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

MR Test Setup

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<th>Sequence</th>
<th>Confining Pressure</th>
<th>Deviator Stress</th>
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Testing System

Loading Procedure
HATB Mₚ Testing Results

**Bulk Stress (psi)**

- Temperature: -10°C, 0°C, 20°C
- (northern region, 3.5% binder)

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HATB Mₚ Testing Results

**Bulk Stress (psi)**

- Temperature: 2.5%, 3.5%, 4.5%
- (northern region, 20°C)

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HATB Mₚ Testing Results

**Bulk Stress (psi)**

- Temperature: Southwest, Central, Northern
- (3.5% binder content, 20°C)

\[ M_p = 3.1734 \times e^{(0.0477 \times -0.0586 + (-0.0172 \times P_p)} \]
FATB MR Testing Results

(northern region, 3.5% binder)

FATB MR Testing Results

(3.5% binder content, 20°C)

FATB MR Testing Results

(northern region, 20°C)
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

Project Scope

- 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

(Southeast D-1, FC = 10%, MC = 3.3%)
**MR Testing Results**

Freezing thawing

- Combining pressure: 20 psi, Deviator strain: 16 psi (50 thawed D-1)

**MC = 5.3%**

**MC Testing Results**

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

**MC = 5.3%**

**FC = 6%**

**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
SPT- $F_N$ and Microstrain

![Graph showing SPT- $F_N$ and Microstrain](image)

**Asphalt Pavement Analyzer**

![Imagery of an asphalt pavement analyzer](image)

**During Test**

**After Test**

**APA-Rutting Depth**

![Graph showing APA-Rutting Depth](image)

<table>
<thead>
<tr>
<th>Rutting Depth (mm)</th>
<th>Control</th>
<th>0.8%S</th>
<th>1.5%S</th>
<th>3.0%S</th>
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<td>4.222</td>
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Indirect Tension Setup

Cox IDT Fixture and Test System

Indirect Tensile Strength

![Graph showing tensile strength vs. temperature](image)

Moisture Sensitivity Test

![Bar chart showing moisture sensitivity](image)
Further Information...

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Beam Fatigue Tests (on-going work)