



# PAVEMENT REINFORCEMENT SYSTEM

## SYSTEM OVERVIEW



**Tensar**<sup>®</sup>

➤ The GlasGrid® System extends pavement life, reducing maintenance and life cycle costs.

## Today's Most Advanced Pavement Rehabilitation System

Fatigue and reflective cracking in pavements are typically caused by traffic loading, age hardening or temperature cycling. When cracking is present, the traditional remedy has been to apply thicker asphalt overlays. For each inch of applied overlay, existing cracks are generally deterred from reflecting to the surface for a period of one year.

### THE GLASGRID® SYSTEM EXTENDS PAVEMENT SERVICE LIFE BY UP TO 200%

The GlasGrid® Pavement Reinforcement System resists the migration of reflective cracks and increases the fatigue life of asphalt overlays in roadway applications. This interlayer system is composed of a series of fiberglass strands coated with an elastomeric polymer and formed into a grid structure. Each strand has a remarkably high tensile strength and high modulus of elasticity; this is particularly important as asphalt concrete typically cracks at low strains.

When the GlasGrid System is installed between the leveling course and the surface course asphalt in a conventional asphalt overlay, it becomes the hidden strength in the road, turning vertical crack stresses horizontally to effectively dissipate them. The GlasGrid System has a significant modulus advantage over asphalt at warm temperatures, but more importantly, it also installs at low temperatures without becoming brittle to perform across all temperature ranges.

### EASILY INSTALLED AND UP TO THE TASK

The GlasGrid System is easily installed without specialized equipment or labor. Thanks to its pressure-activated adhesive, it's considered to be the fastest interlayer system to install and has proven effective in every geographical area and climate – from desert environments to near-arctic conditions.

The GlasGrid System can be used on virtually any asphalt concrete or composite pavement structure, including:

- ▶ Interstate highways
- ▶ State highways/roads
- ▶ Collector/regional roads
- ▶ Residential/service roads
- ▶ Residential/parking areas
- ▶ Parking lots
- ▶ Airport runways, taxiways and aprons
- ▶ Ports and intermodal facilities

### GLASGRID® TF (TACK FILM): ENHANCED CONVENIENCE AND PERFORMANCE

The GlasGrid® TF (Tack Film) System provides all the benefits of the GlasGrid System without the challenges of applying a conventional tack coat. With its pre-installed elastomeric polymer film layer, GlasGrid TF performs better than the original GlasGrid System to protect against reflective cracking due to its enhanced bond to asphalt overlays. And, with no tack coat to prepare and apply, owners and installers save on time, labor and material costs.



A GlasGrid full width installation using a high speed, 5 ft wide installation device.



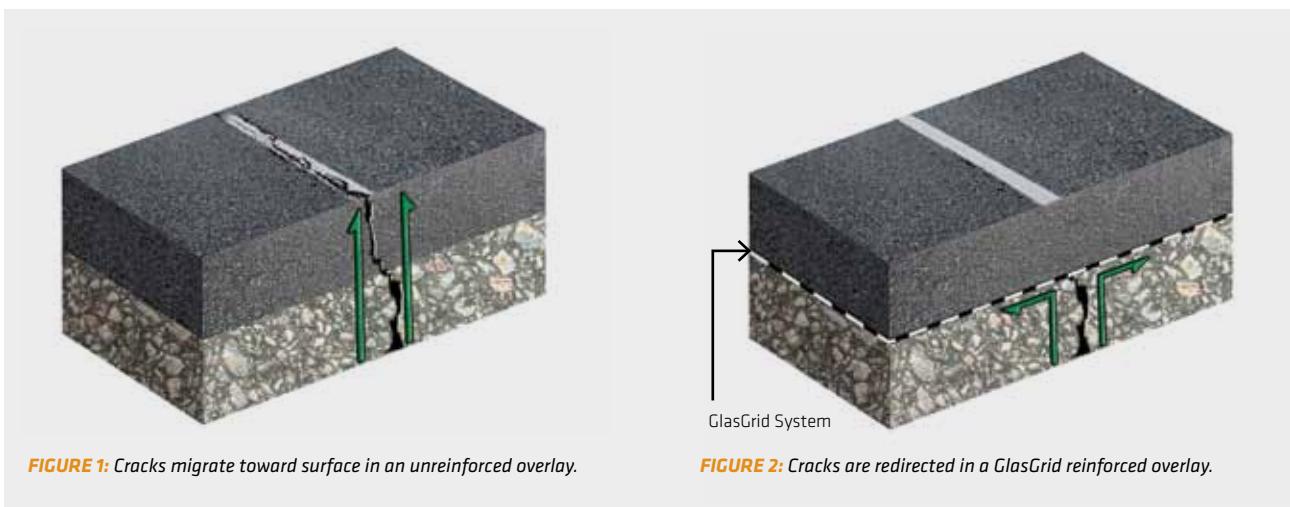
GlasGrid detail repair installation where an asphalt transfer device is used as part of the paving train.

## How the GlasGrid® System Reinforces a Pavement

When conventional rehabilitation procedures are used, an asphalt overlay is placed over the existing rigid or flexible pavement. This provides some additional road service life, but the existing cracks propagate prematurely toward the surface, as shown in Figure 1.

