TxME for Flexible Pavement Design

Fujie Zhou, TTI

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Presentation Outline

- Introduction
- TxME for New Pavement Design Check
- TxME for Asphalt Overlay Design Check
- TxME Application: Case Studies
- Summary

What is Mechanistic Empirical (ME) Pavement Design

- Mechanistic
  - Computes Stresses and Strains with pavement structure for each design load
  - Changes materials properties for each month of year
- Models
  - Uses models to predict rutting and cracking damage in all pavement layers
- Empirical
  - Compares model predictions to measured field performance
  - Introduces calibration factors to ensure predictions are reasonable

Introduction: Flexible Pavement Design

New Construction and *Asphalt Overlay*

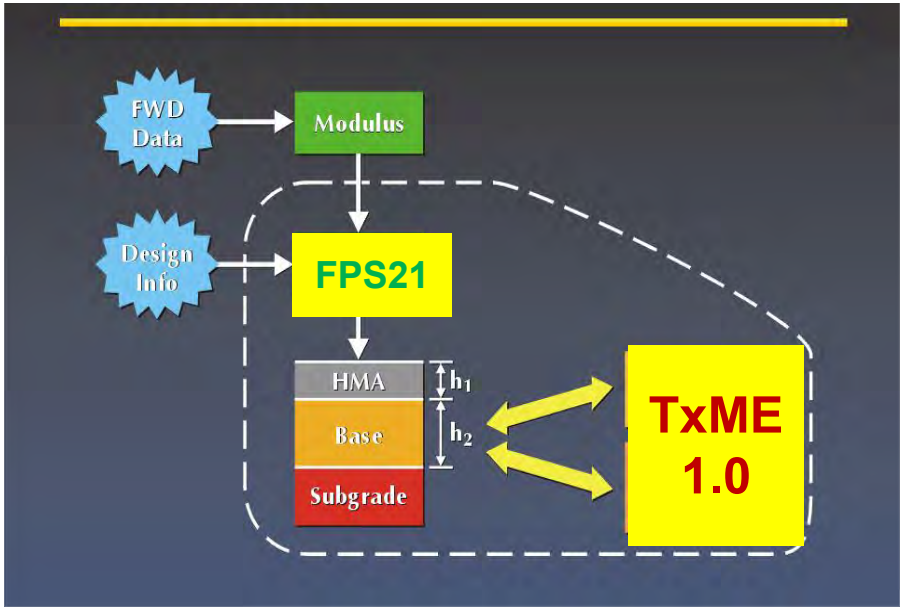
- New Construction
  - Surface treatment
  - Conventional AC
  - Perpetual pavement

- Asphalt Overlays for Cracked pavements
  - Existing cracks before overlay

Texas Pavement Design and ME Check Concept

- Pavement design: FPS21
  - Pavement structure alternatives
- M-E check for overlay and new pavements
  - Mix type (Binder,….)
  - Traffic
  - Climate
  - …

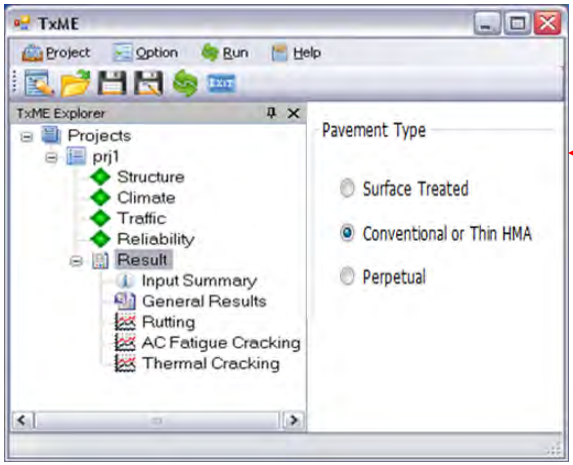
Future TxDOT's Flexible Pavement Design System



