



PERFORMANCE BASED SPECIFICATIONS

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Outline

- AASHTO/FHWA Information
- Measure Performance
- Impact on Risk
- Implementation Thoughts

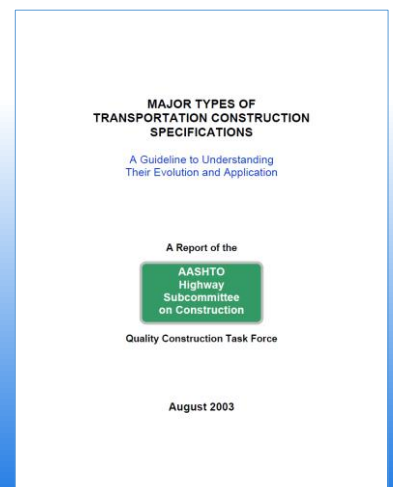


AAHSTO/FHWA INFORMATION



AASHTO Highway Subcommittee Report

- www.fhwa.dot.gov/construction/specs.cfm
- Report published August 2003
 - not official AASHTO Guide or voluntary standard
- Assist Agency & Contractor in understanding different types of specifications





Definitions

- **Method Specifications**
 - Specifications that require the Contractor to produce and place a product using specified materials in definite proportions and specific types of equipment and methods under the direction of the Agency.
- **End-Result Specifications**
 - Specifications that require the Contractor to take the entire responsibility for producing and placing a product. The Agency's responsibility is to either accept or reject the final product or to apply a price adjustment commensurate with the degree of compliance with the specifications.
- **Quality Assurance Specifications**
 - Specifications that require Contractor Quality Control and Agency Acceptance activities throughout production and placement of a product. Final acceptance of the product is usually based on a statistical sampling of the measured quality level for key Quality Characteristics.



Definitions

- **Performance-Related Specifications**
 - Specifications that use quantified Quality Characteristics and Life Cycle Cost (LCC) relationships that are correlated to product performance.
- **Performance-Based Specifications**
 - Quality Assurance Specifications that describe the desired levels of fundamental engineering properties (e.g. resilient modulus, creep properties, and fatigue) that are predictors of performance and appear in primary prediction relationships (i.e. models that can be used to predict stress, distress, or performance from combinations of predictors that represent traffic, environment, supporting materials, and structural conditions).



Performance Related Specifications

- Relate material attributes (Quality Characteristics) to likely performance
- Use models to predict subsequent product performance
 - Performance-prediction Models
 - Maintenance-cost Models
- Pay Adjustments made using:
 - As-Designed LCC
 - As-Constructed LCC
- Quality Data (Pavement Performance, Construction Quality, Construction Cost, Maintenance Cost) needed



Performance Based Specifications

- Relate fundamental engineering properties to likely performance
- Concerned with performance of the final in-place product
 - Not how it was built
- Features
 - Measurement of final product's fundamental engineering properties
 - Statistically valid acceptance limits
 - Models to quantify the relationship between engineering properties and performance
 - Price adjustments based on expected LCC



MEASURE PERFORMANCE

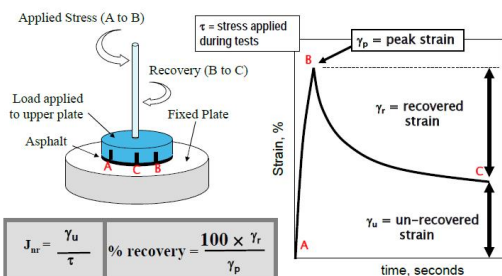


Measure Performance

- Currently
 - Quality Management Programs (PFP/QCP)
 - Smoothness
 - Friction
 - Hamburg Wheel
 - TSR
 - Test Strip
- Future
 - Quality of Binder (Virgin and Recycled)
 - Balanced Mix Design (Durability and Stability)
 - Performance Acceptance of Mixture in Place

Binder Quality (MSCR and ΔT_c)

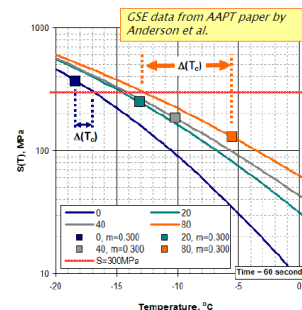
MSCR test performed in DSR



Higher Strains in MSCR!!