When used to reinforce asphalt concrete, the GlasGrid® System helps to create a composite material combining the compressive strength of the asphalt mix with the tensile strength of glass fibers. With a stiff tensile element at the bottom of an overlay, cracks propagating toward the surface are intercepted and prevented from migrating further and tensile strains are reduced to increase the life of the overlay. Cracks are redirected and dissipated horizontally, as shown in Figure 2.

This process works best when through-hole bonding takes place between the asphalt layers. As the term suggests, this involves the development of a strong bond between the overlay and the underlying level-up asphalt layer. When GlasGrid® TF is installed, this bond is increased, more uniform, and allows immediate installation of hot mix overlays. This can be achieved only when an open aperture grid structure is used for reinforcement. The reinforced overlay will eventually show signs of fatigue, but at a much reduced rate, thereby significantly extending the service life of the road.



**FIGURE 1:** Cracks migrate toward surface in an unreinforced overlay.

**FIGURE 2:** Cracks are redirected in a GlasGrid reinforced overlay.

**NOTE:** For illustration purposes only. Leveling course required.

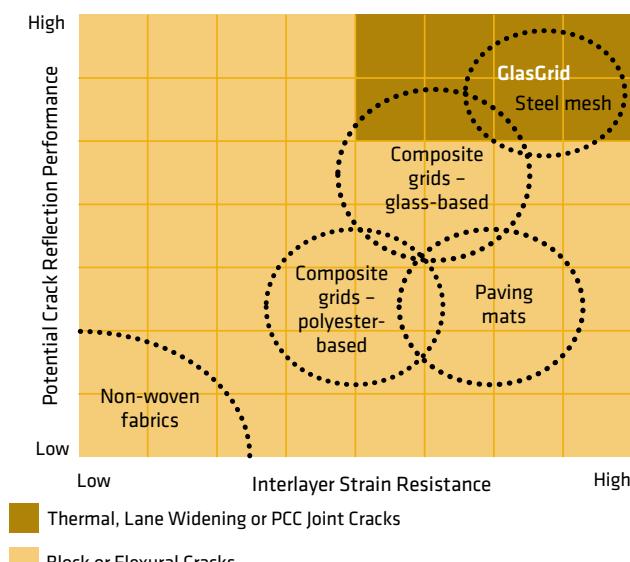
➤ The GlasGrid® System's open grid structure promotes the efficient transfer of stress from both overlying and underlying asphalt layers.



## GlasGrid® System's Performance Exceeds Other Interlayers

Engineers today can choose from several interlayer systems. These systems are made from various asphalt binders in combination with sand and/or aggregate, or from one or more geosynthetics. These binder systems are thermally sensitive, ranging from a soft pliable material in summer to a brittle material in winter. Aging of these systems is also a concern. Examples of these are the bituminous-based slurry or chip seal interlayer systems which provide effective short-term waterproofing, but even with the advancement in modified binders, they offer limited crack mitigation benefits. With their added stiffness, uniform quality and widespread availability, geosynthetic interlayers have proven to be worthy alternatives over the last 30 years.

As depicted in Figure 3, a number of criteria can be used to determine the suitability of a specific geosynthetic interlayer product. Researchers have found that the performance of a geosynthetic interlayer system can be predicted based on the key material's structure and strength properties.



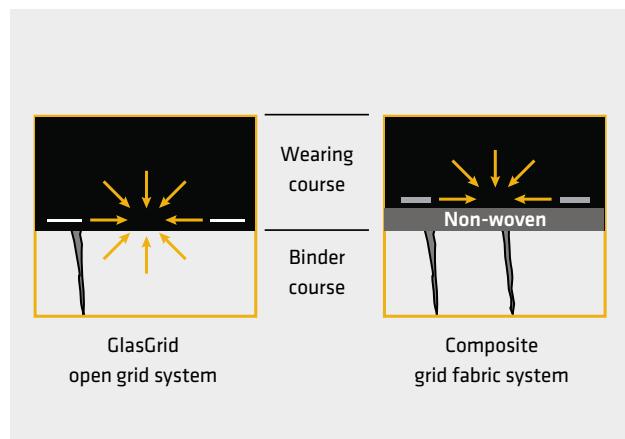
**FIGURE 3:** Suitability of interlayer products for medium to high traffic conditions.

### STRUCTURE

The interlayer system is defined as being either open (GlasGrid® System and steel mesh systems) or closed (composite grids and paving fabrics). An open grid structure promotes through-hole bonding (Figure 4) and more efficient stress transfer to the grid by both the overlying and underlying aggregate matrices of the asphalt layers. This is particularly important to prevent the propagation of traffic activated cracks within the pavement. By contrast, the transfer of crack stresses in high strain capacity fabric-based interlayer systems takes place through the relatively weak tensile bond formed between the asphalt binder film and the fabric.

### STRENGTH

Only GlasGrid System mesh and steel mesh systems have sufficient tensile strength at strains less than 3% to deter the propagation of cracks caused by traffic loading or thermal movement.



