Empirical SHRP+ Specifications versus Performance-Related Models

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Overview

- Current Status of SuperPave Specs and the so-called SHRP+ Specifications
- Why are Users Specifying SHRP+ Specs?
- Are SHRP+ Specs a Good Thing?
- How do We Improve the SuperPave Specs without Proliferating the Specifications or adding too much Complexity?
- Where are the Holes in the existing PG Spec?
- Summary

Current Status of SuperPave Specs and the so-called SHRP+ Specifications

- Most States in the Western, Central and Southern United States as well as some of the Canadian Provinces are now using SHRP+ specifications.
- Empirical, non-performance based tests include:
  - T & T
  - Ductility
  - Force Ductility
  - Elastic Recovery

Current Status of SuperPave Specs and the so-called SHRP+ Specifications

- Examples are:
  - TX - Elastic Recovery
  - OK - Elastic Recovery
  - IL - Force Ductility
  - UT - T&T
  - NV - T&T, Ductility
- Many other states are now contemplating implementing SHRP+ specifications for their high performance binder grades.

Why are Users Specifying SHRP+ Specs?

- Current SuperPave specifications do not capture the field performance adequately.
  – Polymer-modified PG70-22 versus conventional, “blown” PG70-22 or chemically “treated” binders
- Users are concerned about “aphaltoids” and Zupaphalts
  – “Recycled” engine oil bottoms
  – Acid treated systems
  – Tall oil-modified systems

Why are Users Specifying SHRP+ Specs

- User wants a specific type of modification
  - Excellent field performance history with elastomeric modifiers versus plastomeric

Are SHRP+ Specs a Good Thing?

Pros

- Empirical evidence appears to support notion that modified systems of equivalent grading perform better.
- Agency can assure that systems with proven performance history are used.

Are SHRP+ Specs a Good Thing?

- Contras
  - Evolution of proprietary specs that call for a specific modifier type or group rather than a performance level.
  - Empirical tests do NOT correlate with performance and are generally descriptive.
  - Descriptive specs have unintended implication that impact base AC choice rather than modifier.

Are SHRP+ Specs a Good Thing?

- Contras
  - Choices often arbitrary and difficult to justify.
  - The usage of new innovative materials and technologies is stymied.
  - Testing requirements (equipment, time and number) are potentially significantly increased.
  - Every agency has their specific flavor.
    - Sometimes more than one flavor in a given state, e.g., TX and NV.

Are SHRP+ Specs a Good Thing? Unintended Results

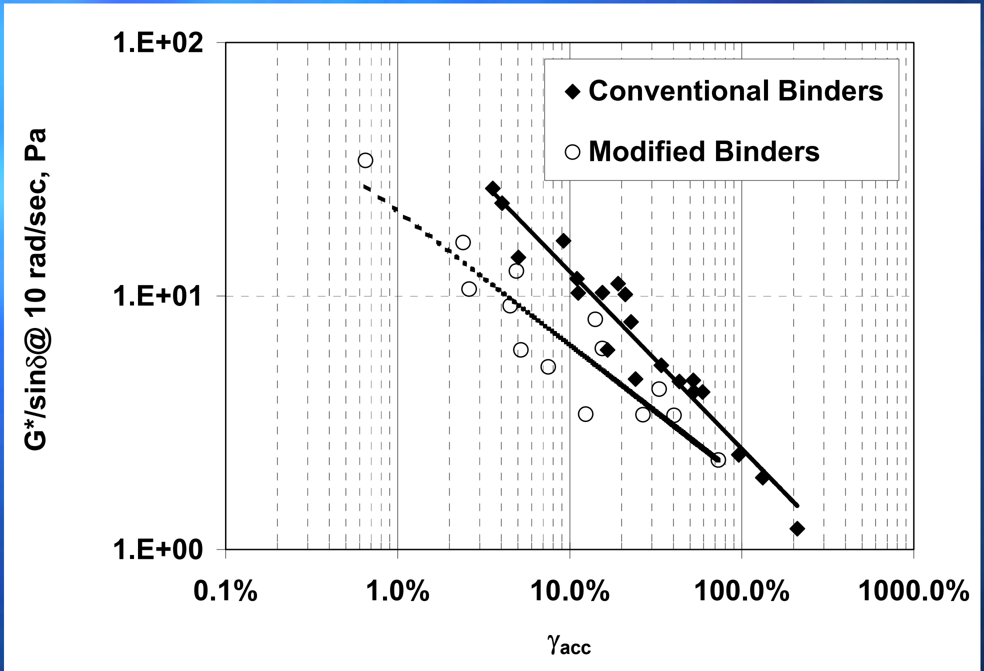
Sample ID	SN1	SN2
Laboratory	DLS	
Component	**Base A**	**Base B**
Base Asphalt	95.15%	96.68%
Elastomer Content, (%)	4.50%	3.00%
SPA Content, %	0.20%	0.20%
Sulfur Content, %	0.15%	0.12%
G* Orig at 64 C	1.35	5.10
δ Orig at 64 C	72.4	50.9
G*/sin δ Orig at 64 C	1.42	6.57
G* RTFO at 64 C	3.19	9.68
δ RTFO at 64 C	63.9	43
G*/sin d RTFO at 64 C	3.55	14.19
BBR S(60) at MPa at -24C	256	65
BBR m-value(60) at -24C	0.298	0.320
Toughness, lbs in	113	45
Tenacity, lbs in	94	32

How do We Improve the SuperPave Specs without Proliferating the Specifications or adding too much Complexity?

