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# TENSAR INTERNATIONAL CORPORATION

## **THE COMPANY YOU CAN BUILD ON<sup>®</sup>**

SYSTEMS OVERVIEW



**Tensar<sup>®</sup>**

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

#### THE TENSAR 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 [www.tensarcorp.com](http://www.tensarcorp.com).

## Proven Solutions and Technologies

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

By providing innovative application technologies and specialized technical services, we supplement our products with value-enhancing alternatives to traditional materials and practices used in earthwork construction. Together, these products, technologies and services constitute engineered systems that serve a variety of commercial and industrial markets.

We are a full service provider of specialty products and engineering services and offer economical solutions to common infrastructure and site development needs. We are committed to serving our clients' global interests by providing innovative engineered solutions using sophisticated earth reinforcement techniques.

Our expertise focuses primarily on the following fields of practice:

- Roadway improvement
- Railway improvement
- Retaining walls/reinforced slopes
- Foundation improvement
- Coastal/waterway protection
- Pavement reinforcement
- Erosion/sediment control
- Turf reinforcement
- Vegetation establishment
- Mining
- Waste management



**Inverness Heights Market – Hoover, Alabama**

*A solution was needed at this retail development to create more useable 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.*



**Port of Los Angeles – Los Angeles, California**

*By incorporating the Spectra® System, pavement sections that allowed a high level of operational flexibility were achieved for this 230-acre terminal.*



**Patton Creek – Birmingham, Alabama**

*For projects with grade separations, the SierraScape® Retaining Wall System is a cost-effective solution that blends more naturally with the site than traditional concrete retaining wall systems.*





#### **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 the 1998 Outstanding Civil Engineering Achievement award.



#### **Cold Water Creek – St. Louis, MO**

This creek was excavated and rebuilt with on-site soils using alternating layers of Tensor® BX and UX Geogrid. The slope was protected with Vmax® C350® permanent turf reinforcement mats resulting in thick vegetation. Vmax® P550® was also installed to protect an outlet from the overflow of a nearby detention basin.



#### **California Gulch – Leadville, Colorado**

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



## Roadway Improvement System



When weak subgrade, heavy loads, thick fill layers, high aggregate costs, variable subgrade conditions or shallow utilities disrupt your construction schedule or budget, the Spectra® Roadway Improvement System is often the best solution. The Spectra System improves flexible pavements in three ways:

- ▶ Simplifying construction
- ▶ Extending service life
- ▶ Reducing required materials

Not only does this system allow access and construction in less than ideal situations, it also provides a predictable engineered solution. The Spectra System increases the performance of the underlying subgrade or aggregate base course by incorporating Tensar® TriAx® Geogrids into the crushed aggregate base, forming a mechanically stabilized layer (MSL). The result – a more durable and cost-efficient roadway structure.

Using proven design principles, the Spectra System achieves results through two distinct, but related methods:

- ▶ **Base Course Reinforcement** – Enhanced performance or thickness reduction of a permanent road when constructed on a relatively firm subgrade.
- ▶ **Subgrade Improvement** – Used to provide a temporary road surface or a stable working platform for a permanent road when weak subgrade conditions are encountered.

The Spectra System for base course reinforcement and subgrade improvement has also been proven in the toughest test of all – real-world performance. The Spectra System has been used by the FHWA, state departments of transportation, as well as local county and municipal agencies and private owners, proving the Spectra System's structural and economic value time and time again.



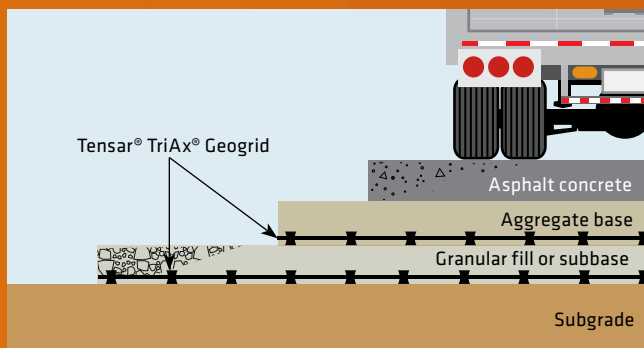
**Access Road – Mobile, Alabama**

*Before: This access road near Mobile, Alabama was a contractor's nightmare. The unpaved road, originally constructed with fabrics, rapidly failed as trucks were delivering fill.*



**Access Road – Mobile, Alabama**

*After: Tensar Geogrids were used on the same site and held up under repeated truck traffic to get the job done.*



Whether the Spectra® System is used to improve the subgrade, to reinforce the base course, or to do both, the result is the same – better performance and economy of flexible pavements. Spectra System design methods have been proven worldwide for nearly 30 years.



