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Pavement Treatment Evaluation Strategies

April 20, 2018

Department Improvement plan: pavement elements

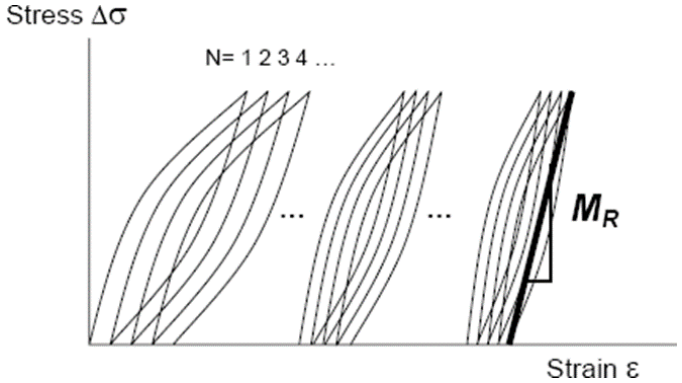
- Infrastructure and network management system
- Analysis-based focus
- Risk/life-cycle-costing
- Return on Investment

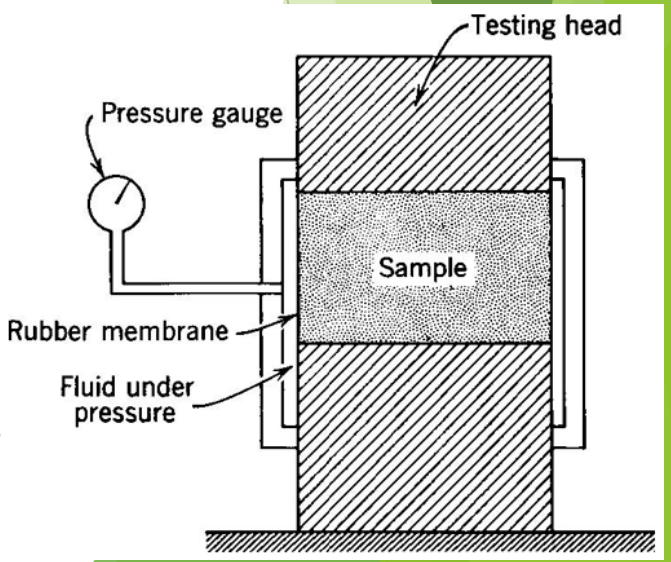
Material Laboratory re-orientation

- Forensic statistical analysis from Network Management System
- Factors contributing to failure
- Factors contributing to longevity
- Materials research testing
- Pavement design

Flexible Pavement Stresses

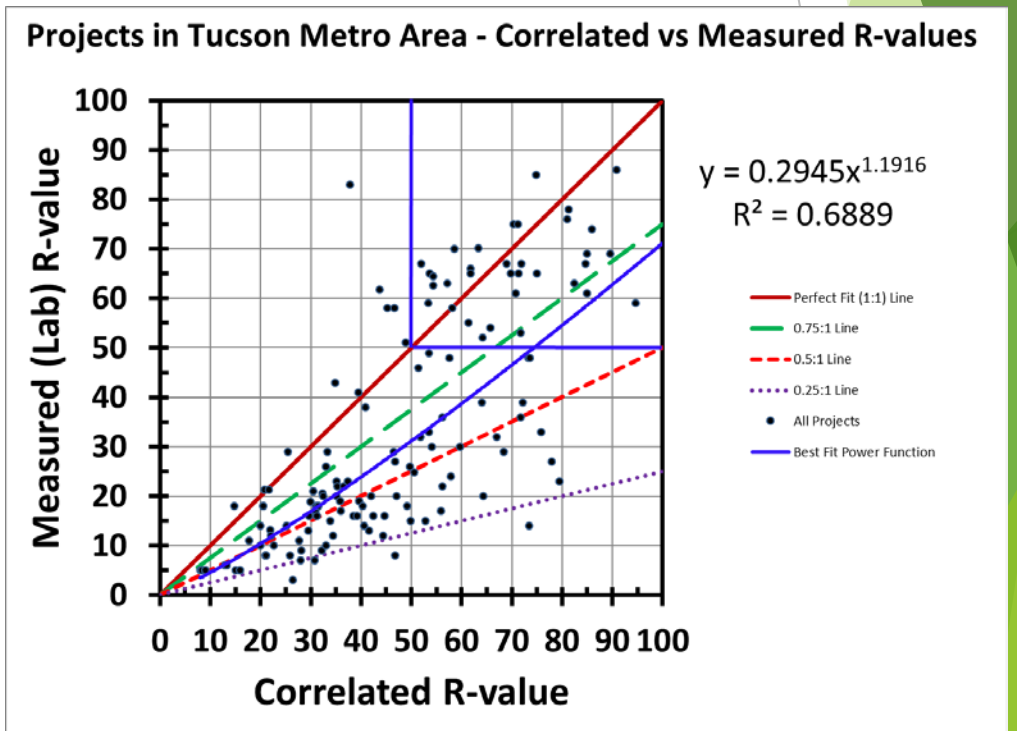
- Flexible pavement stresses (force per area):
  - Horizontal tensile strain (deformation) at bottom of AC layer
  - Vertical compressive strain at top of subgrade
- Stiffness (not strength) is most important property for unbound materials in flexible pavements
- Resilient Modulus (M_R)
  - Stiffness
  - Preferred characterization of subgrade by AASHTO in 1986
  - Definition: ratio of applied cyclic stress to recoverable (elastic) strain after repeated loading cycles
  - Best evaluated in laboratory using a triaxial test





