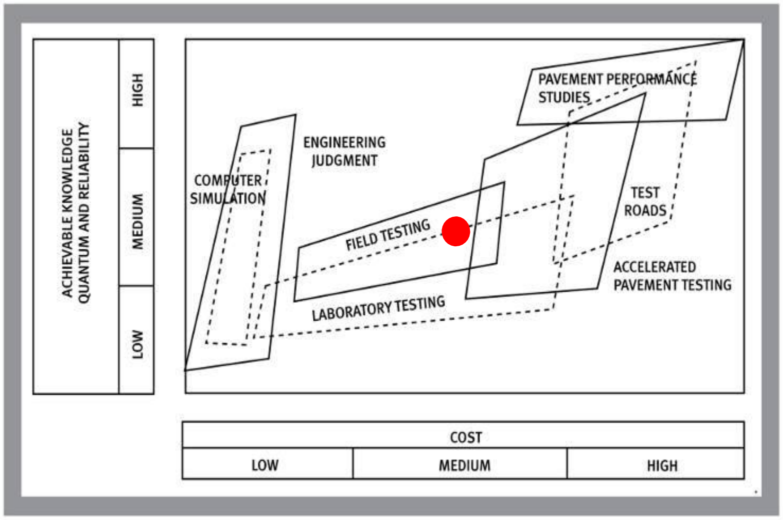
Research Summary

Evaluation of using geogrids for below Rigid Pavements
Interstate 5, Santa Clarita, California

Application:

Rigid Pavements



Type:

Field Structural Performance Study

Geogrid Products Tested:

- Tensar TriAx

Section Profiles:

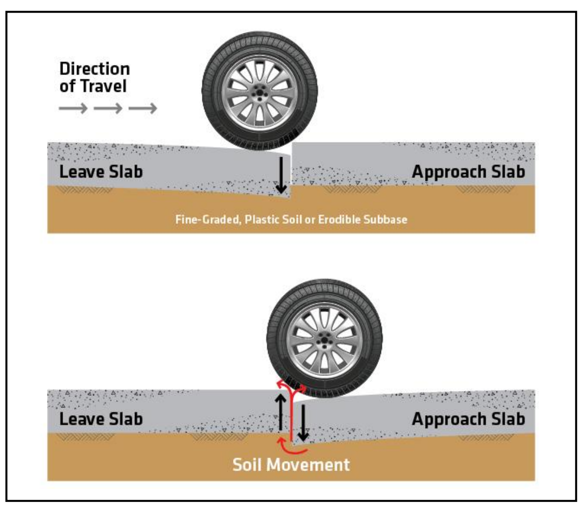
- 4 – 5 inches (102-127mm) thick Aggregate Base stabilized with TriAx
- 8 – 9 inches (203-228mm) Aggregate Base (control)
- Both sections constructed over a subgrade with an Mr > 11,000 psi

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:

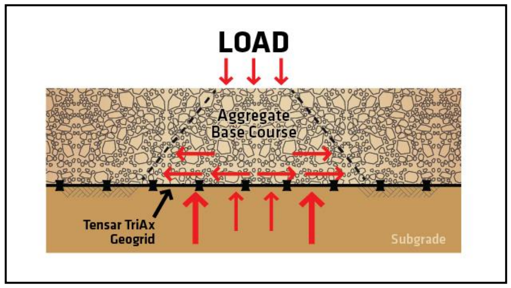
- Uniform support
- Additional load distribution; and
- Drainage

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.

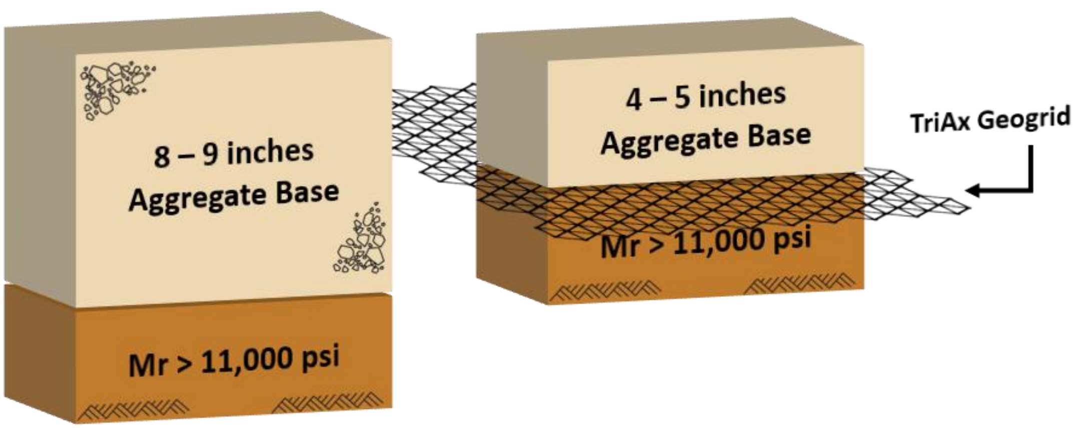
Benefits of the Geogrid Mechanically Stabilized Layer (MSL)



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. This is accomplished by the geogrid 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 Santa Clarita, 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.

