Research Summary

Topic: Comparison of Bi-Axial geogrid to TriAx geogrids
Location: Automated Plate Load Test, Ingios Geotechnics Lab, Minneapolis, Minnesota

Type:

Automated Plate Load Test, Laboratory

Geogrid Products Tested:

- Tensar TriAx geogrid
- Tensar Bi-Axial geogrid

Section Profiles:

- 8-inch-thick Aggregate Base stabilized with TriAx Geogrid
- 8-inch-thick Aggregate Base stabilized with Bi-Axial Geogrid
- Both sections constructed over a Soft Subgrade with an Mr between 2,000 psi and 3,000 psi

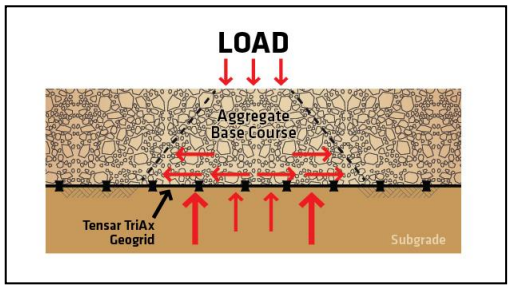
Purpose/Objective:

The purpose of the testing was to prove the benefits of a TriAx geogrid over a Bi-Axial geogrid. The biggest benefit being the reduced deformation seen with granular material stabilized with TriAx geogrids.

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 cycles 1,000,000 times at stress increments between about 5 pounds per square inch and 40 pounds per square inch at 166,666 loading cycles per each stress point.

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 creates a resilient layer that minimizes the potential for differential movements of the pavement surface that contribute to distress.

Results / Key Findings:

Figure 1 shows the resilient modulus of the aggregate base and measured surface deformation versus the applied stress using the 12-inch diameter plate. The graph shows the TriAx geogrid increases the Mr of the aggregate base by about 30% on average compared an aggregate base stabilized using Bi-Axial geogrid. Additionally, the TriAx stabilized section reduces the surface deformation by about 65%.

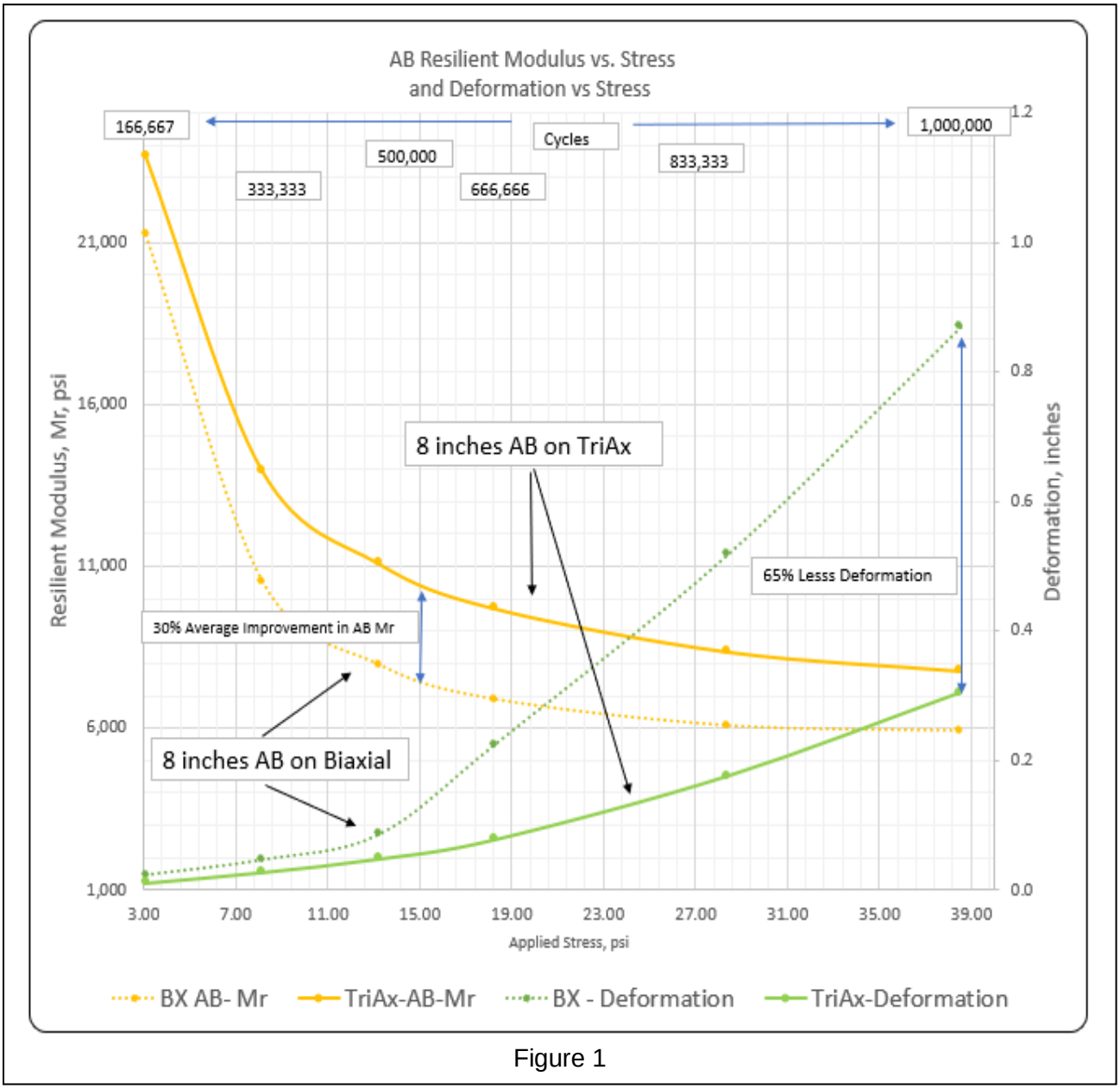
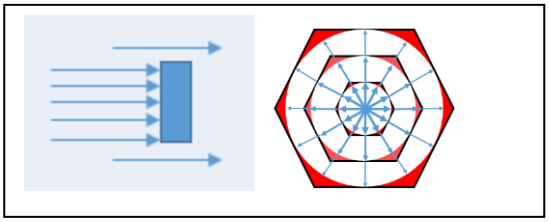


Figure 1

Why does a TriAx geogrid improve performance more than a Bi-Axial Geogrid?

