Research Summary Enhanced Pavement Design Using Tensar Stabilization Technology

Topic: Evaluation of using TriAx geogrids for Permanent Pavements
Caltrans Contract No.: 11-2T1714
Location: I-5, North Coast Corridor, San Diego, California

Application:

Permanent Pavements

Type:

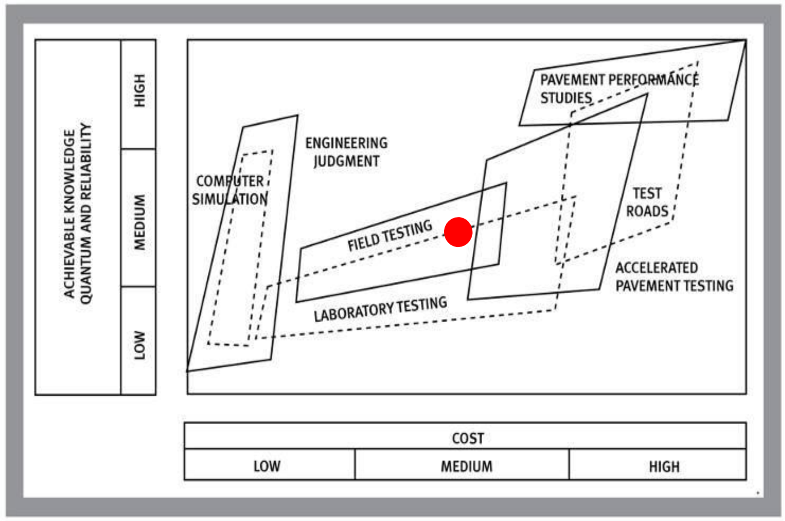
Field Structural Performance Study

Geogrid Products Tested:

- Tensar TriAx

Section Profiles:

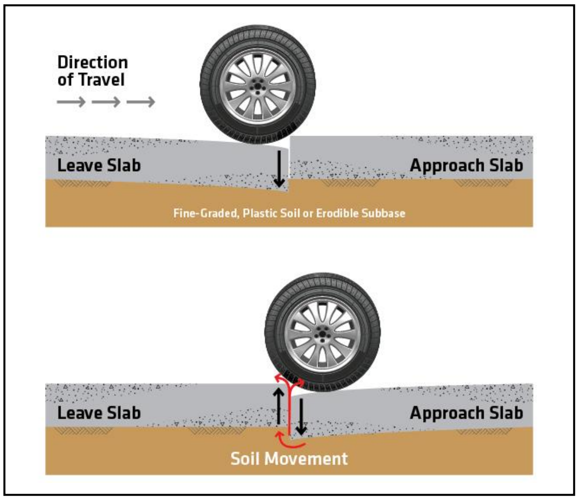
- Enhanced Section: 4 inches (0.35 feet) thick aggregate base stabilized with TriAx Geogrid
- Control Section: 8 inches (0.70 feet) aggregate base
- Both sections constructed over a subgrade with Type II Soils (Subgrade R-Value between 10 and 40)



Background:

A concrete pavement structure distributes load stresses through multiple layers. The concrete layer provides most of the support for the traffic loading and the concrete's strength minimizes the stresses on the foundation structure below the rigid wearing surface. However, the performance is dependent on the foundation structure below the rigid pavement to provide:

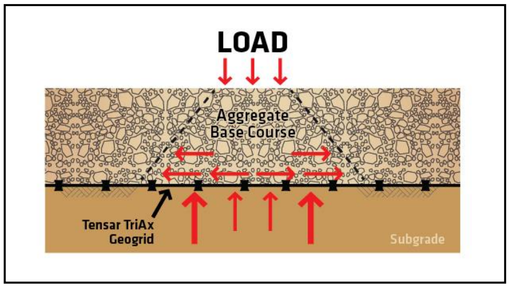
- Uniform support
- Additional load distribution; and
- Drainage



Most performance problems with concrete pavement are a result of poorly performing joints (ACPA, 2001). Poor load transfer creates high slab stresses, which contribute heavily to distresses such as faulting, pumping and corner breaks.

"Load transfer" is a term used to describe the transfer (or distribution) load across discontinuities such as joints or cracks (AASHTO, 1993). When a wheel load is applied at a joint or crack, both the loaded slab and adjacent unloaded slab deflect. The amount the unloaded slab deflects is directly related to joint performance. If a joint is performing perfectly, both the loaded and unloaded slabs deflect equally.