**FIGURE 4:** Through-hole bonding occurs between the ribs in the open grid structure of the GlasGrid System.



*Five foot wide GlasGrid rolls allow for rapid installation due to ease of handling and less manpower.*

## CREEP

Long-term creep strength is required to restrain the propagation of cracks associated with thermal movement or lane widening. The GlasGrid® System possesses sufficient creep characteristics to resist a high level of sustained stress over long periods of time.

## EASE OF INSTALLATION

With its advanced pressure-activated adhesive, the GlasGrid System is the fastest installed interlayer on the market; up to 25,000 sq yds of grid can be installed in one day using a standard laydown unit. In addition, the installation of the GlasGrid System can be easily adapted to local weather conditions or unique construction requirements.

## MILLABILITY AND RECYCLABILITY

With the exception of steel grids in thin asphalt overlays, most geosynthetic interlayer systems are millable using conventional reclaiming equipment. However, when it comes to recycling reinforced asphalt, only pavements reinforced with the GlasGrid® and GlasPave® Systems can typically be ground up and reused in other road projects as recycled asphalt pavement (RAP) (Image A).

## PROVEN PERFORMANCE

Although advancements have been made to the coating and adhesive, the GlasGrid System is still manufactured as it was originally more than two decades ago. This is testament to the product's extensive and proven success on project sites throughout the world.

Most other glass fiber grids use an inexpensive bituminous binder as a coating. These bituminous coatings have a softening point below that of a warm and hot mix, rendering the protective coating deficient during paving.



**IMAGE A:** Milled asphalt containing GlasGrid product can be easily recycled for use on other projects.

**IMAGE B:** GlasGrid was installed at the National Center for Asphalt Technology (NCAT) pavement test track in Opelika, AL.



## Research Quantifies the Benefits of the GlasGrid® System

The use of interlayers for preventing reflective cracking has been extensively studied over the last 40 years. A number of research projects have quantified the benefits of the GlasGrid® System and helped to define its areas of application (Table 1).

### TEXAS A&M UNIVERSITY

At the Texas Transportation Institute (TTI) at Texas A&M University, studies using the Large-Scale Overlay Test and the Beam Fatigue Test (opposite page) on reinforced asphalt beams have demonstrated a two- to three-fold improvement in the life of a GlasGrid System-reinforced overlay compared with an overlay constructed using the same thickness of unreinforced asphalt.

### NATIONAL CENTER FOR ASPHALT TECHNOLOGY

The National Center for Asphalt Technology (NCAT) at Auburn University features a 1.7-mile long test track (Image B). An unreinforced and a GlasGrid System-reinforced paved section were trafficked. After 40 million ESALs (Equivalent Single Axle Loads) over more than a decade, distresses were clearly evident in the unreinforced section, while the reinforced section showed no signs of distress cracks.

### THE UNIVERSITY OF NOTTINGHAM, UK

An interface bond test was used to measure the quality of the bond between various interlayers and the asphalt. The test results strongly suggest that the presence of a fabric – and not grids – results in a significant reduction in the interface shear stiffness and therefore also a reduction in performance. Semi-continuously supported notched beam tests were also conducted to determine the ability of interlayer materials to resist crack propagation (Table 2).

### EMPA LABORATORY, SWITZERLAND

At this national Swiss laboratory, the GlasGrid System was tested with a model accelerated pavement testing device

(MMLS3) that induces a unidirectional load on the pavement to simulate traffic loading. The test determined that the GlasGrid System-reinforced slabs have a durability approximately three times longer than the control slab. Visual inspection of the reinforced slabs showed that the cracks were interrupted and arrested along the reinforcing grids.

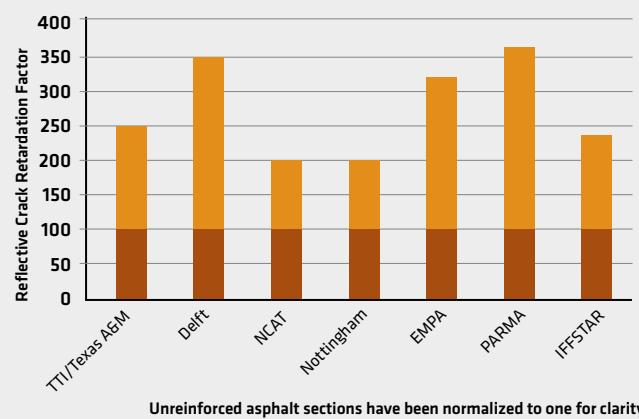
### UNIVERSITY OF PARMA, ITALY

The objective of this research was to quantify the effectiveness of the GlasGrid System to affect fatigue cracking and extend pavement service life. Center-point bending tests were conducted using beam and slab samples designed to simulate bottom-up cracking. On the beam tests, the GlasGrid System-reinforced samples provided about 1.5 times higher maximum load than the unreinforced samples, and GlasGrid® TF-reinforced beams withstood at least twice the fracture energy of the GlasGrid System-reinforced beams. On the slab tests, GlasGrid System-reinforced samples provided more than one and a half times greater maximum load than the unreinforced samples, while the GlasGrid TF-reinforced slabs required at least three times higher strain to failure compared to the GlasGrid System-reinforced samples.