- Use existing hardware.
- Possibly modify tools and/or software.
- Don’t make test too time consuming.
- Don’t use tests that have poor repeatability or reproducibility.
- Eliminate non-meaningful tests.

Where are the Holes in the existing PG Specification?

- High Temperature - Permanent Deformation



Where are the Holes in the existing PG Specification?

- High Temperature
  - G*/sin δ does not properly rank PMAs vs conventional ACs.
  - Repeated creep test cumbersome and potentially difficult to implement.
  - Zero shear viscosity (ZSV) appears to do a better job.

Where are the Holes in the existing PG Specification?

- High Temperature Continuation.
  - Zero shear viscosity (ZSV) ranks field projects properly.

    Cons:
    - Is not dependent upon loading time. Doesn't tell the WHOLE story.
    - Computation needs to be simplified.

    Pros:
    - Works with existing equipment.
    - Relatively fast.
  - Add phase angle to spec.

High Temperature
NV I-80

Binder	Field Performance	G*/Sin(δ)	ZSV	Repetitive Creep
PG 64-22	2	1	2	2
AC20P	1	2	1	1

High Temperature
Mississippi I55

Binder	Field Performance	G*/Sin(δ)	ZSV
ASR (SBR)	4	3	4
CSR (Control)	5	3	5
GSR (SealoFlx)	1	1	1
PSR (SBS)	3	3	3
TSR (SB)	1	2	2

Where are the Holes in the existing PG Specification?

- Intermediate Temperature - Load Induced Fatigue
  - $G^* \times \sin \delta$ does not capture fatigue performance.
  - NCHRP 9-10 fatigue test is cumbersome and possibly test artifact.
  - As a substitute test we need:
    - Need strain tolerance test for overlays and inlays.
      - Possibly a modified DTT test.
    - Need low deflection binders for structural layers.
      - Minimum G^* at T_{int}.

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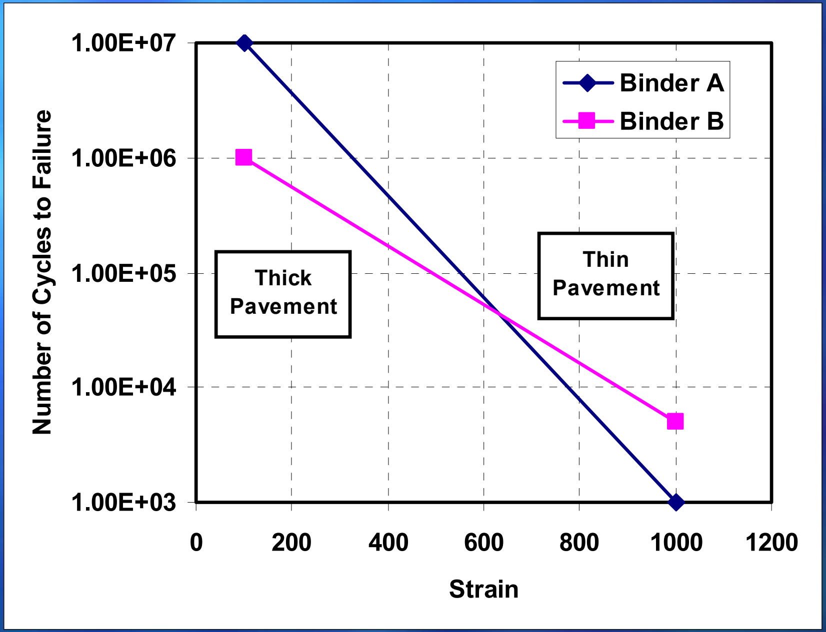

Where are the Holes in the existing PG Spec?

- Low Temperature - Thermal Fatigue
  - T_{cr} does not capture thermal fatigue.
  - Low T strength is critical parameter as well as range of transition from brittle to ductile.
    - $\Delta T = T_{2.5\%} - T_{cr}$
- Possible spec:
  - $T_{cr} < T_{spec}$
  - $\Delta T < 3C$
  - $\sigma^* > 5MPa$

Summary

- Modifications of PG grading necessary and user driven.
- Unified approach needed.
- Simple performance-related tests can be easily implemented.
- Unified AASHTO spec needed to stop proliferation.
- Specs are purchase specs not performance predictors.