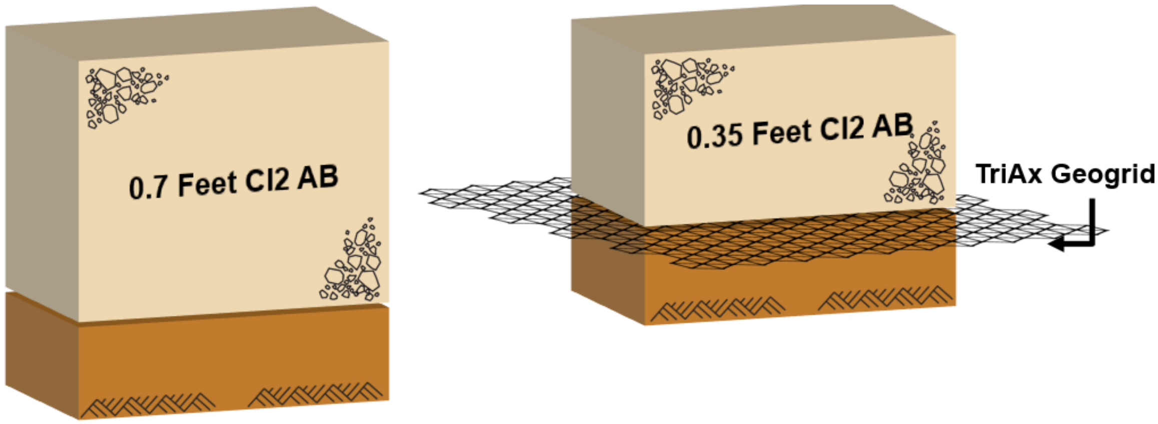
Benefits of the Geogrid Mechanically Stabilized Layer (MSL)



Incorporating geogrids into the roadway section is an effective method of creating a stiffer and more uniform foundation that will maintain integrity over time improving the Load Transfer. The geogrid enhancement results in less deformation during construction, and during the pavement's life. The geogrid achieves this by interlocking with and confining the aggregate base. The confinement reduces the potential for contamination of the aggregate base with the subgrade soil. The geogrid and aggregate base together create a mechanically stabilized layer (MSL). The MSL provides a resilient layer that minimizes the potential for differential movements of the concrete surface that initiate faulting and corner breaks.

Field Test

The test was located along Interstate 5 in Encinitas, California. A contractor constructed the test section within the limits of project area. The diagrams below present the test sections:



Purpose/Objective:

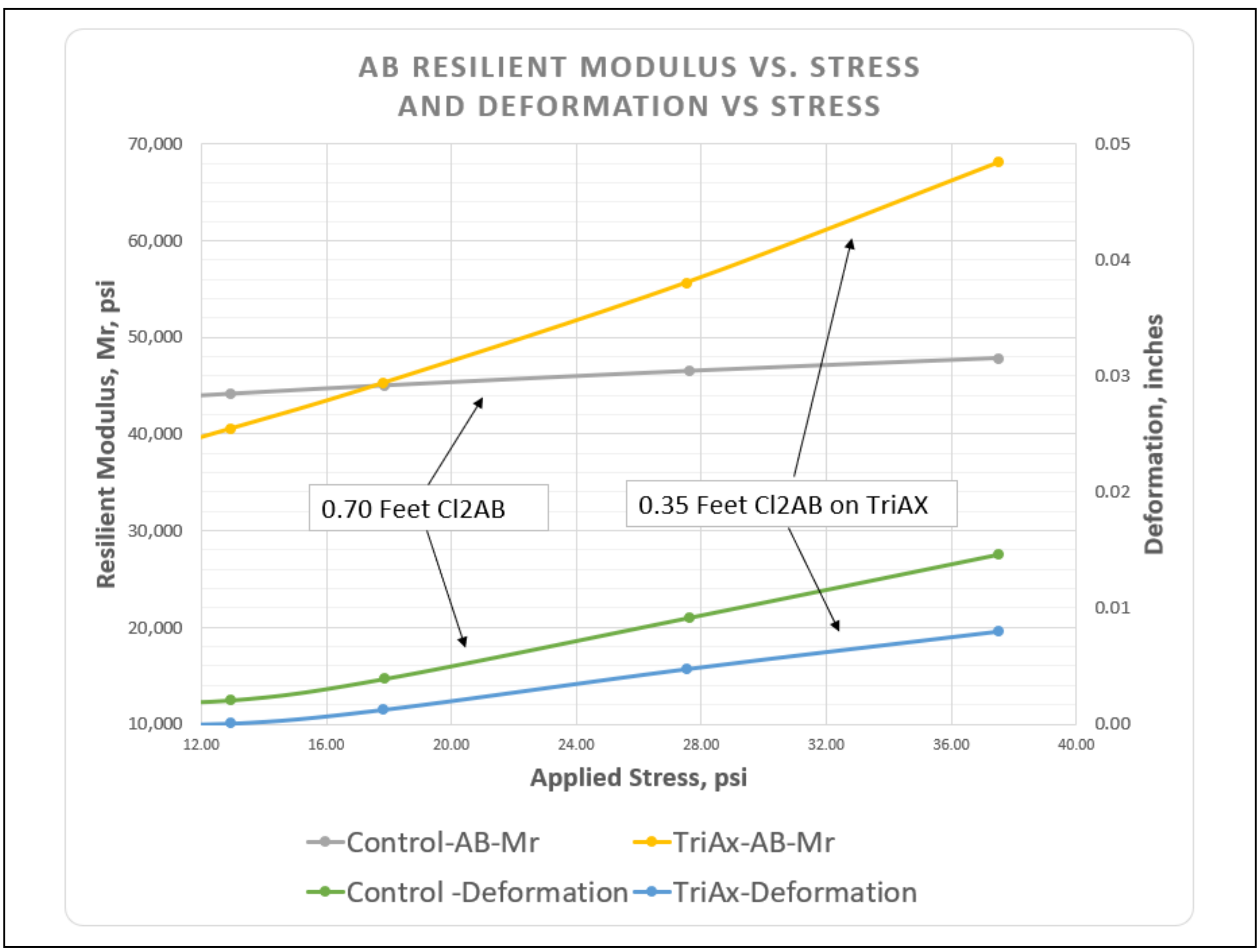
The purpose of the testing was to demonstrate that an MSL below a rigid pavement will reduce deformation better than a thicker aggregate base section creating more uniform support. Additionally, the MSL will create a more resilient foundation section and not lose strength over time.

