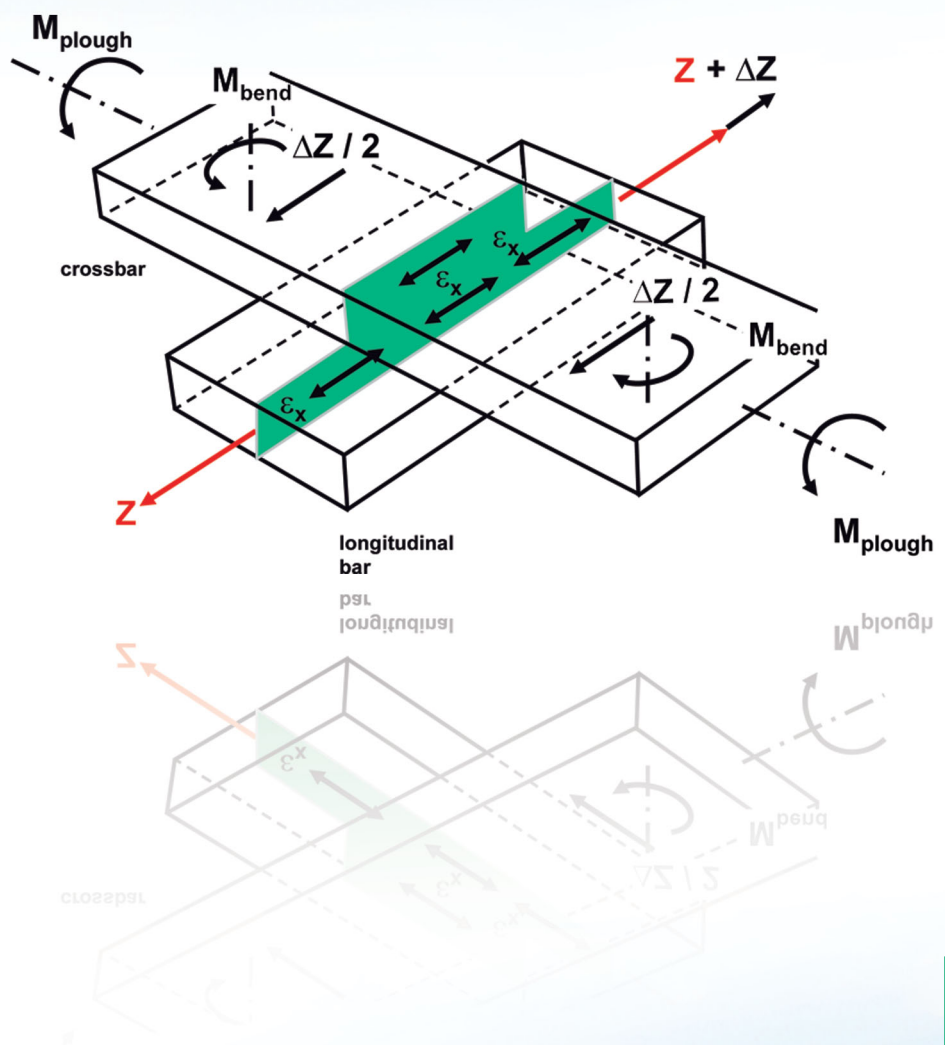


Secugrid® - Torsional Rigidity

TN-SG 4



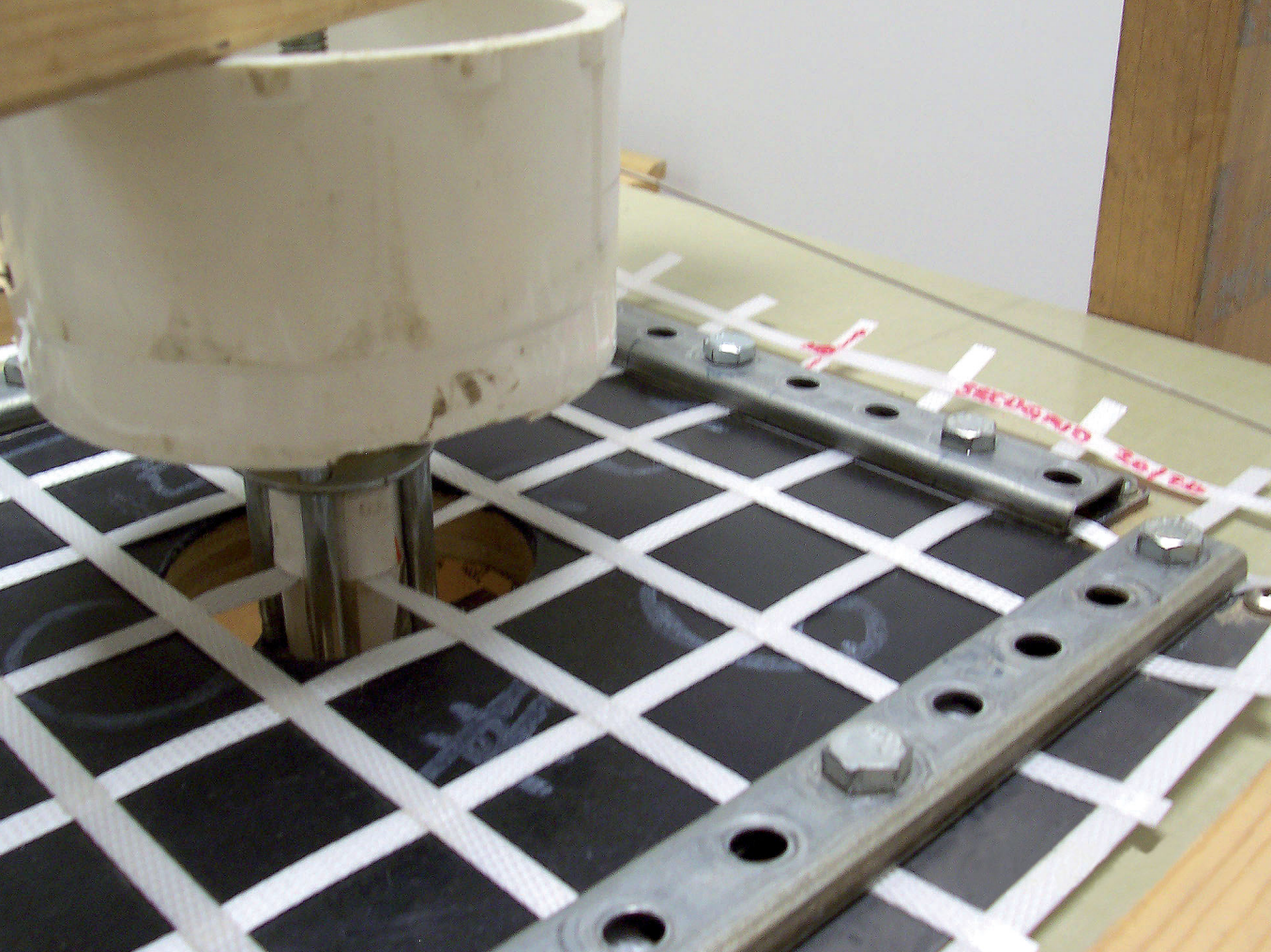


Figure 1
Efficiency of
Secugrid® geogrids

Introduction

In 1993 the US Army Corps of Engineers performed a series of large-scale tests using different geogrids for base reinforcement under paved light aircraft runways at the Waterways Experiment Station (WES) in Vicksburg, MS. To explain the relative improvement afforded by the geogrids, Kinney & Xiaolin (1995) developed a series of tests to evaluate the rigidity of the various geogrids, to see if the rigidity would correlate to the WES test results.

The strains measured at the plane of the geogrid were very low indicating very low stresses in the geogrid. It was thus concluded by Kinney & Xiaolin that the main effect which is improving the bearing capacity, would be related to the stiffness of the geogrid and its ability to interlock with the base course material.

Several tests were attempted and in particular one, the so called "Geogrid Aperture Stability by In-Plane Rotation"-Test (a.k.a. Torsional Rigidity or Torsional Stiffness), showed a particularly good correlation to the WES test results. Kinney & Xiaolin interpreted from their gained test results, that geogrids with high torsional rigidity behaved superior to geogrids with less torsional stability, like e.g. woven geogrids, due to more effective interlock and lateral restraint of the granular base course material.

Test method

The test apparatus and initial testing procedures were developed by Kinney and Yuan (1995). In this test method an unsupported square geogrid specimen is fixed on its four sides in a horizontally oriented containment box. Its central node is then clamped by a torquing device which has the capability of applying moment to the geogrid structure and of simultaneously measuring the resulting rotation. The modulus of the rotation versus moment curve is the desired value of geogrid stiffness in units of N-m/deg.

The benefit of using reinforcing elements with high torsional rigidity

