventional light to heavily loaded floor slabs in industrial, commercial, and residential applications.

Geopier ground improvement solutions allow for conventional slab-on-grade design and construction. This eliminates the need for costly grade beams and structural slabs which are typically required for deep foundation supported slabs.

Geopier systems are commonly used floor slab support structures, including:

- ▶ Retail warehouses
- ▶ Data centers
- ▶ Distribution centers
- ▶ Manufacturing facilities



Office Building and Garage - Connecticut

Geopier Rammed Aggregate Pier® (RAP) and GeoConcrete® Columns (GCCs) allowed for traditional shallow footings and slab-on-grade construction of this 12-story structure built on soft organic soils. The combined Geopier solution resulted in substantial cost savings compared to deep foundations.



Facebook Data Center - Omaha

Geopier GP3® and X1® systems were used to support two Facebook data centers. The fast installation accommodated an accelerated construction schedule and proved to be significantly less expensive than deep foundations and structural slabs.



Madison Farmers Grain Bin - South Dakota

The Geopier GP3® system was used to support a grain bin with a 135 feet diameter and an eave height of 91 feet in stiff lean clay and alluvium soils. This provided significant cost savings and schedule advantages while keeping existing grain bins operational.

Geopier® Global Stability for Retaining Wall Systems



Constructing MSE walls and embankments on weak or soft foundation soils can result in excessive settlement or inadequate factors of safety for global stability or bearing capacity. Using Geopier ground improvement solutions increase the composite stiffness of the soft foundation soils and provide additional shear reinforcement that increases the factor of safety for bearing capacity and global stability and significantly reduces embankment and retaining wall settlement.

EXTERNAL GLOBAL STABILITY

Geopier soil reinforcement effectively increases the factor of safety against global instability of retaining walls and embankments. The high angle of internal friction exhibited by the Geopier RAPs provides significant increases in the shear resistance, thus improving the factor of safety for global/slope stability.

INCREASED BEARING CAPACITY

Tall cast-in-place retaining walls and MSE walls exert high bearing pressures near the toe of the wall which often exceed the soil bearing capacity. Geopier ground improvement systems are installed beneath MSE and retaining walls to cost-effectively increase the bearing capacity of weak or soft foundation soil and fill. The high friction angle of the Geopier systems provides significant increases of 2 to 3 times in the allowable bearing pressure, offering reliable support of tall walls.

SETTLEMENT CONTROL

The increase in lateral stress achieved during ramming improves the surrounding soil stiffness. The improved stiffness is coupled with the high stiffness of the Geopier foundation elements to significantly reduce embankment and retaining wall settlement. The piers may be constructed with open-graded stone to facilitate radial drainage thereby reducing the time for settlement to occur. The reduction in settlement magnitude and duration eliminates the need for staged embankment construction and reduces overall construction schedules while delivering superior performance.

GEOPIER® EXPERIENCE

Geopier offers the only ground improvement technology evaluated by an independent HITEC committee for transportation projects. Our ground improvement systems have supported hundreds of retaining walls and embankment projects providing an unmatched value and performance by supporting transportation projects in most states in the U.S.



Retaining Wall and Railroad Line – Rhode Island

The Geopier Impact® system was used to penetrate the fill and organic soils to meet the project performance requirement for global stability, bearing capacity and settlement, without disrupting normal train operations.



MSE Walls And Embankments - Wisconsin

Geopier's GP3® system provided shear reinforcement for global stability and bearing capacity and settlement control in mixed sand and clay fills. The Geopier system was much cheaper than lightweight fill and enabled the contractor to expedite the erection schedule for 10 locations.



Sam Houston Tollway Widening - Texas

The Geopier GP3® system was used to support embankment design pressures of 3,000 psf in very stiff clay and dense silty sand. The rapid installation of piers allowed the project team to expedite the construction schedule with minimal impact to existing traffic.

Geopier® Seismic and Wind Solutions



Projects constructed in regions with high transient forces associated with wind or seismic activity face unique design challenges, including increased uplift and lateral loading demands, as well as potentially liquefiable subgrade conditions. Geopier ground improvement solutions, can be provided to meet seismic design challenges at considerable cost savings compared to traditional deep foundation approaches or other ground improvement techniques.