Test Procedure:

Ingios® performed a series of Automated Plate Load Test's (APLTs) at the subject site. APLT is a system developed to perform fully automated static and repetitive/cyclic plate load tests, per AASHTO and ASTM test methods. To evaluate the stress dependent resilient modulus a 12-inch diameter plate was cycled 100 times at stress increments between about 5 pounds per square inch and 40 pounds per square inch.

Results / Key Findings:

The chart below shows the resilient modulus of the aggregate base versus the applied stress using the 12-inch diameter plate. The results demonstrate how the resilient modulus of the 0.35 feet Class 3 AB section underlain by TriAx geogrid is more resilient as the stress and loading increments increase as compared to the control sections with 0.70 feet Class 3 AB and 0.85 feet Class 3 AB. The 0.35 feet Class 3 AB on TriAx section increased the AB resilient modulus by 15% and reduced AB surface deformation by 40% compared to the 0.70 feet AB section.



Why is this concept significant to the rigid pavement design?

The aggregate base within a rigid pavement section is a construction platform. The purpose of the construction platform is to create an acceptable working surface for placement of the wearing surfaces consisting of asphalt concrete or Portland cement concrete above the aggregate base. During construction, the aggregate base layer will be trafficked by typical construction equipment. Without geogrid the aggregate base layer will become intermixed with the underlying subgrade. This intermixing results in non-uniform support characteristics and added maintenance during construction to maintain a surface that can be paved on. Additionally, the aggregate base will sometimes move and rut under the traffic loading.

The results demonstrate the intermixing at the aggregate/subgrade interface as well as the benefits of the TriAx geogrid. As the applied stress increases there is only a slight increase in the resilient modulus of the aggregate base for the control section. This is a result of aggregate/subgrade intermixing. Placing a geogrid on the subgrade creates an MSL. The geogrid within the MSL prevents intermixing of the aggregate base and subgrade material. As the applied stress increases the resilient modulus of the aggregate base increases significantly. This occurs because the geogrid interlocks with and confines the aggregate base preventing movement.

Why does a TriAx geogrid improve performance?

A geogrid's performance is based on the materials ability to interlock with the aggregate base and confine the aggregate from moving laterally. Triangle apertures with high ribs create a hexagonal structure of aggregate creating stiffer structures. Initial lateral and vertical confinement during construction is clear as aggregate locks into geogrid and "soil-arching" begins. Performance is dependent on a geogrids rib shape, rib height, confinement ring geometry, aperture size, geogrid stiffness, and junction efficiency. Performance is dependent on the efficiency and stability of the confinement ring geometry, less potential for movement equals less surface deformation and better performing pavements.

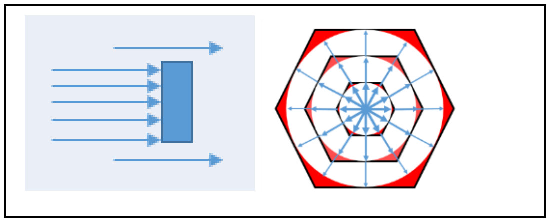


Figure 2 summarizes these benefits.

