

1<sup>st</sup> International Symposium on Binder Rheology  
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**Low Temperature  
Pavement Performance -  
Theory to Practice**

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# Low Temperature Pavement Performance

- Why do asphalt pavements crack at low temperatures?
- When do they crack?
- How much will they crack?
- How do we design asphalt pavements to mitigate low temperature cracking?
- What do we do with cracked pavements?



Hwy 2, South of Edmonton, Alberta



Deterioration at Transverse Crack



Dipping at Transverse Crack

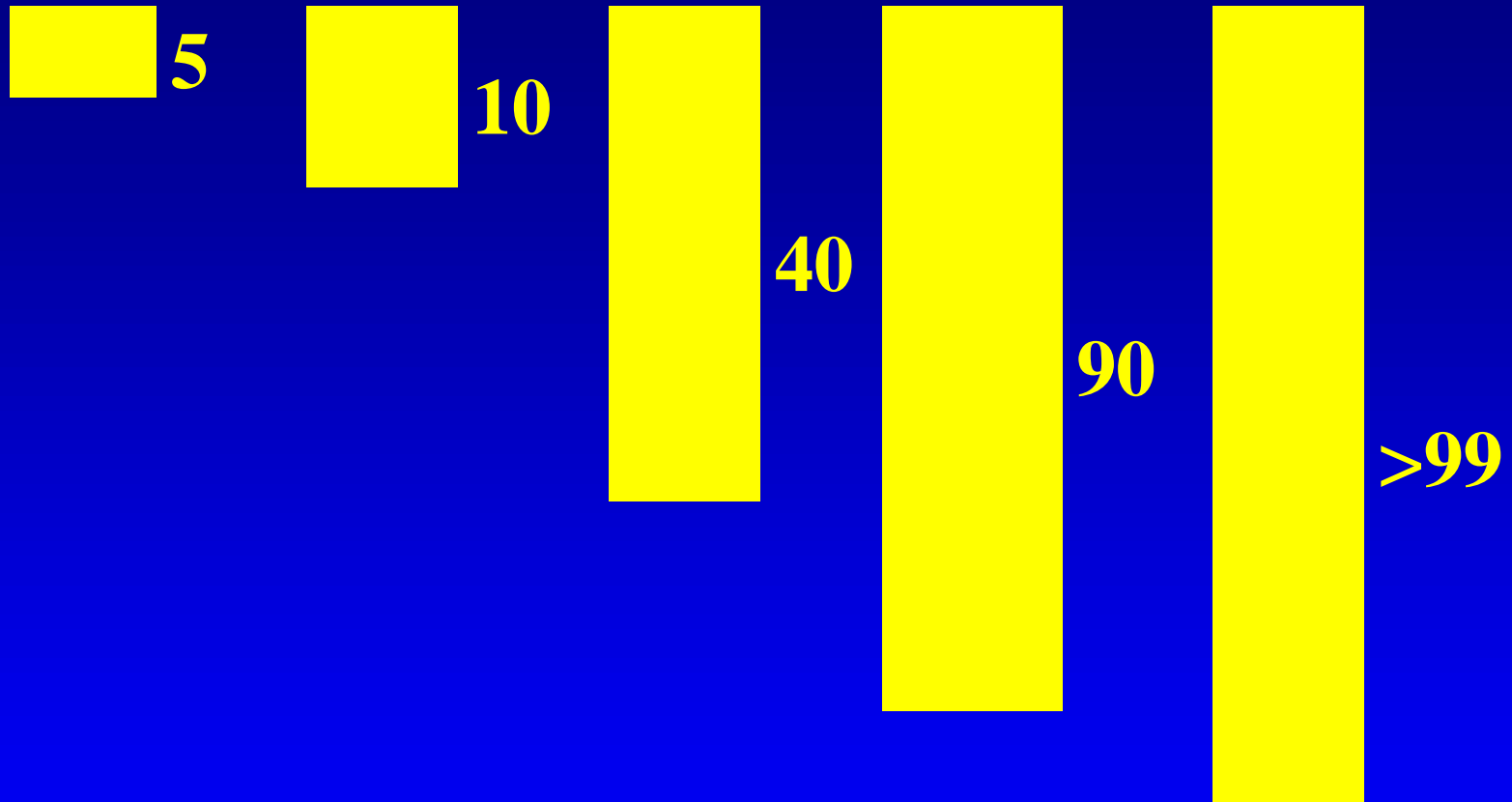


Heaving at Transverse Cracks

# Western Canada Test Roads

- Alberta Test Road - 1966
- St. Anne Test Road - 1967
- Lamont Test Road - 1991

# % Asphalt Binder



Mass

Volume

\$

Low  
Temperature  
Performance

Research  
Efforts

# Factors Affecting Low Temperature Performance - The Other 10%

- McLeod (CTAA 1969)
- Hajek and Haas (CTAA 1971)
- Deme (CTAA 1968, 1987)
- Palsat (CTAA 1988)
- MacLeod (CTAA 1999)

# Other Factors Affecting Low Temperature Performance

- Air Temperature Conditions
- Pavement Temperature Conditions
- Pavement Design
- Traffic
- Plant Mixing/Construction
- Long Term Aging

# Air Temperature Conditions

$$T_{\text{design}} = f(\text{Minimum Annual Air Temperature})$$

- Temperature cooling Rates?
- Temperature Cycling effects?
- $T_{\text{actual}} < T_{\text{design}}$

# Pavement Temperature Conditions

- Effects of insulated pavement structures
  - bottom ash
  - styrofoam



**Bottom Ash Installation - Edmonton, Alberta**



**Styrofoam Installation, Edmonton, Alberta**



**Transverse Crack in Styrofoam Insulated Pavement, Edmonton, Alberta**

# Pavement Design

- Thickness of Asphalt Concrete Pavement Layer
- Composite Pavements
