

MnPAVE Update

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 - ◆ Bruce Chadbourn
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 - ◆ John Zollars



Outline of Presentation

- Background
- Brief Overview of MnPAVE procedures
- Recent Developments
- Future work
- Demo of MnPAVE



Background

■ Current Design

- ◆ Subgrade R-value
- ◆ Granular Equivalents
- ◆ Layer equivalency factors
 - ☞ HMA 2.25
 - ☞ Aggregate base 1.0
- ◆ Difficult to consider seasonal factors, new materials, etc.

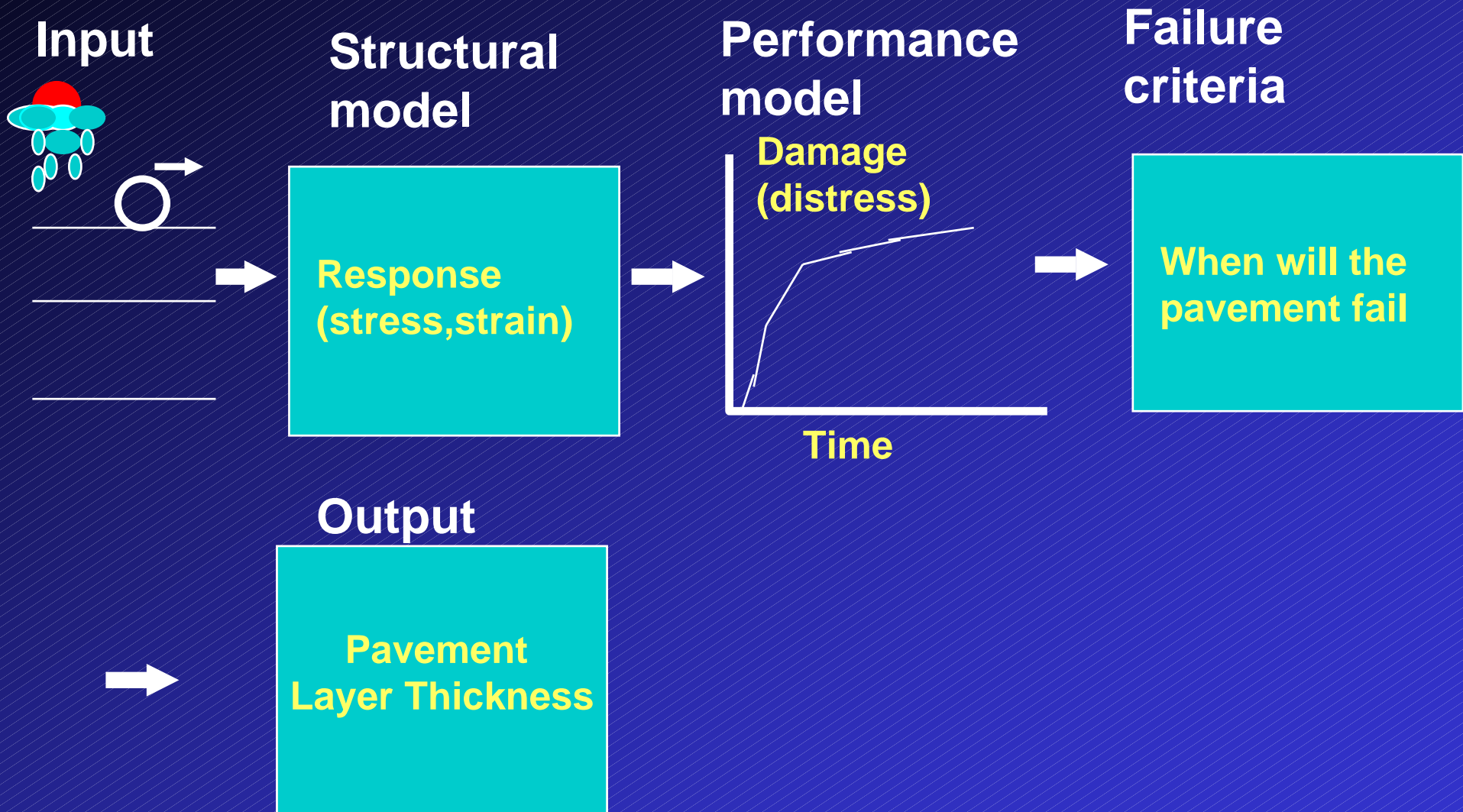


Background

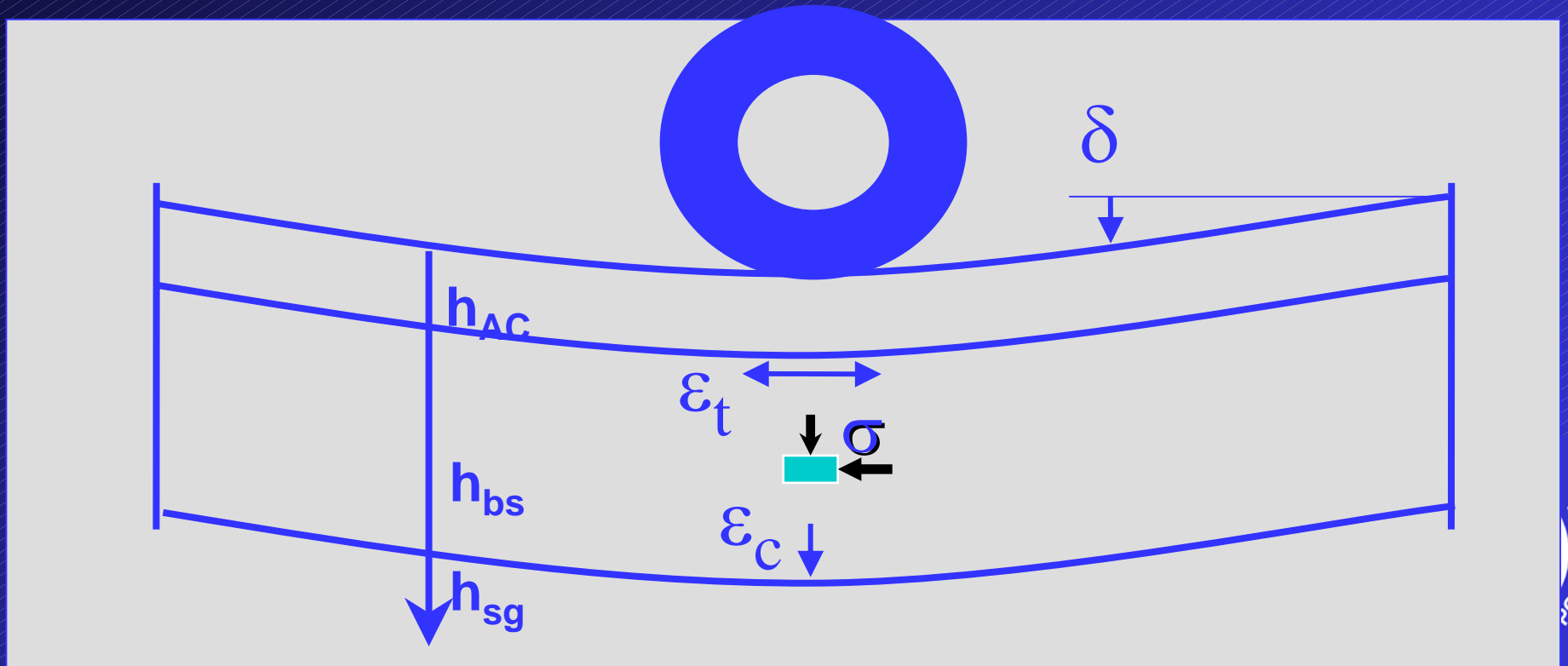
- **Advantages of Mechanistic-Empirical (M-E) methods:**
 - ◆ Evaluate traffic loading and configuration on pavement performance.
 - ◆ Show benefit of improved materials.
 - ◆ Evaluate seasonal effects on performance.



Overview of MnPAVE Procedures



- Pavement is modeled as a multi-layered elastic structure
- Failure criteria: fatigue of HMA, shear of aggregate base and rutting of subgrade.



Recent Developments

- A trial version of MnPAVE has been released in 2002.
- Trainings were provided to districts, counties and cities.
- Most of constructions are overlays.



