WSDOT Test Method T926

Geogrid Transverse Flexibility Test

Purpose and Scope

The purpose of the Transverse Flexibility test (TFT) is to determine whether or not the geogrid product is likely to exhibit rapid crack growth, or “splitting” through the transverse rib, in the case of uniaxial geogrid products, or through either the longitudinal or transverse rib in the case of biaxial geogrid products, when the rib is bent 90° at various points along its length. The test is applicable to High Density Polyethylene (HDPE), fiberglass and other relatively stiff geogrid materials.

Equipment

The testing device shall have two planes tangent to a specified radius curve fixed at a 90° +/- 2 degree angle, as shown in Figure 1. The radius of the curve shall be accurate to ±0.025 inch, and shall vary as a function of product rib maximum thickness as summarized in Table 1. Each leg of the device shall be 6 ± 0.1 inches in length. The bend radii are determined such that the strain in outer surface the bent geogrid rib is consistent regardless of the maximum rib thickness. The inside legs of the device shall be rigidly fixed to the tube or cylinder that forms the inside surface of bending. The outer plates shall be moveable, but capable of applying a uniform pressure to the geogrid specimen during bending of the specimen in the test. The upper (horizontal) outer plate shown in Figure 1 shall firmly clamp the specimen such that the specimen cannot slip during the bending process. The lower outer plate shall be capable of applying a uniform rate of angular distortion to bring the free end of the geogrid specimen to the full 90° bend.

Figure 1. Geogrid bend test setup.
Table 1. Bend radius as a function of product rib thickness.

<table>
<thead>
<tr>
<th>Max. Geogrid Rib Thickness for HDPE Geogrids (in.)</th>
<th>R (in.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.095±0.005</td>
<td>0.50</td>
</tr>
<tr>
<td>0.105±0.005</td>
<td>0.55</td>
</tr>
<tr>
<td>0.17±0.005</td>
<td>0.95</td>
</tr>
<tr>
<td>0.22±0.005</td>
<td>1.25</td>
</tr>
<tr>
<td>0.28±0.005</td>
<td>1.55</td>
</tr>
</tbody>
</table>

Sampling and Specimens

Sampling shall be in conformance to WSDOT Test Method 914.

For uniaxial geogrid products, a specimen shall consist of a single transverse rib cut from the full roll width. The longitudinal ribs attached to the transverse rib specimen shall be cut approximately 2 inches in length on each side of the transverse rib. A minimum of one specimen per sample shall be tested.

For biaxial geogrid products, in addition to the transverse rib specimen described above, longitudinal rib specimens shall also be obtained. A minimum specimen length of 14 inches, or three longitudinal ribs, which ever is the greater length, should be used. The longitudinal ribs attached to the transverse rib specimen shall be cut approximately 2 inches in length on each side of the transverse rib. Longitudinal rib specimens shall be taken randomly across the full roll width, but no specimen shall be taken within 12 inches of each roll edge.

Procedure

The laboratory temperature shall be 70 +/- 4 degrees F. Samples shall be allowed to remain at the laboratory temperature for a minimum of 1 hour before testing.

For uniaxial geogrids, the specimen shall be bent at approximately 6-inch or greater uniformly spaced intervals along its length, starting at approximately 12 inches from one roll edge and extending to the same distance from the opposite roll edge. A minimum of 6 points along the transverse rib shall be bent. The center of the bend shall be located along the center of the longitudinal ribs attached to the transverse rib as illustrated in Figure 1. The distance between bending marks should be such that wide width tensile tests (WWT) per ASTM D6637 can be conducted on adjacent samples if required. WWT tests require a minimum of five longitudinal ribs, three loaded and the outer two cut. The center longitudinal rib for WWT tests shall be rib located at the apex of the bends in the transverse bar.

Once the bending points have been identified, place the geogrid rib on the bending template as shown in Figure 1. Select the bending template with the radius appropriate to the geogrid product thickness being tested (see Table 1). Apply the top cover plate on the geogrid, and apply uniform pressure on the plate and the geogrid specimen. Once the upper plate is in position and
fixed such that the geogrid between the plates is flat and unable to move, place the remaining cover plate over the geogrid, applying uniform pressure, causing the geogrid rib to conform to the radius specified in Table 1 in approximately 5 seconds at a uniform rate of bending. Hold the geogrid in place for one second, then release the specimen.