LIQUEFACTION

Geopier® ground improvement systems provide economical liquefaction mitigation solutions. The installation of Geopier elements within liquefiable soils replaces loose soil with dense (dilatant) Geopier elements and increases the density of granular soils. Geopier ground improvement solutions reduce the potential for liquefaction by:

- ▶ Providing a stiff, non-liquefiable inclusion in the liquefiable soils
- ▶ Improving the matrix soil between the piers by increased lateral stress and soil densification
- ▶ Providing drainage elements for rapid drainage of excess pore water pressures that develop during seismic shaking

Geopier ground improvement reinforces soils with higher fines content to reduce liquefaction potential. Our solutions are tailored for site specific conditions to provide acceptable levels of static and dynamic settlement through a combination of densification and reinforcement.

UPLIFT AND LATERAL LOAD RESISTANCE

Buildings subjected to wind and seismic loading often require solutions to resist large uplift and lateral forces on foundations. Geopier® ground improvement systems provide cost-effective, reliable solutions for these dynamic loading conditions.

- ▶ Uplift anchors can be used with Geopier Rammed Aggregate Pier® (RAP) elements to provide allowable uplift resistance up to 75 kips per anchor. These uplift anchors often eliminate the need for deep foundations or over-sizing of shallow foundations.
- ▶ Lateral load resistance is developed through similar mechanisms as conventional shallow foundations. The unique combination of high normal stress, through stress concentration and the high friction angle of the piers, results in substantial increases in lateral load resistance.



Sanmar Shipyard - Talova, Turkey

The Geopier Impact® system was used to form a densified crust against liquefaction, thereby reducing the amount of total and differential settlement under both static and seismic loads.



Casino Queen - Illinois

Geopier Impact® elements were used in lieu of traditional ground improvement technologies for foundation support and liquefaction mitigation for this new casino featuring a parking garage, theater, retail, restaurant and entertainment area.



C-17 Hangars 164th Airlift Wing - Tennessee

The Geopier GP3® system was chosen to support the high compression and uplift forces of the 10-story hangars to accommodate the C-17 Galaxy, instead of the more costly and time-consuming auger-cast piles.

Geopier® Specialty Applications



Through continued research and development, Geopier has expanded its system offerings to include turn key solutions for specialty ground improvement applications.

SLOPE REINFORCEMENT

The Geopier SRT® system is an efficient and cost-effective solution for the stabilization of new slopes and active slides up to 12 feet deep. With fast and easy installation, our Plate Piles™ allow for emergency response and immediate stabilization without the need for massive earthwork, traffic disruption, or the use of anchors or retaining walls.

- ▶ Turn-key solutions for shallow slides or constrained sites
- ▶ Method has been used to repair landslides within roadway slopes, commercial and residential developments, and pipeline alignments
- ▶ Increases global stability FS for steeper constructed slopes, resulting in more developable property

The Geopier SRT® system is designed to stabilize slopes where the soil conditions consist of an upper zone of weathered, loose, soft or disturbed soil over a stable zone of soil or soft rock. The closely spaced Plate Pile elements form a series of horizontal barriers where the soil arches between the plates, forming a continuous line of resistance against downslope movement.



Geopier SRT® system utilizes Plate Piles™ to rapidly and economically stabilize shallow landslides that occur on site with difficult access or that require minimized environmental disturbance.

RAILWAY SUBGRADE STABILIZATION

The Geopier GeoSpike™ system is a low-cost method for treating weak railroad track subgrades. This turn key system can be installed without removing railroad tracks or ties. The GeoSpike shell is driven in-place by inserting a driving mandrel within the shell and advancing the mandrel to design depths. After driving to design depths, aggregate is placed within the confining GeoSpike shell and compacted. The dynamic loads from the passing rail cars arch through the ballast and are effectively transferred through the sell and densely compacted aggregate down to a suitable bearing layer.

- ▶ Rapid installation process without track tie or ballast removal
- ▶ Reduces the need to re-build and repair track sections.



The Geopier GeoSpike™ system increases the railroad track subgrade modulus response and decreases permanent track deflections due to dynamic loads.

Tensar®

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