What is ΔT_c ?

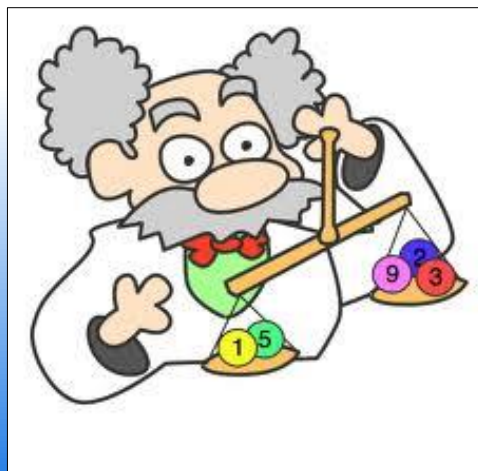
- $S(60s)$ and $m(60s)$ plotted vs. temperature
 - For these we get a limiting temperature value when $S=300$ MPa and $m=0.300$



Slides courtesy of Geoffrey Rowe, Abatech Inc.
56th Illinois Bituminous Conference

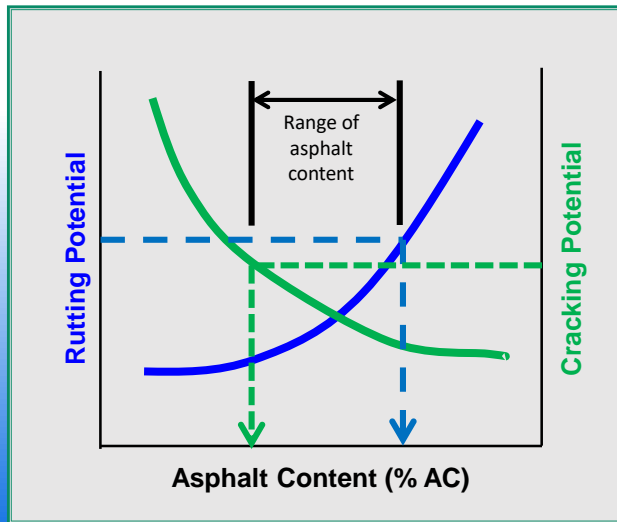
Balanced Mix Design

- AKA
 - Optimized Mix Design
 - Performance Mix Design
 - Engineered Mix Design
- Balance
 - Safety
 - Durability
 - Stability
 - Constructability
 - Sustainability
 - Cost
 - Risk

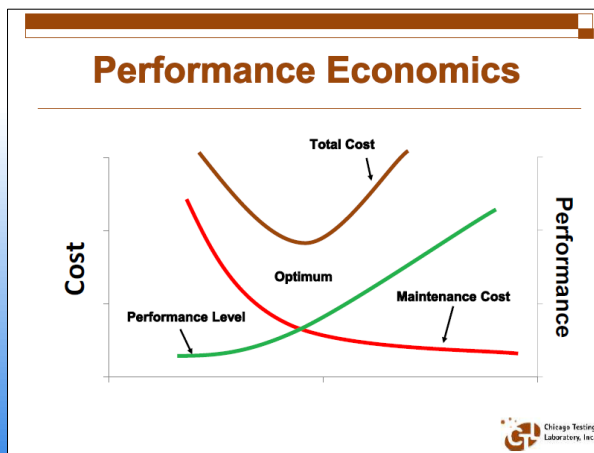
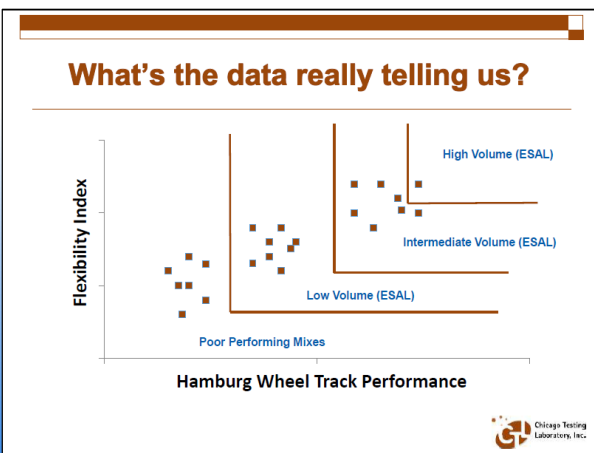