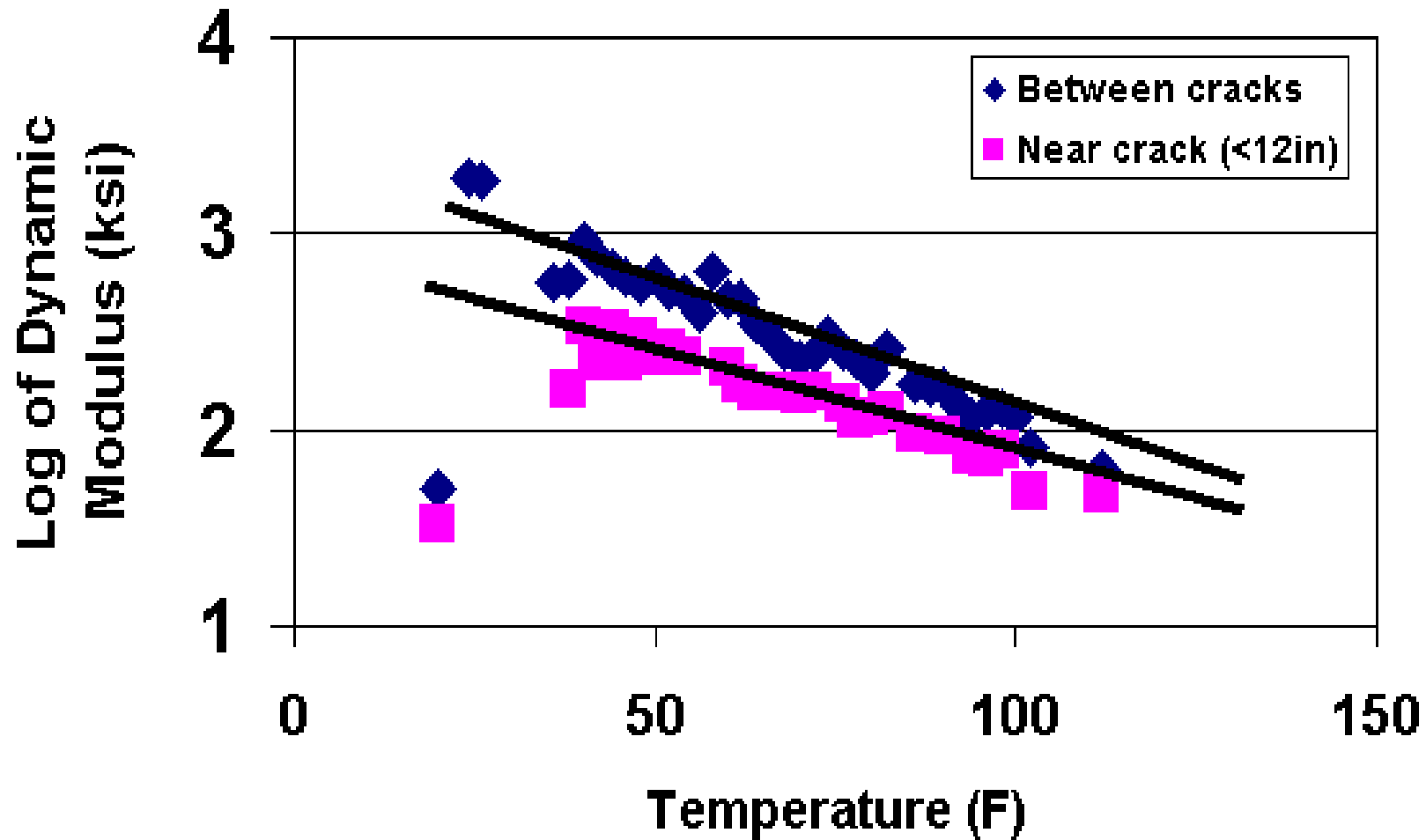
Recent Developments

- **How to characterize the existing pavements?**
 - ◆ **Major distress: thermal cracking.**
 - ◆ **Thermal crack weakens pavement: reduces E***
 - ◆ **FWD near cracks and between cracks were conducted on MnROAD**
 - ◆ **E* was calculated based on FWD deflections:**
 - ☞ $\text{Log}(E^*) = 1.48 + 1.76 * \text{Log}(\text{Area}/D_0) + 0.26 * \text{Area}/T_{ac}$



