Research Summary

Evaluation of using geogrids on unyielding subgrades
UPRR LATC Intermodal Yard, Los Angeles, California

Application:

Un-yielding subgrades

Type:

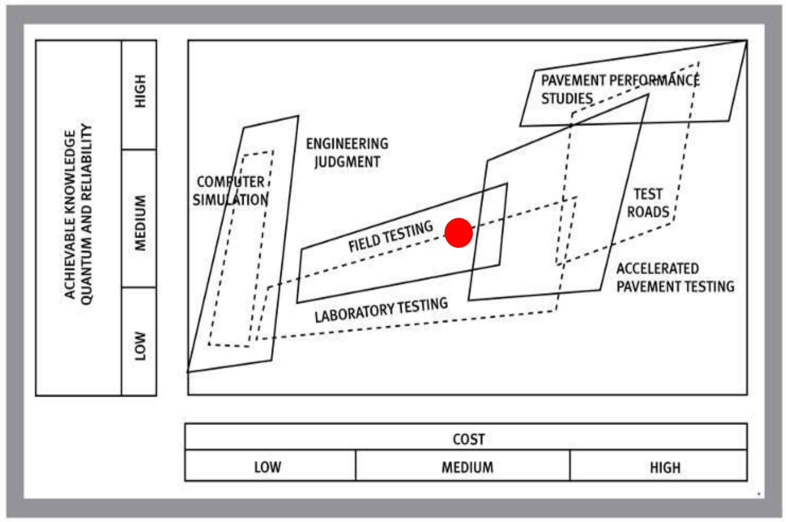
Field Structural Performance Study

Geogrid Products Tested:

- Tensar TriAx TX8

Section Profiles:

- 5-6 inches (125 -150 mm) thick Aggregate Base stabilized with TriAx
- 11-12 inches (280 -305 mm) Aggregate Base (control)
- Both sections constructed over a Silty Sand soil with a predicted Mr greater than 10,000 psi

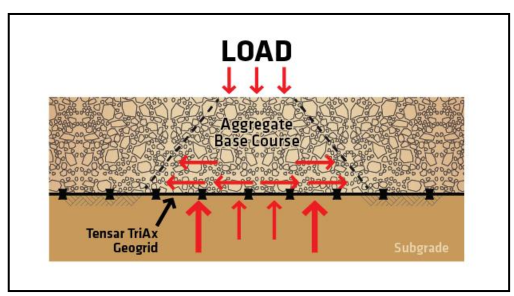


Background:

Historically, geogrids are considered when soft or yielding subgrade conditions are encountered. A geogrid will be placed on the yielding area with aggregate base to achieve a firm and unyielding surface. However, recent research indicates that designing with a geogrid over competent subgrade soils can enhance the pavement section as well as reduce the thicknesses of the pavement sections structural components. Many Departments of Transportation have recognized this and allow a reduction in the aggregate base layer up to about 25% for softer subgrades but not for firmer subgrades. However, studies indicate a reduction in aggregate base can still be achieved for firmer non-yielding subgrades.

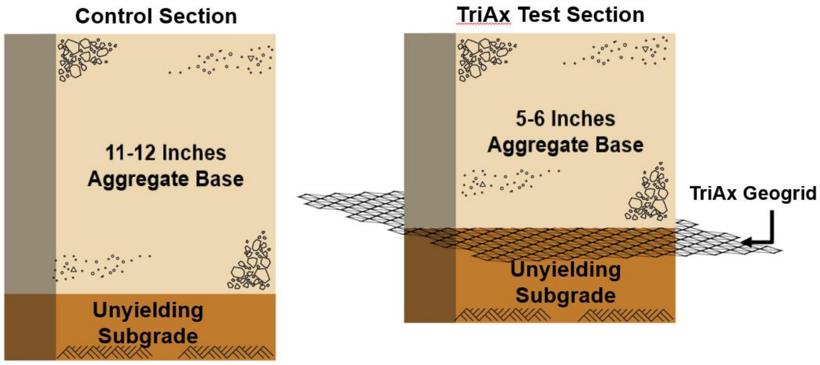
Benefits of the Geogrid Mechanically Stabilized Layer (MSL)

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 pavement surface that initiate structural distress.



Field Test

The test was located within the Union Pacific Railroad Los Angeles Transportation Center(LATC) Intermodal Facility in Los Angeles, California. A contractor constructed the test section within the limits of project. The diagrams below present the test sections:



Purpose/Objective:

The purpose of the testing was to demonstrate that geogrids used with firm and unyielding subgrade can provide equivalent performance to thicker AB sections.

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. For performance validation the measured deformation between the control sections and TriAX test sections are compared with stress dependent resilient modulus testing, static "K" value tests and extended cycle tests.

Results / Key Findings:

Table 1 presents the data collected from multiple APLT's at the site.

Table 1
Deformation Results

Point	Stress Dependent Mr Testing, Composite Section[1,2]		10,000 Cycle Test, 25 PSI		Static "K" Value Test	
	Control	TriAx	Control	TriAx	Control	TriAx
AB Thickness	11-12 inches	4-5 inches	11-12 inches	4-5 inches	11-12 inches	4-5 inches
1	0.0232	0.0051	0.014	0.017	0.0313	0.0198
2	0.0050	0.0076				
3	0.0037	0.0060				
4	0.0078	0.0054				
5	0.0095	0.0043				
Average, inches	0.0098	0.0057				

1. Permanent Deformation measured minus the initial plastic deformation after the first cycle
2. Permanent Deformation measured after 600 cycles with stress ranging between about 5 psi and 40 psi

The testing compared about 11½ inches of aggregate base on subgrade to about 5 inches of aggregate base underlain by TriAx geogrid. <u>The subgrade material below each section consisted of Silty Sand that was firm and unyielding. DCP refusal was encountered at 12 of the 16 test locations.</u> Table 2 summarizes key findings from the test results.

Table 2
Deformation Summary

Testing Type	Control	TriAx	Key Finding
	11-12 inches	4-5 inches	
Permanent Deformation Stress Dependent Testing	0.0098 inches	0.0057 inches	42% less deformation with TriAx
10,000 Cycle Test, 25 PSI	0.014 inches	0.017 inches	Nearly Equivalent Deformation, Additionally, higher Mr of the base was observed as the stress increased. The control base Mr degraded or remained constant as stress increased.
Static "K" Value Test	0.0313 inches	0.0198 inches	36% less deformation with TriAx

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

- Reduces deformation as compared to thicker aggregate base sections with firm and unyielding subgrades
- 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 100 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. *"In Situ Performance Verification of Geogrid-Stabilized Aggregate Layer Using Automated Plate Load Testing, "Union Pacific Rail Road(UPRR) Intermodal Facility Test Sections, Los Angeles, California", prepared by David J. White, Ph.D., P. E. dated December 15, 2017.*
2. *AASHTO, MEPDG, 2015*
3. *"Full-Scale Evaluation of Geogrid Reinforced Thin Flexible Pavements"* prepared by U.S Army Engineer Research and Development Center, dated August 2, 2011.
4. *"Performance of Geogrid-Stabilized Flexible Pavements"* prepared by U.S Army Engineer Research and Development Center, dated July 2014.
5. *"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*