#### **1st Avenue – Chula Vista, California**

The City of Chula Vista wished to improve 1st Avenue, however traditional construction methods required deep excavation work. The Spectra System 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.



#### **ADOT I-10 Widening – Casa Grande, Arizona**

The Arizona Department of Transportation (ADOT) used the Spectra System to create an unyielding and stable test construction platform over a section of weak soils on the Interstate 10 roadway widening project.



#### **Imperial County Airport – El Centro, California**

The Spectra System 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 more 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® Geogrids, the system's key component. The American Railway Engineering and Maintenance-of-Way Association (AREMA) has recently recognized the use of geogrids in rail designs by including a new chapter in its 2010 Manual for Engineering.

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

- Help to minimize ballast settlement and lateral creep, reducing the rate of trackbed deterioration. In fact, rates of settlement are comparable to those of tracks constructed over solid bedrock. This reduces the overall maintenance requirements.

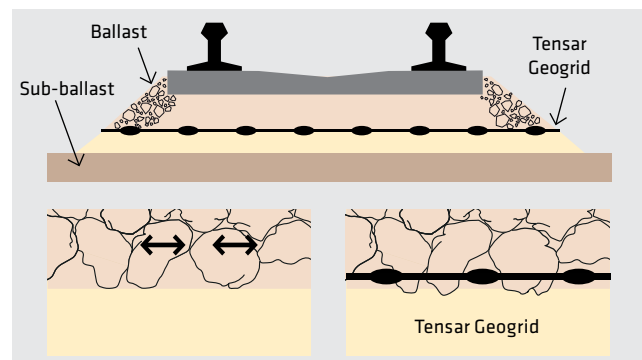
- Stiffen the ballast layer as aggregate and geogrid mechanically interlock. Shear forces from passing trains are transferred from the aggregate to the geogrid, ultimately reducing wear and tear on the track and its associated mechanical components (ties, insulated joints, etc.).
- Reduce the buildup 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 reinforcement projects around the world. When performance and economy are top priorities, railway maintenance engineers, railway owners and transportation authorities rely on the Spectra Rail System.



**BNSF Hobart Yard - Commerce City, California**

*Tensar Geogrid was used to keep soft soils in place, provide a platform for construction equipment and minimize downtime for nearby rail lines.*



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





#### **CSX Rail Line – Milstead, Alabama**

*The existing track was raised using powerjacks to allow placement of the geogrid within the ballast section.*



#### **Canadian Pacific Intermodal Facility – Detroit, Michigan**

*A total of 70,000 square yards of BX Geogrid was installed at the facility with construction finishing three weeks ahead of schedule.*



#### **CSX Intermodal Facility – Chicago, Illinois**

*Tensar® Geogrids led to 20% to 30% cost savings compared to a design that included a concrete pavement section.*



## Pavement Reinforcement System



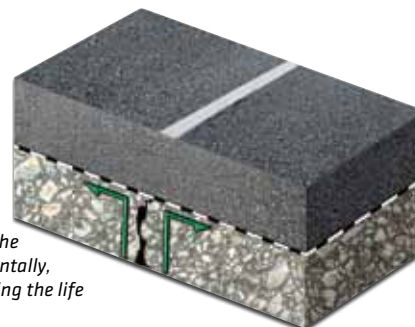
Reflective cracking in pavements is typically caused by traffic loading, age hardening or temperature cycling of asphalt. Traditional responses have included the application of thicker asphalt overlays – a solution that addresses the problem only at the surface.

The GlasGrid® Pavement 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, airport aprons and runways 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, turning reflective crack stresses horizontally to effectively dissipate them.

The GlasGrid System is effective in every geographical area and climate extreme. Installation is easy, with no need for specialized equipment or labor. And now with its pre-installed tack film, GlasGrid TF is considered to be the fastest interlayer system installed. And since it's made primarily from fiberglass, the GlasGrid product is easily millable and recyclable.



*With the GlasGrid System, cracks propagating toward the surface are redirected horizontally, thereby significantly extending the life of the road.*



### Integrated Tack Film

With its pre-installed film layer made of elastomeric polymer, GlasGrid TF protects against reflective cracking while it effectively bonds to asphalt overlays.



### U.S. Interstate 40 – New Mexico

Installation of the GlasGrid System saved the New Mexico DOT \$500,000 in repair cost 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 250-1,000 yds and three different roll widths to maximize layout efficiency.*



GlasPave™ Waterproofing Paving Mats are among the strongest paving mats available on the market. GlasPave Mats are a geosynthetic paving material that combine fiberglass mesh with high performance polyester mats, resulting in engineered fiberglass paving mats that deliver the highest tensile strength at 2% strain 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.