Recent Developments

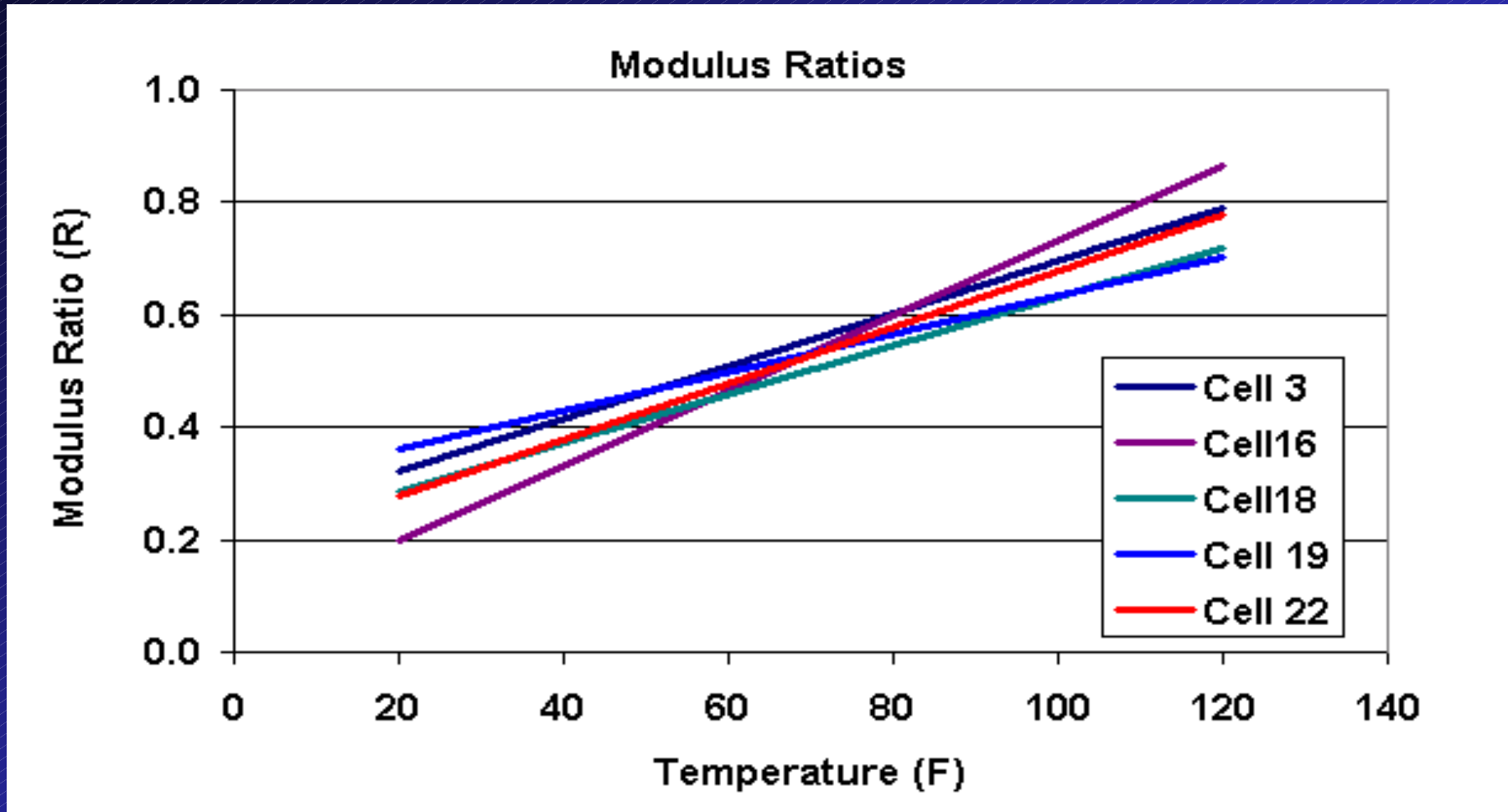
Cell 22 Modulus Comparison



Recent Developments

◆ Modulus Ratio (R)