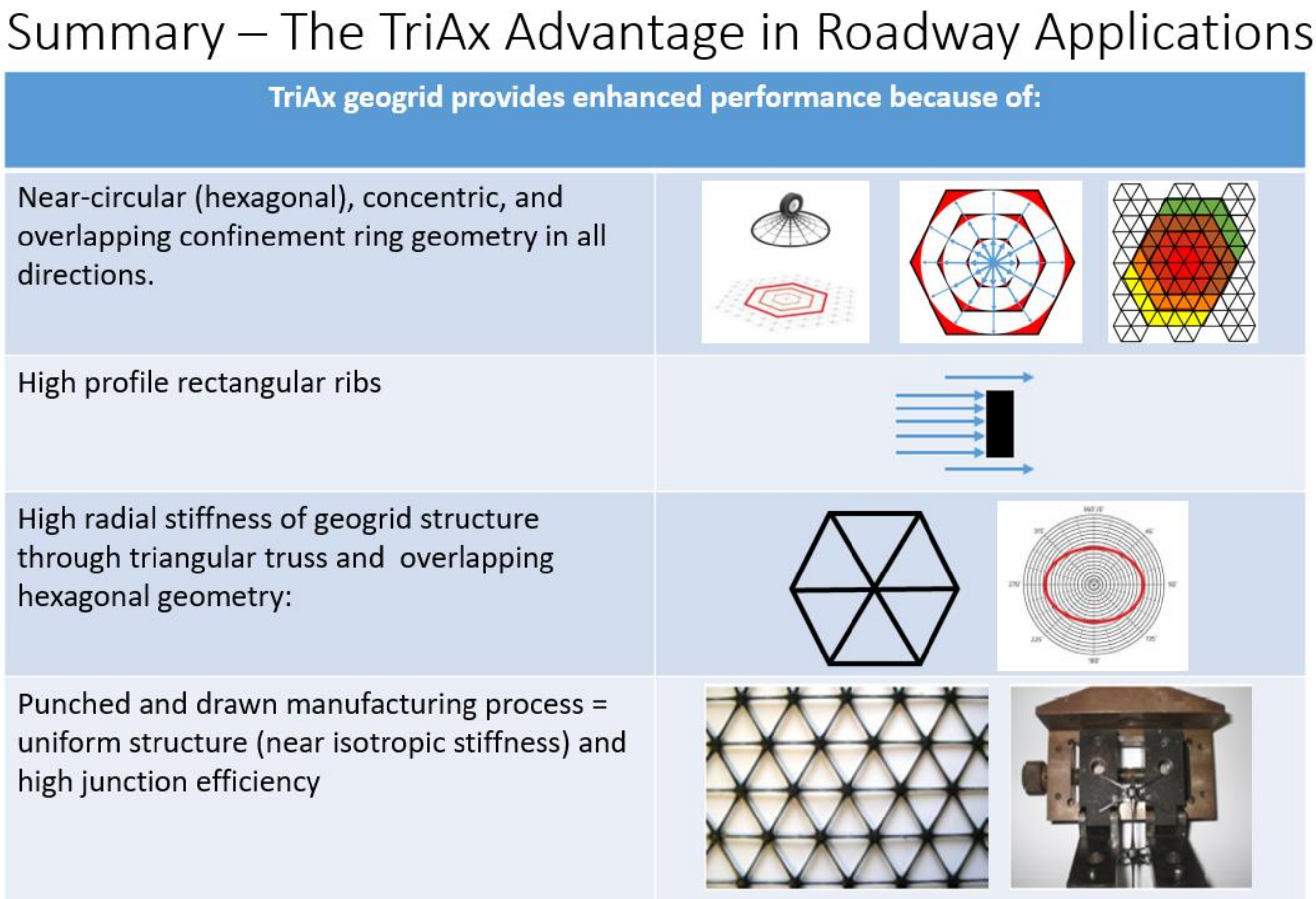


Figure 2

Conclusions

The testing here shows that 0.35 feet aggregate base placed on TriAx Geogrid improves performance compared to the control section of 0.70 feet aggregate base by:

- Reducing deformation as compared to thicker aggregate base sections
- Providing more uniform support characteristics improving pavement performance
- Improving the performance of the aggregate base through confinement and less subgrade soil contamination. This will maintain drainage properties of the aggregate base over time.

The results of the testing are consistent with the findings of the Accelerated Pavement Testing and over 150 APLT's performed on sections enhanced with TriAx geogrid. Results can vary depending on the quality of the aggregate, type of geogrid and subgrade strength.

References:

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