Advantages of the GlasPave Paving Mats include:

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

- ▶ **Easily Milled** – Fibers are easily disbursed in asphalt millings and will therefore 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 since 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 Pavement Reinforcement System, GlasPave Paving Mats offer less maintenance and easy installation to become an affordable pavement rehabilitation option. And as with all Tensar products and systems, design and installation assistance are available.



*Due to its high temperature fiberglass matrix, GlasPave Paving Mats 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 GlasPave Paving Mats make them more robust to paving fabrics and other paving mats, and are 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 foundations over poor soils.

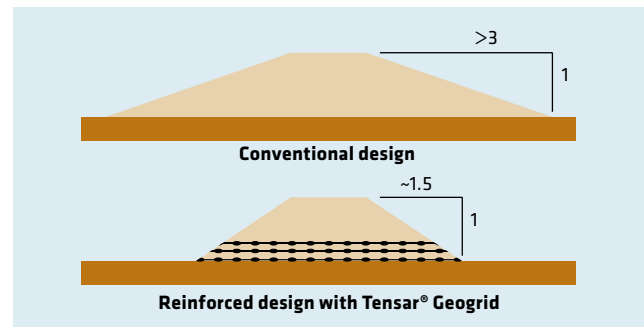
The Prism System is similar in concept to a concrete raft foundation, but without the time and expense. By distributing loads more efficiently over underlying soils, the system often eliminates the need for undercutting and backfilling. Furthermore, this system can be used alone or in combination with other soil modification techniques such as deep foundations, surcharging and chemical stabilization.

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

- ▶ Stable embankments
- ▶ 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 creates 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 high (3 m) hurricane protection levee over weak, marshy soils.*



**Bridge Approach – State Road 15/US 17, Florida**

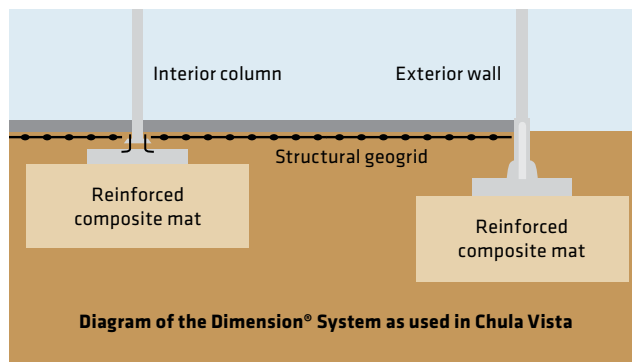
*When soft soils were discovered under the proposed site for a new bridge, the Prism System was used on the bridge approach to reinforce a high-level embankment and to reduce the bridge length by 361 ft (110 m). Total costs were reduced by \$970,000 on this bridge project.*



## Foundation Improvement System for Shallow Spread Footings



Weak and variable soils pose a major threat to the performance of any structure's foundation. Additionally, the costs associated with conventional foundation improvement solutions can be just as 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 weak, 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 rammed aggregate piers and 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

Because the Dimension System is tailored to individual site conditions, 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**

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

## Retaining Wall Systems



DOTs, contractors and engineers have long appreciated the many advantages of mechanically stabilized earth (MSE) panel walls. Their wide range of appearances and finishes, combined with the simplicity and speed of construction, make them attractive when compared to other types of wall systems. Unfortunately, limitations imposed by the behavior of steel reinforcing materials and a very narrow and expensive range of acceptable backfill properties have restricted their use until the introduction of the ARES® Systems featuring Tensar® Geogrids. By mechanically connecting Tensar Geogrids to the panel facing, the fully integrated ARES Retaining Wall Systems now offer a long lasting, cost-effective and aesthetic solution.

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

### NO METAL – NO CORROSION

With soil reinforcement that is 100% synthetic, ARES Retaining Wall Systems are proven concrete panel wall solutions that eliminate corrosion concerns. ARES 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 electric current potential. This makes ARES Systems the logical choice for “hot” backfill soils, transformer platform areas and electrified rail systems.

### THE ARES SYSTEMS ADVANTAGE

The ability to utilize non-metallic earth reinforcement makes the ARES Systems inert to chemical and electrical corrosion. The inert properties of Tensar Geogrids permit the use of a wide range of backfills, including recycled materials, translating into greater economy and the potential for 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 Tensar ARES Full-Height Panels 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 Panels permits the use of a wide range of architectural finishes.*





**Eastgate Road – Henderson, Nevada**

The proposed road extension required the construction of four bridge approach MSE walls. The ARES walls were able to utilize stockpiled backfill material that was deemed too corrosive to be used with metallic reinforcement, providing overall material savings and reduction in carbon footprint.