☞ $R = E^*(\text{near crack}) / E^*(\text{between cracks})$



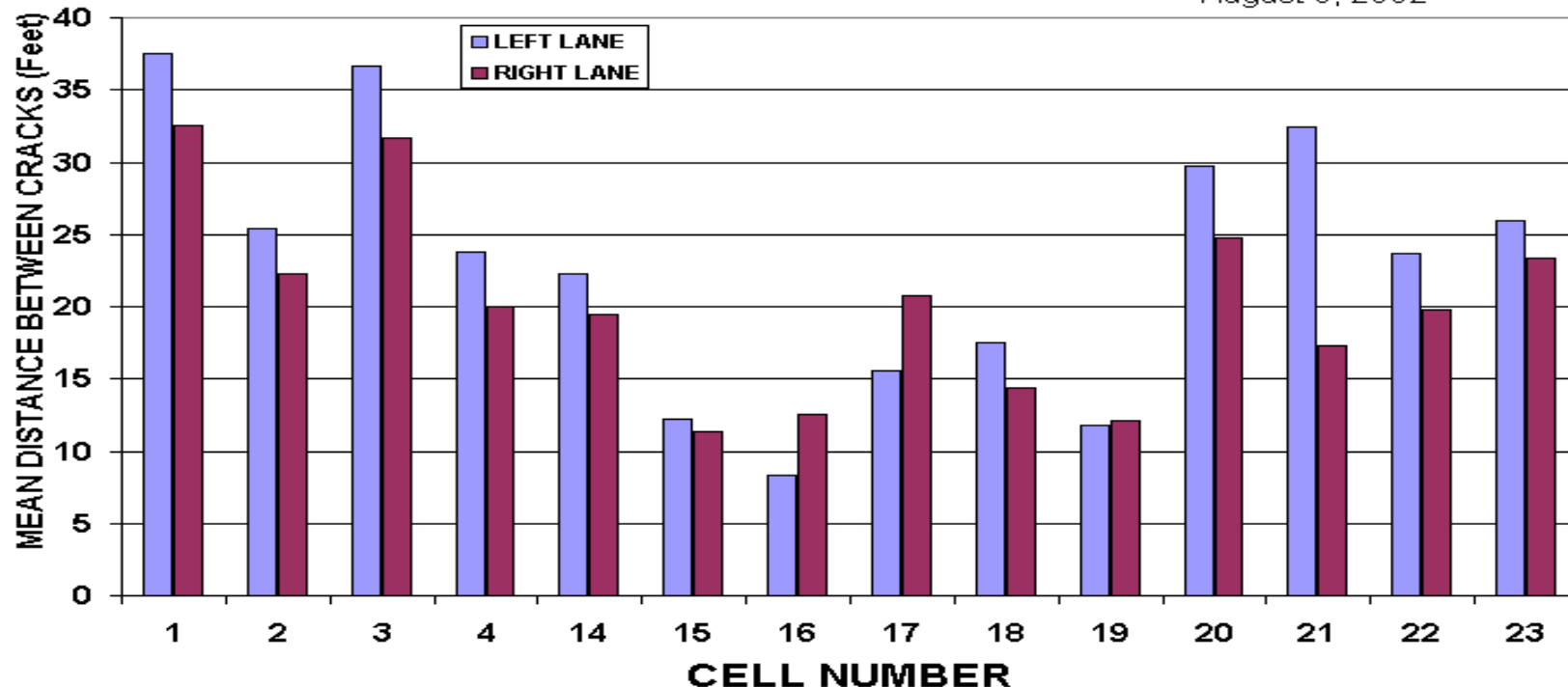
Recent Developments

◆ Crack spacing effect

- ☞ The more the cracks, the less the E^* .
- ☞ Correction factor $C = E^*(\text{between crack})/E^*$ (original)
- ☞ Under development.

THERMAL CRACK SPACING - AVERAGE

August 8, 2002



Recent Developments

◆ Failure criteria

- ☞ Fatigue of overlay and existing pavement
- ☞ Shear strength of aggregate base
- ☞ Rutting of subgrade.

