Predictive Model for Nonlinear Resilient Modulus of Emulsified Asphalt Treated Base

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Outline

- Background
- Experimental Design
- Test Results and Analysis
- Predictive Equation
- Conclusion
Background

- ATBs is the most commonly used stabilized layers because of available local asphalt resource
- Problem - lack of engineering characteristics for typical Alaskan ATBs
- Need - properly characterize these materials to better understand the effects of asphalt content on ATB behavior and provide accurate $M_R$ values for flexible pavement design
# Experimental Design

<table>
<thead>
<tr>
<th>Source</th>
<th>Abrasion Resistance (% Loss)</th>
<th>Percent Fractured Face (one fractured face) Test Results</th>
<th>Flat or Elongated Pieces (5:1) Test Results</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Southeast Region</td>
<td>9.7%</td>
<td>100%</td>
<td>3%</td>
<td>≥80%</td>
</tr>
<tr>
<td>Central Region</td>
<td>5.8%</td>
<td>91.7%</td>
<td>0</td>
<td>≤8%</td>
</tr>
<tr>
<td>Northern Region</td>
<td>2.7%</td>
<td>84.5%</td>
<td>0</td>
<td>≤8%</td>
</tr>
</tbody>
</table>
Experimental Design (Continued)

Compaction:

- ASTM D1557
- At “pseudo OMC”
- Diameter: 100mm
- Height: 150mm
Experimental Design (Continued)

Testing Equipment Setup
Test Results and Analysis

Effects of Temperature on MR of EATB
(Northern Region, 3.5% Residual Binder)
Test Results and Analysis (Continued)

Effects of Binder Content on MR of EATB (Northern Region, 20°C)
Effects of Aggregate Source on $M_R$ of EATB
(20°C, 3.5% Residual Binder)
Stress Dependent Property
(20°C, 3.5% Binder, Northern Region)
Internal Structure Sketches of HATB and EATB

HATB

EATB
Stress Dependent Property
(3.5% Binder, Northern Region)
Predictive Equation

\[ M_R = k_1 P_a \left( \frac{\theta}{P_a} \right)^{k_2} \left( \frac{\tau_{oct}}{P_a} + 1 \right)^{k_3} \]

\[ \text{MEPDG} \]

\[ \ln(M_R) = a_0 + a_1 F + a_2 T + a_3 P_b + (b_0 + b_1 F + b_2 T + b_3 P_b) \ln \left( \frac{\theta}{P_a} \right) + (c_0 + c_1 F + c_2 T + c_3 P_p) \ln \left( \frac{\tau_{oct}}{P_a} + 1 \right) \]
Conclusions

- $M_R$ increases as:
  - Bulk Stress $\uparrow$
  - Temperature $\uparrow$
  - Aggregate Angularity $\uparrow$
  - Shear Stress $\downarrow$

- Predictive Model was proposed.