Previous Balanced Mix Design Concept



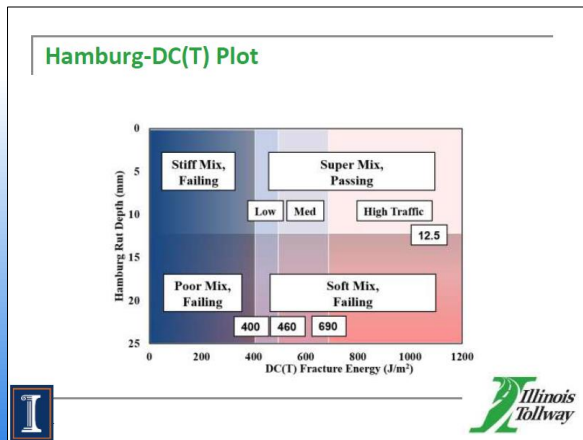
Balanced Mix Design Concepts



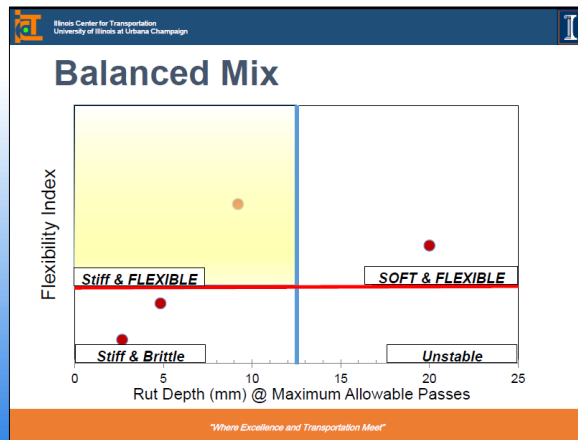
Slides courtesy of Abdul Dahhan, Chicago Testing Lab
79th Illinois Asphalt Pavement Association Annual Conference



Balanced Mix Design Concepts



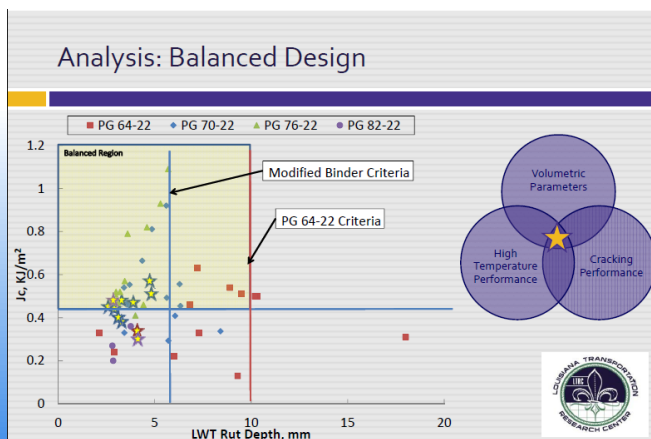
Slide courtesy of Steve Gillen, Illinois Tollway
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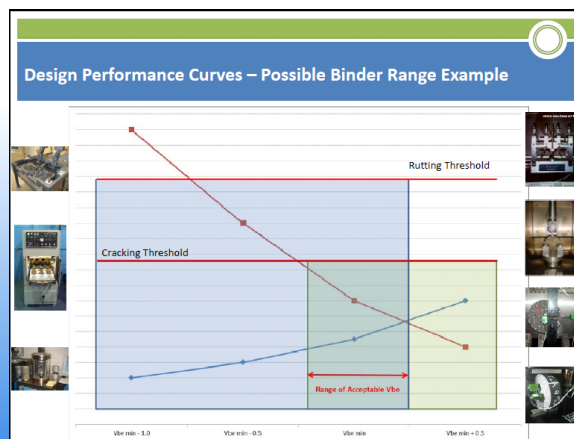
Slide courtesy of Imad Al-Qadi, Illinois Center for Transportation
56th Illinois Bituminous Conference



