Investigation of Low Temperature Cracking in Asphalt Pavements

National Pooled Fund 776

Why do we need Phase II?

- **Phase I has resulted in a number of important findings**

1. Field performance correlates best with fracture parameters for both asphalt mixtures and binders
2. The PG specification for binders provides a good start, however, other factors such as aggregate type and air voids affect fracture resistance
3. At low temperature, asphalt mixtures are complex viscoelastic composite materials that are significantly temperature and loading rate dependent

- **Therefore…**

- It is strongly recommended that the selection of fracture resistant binders and mixtures be based on simple fracture tests

  - A mix simple performance test for low temperature will be recommended out of the two tests investigated in phase I
  - Need to develop mixture selection criteria similar to the PG system for binders
    - Limiting values for fracture energy or fracture toughness

- For binders, the PG system provides a good starting point, however, further refinement is needed for modified binders and mixtures

  - Refine current binder fracture test (Direct Tension)
  - Reconsider and further evaluate the role of the BBR "m" value in the specification to control thermal cracking
  - Reconsider the effect of physical hardening on fracture properties of binders and mixtures

- Asphalt binder testing alone does not provide sufficient reliability to predict low temperature cracking of asphalt pavements

  - Need to evaluate different types of mixtures
    - Warm mixtures
    - RAP
    - SMA
    - PPA and others
  - Also expand set to include more aggregate sizes and more binders

- At low temperature, asphalt mixtures are complex viscoelastic composite materials that are significantly temperature and loading rate dependent

  - The effect of loading rate needs to be investigated to better match true field cooling rates.
  - The mixture and binder test temperatures should be matched to better understand the contribution of the binder to the fracture properties of mixtures

- Address and clarify a number of "performance" issues

  - What is good performance?
    - Frequent but hairline cracks
    - Rare but large cracks
    - No cracks
  - Effect of aging on crack resistance
    - Aging penetration depth
  - Validate with statistically sound, long term, accurate field data

- Refine pavement mechanics models developed in phase I to:
  - Quantify the improvement in prediction relative to current MEPDG
  - Investigate the influence of good fracture properties at low temperature on other distresses
    - Fatigue cracking
    - Reflective cracking
    - Top-down cracking