Texas Pavement Design and ME Check Concept

- FPS21 Design options

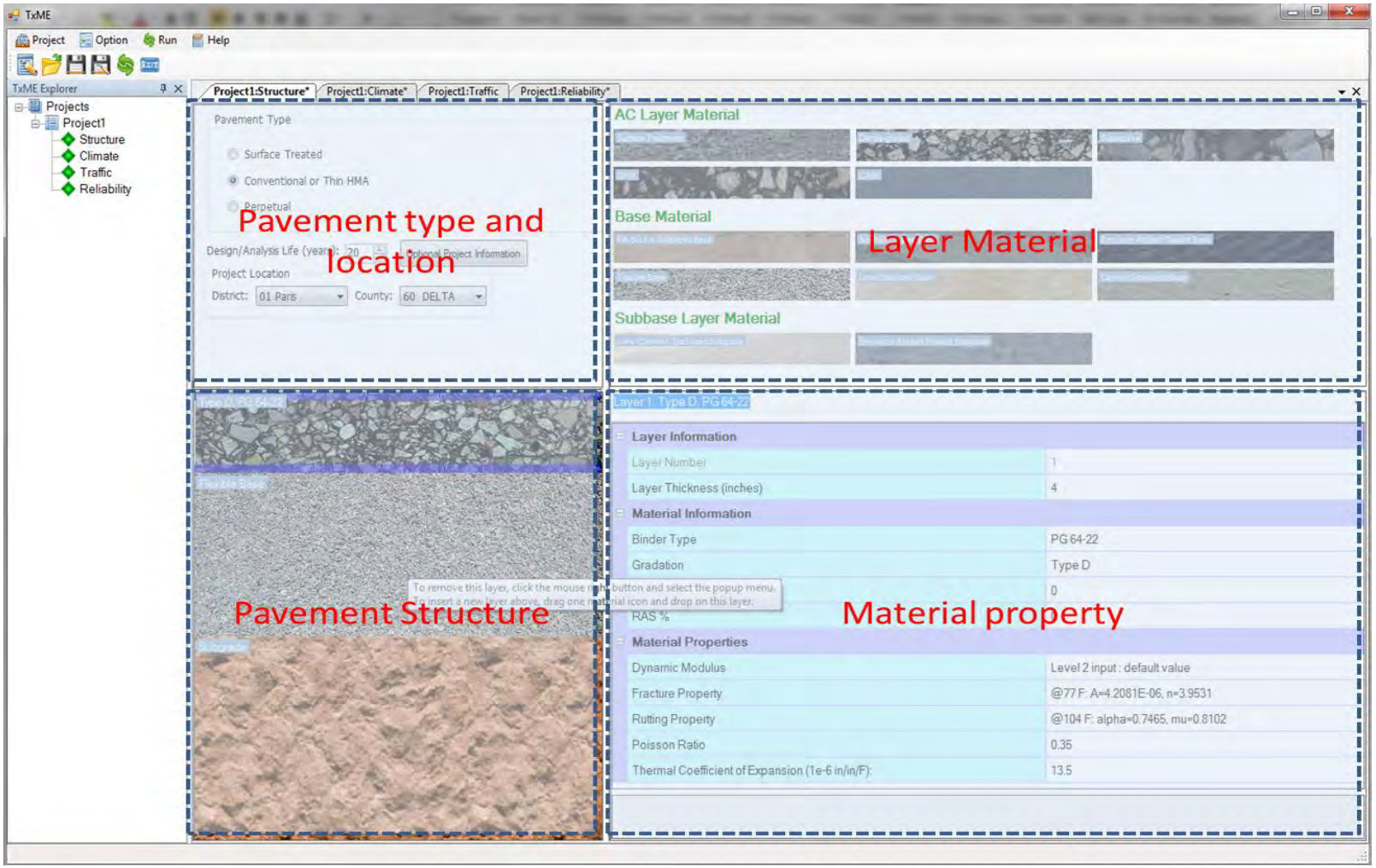
- TxME: Mechanistic Check
  - Specific layer material properties
  - Specific climatic conditions
  - Specific traffic (load spectrum)
  - Specific variability: Inputs



New Asphalt Pavement Design

- New Construction
  - Surface treatment
  - Conventional AC
  - Perpetual pavement

TxME for New Pavements: Overview



TxME for New Pavements:

Specific material properties

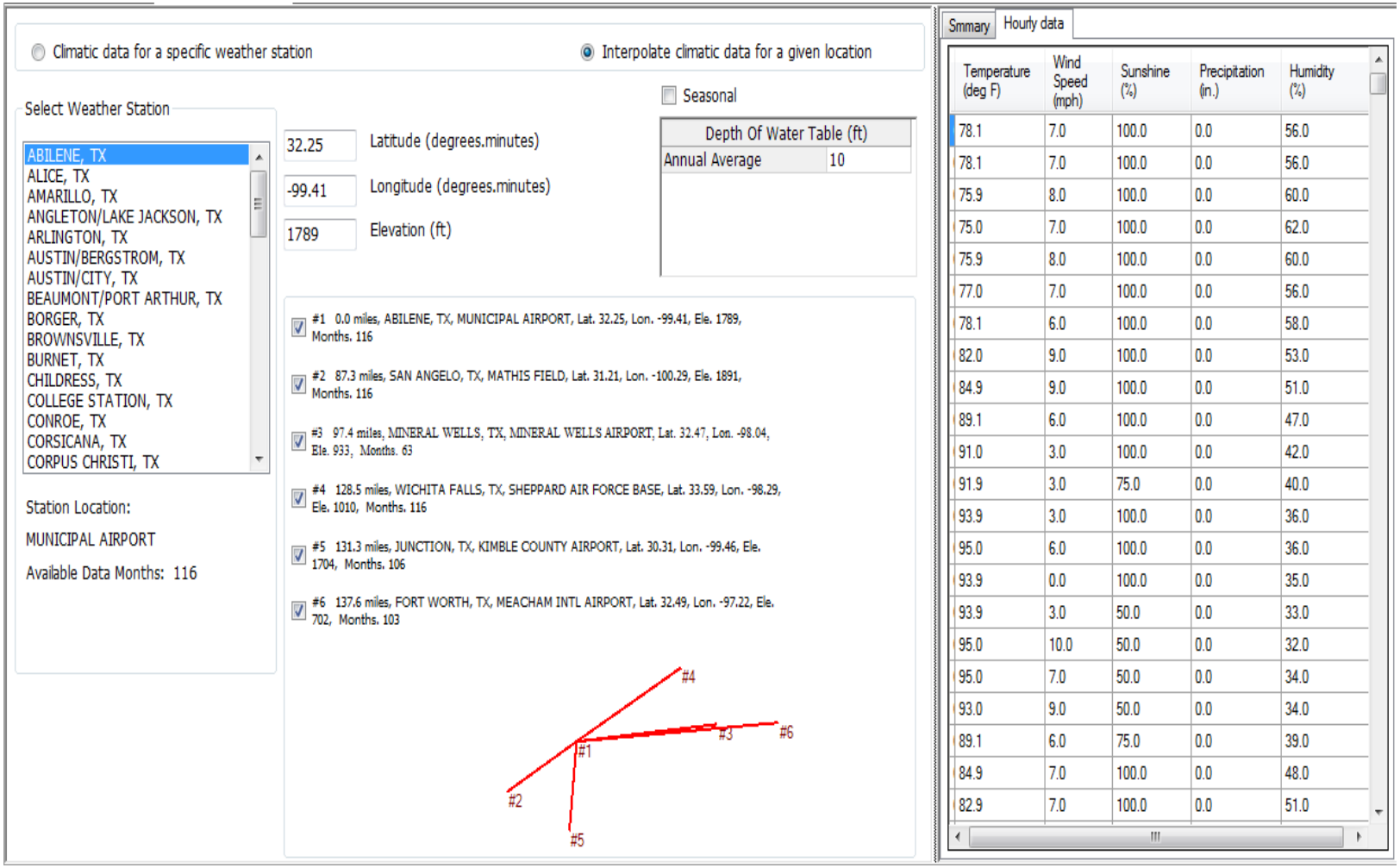
Layer Information	
Layer Number	1
Layer Thickness (inches)	4
Material Information	
Binder Type	PG 64-22
Gradation	Type D
RAP %	0
RAS %	0
Material Properties	
Dynamic Modulus	Level 2 input : default value
Fracture Property	@77 F: A=4.2081E-06, n=3.9531
Rutting Property	@104 F: alpha=0.7465, mu=0.8102
Poisson Ratio	0.35
Thermal Coefficient of Expansion (1e-6 in/in/F):	13.5