### IFFSTAR TESTING FACILITY, FRANCE

The fatigue benefits of a 100 kN/m GlasGrid System were evaluated at the IFFSTAR facility, a circular full-scale accelerated pavement test track located in France. Crack percentage was determined by the ratio between the length of pavement with cracks and the initial length. The test was run until the extent of cracking increased such that the control section was too damaged to continue, which occurred at 1.2 million cycles. At this point, the control section exhibited a cracked area of 70%, while the GlasGrid System-reinforced section exhibited less than 10% cracking.

TABLE 1



## GlasGrid® TF-Reinforced Pavement Lasts Up to Five Times Longer than Unreinforced Structures

Engineers at the Saint-Gobain ADFORS Research and Development Center conducted a series of AASHTO-recognized cyclic loading tests to quantify the effective fatigue life and crack retardation properties of unreinforced (CRS-2P tackcoat), GlasGrid® System-reinforced (CRS-2P tackcoat) and GlasGrid® TF-reinforced asphalt composite beams. Beams measuring 2.5 in. x 2 in. x 15 in. were tested to failure. Three samples of each type of beam were tested.

Results show that the samples reinforced with GlasGrid TF outperformed not only the unreinforced beams but also the beams reinforced with the original GlasGrid System product. These tests demonstrated that GlasGrid TF offers a significantly longer effective fatigue life, improving resistance to fracture of the overlay system by effectively withstanding cracks at the grid interface. Fatigue life was enhanced by the quality of the tack film bond to the overlay due to the presence of GlasGrid TF's elastomeric tack film.

Specifically, the measured fatigue life ratio was:

- Unreinforced beam: 1.0
- GlasGrid System-reinforced beam: 3.3
- GlasGrid TF-reinforced beam: 5.1



An unreinforced asphalt pavement beam with a conventional tack coat predictably cracks under stress in a short period of time.



The original GlasGrid System with a conventional tack coat successfully redirects cracking to extend pavement life.



GlasGrid TF provides a superior bond in the pavement cross-section to minimize cracking and maximize performance.

Products	Interface Shear Stiffness (MPa/mm)	Interface Shear Stiffness (psi/in.)
Open Grid Type 1	24.7 (68%)	90,994
Composite Grid Type 1	8.1 (22%)	29,840
Composite Grid Type 2	14.3 (40%)	52,681
GlasGrid	36.4 (100%)	134,096
Composite Grid Type 3	14.1 (40%)	51,944

TABLE 2: Reported values of interface shear strength and stiffness completed at University of Nottingham, UK.



The open aperture of the GlasGrid product ensures through hole bonding.

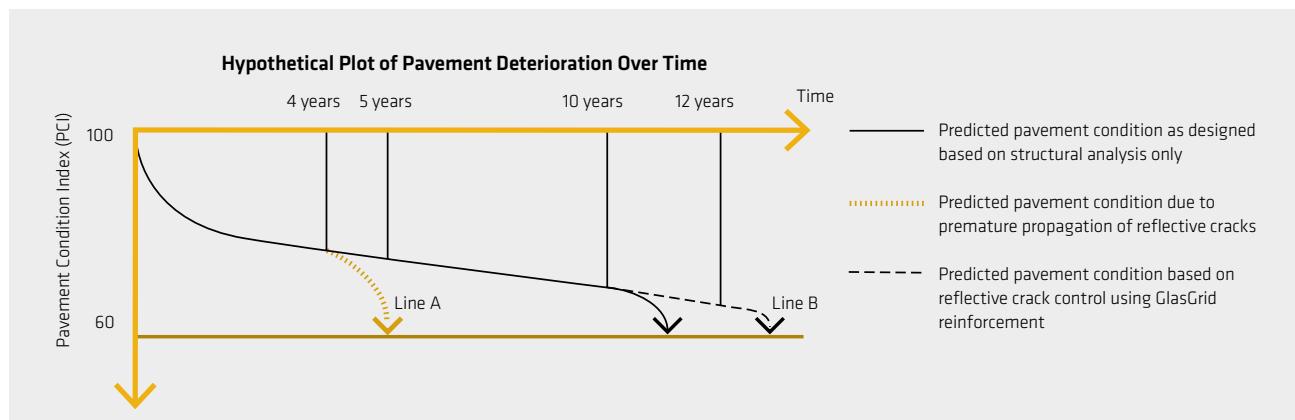
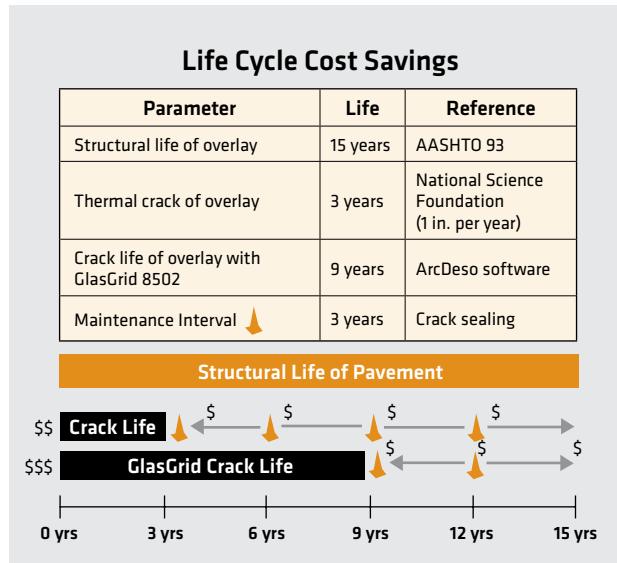
## Cost Benefits of the GlasGrid® System

To determine the potential long-term cost benefits of the GlasGrid® System, it is first necessary to predict the performance of a particular overlay (Table 3).

