# Pavement Research at AUTC

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November 18, 2009

## 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

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## 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

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## 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

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## 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

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## $M_R$ Test Setup

Testing System

| Sequence | Confing Pressure | Deviator Stress |
|---|---|---|
| 0 | 15 | 15 |
| 1 | 3 | 3 |
| 2 | 3 | 6 |
| 3 | 3 | 9 |
| 4 | 5 | 5 |
| 5 | 5 | 10 |
| 6 | 5 | 15 |
| 7 | 10 | 10 |
| 8 | 10 | 20 |
| 9 | 10 | 30 |
| 10 | 15 | 10 |
| 11 | 15 | 15 |
| 12 | 15 | 30 |
| 13 | 20 | 15 |
| 14 | 20 | 20 |
| 15 | 20 | 40 |

Loading Procedure

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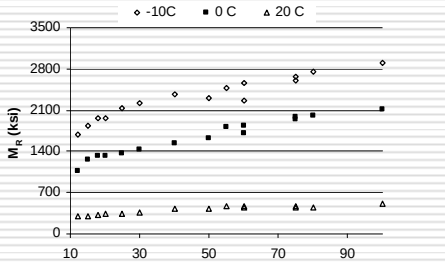
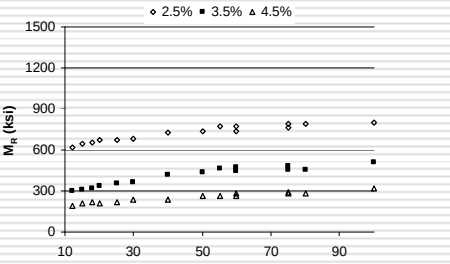
## HATB $M_R$ Testing Results




(northern region, 3.5% binder)



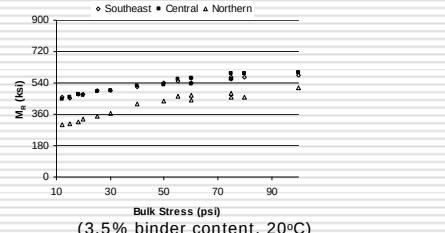
## HATB $M_R$ Testing Results




(northern region, 20ºC)



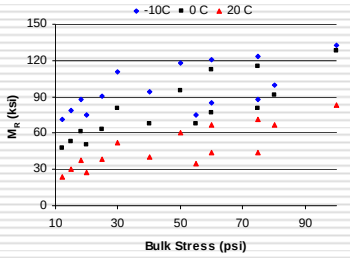
## HATB $M_R$ Testing Results




(3.5% binder content, 20ºC)

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

## FATB $M_R$ Testing Results




(northern region, 3.5% binder)

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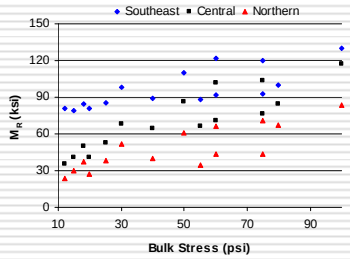
## FATB $M_R$ Testing Results




(3.5% binder content, 20ºC)

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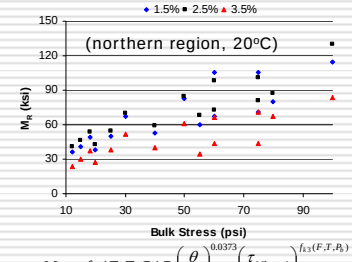
## FATB $M_R$ Testing Results




$$M_R = f_{k_1}(F,T,P_b)P_a\left(\frac{\theta}{P_a}\right)^{0.0373}\left(\frac{\tau_{oct}}{P_a}+1\right)^{f_{k3}(F,T,P_b)}$$

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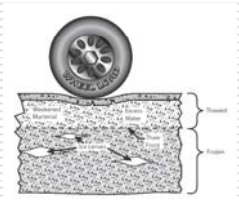
## Impact of Fines Content on Resilient Modulus Reduction of Base Courses during Thawing



## 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

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## 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, 20ºC, and 20ºC after a freeze-thaw cycle

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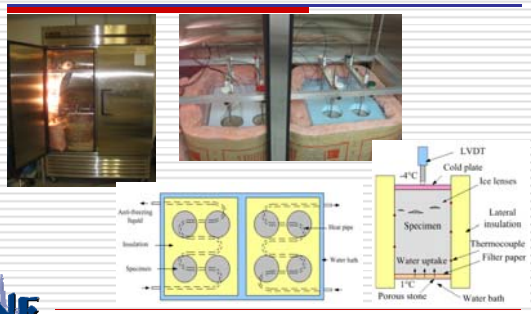
## Frost Heave Test Setup

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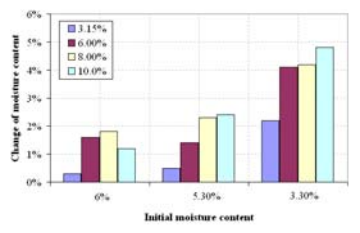
## Frost Heave Test




(Southeast D-1, OMC = 5.3%)