Type A
Type B
Type C
Type D

PG 64-22
PG 76-22
PG 70-22
PG 70-28
PG 64-22
PG 64-28

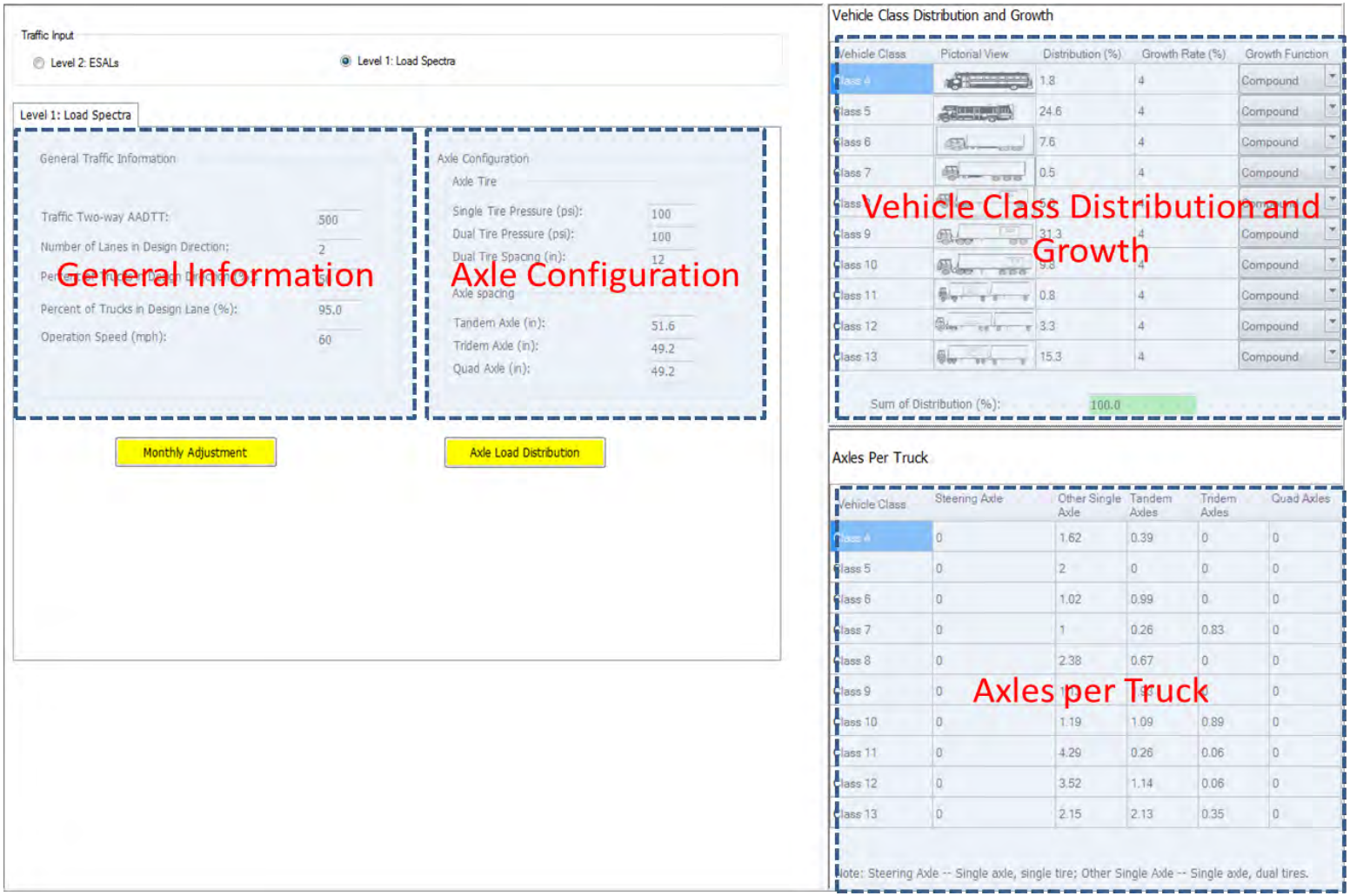
TxME for New Pavements:

Specific climatic condition



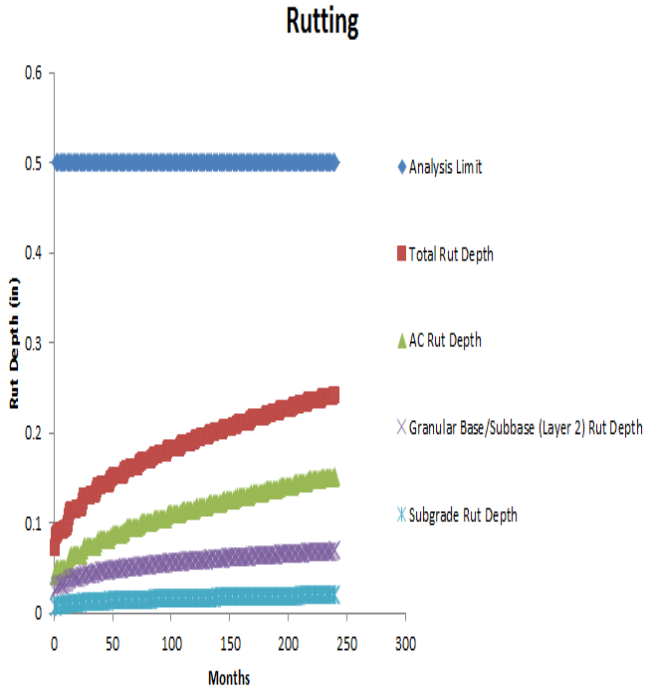
TxME for New Pavements:

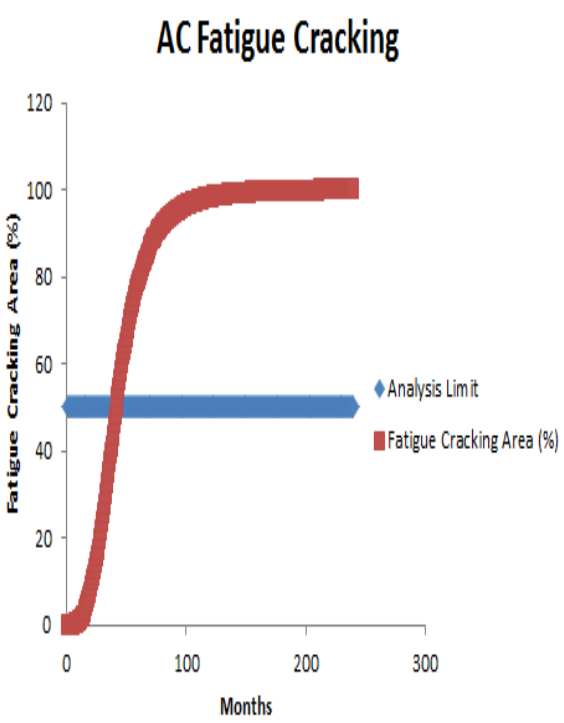
Specific traffic (load spectrum)