Note that for geogrids in which their thickness is highly irregular, a cushion layer between the plates and the geogrid specimen may be necessary to prevent damage to the specimen from the clamping process.

Once the geogrid transverse bar has been bent, release the plates and reposition the geogrid specimen such that the rib bending point is centered over the bending radius and repeat the process. For biaxial grids, instead, replace the tested specimen with a new specimen and repeat the process.

Determine whether or not the geogrid breaks upon bending at each bend point. A break defined as an instantaneous (and audible) split completely through the bent rib and the ends adjacent perpendicular ribs at their junction with the bent rib.

Report

Identify the locations of any bend points in the specimen where breaks occurred. Close-up photographs of any breaks within the specimen shall be taken and included in the test report. The geogrid lot and roll numbers and the project from which the sample was taken shall also be included in the test report. If 50% or more of the bend points break, the specimen is considered to have failed the test.

Follow-Up Testing to Assess Impact of Rib Breaks

If breaks were observed in 50 percent or more of the bend points in the geogrid specimen in the Transverse Flexibility Test (TFT), the geogrid supplier/manufacturer may request a more detailed evaluation of the roll from which the TFT specimen was taken to allow assessment of the impact of the rib splitting on the tensile strength and performance of the geogrid.

This additional evaluation shall consist of a laboratory installation damage test conducted in accordance with ISO/DIS 10722-1 (Procedure for simulating damage during installation. Part 1: Installation in granular materials) conducted on a sample from the same roll of material on which the transverse flexibility test was conducted. If the specimens of the geogrid to be subjected to the laboratory installation damage are more than 12 inches in length, the portion of the specimen subjected to installation damage shall be located centrally within the specimen, and must include at least one transverse rib.

If the mean of the average strength of the sample after damage as a percent of the undamaged strength is less than the average value obtained for the same product and condition during the evaluation of the product for inclusion in the WSDOT Qualified Products List (QPL), the maximum difference between the two means shall be no greater that what is defined as statistically insignificant based on a one-sided student-t distribution at a level of significance of 0.05. In this case, t is determined as follows:
\[
t_{\alpha/2,n_1+n_2-2} = \frac{(\bar{P}_1 - \bar{P}_2) - \delta}{\sqrt{\frac{1}{(n_1-1)s_1^2} + \frac{1}{(n_2-1)s_2^2}}} \sqrt{\frac{n_1n_2(n_1+n_2-2)}{(n_1+n_2)}}
\]

where,

\[t_{\alpha/2,n_1+n_2-2}\] = value of the \(t\)-distribution for the installation damage samples

\[\bar{P}_1\] = the mean of the strength retained after installation damage (i.e., \(T_{\text{dam}}/T_{\text{lot}}\)) obtained for evaluation of the product for inclusion in the WSDOT QPL

\[\bar{P}_2\] = the mean of the strength retained after installation damage (i.e., \(T_{\text{dam}}/T_{\text{lot}}\)) obtained for project acceptance testing

\[\delta\] = the difference in the means for the populations corresponding to the sample means \(\bar{P}_1\) and \(\bar{P}_2\) (assumed equal to zero for this test)

\[s_1\] = the standard deviation corresponding to \(\bar{P}_1\)

\[s_2\] = the standard deviation corresponding to \(\bar{P}_2\)

\[n_1\] = the number of data points corresponding to \(\bar{P}_1\)

\[n_2\] = the number of data points corresponding to \(\bar{P}_2\)

\(t_{\alpha/2,n_1+n_2-2}\) calculated using Equation 1 shall be no greater than \(t\) determined from the applicable Student \(t\) table (or from the Microsoft EXCEL function TINV(\(\alpha,n-2\))) at \(\alpha = 0.05\) and \(n_1+n_2-2\) degrees of freedom. If this is not true, the difference between \(\bar{P}_1\) and \(\bar{P}_2\) is determined to be statistically significant, and \(\bar{P}_1 > \bar{P}_2\), two additional samples from the same installation condition shall be tested and \(\bar{P}_2\) recalculated and statistically compared to \(\bar{P}_1\). If the project acceptance test results are still too low, the lot of material tested shall be considered to have failed the test.