Geosynthetic Applications for Indiana Roads

Athar A. Khan, Chief Geotechnical Engineer
Materials and Tests Division – Indianapolis, Indiana

INDOT Requirements for use of Geosynthetic Products

1. From the INDOT Approved List of Geotextile and Geogrid

2. Acceptance is based on
   a.) Type A Certification
   b.) per Section 913.18 for riprap
   c.) per Section 913.19 for under-drains
   d.) per Section 913.21 for geogrid
Geosynthetic applications currently in use:

**Geotextile**
1. Under drains
2. Erosion control
3. Separator layer
4. Drainage

I-69 Installation of the geotextile
I-69 Erosion Control Mat

I-69 Erosion Control Mat
Geosynthetic applications currently in use (con’t.):

**Geogrid**
1. Subgrade Treatment
2. Foundation Improvement for
   a) Retaining walls
   b) Embankment over the soft ground
3. Slope reinforcement
4. Modular Block Wall

Types of geogrids
Biaxial Geogrid

<table>
<thead>
<tr>
<th>Property</th>
<th>Test Method</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Material:</td>
<td>ASTM D 4101</td>
<td>98% (min.)</td>
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<tr>
<td>Polypropylene</td>
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<td></td>
</tr>
<tr>
<td>Carbon Black</td>
<td>ASTM D 4218</td>
<td>0.5% (min.)</td>
</tr>
<tr>
<td>Rib Spacing MD</td>
<td>I.D Calipered¹</td>
<td>35.6 mm (nom.)</td>
</tr>
<tr>
<td>CMD</td>
<td></td>
<td>35.6 mm (nom.)</td>
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<tr>
<td>Open Area</td>
<td>COE Method ²</td>
<td>70% (min.)</td>
</tr>
<tr>
<td>Modulus</td>
<td>GRI GG1-87 ³</td>
<td>204.3 kN/m (min.)</td>
</tr>
</tbody>
</table>

¹Maximum inside dimension in each principal direction measured by calipers.
²Percent open area measured without magnification by Corps of Engineers method as specified in CW 02215 Civil Works Construction Guide, Nov. 1977.
³Secant modulus at 2% elongation measured by Geosynthetic Research Institute Test method 1-87.

Subgrade Treatment
Section 207.03
General Requirements
The subgrade shall be constructed uniformly transversely across the width of the pavement including 2 ft. outside the edge of the shoulders or curbs unless shown otherwise on the plans, by one of the following methods:

a) **Chemical Modification in accordance with 215**,  
b) **Aggregate No. 53 in accordance with 301**,  
c) **Geogrid in accordance with 214 placed** **UNDER Aggregate No. 53 in accordance with 301**, or,  
d) **Soil Compaction to 100% of Maximum Dry Density.**

Type IV

- **225 mm (9 in.) of the subgrade excavated and replaced with coarse aggregate No. 53 on geogrid.**

![Diagram of Type IV subgrade construction](image)
Where to use geogrid option for subgrade treatment

1. Shallow Utilities
2. Urban Areas
3. Narrow Widenings
4. Unstable Subgrade
5. Restricted Schedule for Construction
6. Minimize Traffic Hazards

