Field Performance Evaluation of Low Volume Gravel Road Sealed with Bituminous Surface Treatment

Presented by:
Jay Kwon, Ph.D., P.E.
Application Technology Manager
Tensar International Corporation

Project Location – Dawson Creek, BC
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Field testing focused on evaluating unpaved/thin chip seal surfaced roads with TX geogrids in BC

Drilled hole through geogrid reinforcement.

Example of 20 to 30 mm thick chip seal surface.
Benkelman Beam method is commonly used in BC for setting load restrictions

Newly developed APLT was used to directly determine $k$ and $M_r$ values
Automated Plate Load Test (APLT)

- The APLT equipment is capable of accurately and efficiently measuring a range of parameters including the following:
  - Modulus of subgrade reaction
  - Confining stress dependent resilient modulus
  - Undisturbed tube sampling and extrusion
  - Stress controlled wheel rutting simulation
  - Bearing capacity
  - Shear wave velocity/modulus
  - Cone penetration testing
  - Borehole shear testing

It is important to differentiate elastic versus resilient modulus

\[
M_r = (1-v^2) f \frac{\sigma_o}{a / d_r} \\
d_r = \text{recoverable deformation}
\]

\[
E = (1-v^2) f \frac{\sigma_o}{a / d_o} \\
d_o = \text{Elastic deformation}
\]
12 in. and 8 in. APLT configurations were used on this site

APLT Tests

- Static tests
  - 8 in. diameter plate
  - @ increments of 2, 4, 10, 20, 80, 160, and 250 psi
- Cyclic tests
  - 12 in. diameter plate
  - 200 to 250 cycles @ cyclic stress of 20 psi and 80 psi.
  - 1000 cycles @ cyclic stress of 70 psi
Comparison between control and geogrid stabilized sections

<table>
<thead>
<tr>
<th>Location</th>
<th>Control (Rd 207)</th>
<th>Old Edmonton</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction</td>
<td>control</td>
<td>2012</td>
</tr>
<tr>
<td>Designed Pavement Section</td>
<td>~150 mm gravel over subgrade</td>
<td>300mm crushed gravel base and TX140 triaxial geogrid</td>
</tr>
<tr>
<td>Seal Coat (Y/N)</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td>Beam Deflection (mm)</td>
<td>6.2</td>
<td>1.08</td>
</tr>
<tr>
<td>Mr. (psi) @ 80 psi (70 psi for 1000 cycle tests)</td>
<td>16,560</td>
<td>13,640</td>
</tr>
<tr>
<td>Sp (in) @ 80 psi (70 psi for 1000 cycle tests)</td>
<td>0.421</td>
<td>0.475</td>
</tr>
<tr>
<td>1,000 cycle test</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td>k-values (80-160 psi) (pci)</td>
<td>120</td>
<td>2820</td>
</tr>
<tr>
<td>Crushed gravel base (mm)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Geogrid</td>
<td>TX140</td>
<td></td>
</tr>
<tr>
<td>Gravel below geogrid (mm)</td>
<td>150mm +100mm mixed gravel</td>
<td>330</td>
</tr>
<tr>
<td>Subgrade</td>
<td>Glacial till</td>
<td></td>
</tr>
</tbody>
</table>

Thickness verification using DCP and Hand auger
APLT results showed significant improvement in *k*-values in TX geogrid stabilized section

APLT results showed significant improvement in *Mr* and resistance to permanent deformation in TX geogrid stabilized section
BB results correlated with permanent deflections but not sensitive to $M_r$ values at < 2 mm deflection

BB results not sensitive to high $k$ values at < 2 mm deflection
$M_r$ versus $k$ relationship is cyclic stress dependent
– *Empirical relationships have limitations*

![Graph showing the relationship between $M_r$ and $k$](image)

**Key Findings**

- TX geogrid stabilized sections demonstrated improved performance over control sections.
- BB results correlated to the APLT measurements, but are not sensitive to high $k$-values (> 1000 psi) and high in-situ $M_r$ values (> 40,000 psi).
- In-situ $M_r$ versus $k$ relationships are cyclic stress dependent.
- APLT testing during spring-thaw is recommended.
Questions are welcome.

Thank you for your interest.

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