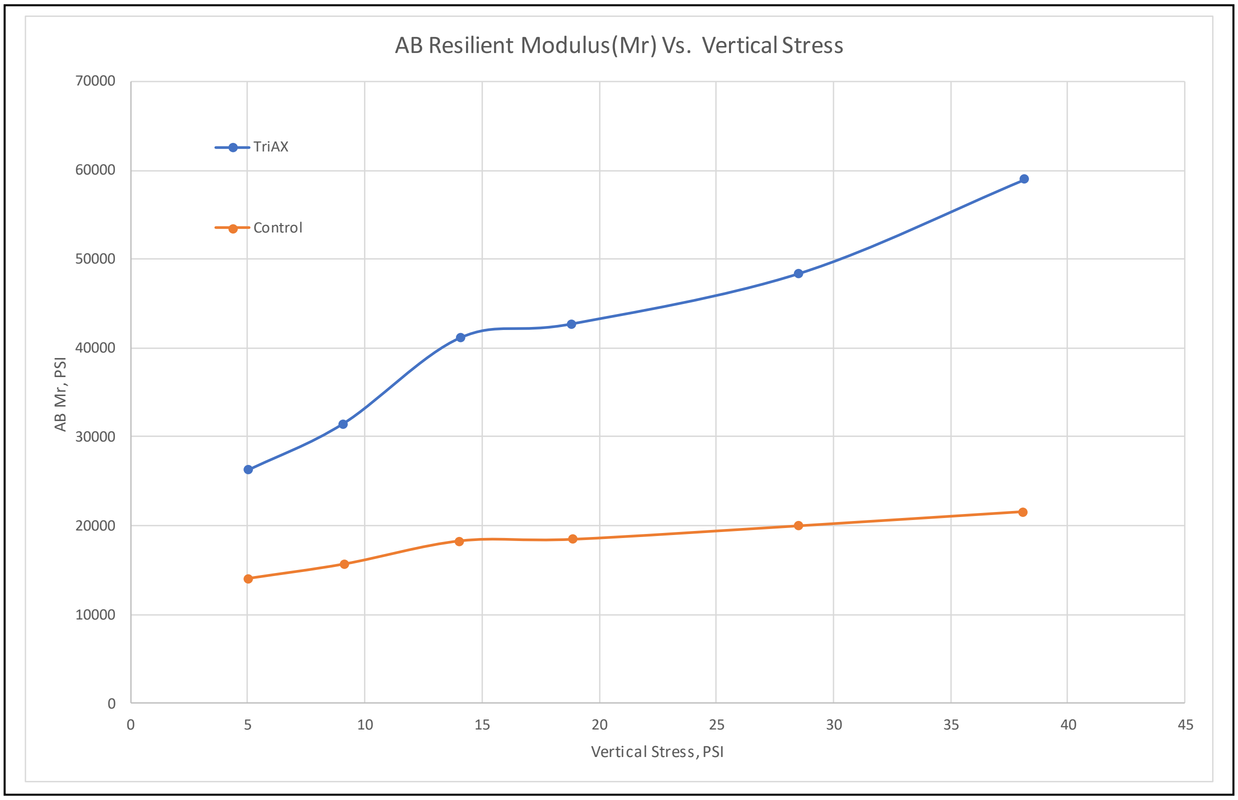
Test Procedure:

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. Additionally, 10,000 cycle tests with a 12-inch diameter plate on the control section and the TriAX section at a stress of about 15 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 4-inch section of aggregate base underlain by TriAX geogrid is more resilient as the stress and loading increments increase as compared to the control section with 8 inches of aggregate base.



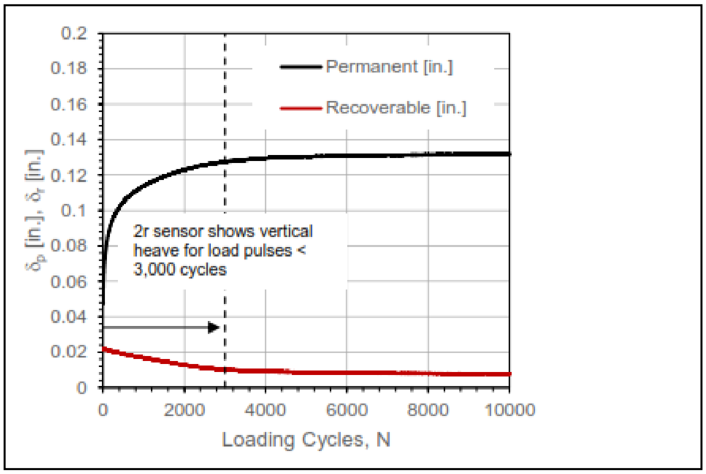
Note: Average aggregate base resilient modulus