Subgrade Dilemmas…

- Soft and wet subgrade

UN-MODIFIED SUBGRADE

RUTTING
### US27 Subgrade Soil Test Results

<table>
<thead>
<tr>
<th>Boring</th>
<th>Sta &amp; Offset</th>
<th>Sample Depth (m)</th>
<th>Blows per 0.3m</th>
<th>Texture / AASHTO Classification</th>
<th>Dry Unit Wt (kN/m³)</th>
<th>Max. Dry Unit Wt (kN/m³)</th>
<th>Relative Comp. (%)</th>
<th>Moisture Content (%)</th>
<th>Optimum Moisture Content (%)</th>
<th>Moisture Content Difference (%)</th>
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<tbody>
<tr>
<td>SG-1</td>
<td>395+05 CL</td>
<td>0.45–0.90</td>
<td>11</td>
<td>Si Cl (Ve) / A-6(8)</td>
<td>16.4</td>
<td>17.5</td>
<td>94</td>
<td>21</td>
<td>15</td>
<td>+6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.90–1.20</td>
<td>11</td>
<td>Si Cl Lo / A-6(8)</td>
<td>16.3</td>
<td>17.5</td>
<td>94</td>
<td>24</td>
<td>15</td>
<td>+9</td>
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<tr>
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<td>402+15 375' Lt.</td>
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<td>9</td>
<td>Si Cl Lo / A-4(8)</td>
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<td>17.2</td>
<td>93</td>
<td>25</td>
<td>16</td>
<td>+9</td>
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<tr>
<td></td>
<td></td>
<td>1.05–1.20</td>
<td>10</td>
<td>Si Cl Lo / A-4(6)</td>
<td>16.5</td>
<td>17.2</td>
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<td>16</td>
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<td>Cl / A-6(8)</td>
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<td>17.6</td>
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<td>25</td>
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<td>+9</td>
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<tr>
<td></td>
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<td>1.05–1.20</td>
<td>9</td>
<td>Cl / A-6(8)</td>
<td>16.5</td>
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<td>18</td>
<td>16</td>
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<td>93</td>
<td>20</td>
<td>15</td>
<td>+5</td>
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<td>1.05–1.20</td>
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<td>Si Lo / A-4(3)</td>
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<td>18</td>
<td>15</td>
<td>+3</td>
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<td>SG-6</td>
<td>428+50 200' Lt.</td>
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<td>Cl / A-7(6)(30)</td>
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<td>+8</td>
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<td>1.05–1.20</td>
<td>10</td>
<td>Cl / A-7(6)(30)</td>
<td>15.9</td>
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<td>SG-7</td>
<td>434+15 250' Rt.</td>
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<td>13</td>
<td>Sa and Grvl.*</td>
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<td>0.90–1.20</td>
<td>7</td>
<td>Cl / A-7(6)(30)</td>
<td>15.1</td>
<td>17.2</td>
<td>87</td>
<td>27</td>
<td>16</td>
<td>+11</td>
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</tbody>
</table>

SS = Split Spoon  * Test not performed on Sand and Gravel  
PT = Push Tube
US27 Reconstruction thru Decatur, Indiana

After encountering soft subgrade under the mainline and turn lanes, geogrid was installed after consultation with the INDOT Project Engineer.

Deflection Evaluation (by FWD)

- Geogrid Reinforced Subgrade
- Control Section
SR9 Bypass Reconstruction
Marion, Indiana

Unstable subgrade conditions in this highly developed corridor on the south side of Marion required the use of geogrid.

Hendricks County Courthouse Square

Geogrid was chosen due to poor subgrade material.
North East 2nd Street, Carmel, Indiana

Wet, soft subgrade conditions warrants a need for quick and effective construction.

Foundation Improvement
Geogrid Embankment Over Soft Foundations

NOW WHERE IS THAT GEOTECH MAN?

HELP!
I'VE GOT THAT SINKING FEELING.
US24 “Hoosier Heartland Highway”
West of Huntington, Indiana

2 layers of geogrid is sandwiched between 2’ of native material.

Sandwich design of geogrid and 2’ of native material provided a solid platform on which to build.
US24 “Hoosier Heartland Highway”
Peru, Indiana

Using partial undercut and replace with geogrid over wick drains to provide a drainage blanket over the (30’) peat deposit.

US24 “Hoosier Heartland Highway”
in Peru, Indiana

Two layers of grid sandwiching 2’ of #8 stone, 4000 wick drains overlaid 30’ of peat deposit on this northbound to eastbound on-ramp.
Slope Reinforcement

I-69 Slope Failure
I-69 During Construction

I-69 Slope Correction Using Geogrids as Reinforcement
I-69 Installation of the geotextile

I-69 Finished Slope with Erosion Control Mat
Indianapolis Museum of Art
River Bank Stabilization

Geogrid combined with non-woven geotextile in welded wire baskets and riprap fill. Terraced slope treatment used to restore and stabilize a breach in narrow bank separating the White River from an oxbow lake.

Modular Block Walls

• At the present time, no pictures are available.
Future Uses of Geogrid

1. Reinforcement for MSE Walls
2. Geogrid Casing for Geopier Applications
3. Use of Geogrids with Tire Shreds

Questions?