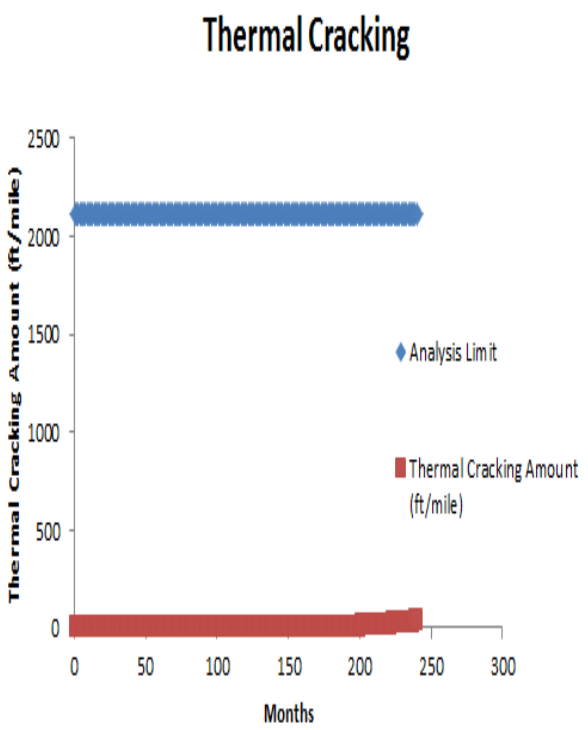


TxME for New Pavements: Output

Whether or not the design meets requirements



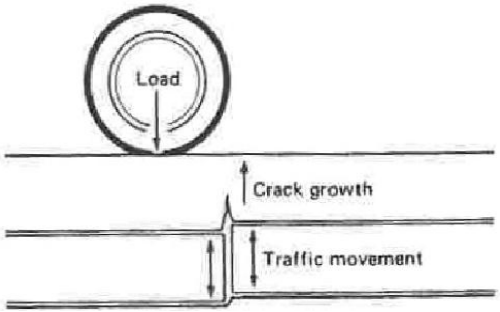


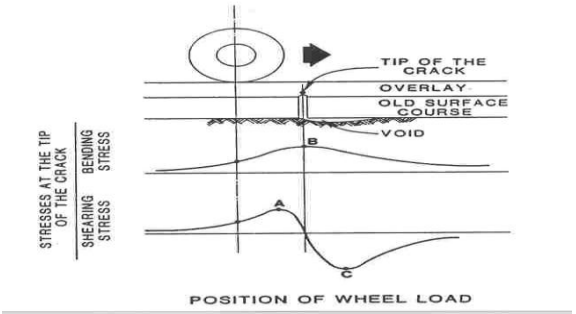


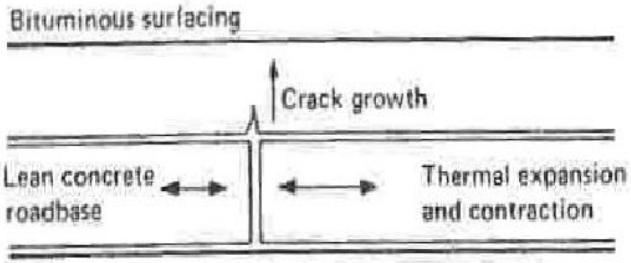
TxME for Asphalt Overlays

- Rutting:
  - HMA layer only
  - Controlled by mix design

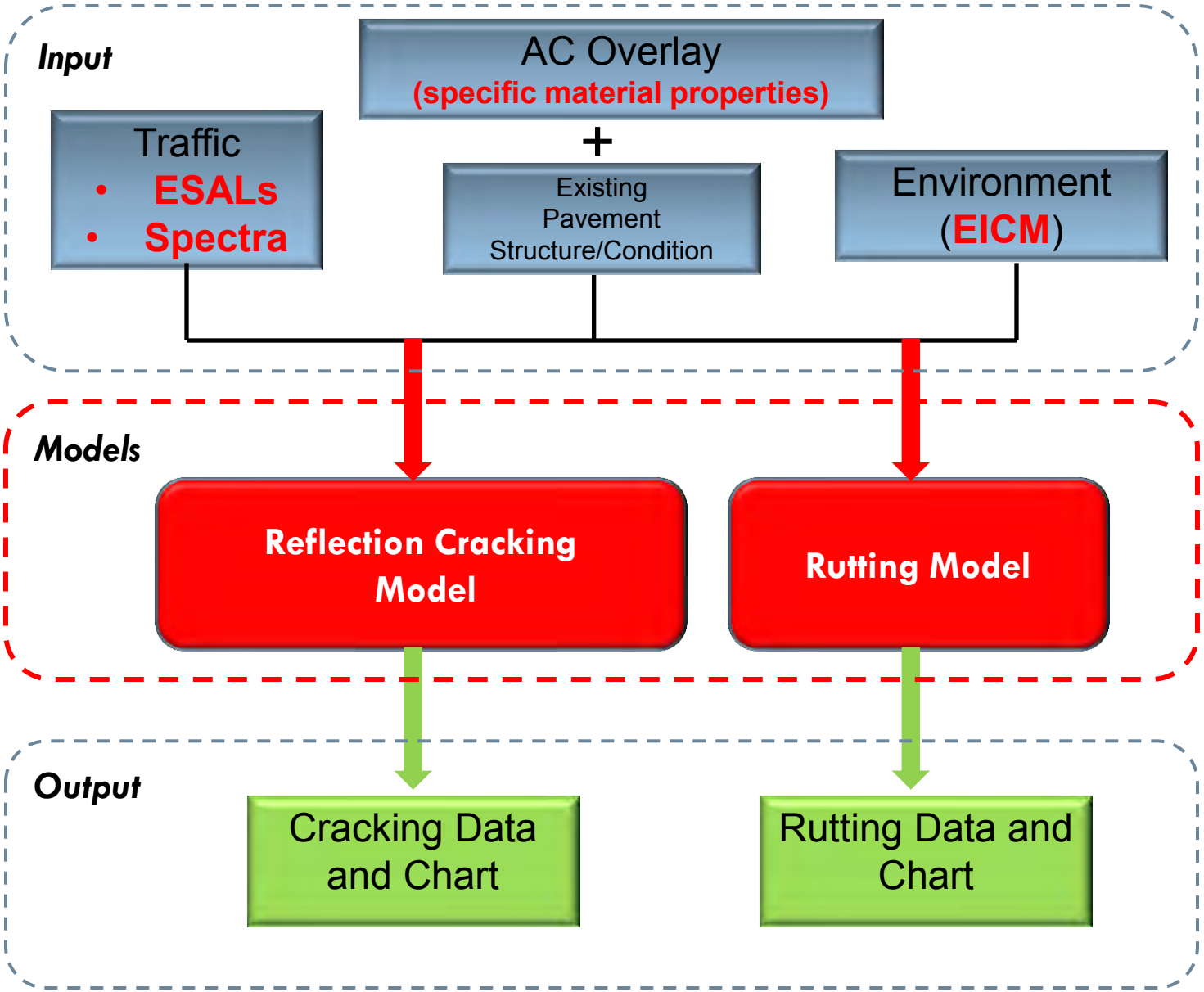
- Reflective Cracking
  - Impacted by thickness, …
  - Three mechanisms: shearing, bending, and thermal stress