In Figure 5, the continuing deterioration of a pavement surface is indicated by a corresponding reduction in the Pavement Condition Index (PCI). In this example, a 4 in. thick overlay for a high volume road has been designed to last 10 years. If there were no cracks reflecting upward from the underlying pavement surface, the deterioration of the new pavement would likely continue along the solid line shown.

However, the existing pavement surface exhibits cracking that will reflect to the surface. Therefore, although the 4 in. thick asphalt overlay is sufficient to last for 10 years from an overall structural perspective, nearly all of the existing cracks will have propagated through the new asphalt after approximately four years; this is based on the general rule that cracking propagates through an asphalt layer at a rate of 1 in. per year.

As significant reflective cracking begins to appear at the surface, the rate that water seeps into the pavement increases. The pavement surface is predicted to deteriorate as indicated by Line A in Figure 5. In this example, the pavement would require a major rehabilitation after only five years as opposed to the scheduled 10 years.



**FIGURE 5**

The GlasGrid System is easily installed with a belly dump asphalt paving operation.

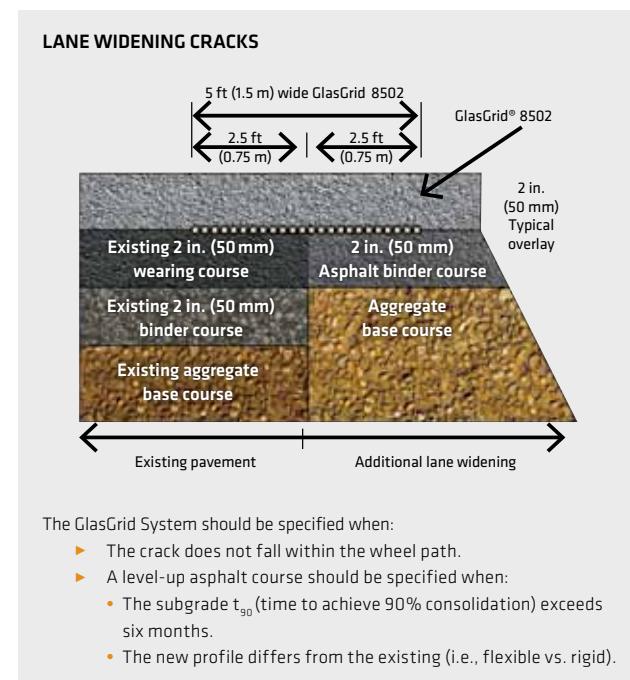
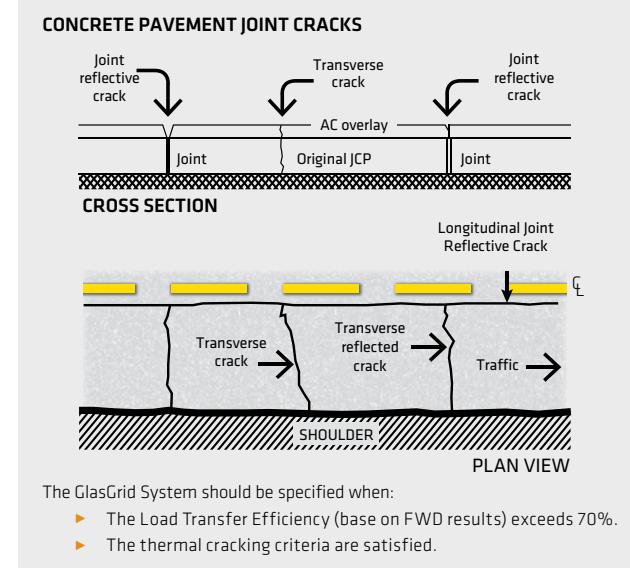
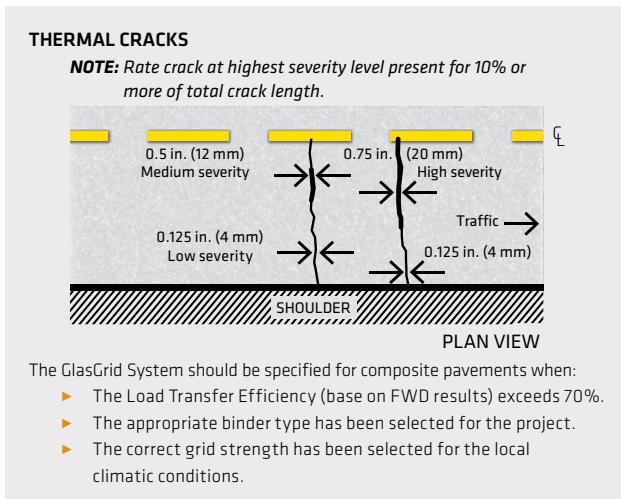
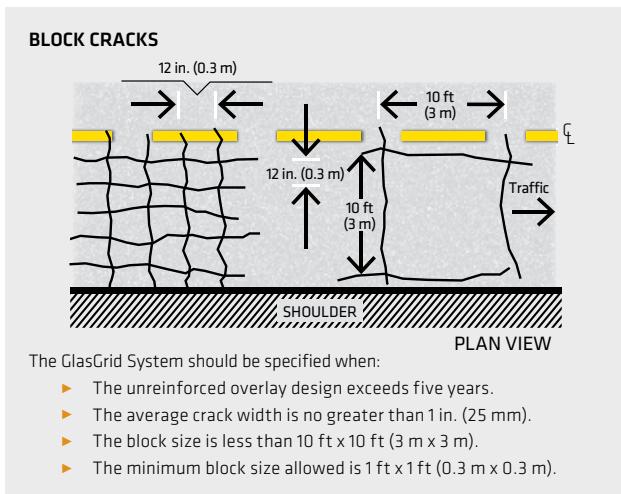


