Pavement Research at AUTC

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Who Are We?

ALASKA UNIVERSITY TRANSPORTATION CENTER
AUTC: One of Ten National Centers

- **Theme:** Safety, Security and Innovation in Cold Regions

- **Mission:**
  - Education
  - Workforce development
  - Diversity
  - Research
  - Information dissemination/Implementation
  - Outreach
Research Goal

- Develop a robust and sustainable research program that meets the needs of AUTC partners including USDOT, DOT&PF, local governments, and the transportation industry
Transportation Research and Education

- Environmental stewardship
- Operating and planning transportation systems
- Designing transportation systems
  - Impact of fines content of base courses
  - Characterization of asphalt treated base
  - Evaluation of warm-asphalt mixes for Alaskan conditions
- Constructing and maintaining transportation systems
Characterization of Asphalt Treated Base Course Material
Background

- AKFPD and statewide policy stipulate the use of stabilized layers for the majority of roadway pavements.

- One option: inclusion of asphalt to construct ATBs.

- Problem - lack of engineering characteristics for typical Alaskan base materials.

- Need - properly characterize these materials to better understand the effects of temperature and asphalt content on ATB behavior.
Project Scope

- Objective - determine the stiffness, fatigue and permanent deformation characteristics for base courses treated by
  - Hot asphalt
  - Emulsion
  - Foamed asphalt
- Better understanding of ATBs’ behavior
- Design equations and moduli values to be incorporated in pavement design
**$M_R$ Test Setup**

**Testing System**

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<th>Sequence</th>
<th>Confing Pressure</th>
<th>Deviator Stress</th>
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**Loading Procedure**
HATB $M_R$ Testing Results

Bulk Stress (psi)

$M_R$ (ksi)

-10C  •  0C  ▲  20C

(northern region, 3.5% binder)
HATB $M_R$ Testing Results

- $2.5\%$ $\bullet$ $3.5\%$ $\triangle$ $4.5\%$

Bulk Stress (psi)

(northern region, $20^\circ$C)
HATB $M_R$ Testing Results

(3.5% binder content, 20°C)

$$M_R = 3.1734 \times e^{0.0473F - 0.0596T - 0.0172P_b} \left( \frac{\theta}{P_a} \right)^{0.2670} \left( \frac{\tau_{oct}}{P_a} + 1 \right)^{-0.4109}$$
FATB $M_R$ Testing Results

(northern region, 3.5% binder)
FATB $M_R$ Testing Results

(3.5% binder content, 20°C)
**FATB $M_R$ Testing Results**

(northern region, 20°C)

\[
M_R = f_{k_1}(F,T,P_b)P_a \left( \frac{\theta}{P_a} \right)^{0.0373} \left( \frac{\tau_{oct}}{P_a} + 1 \right) f_{k_3}(F,T,P_b)
\]
Impact of Fines Content on Resilient Modulus Reduction of Base Courses during Thawing
Background

- Base course saturation and weakening - reflected by reductions in the resilient properties
- Excess fines content will cause thaw weakening
- Critical excess fines content with different aggregate sources, gradations, and moisture contents
Objective – evaluate resilient modulus of base course materials during thawing with varied fines contents and moisture conditions

- D-1 material from 3 regions
- 3 different moisture contents (OMC-2%, OMC, OMC+0.7%)
- 4 fines contents (3.15%, 6%, 8%, 10%)
- 7 different subfreezing temperatures, 20°C, and 20°C after a freeze-thaw cycle
Frost Heave Test Setup
Frost Heave Test

(Southeast D-1, OMC = 5.3%)
$M_R$ Testing Results

20°C

(Southeast D-1, FC= 10%, MC= 3.3%)
$M_R$ Testing Results

Confining pressure, 20 psi; Deviator stress, 36 psi (Southeast D-1)

Resilient modulus (ksi)

Temperature ($^\circ$C)

freezing

thawing
MR Testing Results

(Central D-1, CP = 3.0 psi, and DS = 2.7 psi, undrained)

MC = 5.3%

FC = 6%

UAF INE AUTC
WMA for Alaskan Conditions
Background

- Difficulty in achieving density in later paving season
- Improved overall mix workability leads to improved compaction
- Fuel savings and environmental friendliness
- How well WMA functions in cold weather environments
Project Scope

- Objective - assess the engineering properties of WMA binders and mixes in the lab
  - constructability of WMAs
  - correlation between the content of additives and Superpave PG
  - dynamic modulus, rutting performance, low temperature cracking potential, and moisture sensitivity of WMAs
Constructability

![Graph showing viscosity vs. temperature for different concentrations.](image-url)
Binder PG Summary

![Graph showing PG grade vs. Sasobit content (%)](image)
Simple Performance Tester

SPT Tester

During Test

SPT Tester

After Test
SPT- $|E^*|$
SPT- $F_N$ and Microstrain

![Graph showing $F_N$ and Microstrain for different conditions.](image)

- Field VTM2%
- Field VTM4%
- Control
- 0.8%S
- 1.5%S
- 3.0%S
Asphalt Pavement Analyzer

During Test

After Test
APA-Rutting Depth

<table>
<thead>
<tr>
<th>Control</th>
<th>0.8%S</th>
<th>1.5%S</th>
<th>3.0%S</th>
<th>Field</th>
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<td>3.871</td>
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Indirect Tension Setup

Cox IDT Fixture and Test System

LVDT Set-Up

After Test
Indirect Tensile Strength
Moisture Sensitivity Test

- Control: 68.61%
- 0.8% S: 68.46%
- 1.5% S: 72.79%
- 3.0% S: 77.69%
- Field: 74.74%
Further Information...

<table>
<thead>
<tr>
<th>Billy Connor, P.E.</th>
<th>Jenny Liu, Ph.D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Director of AUTC</td>
<td>CEE, UAF</td>
</tr>
<tr>
<td><a href="mailto:bgconnor@alaska.edu">bgconnor@alaska.edu</a></td>
<td><a href="mailto:jliu6@alaska.edu">jliu6@alaska.edu</a></td>
</tr>
<tr>
<td>(907) 474-5552</td>
<td>(907) 474-5764</td>
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