**Stoney Trail – Alberta, Canada**

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



**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



For over a decade, Mesa® Retaining Wall Systems have been the solution of choice for many engineers and architects. As one of the only segmental retaining wall (SRW) systems with a proven, positive mechanical connection, Mesa Systems offer superior and cost-effective solutions for all of your structural and landscaped retaining wall needs in the transportation, commercial, industrial and residential markets.

With a network of licensed block manufacturers located throughout North and South America, Mesa Walls have become a new standard in SRW technology. Designed as a truly integrated solution, they are the only SRW system that comes from a single source.

Wall components include high-strength concrete units, polymeric Tensar® Geogrid reinforcement and a unique, patented, locking

connector. Each of these has been specifically designed and detailed to work together to forge a mechanically stabilized earth (MSE) structure that meets or exceeds every industry standard. In fact, as a result of the high connection strength and reliability of the system, core fill is rarely needed. Using less core fill results in greater project savings through less imported stone and less labor.

Mesa Walls are at the forefront of the industry with a wide variety of styles, colors and dimensions to meet your project's specific needs. From building structural walls to tiered gardens, the Mesa Systems combine form with function to provide the dependability engineers require, the efficient installation contractors expect and the aesthetics owners and architects demand in the growing SRW industry today.



**I-25 Founders Meadow – Castle Rock, Colorado**

*Thanks to the Mesa Systems, this is 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™ Wall was specified at the St. Anthony's Hospital campus for both its aesthetic and 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 the Mesa Systems' structural integrity, which is why it is the first SRW system to achieve approval for heavy rail loading.*



## Retaining Wall Systems



### TENSAR® TEMPORARY WALL

Temporary walls are a necessity for many types of staged construction, but conventional means of constructing them are expensive and require heavy lifting and pile driving equipment. Fortunately, there is a proven technology that allows you to build temporary walls without the difficulties and expense of conventional techniques – the Tensar® Temporary Retaining Wall System.

A Tensar Temporary Retaining Wall can change the construction parameters for applications, such as bridge improvements, road widening projects, phased or staged construction or the construction of surcharge load cells. Tensar Geogrids internally reinforce the fill within the wall and utilize an inexpensive

wire-form facing system. Construction of temporary walls is no longer restricted to sheet pile or soldier pile and lagging walls. Both of these typically require toe penetration equal to or greater than the wall height and/or the use of secondary bracing or deadmen to safely retain the fill.

Pile systems have been the temporary wall of choice for many years. These walls require the use of expensive equipment and labor, resulting in significant project costs.

By utilizing less expensive materials, unskilled labor and lightweight equipment, the Tensar System provides a low-cost alternative for temporary wall applications. Additionally, the materials may be left in place or easily removed as required.



**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 constantly under pressure to find cost-effective alternatives to traditional wall systems. In a range of applications, they are finding that the best solution – in terms of appearance, performance and overall value – is the SierraScape® Wire-Formed Retaining Wall System. Backed by over two decades of engineering experience and over 10 million square feet of installations worldwide, the SierraScape System is a complete retaining wall solution which includes materials, design, specifications and technical assistance when needed.

### THE POSITIVE CONNECTION™

The SierraScape System combines Tensar® Geogrids with a positive mechanical connection, providing a dependable and cost-effective solution for 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 virtually eliminates surficial stability problems often associated with other alternatives. The SierraScape Connection 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. And, because the system can be backfilled with general embankment fills or on-site soils, cost savings for fill materials and disposal costs can also be realized.

### 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 project conditions, design requirements and aesthetic options. When compared to concrete, the system can be a more cost-effective solution. Better yet, the SierraScape System's resistance to environmental degradation, low maintenance and design versatility help make it the right choice for a variety of any 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 the 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 Wire-Formed Retaining Wall System was used for the slope on this large retail site over segmental retaining walls or poured walls because it met the aesthetic demands of the town. It also met the engineer's space requirements while saving time and money, as on-site soils and blast rock were used to create the structure.*



**Webb Gin – Gwinnett County, Georgia**

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

## Slope Retention System



The Sierra® Slope Retention System creates structurally stable, natural-looking earth retention structures in the form of oversteepened slopes that typically range from 2H:1V to 1H:2.75V. This alternative to conventional retaining walls increases the useable area versus traditional flatter slopes and generally costs significantly less than a vertical retaining wall. Sierra Slopes are also impacted less by differential settlement than conventional retaining walls and are more resistant to seismic activity. In fact, over 200 Sierra Slopes in California survived the earthquakes of 1989 and 1992 without damage.