## GlasGrid® System Applications for Reflective Cracking

The four primary types of cracks are:

- ▶ Block Cracks
- ▶ Thermal Cracks
- ▶ Concrete Pavement Joint Cracks
- ▶ Lane Widening Cracks

Please refer to our *GlasGrid/GlasPave Product Selection Guide* for additional information on pavement cracking.





IMAGES  
C AND D:  
Nebo Loop

## Proven Field Performance

Unlike most other interlayer products, the GlasGrid® System has decades of proven performance. Thousands of successful projects worldwide have utilized it to retard the migration of reflective cracks; four diverse examples illustrate the wide variety of applications.

### U.S. INTERSTATE 40 NEWKIRK TO TUCUMCARI, NEW MEXICO

A five-mile segment of I-40 located in eastern New Mexico was spot-repaired with the GlasGrid System. The work was part of a four-year, four-phase, \$70 million reconstruction project.

The project began as a mill-and-overlay job with some full reconstruction up to 2 ft down into the subgrade. But full-depth reconstruction would have required lane widening or construction of detour lanes to accommodate the truck traffic. That would have delayed construction schedules and wasn't included in the budget.

The highway contractor proposed the GlasGrid System as a value-engineered alternative. The surface was topped with a 3 in. layer of asphalt concrete (AC), followed by a layer of GlasGrid System mesh, a 6 in. lift of AC, a second GlasGrid System layer and a 3 in. asphalt surface course. The less distressed areas were treated with a 6 in. AC lift and a single GlasGrid System layer before installing the asphalt surface course. The New Mexico DOT saved \$500,000 in direct costs by avoiding the full depth reconstruction.



IMAGE E: U.S. Interstate 40 Newkirk to Tucumcari, New Mexico

### NEBO LOOP SCENIC BYWAY UTAH COUNTY, UTAH

Officials from Utah County, located south of Salt Lake City, chose the GlasGrid® TF System to reinforce a five-mile segment of the Nebo Loop Scenic Byway (Image C). The county needed to reinforce the road, which is closed through winter, with a pavement system that could protect against reflective cracking and thereby reduce the associated maintenance and life cycle costs. The rugged canyon environment and resulting road profile mandated that challenging slope, temperature, dampness and directional factors be addressed.

Longitudinal, transverse, block and some alligator cracking were all present on the winding stretch of the 24 ft wide roadway. In addition, the incline of the canyon wall exposed the road to severe runoff, further deteriorating the asphalt surface.

Standard mill-and-fill with a paving fabric was an option, but the county selected GlasGrid TF instead of GlasGrid with the typical CSS1-h tack coat. Approximately 60,000 sq yds of GlasGrid TF were installed and topped with a 2 in. asphalt overlay, which bonded uniformly (Image D).



IMAGE F: U.S. Interstate 40 Newkirk to Tucumcari, New Mexico



**IMAGE G:**  
Washington Blvd.,  
El Cajon, California

## Proven Field Performance (cont.)

### WASHINGTON BOULEVARD EL CAJON, CALIFORNIA

The City of El Cajon relied on the GlasGrid® Pavement Reinforcement System and associated design components to fully rehabilitate Washington Boulevard between Avocado Avenue and the city's eastern limits. Since the existing overlay had significant reflective cracking caused by aging, oxidation and traffic, city engineers needed to resurface Washington Boulevard in a way that would improve the asphalt overlay's performance while reducing life cycle costs.

After consulting with representatives from Tensar and Road Solutions Inc., the city decided to use GlasGrid 8501 as a full-coverage solution for the road. The product's grid aperture and strength provided a cost-effective means of dissipating crack energy over a large area and extending pavement life. It also allowed the city to accelerate work and limit disruption of normal traffic patterns (Image G).

"The older streets where we have used the GlasGrid System are holding up really well," says City of El Cajon Associate Engineer, Michael Cardoza, who was in charge of design. "So once we decided to use the GlasGrid System, we didn't expect to have to go back to that road for many years. Infact, my expectation is that these designs will last throughout my career."

