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Low Temperature Pavement Performance - Theory to Practice

Dave Palsat, M.Sc., P.Eng.
EBA Engineering Consultants Ltd.
Edmonton, Alberta

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

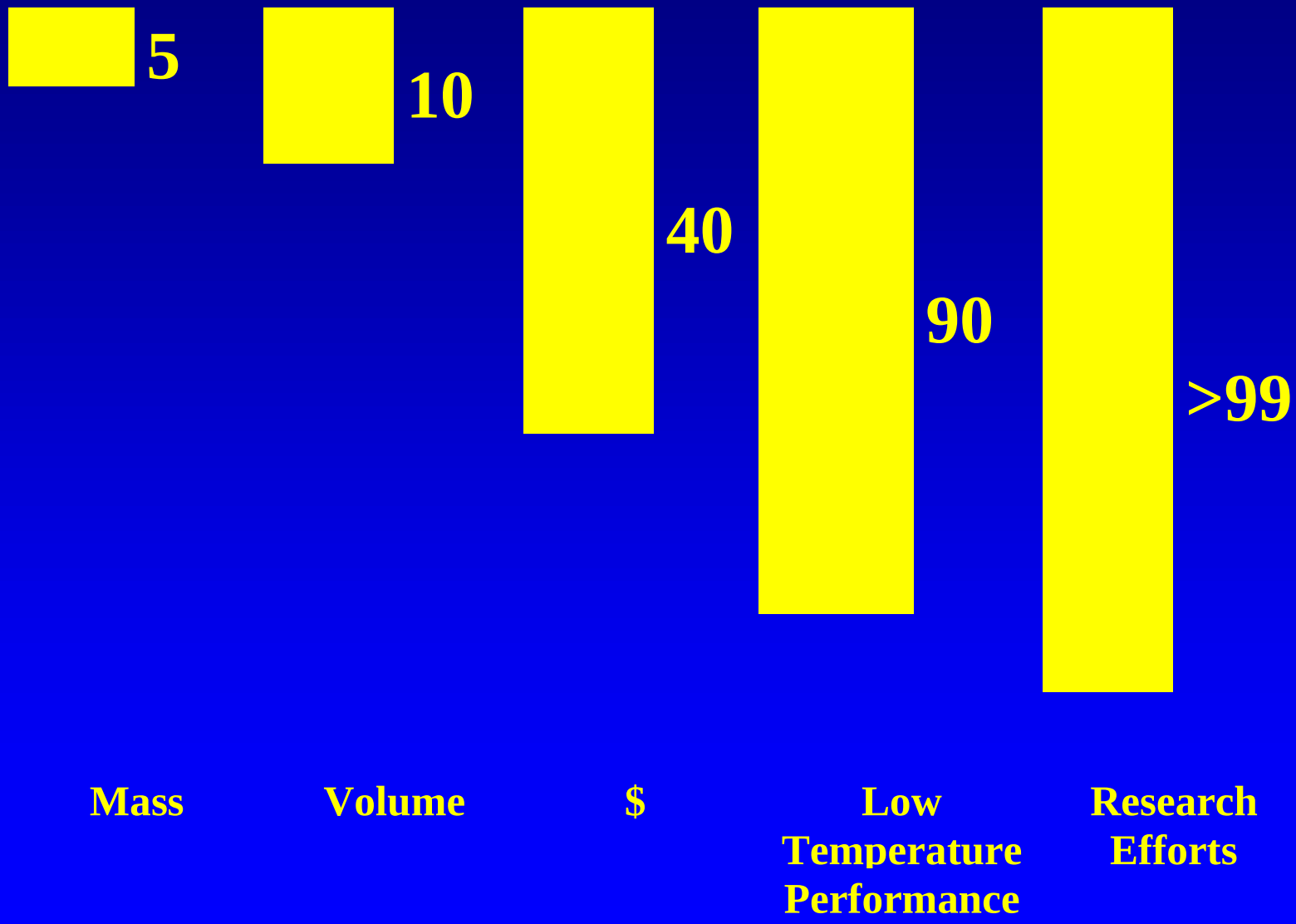
Dipping at Transverse Crack

Heaving at Transverse Cracks

Western Canada Test Roads

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

% Asphalt Binder



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_{design} = f(Minimum Annual Air Temperature)

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

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	
Asphalt Cement Grade	**Abs. Visc. @ 60°C Pa.s.**	**Penetration @ 25°C dmm**
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