Because of its cost-effectiveness and aesthetic appeal, the Sierra System is routinely specified to replace retaining walls for a variety of applications such as:

- ▶ Commercial, industrial and retail
- ▶ Single and multi-family residential
- ▶ Transportation infrastructure

- ▶ Recreation facilities
- ▶ Municipal waste management
- ▶ Water and flood control structures

The Sierra System significantly reduces material and installation costs by virtually eliminating limitations imposed by soil conditions, minimizing fill requirements and allowing the use of on-site fills. The economic benefits of Sierra Slopes have led cost-conscious transportation agencies around the world to select them for landslide repairs, overpasses and roadway widenings.

These same cost advantages have led to the use of Sierra Slopes by site developers concerned with enhancing property values and preserving the natural beauty of their sites. Sierra Slopes can be graded so that the appearance of these stable, reinforced earth retention structures is almost indistinguishable from the native terrain.



**Spanish Hills – Camarillo, California**

*These pictures 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.*



**Post River Apartments – Atlanta, Georgia**

*Environmental impact, budget and aesthetics were concerns when selecting a grade separation solution for this apartment complex. The natural choice was the vegetated Sierra Slope System.*



## Waste Management 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 can maximize 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 flow and extending service life. The systems can be used to:

- ▶ Construct landfills over marginal foundations
- ▶ Structurally support new landfills built on top of existing landfills
- ▶ Build safer, structurally stable, steeper slopes to reduce land requirements and increase capacity

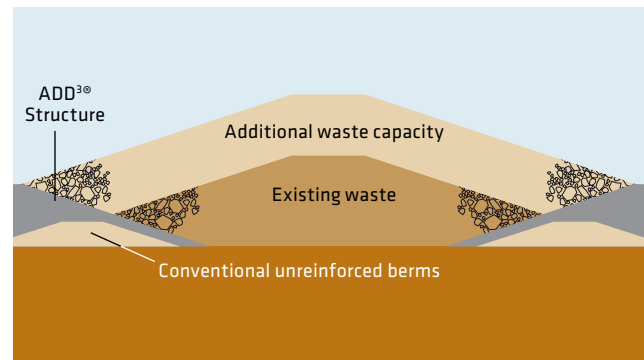
Our waste management systems have also been used to build containment facilities for ash and tailing ponds and as foundation reinforcement for heap leaching projects. Additionally, they are used to construct higher berms that increase the capacity and extend the life of such facilities.

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



**Babylon Municipal Landfill – Babylon, New York**

*This ADD3® System provided significant cost savings over the standard solution and blended with the natural landscape.*



**Perimeter Berm**

*A Tensar® Perimeter Berm with steepened slopes adds capacity, resulting in additional revenue, extended service life and increased waste flow.*

## Erosion Control Systems



Hydraulic erosion control products (HECPs) are designed to provide immediate erosion protection and aid in accelerating vegetation establishment on a wide range of slope conditions. When engineers and contractors are tasked to specify products that offer unsurpassed erosion protection, improve site aesthetics and meet stringent local and federal sediment control regulations, they are turning to the HydraMax™ Systems.

The HydraMax Systems are manufactured with a unique, proprietary blend of straw, reclaimed cotton plant material and tackifiers. This patented blend of fibers forms a highly effective layer of protection over soil to promote healthy vegetation establishment by introducing essential organic nutrients. Additionally, additives and tackifiers combine to ease application, enhance adhesion, retain moisture and provide soil stability.

These products were developed in cooperation with Cotton Incorporated and have been tested extensively by independent third parties, including the American Association of State

Highway Transportation Official's National Transportation Product Evaluation Program (AASHTO-NTPEP).

Within the HydraMax Systems' product line, the HydraCX® Extreme Slope Matrix® delivered perfect erosion prevention results – better than any other HECP or RECP in AASHTO-NTPEP testing to date – following strenuous ASTM D6459 protocol. All tested HydraCX plots experienced 0.000 lbs of soil loss per plot. According to the NTPEP report, “since *no measurable soil loss* was found, a lowest practical C-factor of 0.001 was assigned” with an **effectiveness value of 99.9% and 100% soil retention**.

From mild to extreme slopes, the HydraMax Systems offer high-performing erosion control that outperforms the competition. And, because of the HydraMax Systems' one-step hydraulic application – as opposed to other products' two- or three-step processes to apply mulch, seed or tack – our HECPs can be used as a low-labor alternative to other forms of erosion control – saving you valuable time and money.