Balanced Mix Design Concepts



Slide courtesy of Samuel Cooper III, LA DOT
2016 National Asphalt Pavement Association Annual Meeting



Slide of Shane Buchanan, Oldcastle Materials
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Performance Tests



Performance Test for Stability

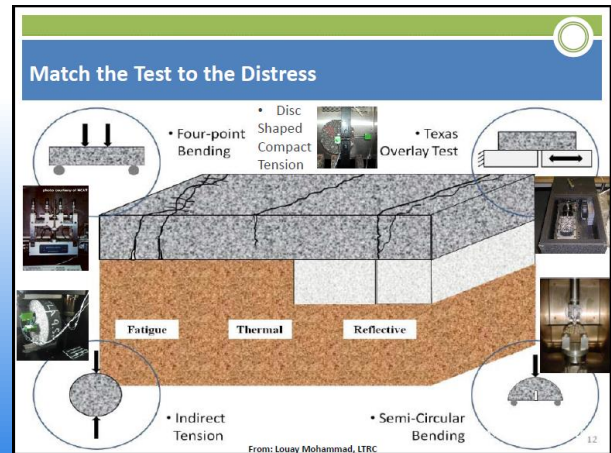
- Hamburg Wheel
 - Torture Test
 - Number of Cycles
 - Maximum Rut Depth
 - Water Bath at 50 C
- Mixes Passing Hamburg Do Not Rut;
Mixes Failing Hamburg May Not Rut





Performance Tests for Durability

- National Issue
- IL DOT/ICT Developed IFIT
 - Based on Intermediate SCB
 - Uses Fracture Energy and FE Curve Inflection Point
- Experimental Projects Underway
 - Validate Research
 - Determine Impact of Aging
 - Determine Variances
 - Identify Issues



*Slide courtesy of Shane Buchanan, Oldcastle Materials
2016 National Asphalt Pavement Association Annual Meeting*



CONTRACTOR RISK

Contractor Risk

- Unnecessary Contractor Risk Increases Cost
- “Performance” Specifications Balances Increased Contractor Risk with Increased Contractor Control
- Performance Measurement Must Be:
 - Relatable (Identify Poor and Good Performance)
 - Reliable (Consistent and Repeatable)
 - Implementable (Practical and Timely)