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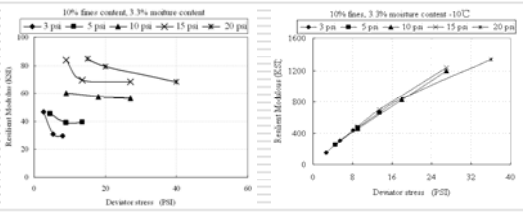
## $M_R$ Testing Results




20°C -10°C

(Southeast D-1, FC= 10%, MC= 3.3%)

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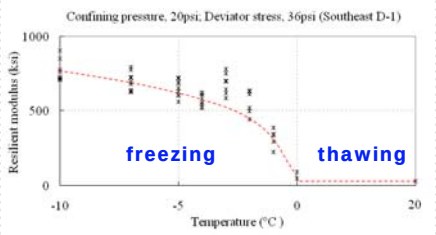
## $M_R$ Testing Results

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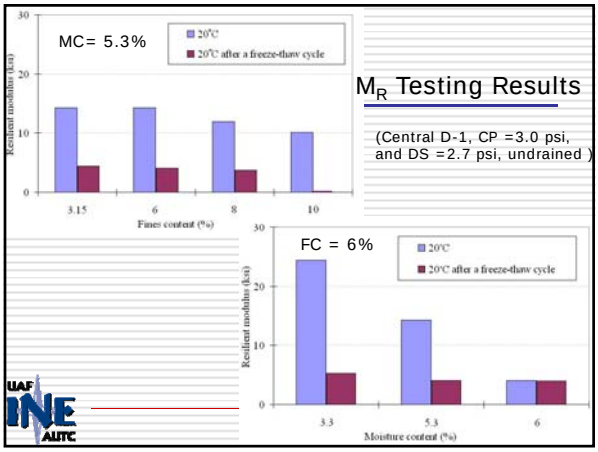
## $M_R$ Testing Results

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




## 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

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## 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

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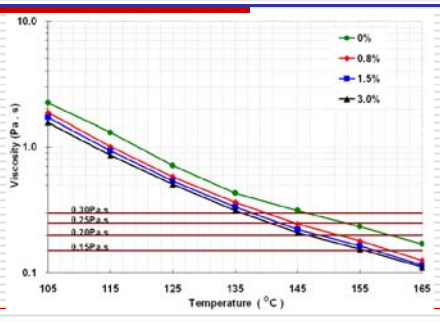
## Constructability

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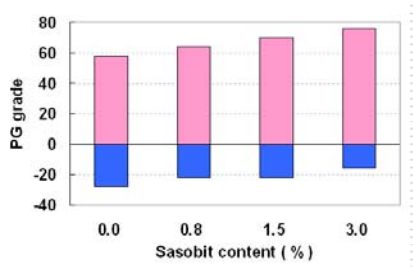
## Binder PG Summary

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## Simple Performance Tester

During Test

SPT Tester

After Test

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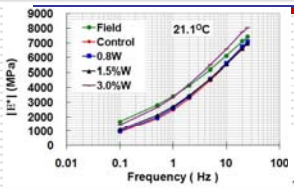
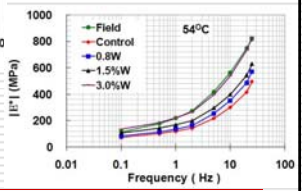
## SPT- | E* |

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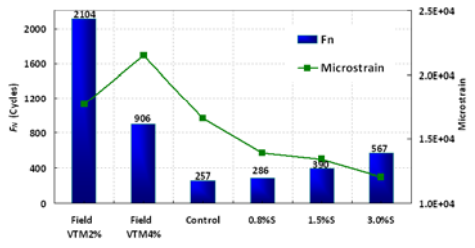
## SPT- $F_N$ and Microstrain

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## Asphalt Pavement Analyzer

During Test

After Test

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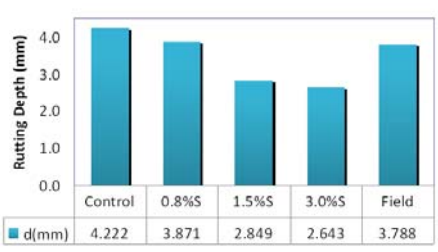
## APA-Rutting Depth

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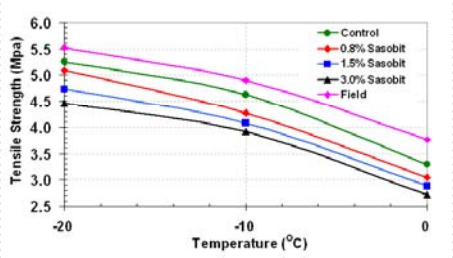
## Indirect Tension Setup

LVDT Set-Up

After Test

Cox IDT Fixture and Test System

## Indirect Tensile Strength

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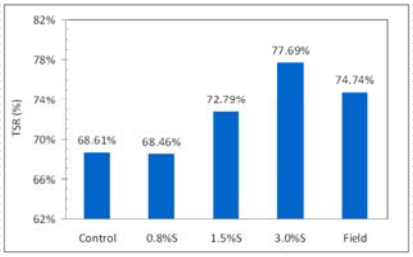
## Moisture Sensitivity Test

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## Further Information…

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## Beam Fatigue Tests (on-going work)

Compactor

Beams

Beam Fatigue Testing Device

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