**Mirimichi Golf Course – Millington, Tennessee**

*This LEED® Platinum certified golf course features high quality playability while offering the highest, eco-friendly, green technology. Pop star and owner Justin Timberlake concentrated on reducing the carbon footprint of his 303-acre course by including solutions such as the HydraMax Systems.*



**Walgreens – York, South Carolina**

*An aesthetically pleasing, natural “green” look was a priority for the property owner of this retail development. The Sierra® Slope Retention System, incorporating the HydraCX high-performance HECP was installed and provided a stable, reinforced structure with rapid vegetation growth – just what the owner needed.*



**I-22/I-65 – Jefferson County, Alabama**

*The ALDOT tested various best management practices (BMP) products, including blown straw and single-net straw erosion control blankets on a 2.5-mile section of 1.5:1 (H:V) roadside slopes. Due to its top performance and rapid vegetation establishment, they chose the HydraCX HECP.*





**GADOT Highway Expansion – Bartow and Cherokee Counties**

When other erosion control measures couldn't assure quick vegetation on this 1:1 (H:V) steep slope stricken with very rocky, poor quality soils, the HydraCX® HECF came to the rescue. Vegetation was established within four weeks and protection was provided against heavy 3- to 4-inch rain events.



**Eagle Creek Reservoir – Indianapolis, Indiana**

This very steep mechanically stabilized earth (MSE) wall needed both soil protection and native vegetation – both provided by the HydraMax™ Systems.



**Flight 93 National Memorial – Shanksville, Pennsylvania**

To honor the passengers and crew of the infamous September 11th Flight 93, this national memorial site could not contend with construction delays. Even with challenging poor soils, HydraGS™ and HydraCX established vegetation quickly before dedication day.

## Erosion Control Systems



Erosion control blankets (ECBs) and turf reinforcement mats (TRMs) are part of the industry standard. But, that doesn't mean you have to rely on simply standard products. To reduce soil erosion and assist in the growth and protection of vegetation, rely on the performance-guaranteed RollMax™ Systems – Tensar's complete line of rolled erosion control products.

### BIODEGRADABLE SOLUTIONS

Our BioNet® ECBs provide effective and all-natural erosion control and vegetation establishment in an environmentally- and wildlife-friendly manner. Our 100% biodegradable materials ensure absolutely no synthetic residues on-site after vegetation establishment, and our flexible netting weave design minimizes the risk of accidental wildlife entrapment, while ensuring strength and structural integrity for resistance under tough conditions.

### PHOTODEGRADABLE PROTECTION

Our EroNet™ ECBs are designed to provide immediate erosion protection and vegetation establishment assistance, then, degrade after the root and stem systems of the vegetation are mature enough to permanently stabilize the underlying soil.



These products are available for short-term protection on moderately sloping areas and low-flow channels, or extended- and long-term protection on steep slopes and medium- to high-flow channels and shorelines.

### HIGH-TENSILE REINFORCEMENT

For high-load and severe erosion applications, our TMax™ TRMs are designed to offer veneer stabilization and high tensile strength for increased durability in high-impact conditions. The combination of high-strength geogrids, heavy UV-stabilized nets and a fiber matrix allow for surface vegetation without soil infilling.

### COMPOSITE TURF REINFORCEMENT

Our VMax® C-TRMs permanently control erosion through all developmental phases of a reinforced vegetative lining. Manufactured with a three-dimensional corrugated structure, VMax C-TRMs anchor and reinforce the roots and stems for long-term stability, while helping create a shear plane that actually deflects flowing water away from the soil surface – improving immediate and long-term erosion control capabilities.



#### **Yellowstone National Park – Cody, Wyoming**

*Steep slopes and drainage channels in wildlife sensitive areas, like this roadway application, naturally benefit from the increased longevity and erosion protection of our BioNet™ SC150BN™ product.*



#### **GO Rail Transit – Greater Toronto, Canada**

*The VMax® SC250® and UX Geogrid stabilized a railway embankment in need of reinforcement during construction of a third track. After vegetation took place, Sunfish Pond, at its base, was well protected from potential slope erosion and sediment runoff as well.*



#### **Port Manatee – Palmetto, Florida**

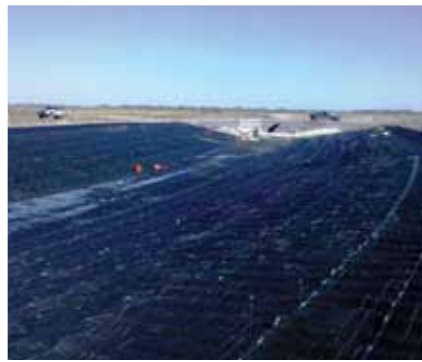
*The Army Corps of Engineers chose VMax® C350® TRM and Tensar® Geogrids to stabilize the 1.5:1 slope surface of a port extension project to improve channel water traffic. This 745 ft holding basin is fully vegetated.*





#### **Residence - Grand Rapids, Michigan**

*Before the redesign, the existing drainage channel was lined with broken concrete slabs and erosion was occurring on side slopes. The VMax® P550® TRM vegetated within one growing season and left a natural, easily maintained channel bed.*