◆ Ride Prediction

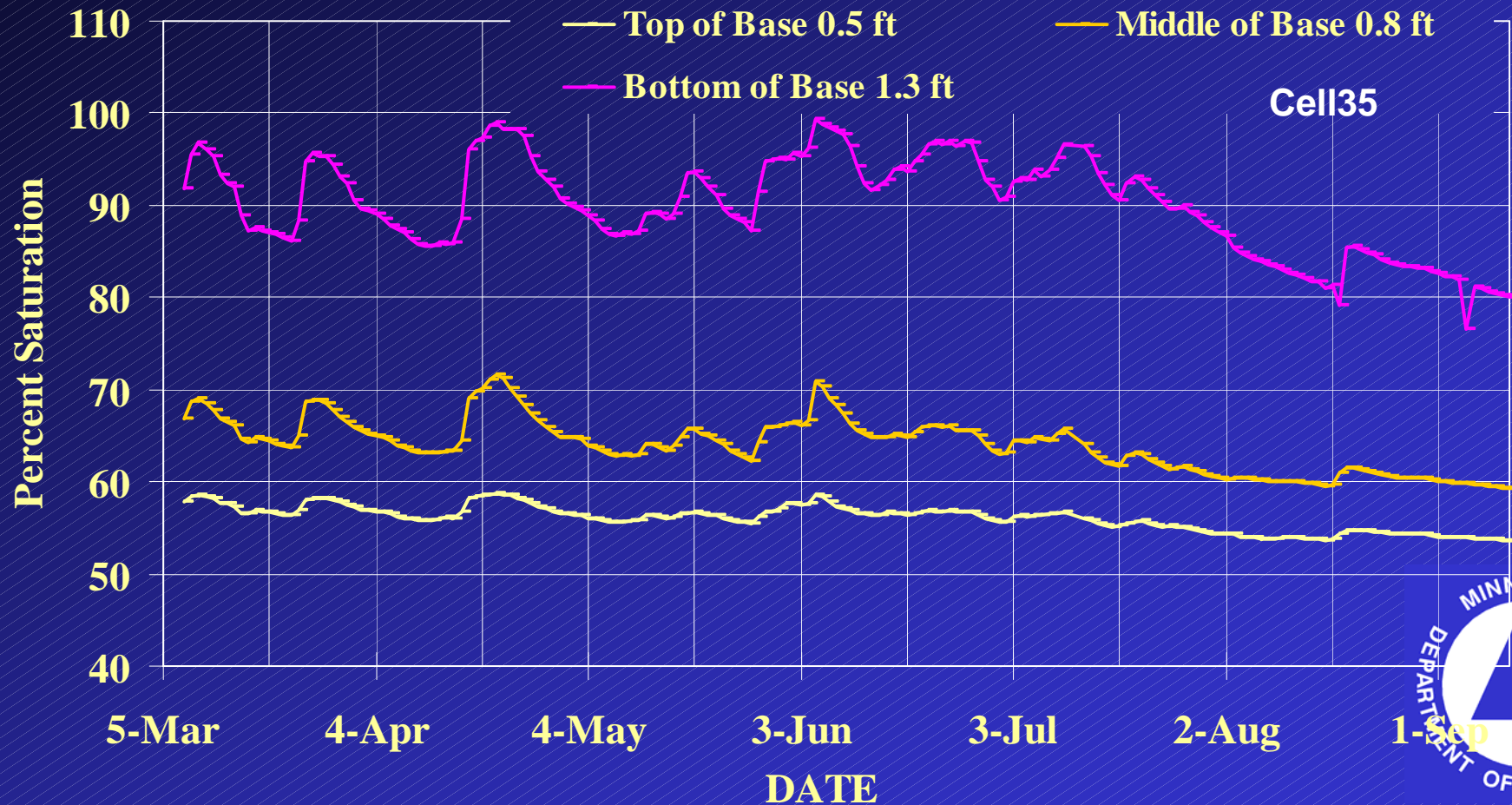
- ☞ Most of overlays fail by ride.
- ☞ Implementing the MnDOT ride predict model