  - use of higher temperature susceptible binders in lower lifts
- Subgrade Type
  - fine grained vs. coarse grained soils

# Traffic

- Ste. Anne - higher frequency in traffic lane than in passing lane for LV 300-400 pen and HV 150-200 pen on sand subgrade.
- James Bay Access - double frequency on sections subject to intensive construction traffic for both granular and non-granular soils.

# Plant Mixing/Construction

- As-built Binder Properties
- As-built Mix Properties

# Plant Mixing/Construction

- Mixing Plant Type
  - batch
  - drum (counter flow, parallel flow)
- Mixing Temperatures
- Mixing Conditions
- Silo Storage
- Haul Distance

# Asphalt Mix Properties

- % compaction - in-place air voids
- film thickness
- mixes containing RAP

# Asphalt Aging Studies

## Properties Following Construction

<b>Asphalt Cement Grade</b>	<b>Abs. Visc. @ 60°C Pa.s.</b>	<b>Penetration @ 25°C dmm</b>
150-200A	150-300	70-110
200-300A	90-180	100-160

Ref - "Guidelines for the Design of Hot In-Place Recycled Asphalt Concrete Mixtures" - CTAA 1997

Low Temperature Pavement Performance - Theory to Practice



SH 813 (NE of Edmonton, Alberta) - Infrequent Transverse Cracking After 3 Years



SH 813 (NE of Edmonton, Alberta) - Significant Transverse Cracking After 3 Years

# Long Term Aging Effects

- Solar Radiation (temperature and latitude)
- Traffic
- Surface Treatments

# Other Related Issues

- Mixtures containing Recycled Asphalt Pavement
- Cold In-Place Recycling
- Hot In-Place Recycling

**Now that we have them, what do  
we do with them?**



Hwy 2, South of Edmonton, Alberta



**Saw and Seal, South of Edmonton, Alberta**



Thermopatch, Calgary, Alberta



Spray Patch in Foreground, Cold Mill and Inlay in Background

NE of Edmonton, Alberta



Secondary Highway, East of Calgary