#### **Mary Creek, Archbold Biological Reserve - Florida**

*The eroding creek bed needed to be realigned and protected to better facilitate the storm runoff from over 1,000 acres of native Florida scrub vegetation. Earth anchors and TMax™ P500™ TRMs provided a soft armor, permanent soil protection solution.*



#### **Cumberland River - Nashville, Tennessee**

*This mile-long riverbank in Shelby Park had become badly eroded as waves and wind sent soil and trees into the water. BioNet® C125BN™ was used in bioengineering practices to stabilize the shoreline.*

## Erosion Control Systems



Unprotected topsoil, particularly on sloping areas, is vulnerable to significant erosion and sediment problems. Erosion and runoff can significantly impact disturbed sites that may not be ready for permanent erosion control measures.

The SediMax™ Systems offer different products, each recognized as Best Management Practices (BMP) by the Environmental Protection Agency (EPA), for reducing soil loss caused by storm-water runoff, while allowing water to pass through – protecting waterways, sidewalks and roadways from sediment accumulation.

SediMax Systems save soil, time and money in applications that include:

- ▶ Forest fire rehabilitation
- ▶ Bioengineering projects
- ▶ Commercial/residential sites
- ▶ Ski slopes
- ▶ Highway construction
- ▶ Industrial sites
- ▶ Pipeline revegetation
- ▶ Steep slopes

Not only economical and easy to install, the SediMax Systems can also aid engineers, specifiers and contractors to stay in compliance with many National Pollutant Discharge Elimination System (NPDES) Phase II rules and other environmental regulations. They even help earn points toward project certification in the LEED® Green Building Rating System.

### FILTRATION ROLLS

Created from 70% straw and 30% coconut-fiber matrix, and reinforced with 100% biodegradable netting, this three-dimensional product is rolled from edge to edge to create a highly effective, temporary sediment retention fiber roll (SRFR). It is water permeable, so water passes through, while soil particles are trapped.

### STRAW WATTLES

An effective and economical alternative to silt fence and straw bales, these cylinders of recycled, compressed, 100% agricultural straw wrapped in photodegradable or biodegradable netting not only capture sediment, but retain moisture from rainfall, aiding the growth of vegetation planted to their up-slope side.



**BioWattle Installation – Poseyville, Indiana**

*A biodegradable solution was required to capture and filter stormwater from a manufacturing facility. The SediMax Systems' straw wattles prevented sediment pollution.*



**Lake Michigan Bluff Restoration – South Haven, Michigan**

*Lake Michigan had highly erodible bluffs that were causing a threat to the surrounding environment. The SediMax filtration rolls were successfully installed to help build steep slope terraces and re-vegetate the bluff preventing further runoff into the lake waters.*



**Residential Development – Roanoke, Virginia**

*To treat roadside runoff quality, attenuate flooding potential and convey stormwater away from critical infrastructure, these SediMax filtration rolls provided a cost-effective alternative to traditional rock checks.*



## Erosion Control Systems



The RevetMax™ Systems are patent-pending flexible transition mats that offer a cost-effective armoring solution in turbulent flow and wave attack applications where hard, rigid materials like riprap or articulated concrete blocks may have been normally selected. When used in combination with TRMs or other underlayments, they can dramatically elevate the permissible shear stress and velocity protection beyond many hard armor solutions.

The unique, highly flexible UV-stabilized mats are the first soft revetment and scour protection system to easily install over difficult topography. The system is non-buoyant so it won't float or uplift in submerged and heavy flow conditions. Each mat is designed with grip lugs that "bite" into the underlying surface, or TRM, to prevent horizontal shifting between the components.

The RevetMax Systems are all designed with voids to allow vegetation to grow through the mat. They require no heavy

equipment to install, allow easier long-term maintenance, and offer greater safety for vehicle and pedestrian traffic in comparison with hard armor products.

The ShoreMax™ Mat, within the RevetMax Systems' product line, is the first scour protection mat in the industry to post unvegetated performance values in the American Association of State Highway Transportation Official's National Transportation Product Evaluation Program (AASHTO-NTPEP).

With *unvegetated* performance greater than any current TRM, and on par with 24-inch rock riprap, it's ideal for boosting performance in critical applications such as:

- ▶ Pipe outlets and outfalls
- ▶ Channel bottoms
- ▶ Shoreline transition zones
- ▶ Other areas subject to highly turbulent water flow



**Culvert Outfall – Poseyville, Indiana**

*This ShoreMax transition mat was installed over a P300® lightweight TRM in an 18-inch culvert outfall. The interlock structure of the mats allowed for easy installation in adverse conditions. Just days after placement vegetation developed through the voids in the mat structure.*



**Center Point Energy Wellhead Site – Shreveport, Louisiana**

*Hard armor rock can be an unsightly solution to drainage channels. This ShoreMax transition mat was installed over a VMax® P550® TRM at the bottom of a steep drainage channel to increase its unvegetated performance.*



**Recreational Lake – Tampa, Florida**

*The combination of wind and waves from boats and other recreational water vehicles was taking a toll on the shorelines of this Tampa lakeside. To combat further wave attack, ShoreMax transition mats were installed over a TMax™ high-tensile strength TRM. Together, they provided protection and a low maintenance, safe entrance for pedestrians and small boat launches.*

## Coastal and Waterway Systems



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

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

They are also used together with conventional solutions to enhance overall performance.