$$PSR = PSR_{ini} - e^{(a-b*t)}$$



Recent Developments

■ Unsaturated material conditions



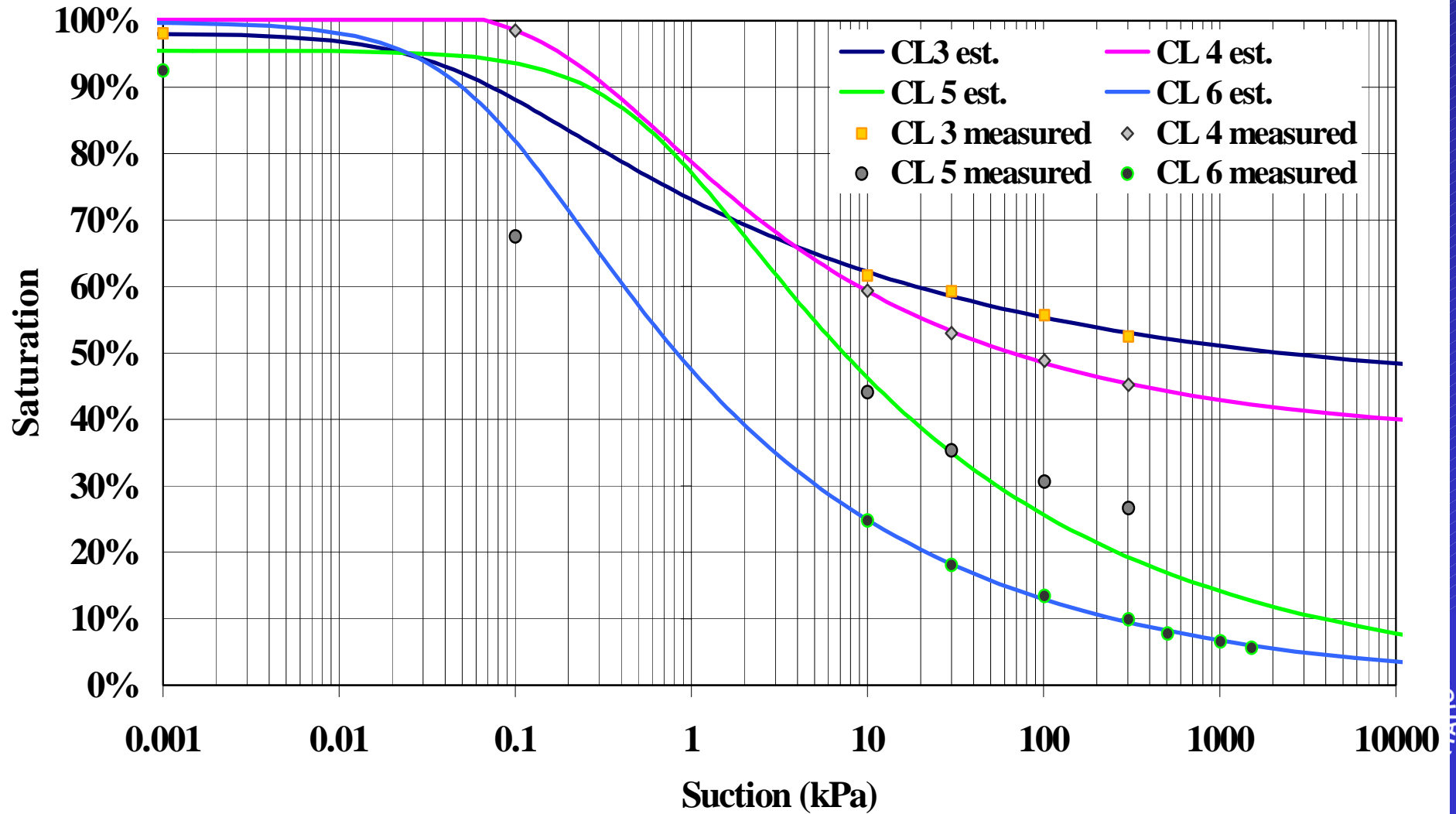
Recent Developments

- ◆ Moisture conditions vary with time and space.
 - ☞ Saturated and unsaturated conditions
 - ☞ Mr and strength vary with time and space too.

- ◆ Predict Mr and strength of materials for various moisture conditions
 - ☞ Mr or Strength = $f(\text{gradation, density, soil-water characteristic curve})$
 - ☞ SWCC – describes how fast a material drains water.



Updates



Future Work

- Complete overlay design procedures and calibrate the procedures.
- Goal is to release a new version and start the second training around the state in this summer.
- Incorporate recycled materials into MnPAVE.
- Validate MnPAVE using the future MnROAD



Thank you