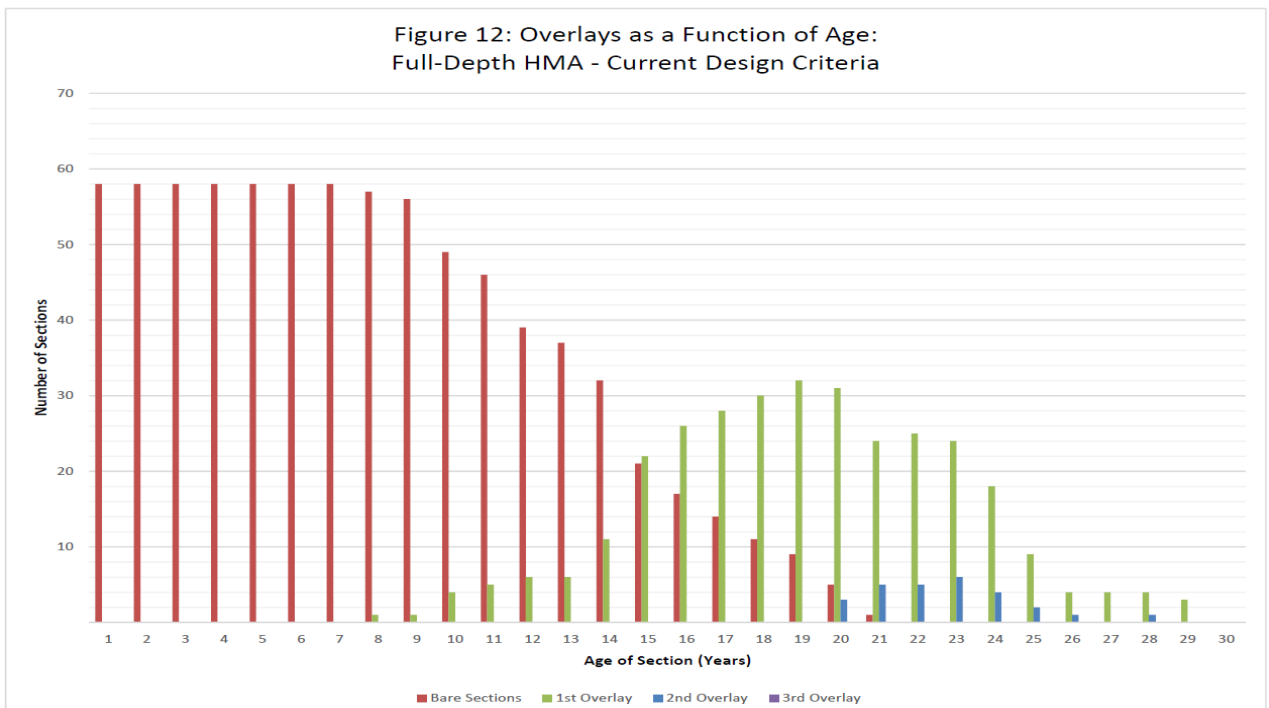


IMPLEMENTATION THOUGHTS



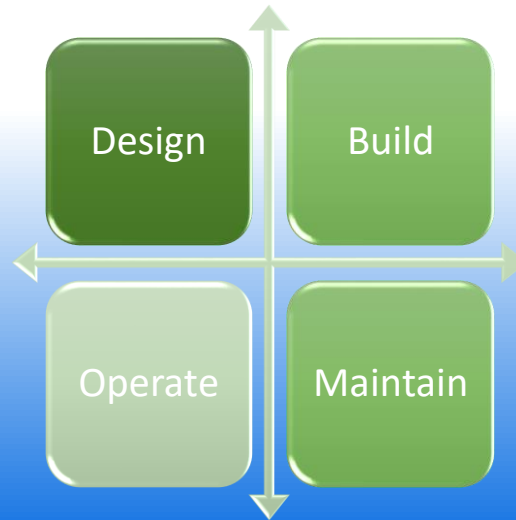
Implementation Thoughts

- Performance Based or Performance Related Specifications are tied to LCC
- Designers impact LCC
- Contractor responsible for final performance (Risk Impact)
- How does this impact lowest responsible bidding?
- Does Illinois have data?
- Quality Assurance Specification using Performance Testing?



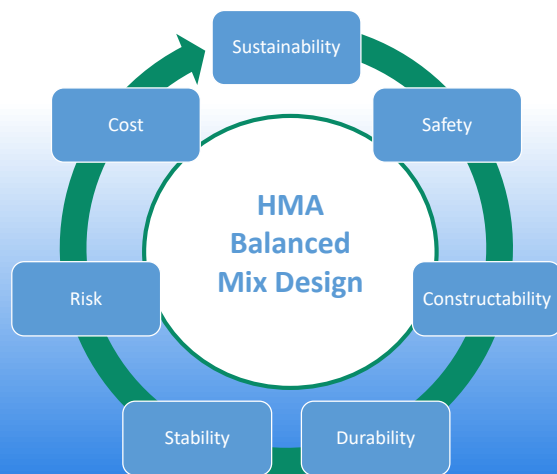


Performance Based Specification?



QA Specs with Performance Testing?

- Select Performance Test(s)
- Determine Performance Criteria/Measurements on In-Place Material
- Establish Acceptance Protocol
- Develop Balanced Mix Design Specifications
- Remove Restrictions on Contractors
- Implement
- Monitor/Adjust





Questions