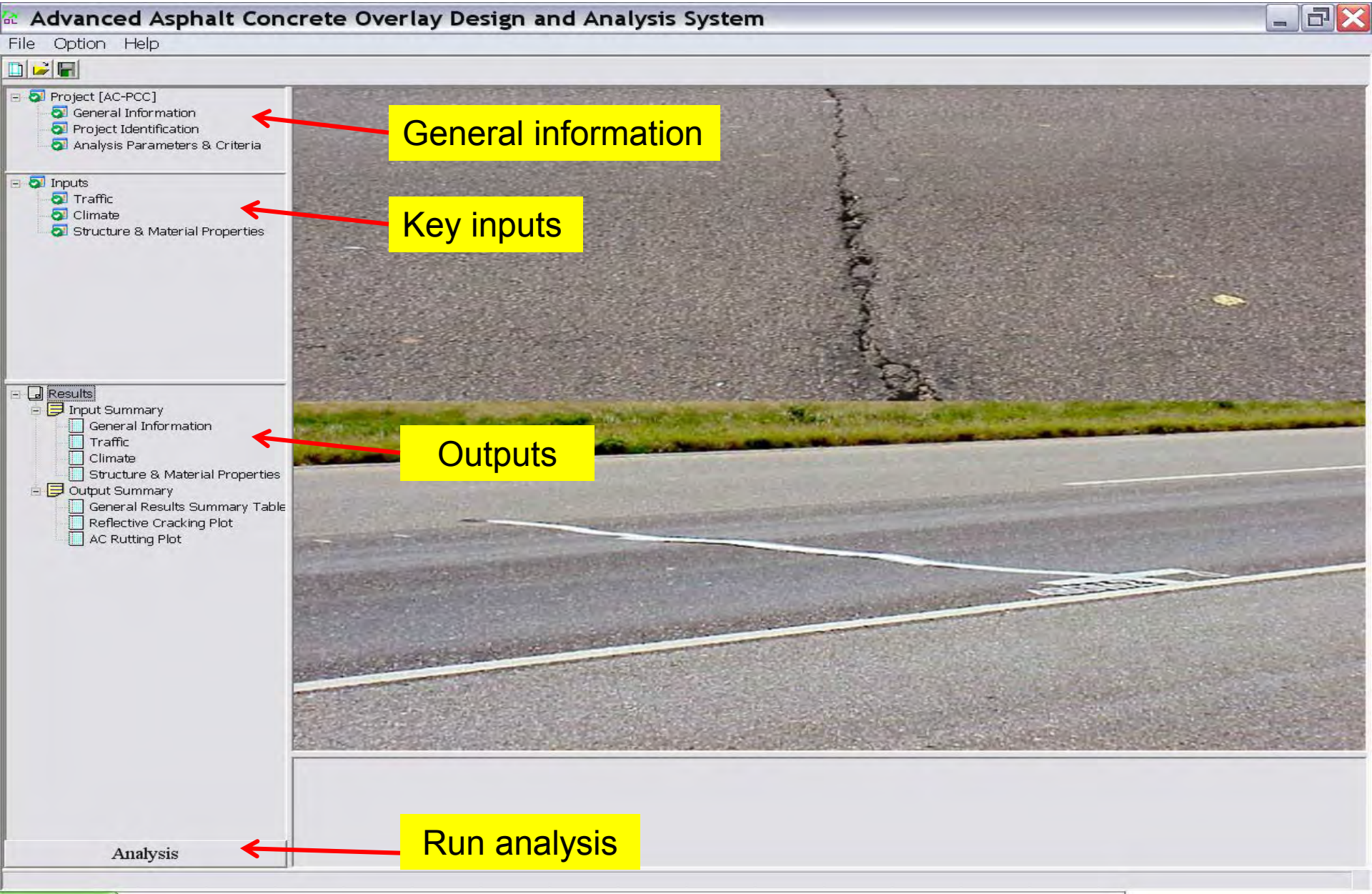




TxME for Asphalt Overlays

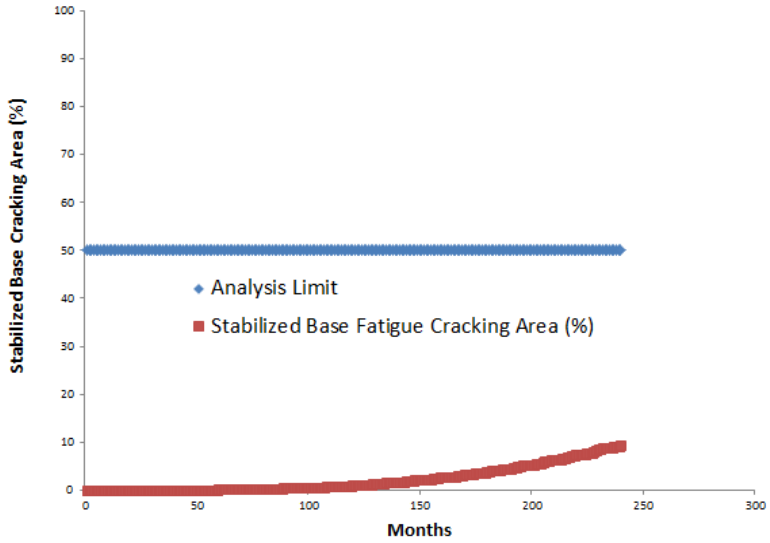


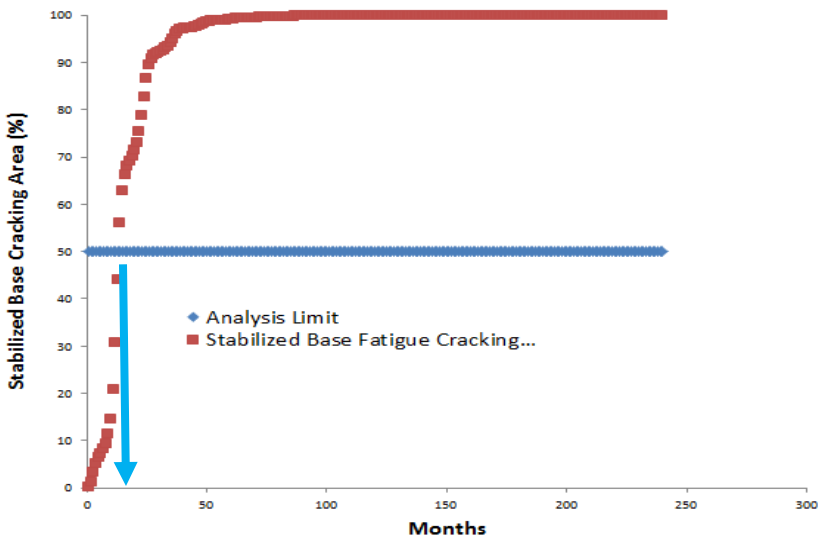
Advanced Asphalt Overlay Design Program



TxME Applications: Case Studies

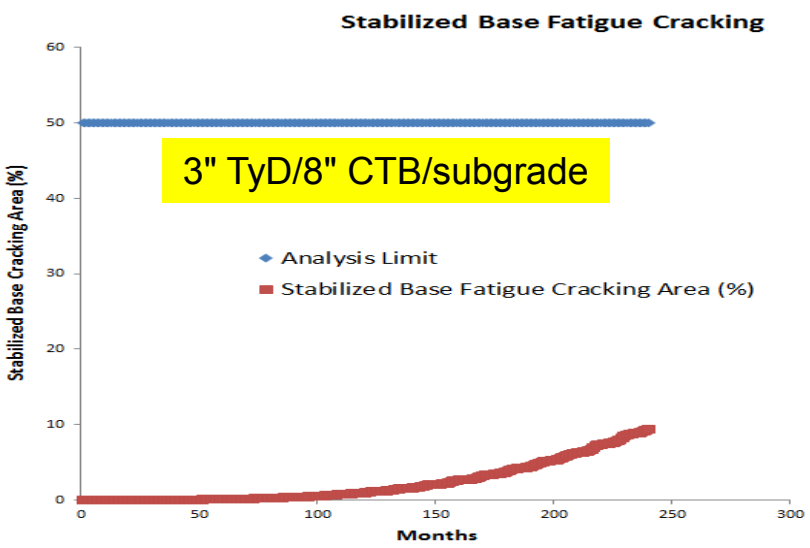
- Case 1:
  - Pavement structure
    - 3" TyD/8" CTB/subgrade
  - Climate: Austin