Currently adopted pavement design

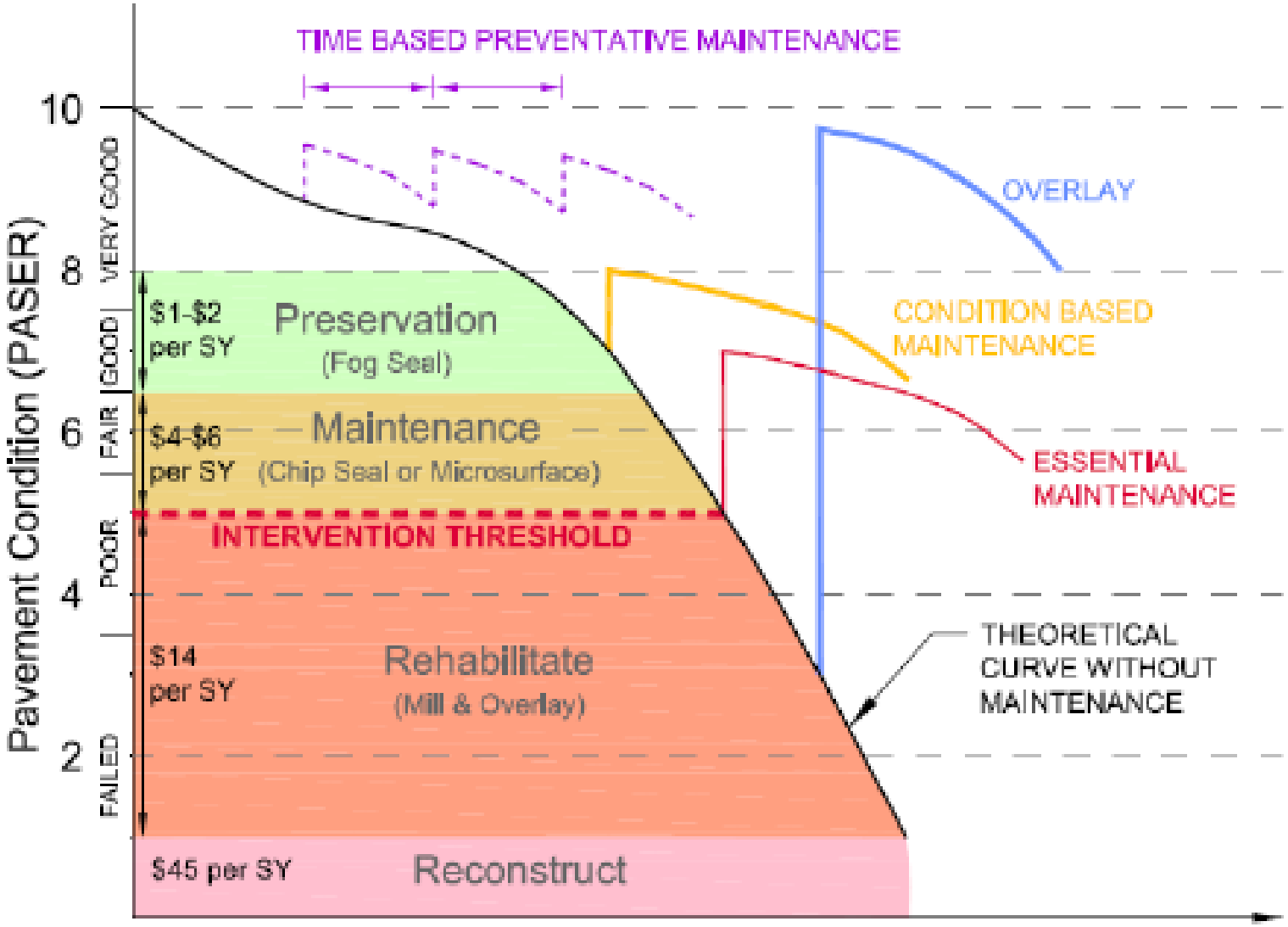
- AASHTO 1993
- ADOT R-value correlation issue
- Minimum local street standard (<1000 ADT)
  - 2.5” Single Lift AC
  - 4” AB
  - 1.49 Structural Number