### INYOKERN AIRPORT INYOKERN, CALIFORNIA

The Indian Wells Valley District airport authority operates Inyokern Airport in a remote corner of the Mojave High Desert. The airport is designed to land almost any class of aircraft; the authority needed to rehabilitate one of the runways in order to maintain this capability.

The Mojave High Desert experiences extreme temperature shifts, from the highest recorded monthly average temperature of 103°F (July) to the lowest monthly average temperature of 30°F (January). Over time, these high thermal stresses resulted in serious thermal cracking and degradation of the runway surface. The surface layer included thermal, alligator, transverse and longitudinal cracks, with many transverse cracks up to 1 in. wide.

The airport authority was concerned that these defects might affect aircraft movement and safety. It considered adding a thicker overlay to the runway, but this approach would have been very expensive. The GlasGrid System was recommended as a lower-cost, longer-lasting alternative. After more than 11 years of service and thermal exposure, the GlasGrid System-reinforced pavement experienced only minor cracking (Image H).



**IMAGE H:** Inyokern Airport, Inyokern, California



*Surface preparation includes blowing off any dust before installing the self-adhesive GlasGrid System.*

## Tack Coats

### TACK COATS

A tack coat is a light coating of liquid asphalt applied either to an existing pavement surface or on top of the installed GlasGrid® System product. It is used to bond a new asphalt concrete course to the existing pavement surface.

When the GlasGrid System was first introduced, tack coats were not universally used on new leveling courses. More recently, however, the pavement industry has implemented changes to asphalt mixes to make them leaner, stiffer and more rut-resistant. These changes and the need to maximize the bond between lifts have led most authorities to mandate the use of a tack coat between all lifts of asphalt.

The GlasGrid System does not require a tack coat for installing the product. However, when a tack coat has been specified for other reasons, or is mandated for use between lifts of asphalt, it should be used in accordance with the following guidelines\*:

- ▶ **Type 1** – Trackless tack. The trackless tack is not sticky when cured, reducing the possibility of pickup or buildup on paving equipment.

- ▶ **Type 2** – Cationic, rapid set, CRS-2P, or similar. In general, cationic emulsions can break and set more quickly than anionic emulsions due to the electro-chemical reaction between the aggregate and binder.
- ▶ **Type 3** – Hot Spray AC – AC20-5TR-PG64-XX. In general, hot spray AC tacks work well in cooler weather, when surface temperatures are at or below 80°F. When surface temperatures exceed 80°F, the manufacturer recommends that an emulsion be applied in place of the hot spray AC.

Emulsions used with the GlasGrid System must “break” and then cure before any additional asphalt is placed. “Breaking” is defined as the point at which the brown-colored fluid turns black. Curing occurs when the residual asphalt cement contains no solvents (water or any volatiles).

Refer to the GlasGrid System Installation Guide for additional information.

*\*Use of a tack coat type other than those specified above is not recommended and will require changes in application procedures and curing time along with on-site supervision by the specifying engineer.*





**IMAGE I**

## The GlasGrid® System: Designed for Easy Installation

Like all of Tensar's geosynthetic systems, the GlasGrid® System is designed and manufactured for easy installation.

Installation is simple and straightforward. Easy to handle and unroll, the GlasGrid System can be placed on an asphalt surface in either of two ways. The more common method features mechanical placement, typically with a tractor that has been modified to front-mount the product (Image I). Mechanical placement is typically used for full-width installations but can also be used for detail repairs that are sufficiently large.

The alternative method uses manual placement. Although placed by hand, it is highly recommended that the GlasGrid System product be mounted on the back of a truck or other

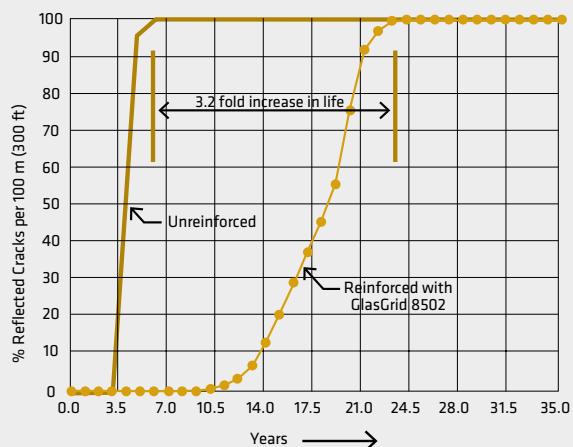
vehicle to help maintain tension during installation. Manual installation is more commonly used for smaller, localized pavement areas (Image J).

Of course, with its pressure-activated adhesive, the GlasGrid System is also the fastest installed interlayer on the market; up to 25,000 sq yds of grid can be installed in one day using a standard laydown unit. Placement is easily adapted to local weather conditions or unique construction requirements.

For additional information on installation procedures, please refer to the GlasGrid Installation Flyer or contact a Tensar representative at **800-TENSAR-1**.



**IMAGE J:** GlasGrid rolls can be installed manually for smaller pavement areas.



**FIGURE 6:** Example of ARCDIESO Software design output showing the estimated life of GlasGrid reinforced vs. unreinforced overlay for a typical composite pavement structure.