  - Traffic:
    - 100 trucks/day; 100 trucks/day, half with traffic load 30% heavier

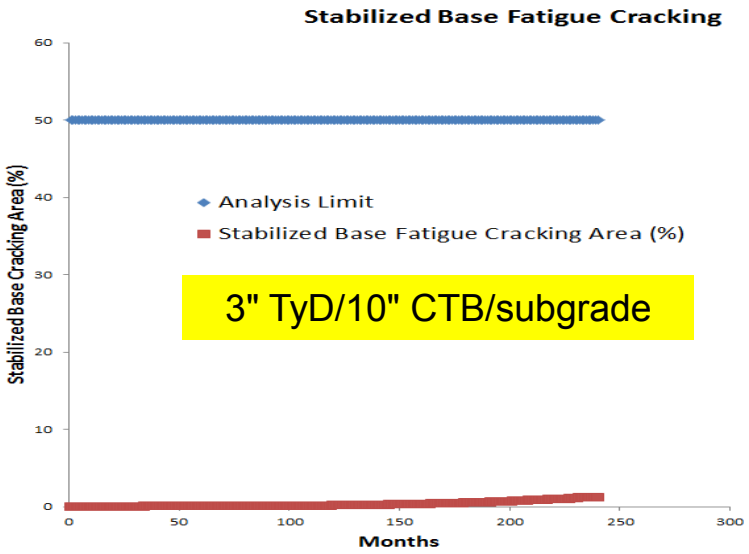




TxME Applications: Case Studies

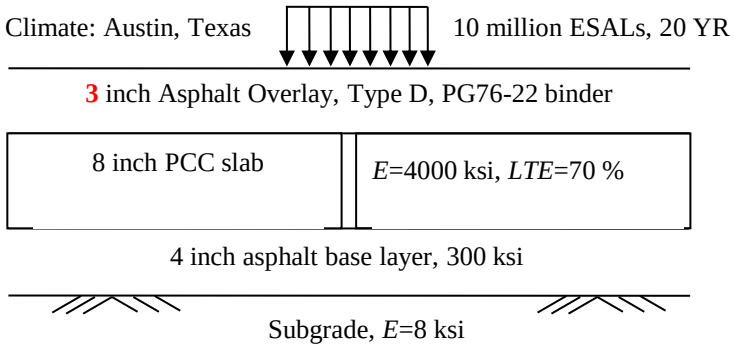
- Case 2:
  - Pavement structure
  - Climate: Austin
  - Traffic:
    - 100 trucks/day; 100 trucks/day, half with traffic load 30% heavier