Pavement design transition

- Moving toward AASHTOWare Pavement ME to better predict performance
  - Materials mechanics
  - Climate data
  - Axle-load spectra
  - Truck counts

Traditional pavement life cycle



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PASER surface distress

- Block Cracking
- Excess Asphalt
- Fatigue cracking
- Longitudinal cracking
- Patching
- Raveling
- Rutting
- Shoving/Pushing/Corrugation
- Transverse cracking
- Oxidation

Pima County standard treatments

- Reconstruction (PASER 1-2)
- 2” Mill/fill (PASER 1-4)
- 2” Overlay (PASER 4-5)
- Major seal coat (PASER 5-6)
  - Chip-seal
  - Micro-surface
  - Micro-seal
- Minor seal coat (PASER 7-9)
  - Fog seal

Factors affecting material behavior

- Base
  - Native
  - AB
  - Cement/lime treated
- Compaction increased from 95 to 96%
- Effective air voids decreased from 4 to 3.5%
- Voids in Mineral Aggregate increased from 15 to 16%
- Recycled asphalt pavement prohibited for local/collector streets
- Binder grade (penetration, viscosity)
- Binder modifiers (polymers)
  - Crumb rubber (asphalt-rubber asphaltic concrete-ARAC)
  - Terminal Blend (terminal blended rubberized asphalt-TR)

Alternative treatments

- Concrete treated base
- Chip seals
- Roller compacted concrete (RCC)
- Polymer-modified AC (ARAC/TR)
- Thin asphalt concrete overlays
- Aramid fibers
- Geofabric & Stress Absorbing Membrane Interlayers
- Surface sealers
  - HA5 (high density mineral bond)
  - SealMaster Liquid Road (polymer-modified, fiber reinforced asphalt emulsion coating)

Pavement Testing Plan

- Objective: test different materials of differing initial cost to evaluate life-cycle ROI
- Test section: San Joaquin Road from Old Ajo Highway to Milky Way Drive
  - Total project length 4.3 miles
  - ADT 2100 vehicles per day
  - Existing pavement 2” chip seal (multi-layer) on subgrade
  - Subgrade R-value 30 – 51
  - PASER Rating 3
  - Number of test sections 13
  - Length of test sections 1000 feet

Test plan treatments

1. 1” Green asphalt over existing
2. 1 ¼” overlay of existing with PAG 3 Terminal Blend
3. 2” overlay of existing (PAG 2 mix)
4. 2” overlay of existing (PAG 2 mix with fiber)
5. 2” overlay of existing (PAG 2 mix terminal blend)
6. Pulverize 5” and compact with cape seal (chip seal plus slurry seal)
7. Pulverize 5” and compact with chip seal
8. Pulverize 5” and compact with cement (300 psi) and chip seal
9. Pulverize 5” and compact with cement (500 psi) and chip seal
10. 6” roller compacted concrete
11. Double chip seal over existing
12. Rubberized chip seal over existing
13. 2” mill and fill (PAG 2 mix)