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.



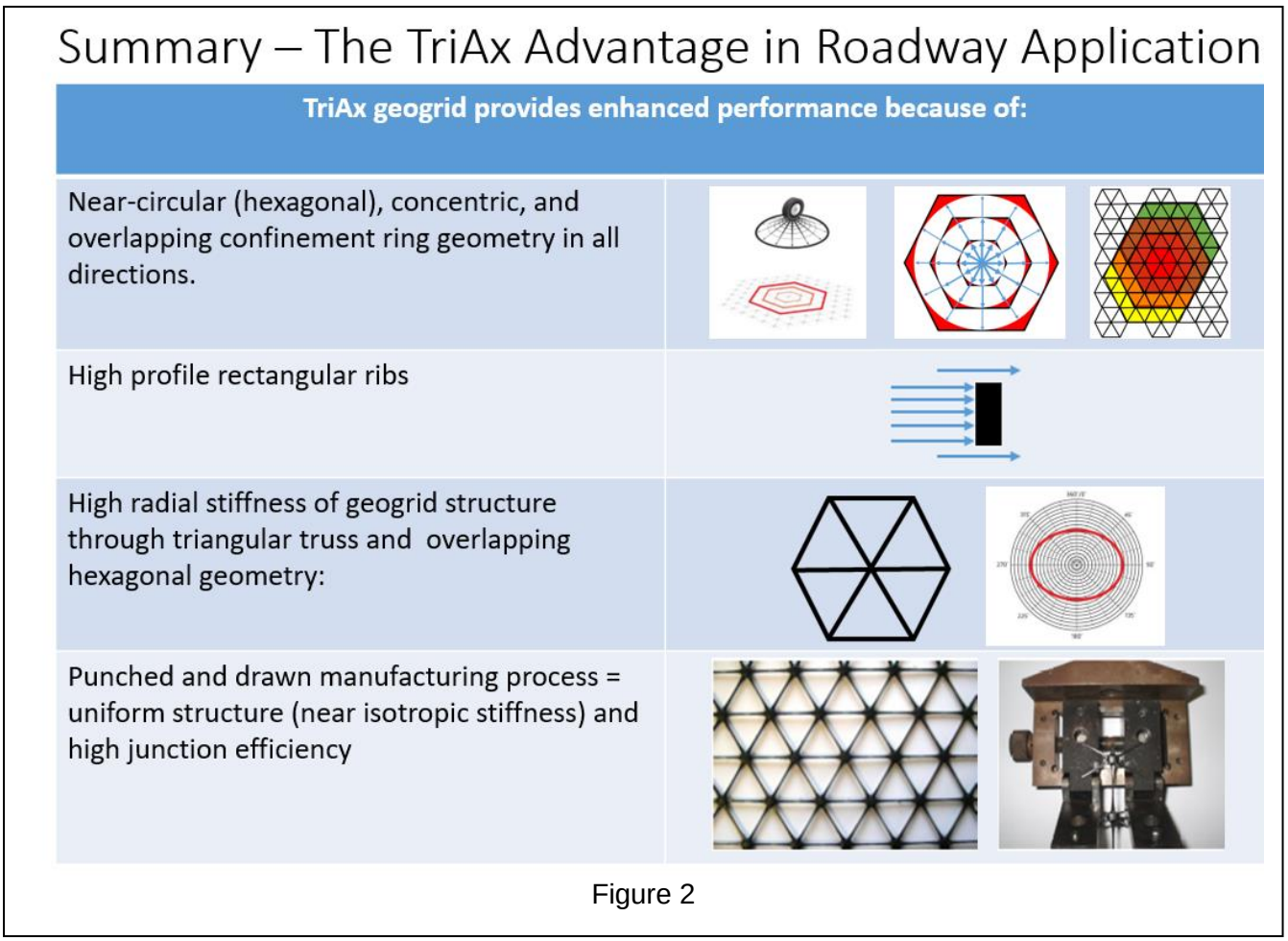


Figure 2

Why is the deformation significant?

Less deformation creates a more uniform surface. Uniformity within a pavement structure provides improved load transfer efficiency for rigid pavement and a reduced potential for rutting of flexible pavements. This test shows the reduced potential for deformation with an MSL.

Conclusions

The testing here shows that TriAx geogrids can provide better performance as compared to Bi-Axial geogrids. The key benefits include:

- Reduced deformation
- More uniform support characteristics improving pavement performance
- Enhance Mr retention of the overlying aggregate material

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:

1. *"Integrated Mobile Accelerated Test System (IMAS), Summary of IMAS Test Results, Ingios Geotechnics Laboratory" prepared by David J. White, Ph.D., P. E. dated April 16, 2019.*
2. *AASHTO, MEPDG, 2015*
3. *"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.*
4. *"Full-Scale Evaluation of Geogrid Reinforced Thin Flexible Pavements"* prepared by U.S Army Engineer Research and Development Center, dated August 2, 2011.
5. *"Performance of Geogrid-Stabilized Flexible Pavements"* prepared by U.S Army Engineer Research and Development Center, dated July 2014.
6. *"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*