As a wheel passes over a granular base course material, which is installed on top of a geogrid, as shear a shear stress develops in the aggregate on the plane of the grid. This shear stress changes in magnitude and direction as the wheel passes. The direction is important because the change in direction causes a twisting motion in the geogrid. The main motion of the aggregate is outward from the wheel, but the stress on an individual particle during this migration changes from predominately forward to predominantly outward, to predominantly backward.

The magnitude is the highest in the outward direction and the stress may not be high enough to cause slippage in all directions, but the stress and the potential for movement change their direction, which results in a twisting stress in the base reinforcement geogrid. Geogrids with high torsional stiffness provide greater resistance against the documented twisting stresses which allows a more effective interlock and lateral restraint of the base course material. A comparison of Torsional Rigidity properties between Secugrid® and an extruded geogrid is given in Table 1:

Geogrid Type	Torsional Rigidity (N-m/deg.)
Secugrid®	
20/20 Q1	0.33 *
30/30 Q1	1.14 *
40/40 Q1	1.30 *
Tensar	
BX 1100	0.32 **
BX 1300	0.58 **
BX 1200	0.65 **
SS30	0.91 ***
SS40	1.36 ***
TX160	0.39 ****
TX 170	0.61 ****

* Tests results according to Kinney et al. / U.S. Army Corps of Engineers Methodology, Source: Secugrid® technical Data Sheet, NAUE GmbH & Co. KG
 ** Tests results according to Kinney et al. / U.S. Army Corps of Engineers Methodology, Source: Tensar Biaxial Geogrid Product Specification, Tensar International Corporation Inc., June 2007

*** Tensar Technical Note TN/PR_SS30/11.07.06
 Tensar Technical Note TN/PR_SS40/11.07.06
 **** Performance-related Model Specification Tensar TX 160, MS_PR_TRIAX_TX_160/25.06.09
 Performance-related Product Specification Tensar TX 170, MS_PR_TRIAX_TX_170/25.06.09

Conclusions

With regards to the above described investigations by Kinney & Xiaolin (1995) it has been concluded that geogrids with high torsional rigidity provide more effective interlock and lateral restraint of the granular base course material than reinforcing elements with lower torsional stiffness. Following this interpretation it can be concluded that higher shear stresses between base course and reinforcement develop, using geogrids with greater torsional stiffness, which has a positive influence on the degree of load distribution of geogrid reinforced based courses.



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