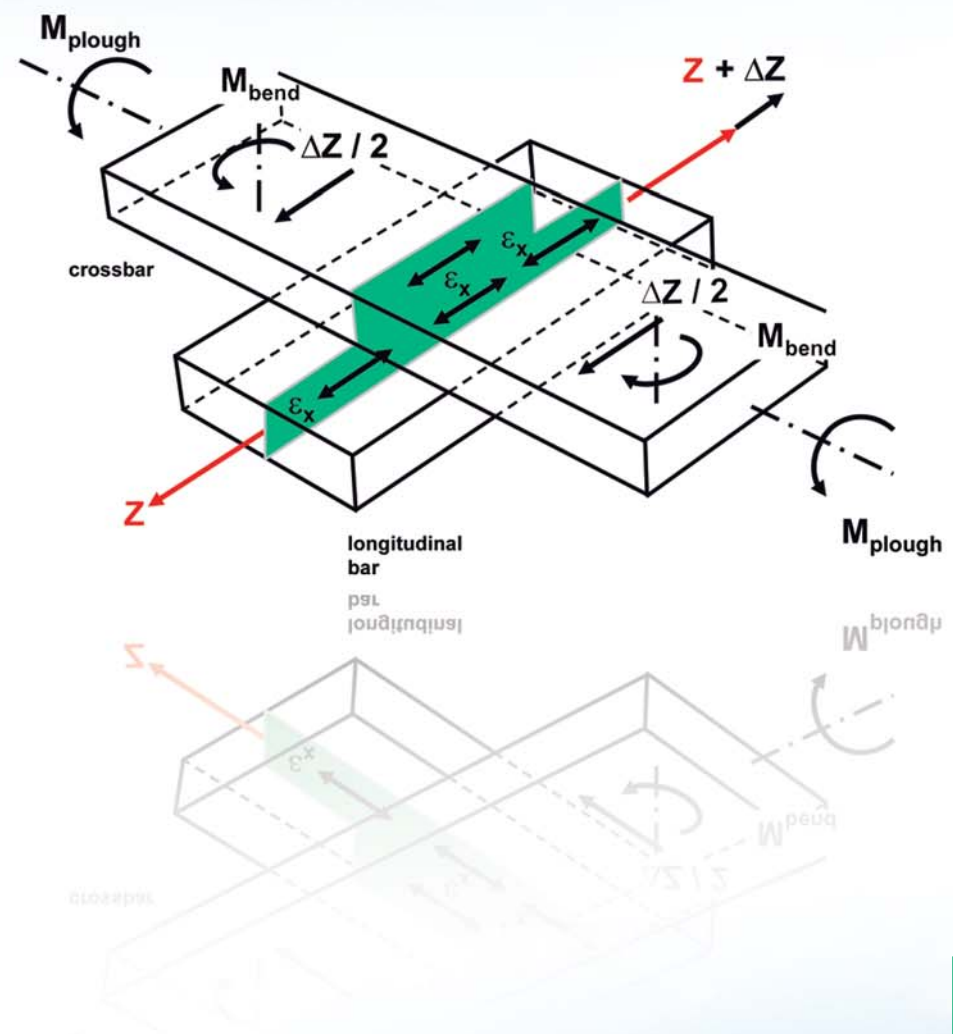


Secugrid® - Flexural Rigidity

TN-SG 2



Introduction

Flexural Rigidity (or Stiffness) is one of the important physical properties of geosynthetic reinforcement materials. This property is indicative of the geosynthetic’s inherent capability of providing a suitable working surface for installation, especially under extremely soft soil conditions. Stiffness is defined as the resistance to bending. The stiffness is a measure of the interaction between the geosynthetic weight and its bending stiffness, as shown by the manner in which the geosynthetic gravitationally bends under its own weight.

Test Method

The test method to obtain stiffness of geosynthetics, is recommended by ASTM D1388. The test measures the overhanging length, defined as the length at which the tip of the specimen is depressed under its own mass to the point where the line joining the top to the edge of the platform makes a 41.50 angle with the horizontal. To calculate the stiffness of a specimen, the bending length *c* is first calculated from the overhang length *O*. The bending length is half of the overhang length.

$$c = O/2 \quad (1)$$

Where: *c* = bending length [cm]
O = length of overhang [cm]

The stiffness (or flexural rigidity) is then obtained from the bending length by using the following equation:

$$G = W * c^3 \quad (2)$$

Where: *G* = flexural rigidity [mg-cm]
W = fabric mass per unit area [mg/cm²]
c = bending length [cm]

The benefit of using reinforcing elements with high product stiffness

When a base course, overlying soft soil settles, the soil beneath the base course moves laterally, to escape toward the ground surface. Control of the resultant heave is the key factor to the successful construction over soft soils and in the bearing capacity mechanism. The reinforcement bending stiffness plays a significant role in preventing the heave (rutting) of the soft soil layer to the base course layer. When the bending stiffness of the reinforcement layer is high, the heave is reduced and distributed over a wider area.

The structural behaviour of the geosynthetic in this situation can be likened to a plate that has bending stiffness (flexural rigidity) and tensile stiffness. The plate-type behaviour of the reinforcement, with high bending stiffness, overlying soft soil provides more than a large displacement mechanism, such as a membrane-type support system. The plate-type behaviour starts with a small vertical deflection of the reinforcement and distributes the heave of the ground surface over a wider area as the vertical deflection of the base course increases.

With the use of pre-stressed stiff, rigid bars in the manufacturing process of Secugrid® geogrids, high product stiffness is achieved, which is highly beneficial for its soil improvement capacity, especially when used on soft soils. A comparison of product stiffness properties (Flexural Rigidity) between Secugrid® and an extruded geogrid is given in Table 1:

Table 1:
 Comparison of different geosynthetic material bending stiffness properties

Geogrid Type	Flexural Rigidity (mg-cm)
Secugrid®	
20/20 Q1	250,000*
30/30 Q1	500,000*
40/40 Q1	750,000*
Tensar	
BX 1100	250,000**
BX 1300	450,000**
BX 1200	750,000**
TriAx Type140	N/A
TriAx Type160	N/A
TriAx Type170	N/A

* Tests results according to ASTM D 1388, Source: Secugrid® Technical Data Sheet, NAUE America, Inc.

** Tests results according to ASTM 5732-01, Source: Tensar Biaxial Geogrid Product Specification, Tensar International Corporation, Inc., June 2007

Conclusions

- The structural behaviour of the geosynthetic reinforcement with bending stiffness used over soft soils is like a stiff plate
- The higher the reinforcement bending stiffness, the higher the bearing capacity of the system
- The use of reinforcement with high bending stiffness (flexural rigidity) reduces the heave of the surface which results in lower rut depths



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