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



### **Rio Matilde - Ponce, Puerto Rico**

*The Triton Marine Mattress System was installed to counter heavy erosive action due to a number of conditions: soft subgrade soils, irregular subgrade surfaces, salt water and steep slopes.*



### **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



### MINING

UNDERGROUND AND SURFACE SYSTEMS

Tensar® 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

Tensar 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. Tensar 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 Tensar Mining Systems easily reduce installation and material handling time by up to 75%.



**Coal Mine – Appalachia, West Virginia**

*Tensar 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.*



#### LONG-WALL SCREENING

Moves that traditionally took weeks several years ago have been reduced to days, enabling our customers to save thousands of dollars working in the most brutal of conditions. Flame-retardant Minex Rock Mesh maintains similar weight characteristics to Tensar Mining Grid, yet is over eight times stronger with increased flexibility.

#### ROAD REINFORCEMENT

Soft bottom and haul road conditions found at mining sites require effective base reinforcement. A layer of Tensar Geogrid covered with suitable aggregate distributes loads over a wide area, which significantly reduces the amount of stone required to maintain travel while increasing the bearing capacity and life of the road. Tensar's Spectra® Roadway System has been proven to provide reinforcement during underground long-wall moves with 50-ton shield/shield hauler loads to 150-ton surface applications.



*Tensar Roof Mats provide the strength and stiffness of 8-gauge welded wire panels with the benefits of a lightweight polymer product.*

## ► Software for Unpaved Roads, Retaining Walls, Shallow Foundations and Erosion Control



## Design Technology

### SPECTRAPAVE SOFTWARE

Tensar breaks new ground with the release of our industry-leading SpectraPave4™ and SpectraPave4-PRO™ Software. This software allows users to accurately predict the performance of geogrid-reinforced and unreinforced conditions of both paved and unpaved surfaces. The software offers three distinct analyses modules and cost analyses tools to evaluate design options for paved roads, unpaved roads and working surfaces.

And now, the new SpectraPave mobile application allows users in the field to quickly and accurately determine aggregate savings for subgrade stabilization projects. The SpectraPave mobile application is a component of the TensarConnect™ platform that allows customers to connect with Tensar products and services from any computer or java-enabled mobile device.

### DIMENSION® SOLUTION SOFTWARE

Dimension® Solution Software reduces costs and improves the performance of a wide range of shallow foundations. The software can result in significant 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. It is the culmination of a significant technology development effort by Tensar.

### ECMDS® 5.0 EROSION CONTROL MATERIALS DESIGN SOFTWARE

This powerful, easy-to-use tool provides guidance in the selection of materials for multiple hydraulic analyses, including slope erosion protection and channel scour resistance. ECMDS® 5.0 ensures the proper evaluation and design for soil-loss prediction, product specification and project planning.

Recommendations within ECMDS 5.0 are based on data from controlled laboratory and field research involving erosion control blankets, turf reinforcement mats, vegetation establishment, hydraulic mulches, sediment control devices and transitioning devices.

ECMDS 5.0 is a necessity for every engineer, designer and contractor who must comply with today's strict erosion and sediment control regulations, while ensuring design protection for projects from start to finish. Start using it today by visiting ECMDS.com.







## TENSARSOIL™ AND TENSARSLOPE™ SOFTWARE

TensarSoil™ and TensarSlope™ Software are unique tools that make the design of Tensar grade separation systems simpler, faster, as well as more cost-efficient. TensarSoil 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, TensarSoil Software 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) 2007

TensarSoil Software is programmed with data on all Tensar wall and slope systems. Fully interactive, it allows you 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, wall or slope design results can be exported to TensarSlope Software, our slope stability application, for a comprehensive, compound and global stability analysis.







## The Engineered Advantage™



## 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 internal soil reinforcement. We have developed products and technologies that have been at the forefront of the geotechnical industry for the past two 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, call **800-TENSAR-1**, visit **[www.tensarcorp.com](http://www.tensarcorp.com)** or e-mail **[info@tensarcorp.com](mailto:info@tensarcorp.com)**. 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.



# Tensar®

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