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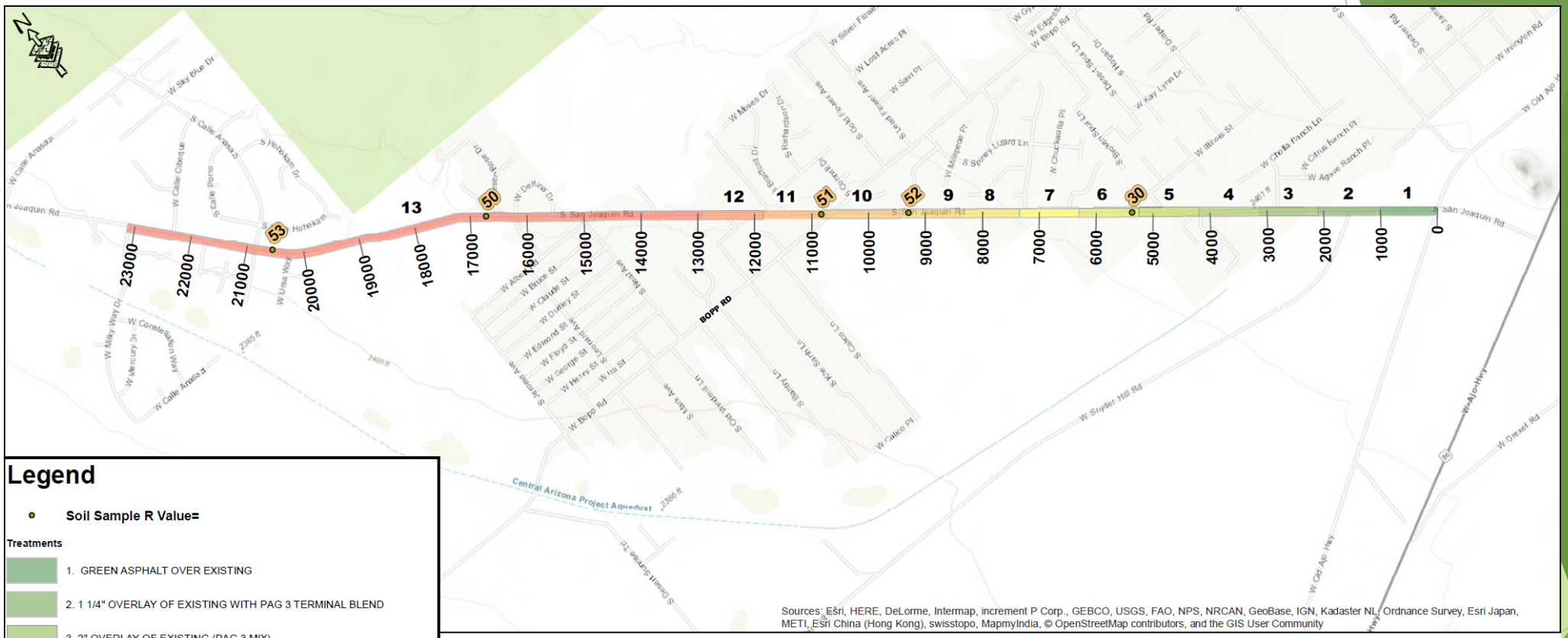
Test plan layout & soil borings



Legend

- Soil Sample R Value=

Treatments

1. GREEN ASPHALT OVER EXISTING
2. 1 1/4" OVERLAY OF EXISTING WITH PAG 3 TERMINAL BLEND
3. 2" OVERLAY OF EXISTING (PAG 3 MIX)
4. 2" OVERLAY OF EXISTING (PAG 2 MIX WITH FIBER)
5. 2" OVERLAY OF EXISTING (PAG 2 MIX TERMINAL BLEND)
6. PULVERIZE 5" AND COMPACT WITH CAPE SEAL
7. PULVERIZE 5" AND COMPACT WITH CHIP SEAL
8. PULVERIZE 5" AND COMPACT WITH CEMENT (300 PSI) AND CHIP SEAL
9. PULVERIZE 5" AND COMPACT WITH CEMENT (500 PSI) AND CHIP SEAL
10. 6" ROLLER COMPACTED CONCRETE
11. DOUBLE CHIP SEAL OVER EXISTING
12. RUBBERIZED CHIP SEAL OVER EXISTING
13. 2" MILL AND FILL

0 1,100 2,200 3,300 4,400 Feet

1 inch = 1,667 feet

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Test evaluation

- Evaluation at regular intervals (6 months, 1 year, 2 years…)
- Localized soil tests & drainage crossings will be identified and correlated to pavement condition evaluation
- PAG/COT Automated Road Analyzer van
- Observations
  - Cracking
  - Rutting
  - Oxidation
  - Surface wear/roughness
- Materials testing
  - Additional lab tests may be used to evaluate cause/effect of visual observations or for purposes of projecting longevity
- Return on Investment (ROI)
  - Treatment-specific ROI curves will be developed based on data from each evaluation interval to rank treatment benefit-cost projection
  - Treatment-specific curves will be correlated against national research curves for that treatment, to infer longer term performance from shorter observation periods

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Next steps

- Solicit TAC subcommittee feedback and recommendations
- Evaluate testing protocols based on feedback
- Evaluate pavement standards based on feedback
- Provide a materials use and testing summary report based on feedback
- Need for follow-up pavement subcommittee meeting?