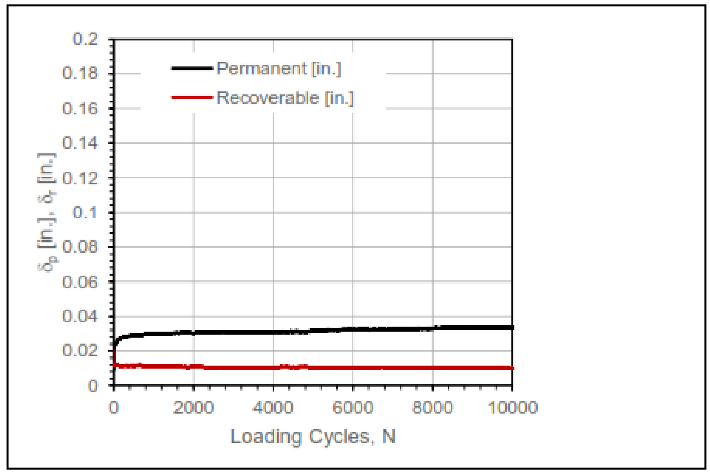
Why is this concept significant to the rigid pavement design?

The aggregate base within a rigid pavement is a construction platform and meant to provide an acceptable working surface for placement of the asphalt concrete layer located between the rigid pavement and the asphalt concrete. As the aggregate base layer is trafficked during construction the aggregate base and the subgrade within the control section are intermixed. Additionally, the particles within the thicker aggregate section base move. Therefore, there is only a slight increase in the Mr of the aggregate base. The MSL creates a composite system where the aggregate base is confined and the unable to become contaminated with the subgrade material or move. This is evident as the Mr of the aggregate base increases as the stress increases, typical of a granular material.

Another test performed at the site to demonstrate the benefit of the MSL was a 10,000 cycle plate load test with an applied pressure of about 14 pounds per square inch on a 12-inch diameter plate. The purpose of this tests is another measurement of the performance of the MSL with multiple cycles of loading, like traffic. The applied load is more than double what the aggregate will experience during the life of the pavement. The critical measurement parameter with this test is the deformation of each system. The charts below show the results.

Control Section 8.25 inches of AB ***TriAX Section 4.5 inches of AB***





The plots above show the permanent and recoverable deformation measured. The control section showed about 3 times more permanent deformation than the TriAX section over the 10,000 cycles.

Why is the deformation significant?

With less deformation a more uniform surface is created. This uniform surface creates a non-yielding surface for paving and ultimately provides a better foundation for the rigid pavement. Additionally, rigid pavement distress typically occurs when the foundation supporting the concrete loses strength and deforms. This is referred to as erosion. This is more critical in rigid pavements where faulting of 0.15 inches can be the threshold at the end of a design life. This test shows the reduced potential for deformation with an MSL.

Conclusions

The testing here demonstrates that using an MSL within a pavements foundation:

- Reduces deformation as compared to thicker aggregate base sections
- Provides more uniform support characteristics improving rigid pavement performance
- Improves 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.

<u>References:</u>

1. *"In Situ Performance Verification of Geogrid-Stabilized Aggregate Layer Using Automated Plate Load Testing, Interstate 5 Test Sections, Santa Clarita, California" prepared by David J. White, Ph.D., P. E. dated January 12, 2018.*
2. *AASHTO, MEPDG, 2015*
3. *Concrete Pavement Joints, Technical Advisory T 5040.30. Federal Highway Administration. Washington, D.C. http://www.fhwa.dot.gov/legsregs/directives/techadvs/t504030.htm.*
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5. *Concrete Types. Web page on the American Concrete Pavement Association's web site. http://www.pavement.com/PavTech/Tech/Fundamentals/fundtypes.html. Accessed 18 January 2002.*
6. *Load Transfer Design on the Pavement Interactive web site.* http://www.pavementinteractive.org/article/joint-design/
7. *"State of California, Department of Transportation, Concrete Pavement Guide" prepared by Division of Maintenance Pavement Program, 5900 Folsom Boulevard, MS-5, Sacramento, California 95819, dated January 2015.*
8. *"Full-Scale Evaluation of Geogrid Reinforced Thin Flexible Pavements"* prepared by U.S Army Engineer Research and Development Center, dated August 2, 2011.
9. *"Performance of Geogrid-Stabilized Flexible Pavements"* prepared by U.S Army Engineer Research and Development Center, dated July 2014.
10. *"Full-scale accelerated testing of multi-axial geogrid stabilized flexible pavements," Geotechnical and structures laboratory, Engineering research and development center, June 2017,report can be obtained at https://erdc-library.erdc.dren.mil/xmlui/handle/11681/22653*