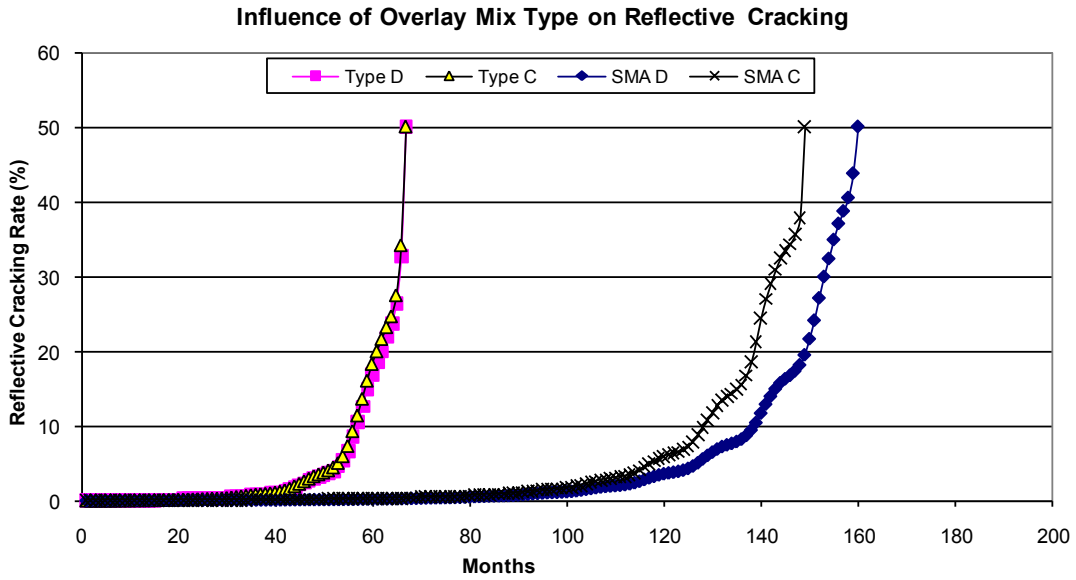




TxME Applications: Case Studies

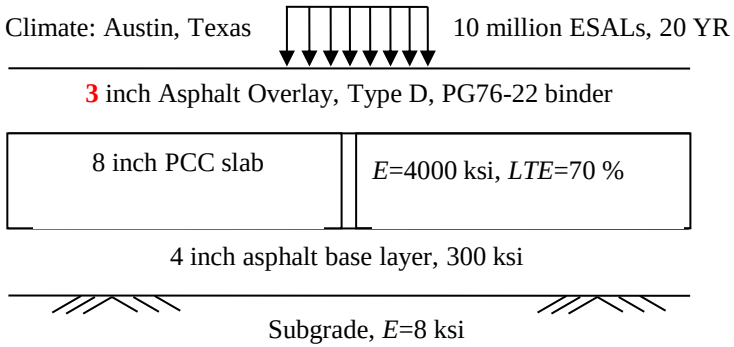
- Case 3: Mix Type

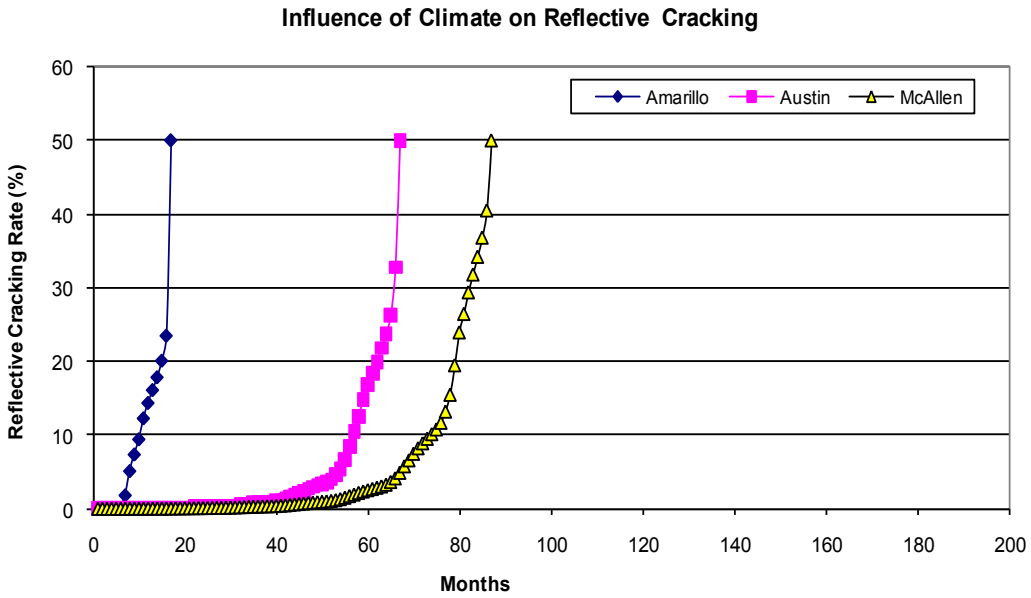




TxME Applications: Case Studies

- Case 4: Climate impact





Benefits of TxME approach

- When to use Performance mixes
- Allows design of stabilized layers to minimize the risk of fatigue damage
- Can evaluate the impact of overloaded trucks on proposed design
- Better accounting to environment in pavement design
- Based on real materials properties rather than only modulus

Summary

- TxME is available for both new and overlay pavement design check
- TTI is working with Joe Leidy and RTI to start a pilot implementation project
- TTI welcomes each District to participate
- TTI will assist each participating District in material characterization and pavement design.

Thank You All!

Reflection Cracking Model

- Reflection Cracking Model
  - Paris' law-based crack propagation model
  - Considered 3 mechanisms: bend, shear, and thermal stress
- Lab test procedure: Overlay Test
  - Validated through field test sections and HVS test
  - Two-step test: 1) E* test and 2) A and n test
- Model calibration and validation studies
  - Calibration: Field test sections
  - Validation: SPS5 Sections on US175, Texas

Asphalt Overlay Rutting

- **Asphalt overlay rutting model**
  - Asphalt overlay rutting only
  - VESYS layer model
- **Lab test procedure: Repeated Load Test**
  - Test condition: 40C/20psi/10000 cycles
  - Validated through SPS1 and NCAT test track
- **Model calibration and validation**
  - Calibration: NCAT: Phases III, SPS5 on US175
  - Validation: NCAT: Phases I