## Design Services

### DESIGN OF REINFORCED OVERLAYS

The following two software programs can be used for the analysis of overlays to resist reflective cracking by incorporating the GlasGrid® System; Tensar provides analyses of asphalt overlays using these programs at no charge. For more information, contact your local Tensar representative.

### OLCRACK SOFTWARE

OLCRACK software was developed following the results of a study undertaken at the University of Nottingham in the UK (page 6). Designs for GlasGrid System-reinforced overlays on flexible pavements are based on traffic-induced stresses (fatigue factor).

Design considerations include:

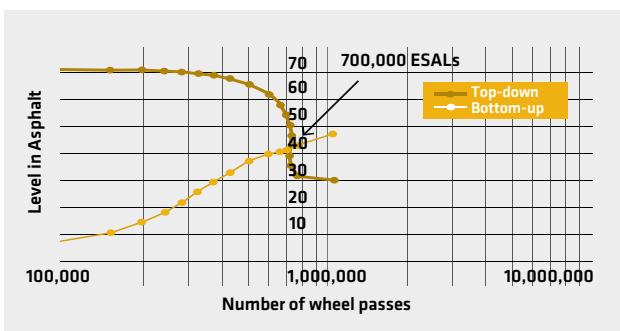
- ▶ Anticipated traffic loading (magnitude)
- ▶ Thickness and material properties of the existing pavement structure and the new asphalt overlay
- ▶ Width and spacing of cracks on the existing pavement
- ▶ Subgrade material properties

### ANTI-REFLECTIVE CRACKING DESIGN SOFTWARE (ARCDIESO)

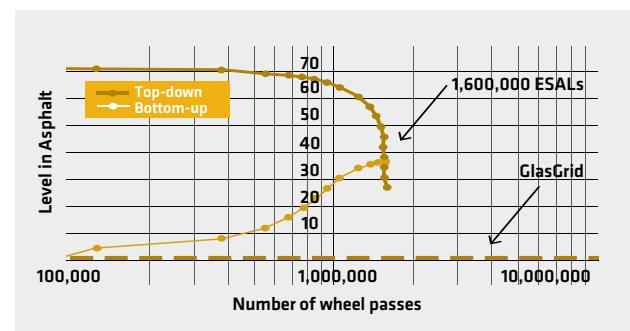
ARCDIESO software, which predicts the thermal crack development rate for reinforced and unreinforced overlays, was developed based on research undertaken at Delft University in the Netherlands. The application helps analyze unreinforced and GlasGrid System-reinforced overlays constructed on flexible, semi-rigid and rigid pavements subjected to thermally induced stresses.

Design considerations include:

- ▶ Location of the project – used to retrieve local temperature data from any recognized local or international weather database
- ▶ Anticipated installation strategy (e.g., tack coat and 4 in. thick asphalt overlay)
- ▶ Thickness and material properties of the existing pavement structure
- ▶ Width and spacing of cracks on the existing pavement
- ▶ Subgrade material properties



**FIGURE 7:** Example of OLCRACK Software design output showing unreinforced crack development plot.



**FIGURE 8:** Example of OLCRACK Software design output showing reinforced crack development plot.



*Most GlasGrid distributors own their own equipment and can therefore provide full installation services.*

## Installation Services

### INSTALLATION SERVICES AND THE TENSAR COMMITMENT

Installation of the GlasGrid® System is simple and straightforward. However, as with all construction products, there are advantages to using experienced personnel. This is particularly true with the GlasGrid System since time is often critical, and the installation team must work quickly enough to keep ahead of the paving machine.

Most authorized distributors are equipped to provide full installation services for the GlasGrid System products they supply. Rates are very reasonable, and since modified equipment is required for mechanical installation, contracting these services is typically the easiest and most cost-effective method for completing your project. For additional information, check with your local GlasGrid System distributor.

With thousands of successful installations worldwide, you can count on the GlasGrid System to reduce maintenance costs and extend pavement service life of your highway, roadway, runway, parking lot or other paved surface.

For more information on the GlasGrid Pavement Reinforcement System, please call **800-TENSAR-1**, visit [www.tensarcorp.com](http://www.tensarcorp.com) or e-mail [info@tensarcorp.com](mailto:info@tensarcorp.com). We're happy to provide additional GlasGrid System information, complete installation guidelines, system specifications, design details, conceptual designs, preliminary cost estimates, case studies, software and much more!



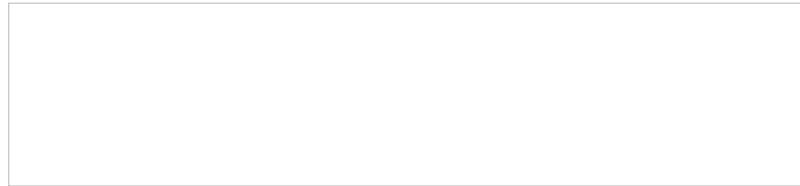
*Positioning the GlasGrid product at the transition to a new roll requires some experience and training, however, is easily handled by experienced installers.*



Tensar International Corporation  
2500 Northwinds Parkway, Suite 500  
Alpharetta, Georgia 30009

800-TENSAR-1  
[tensarcorp.com](http://tensarcorp.com)

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the Americas for:



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