Practical Conclusions from ODOT Research Projects

2008 Ohio Asphalt Paving Conference

ODOT Pavement Research

- 20 active research projects
  - Pavement Design
  - Pavement Rehabilitation
  - Pavement Management
  - Preventive Maintenance

Rational Approach to Base Type Selection

Truck/Pavement/Economic Modeling & In-Situ Field Data Analysis Application

FHWA/OH-2006/3A

Drs. Sargand, Wu, & Figueroa

Ohio University

Rational Approach to Base Type Selection

LOG-33-17.82

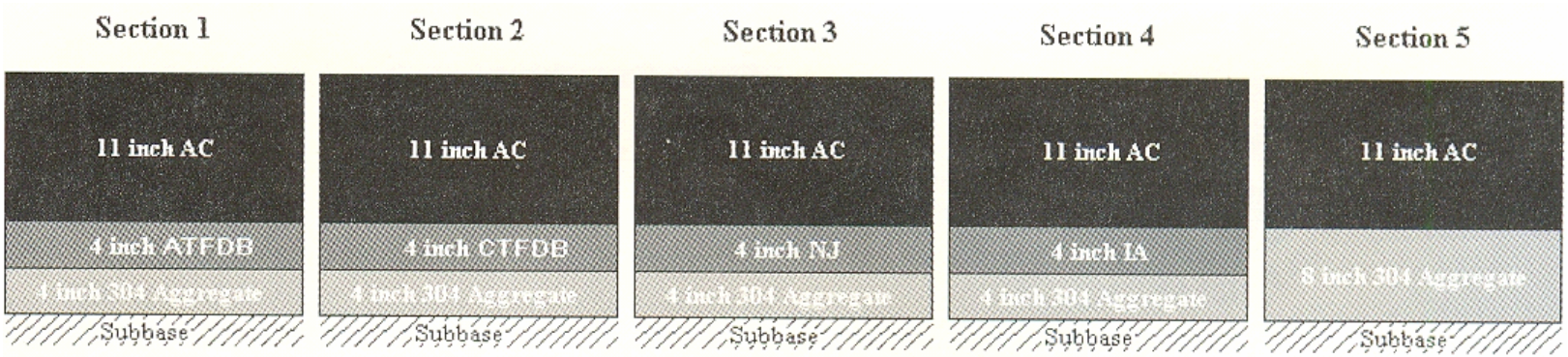
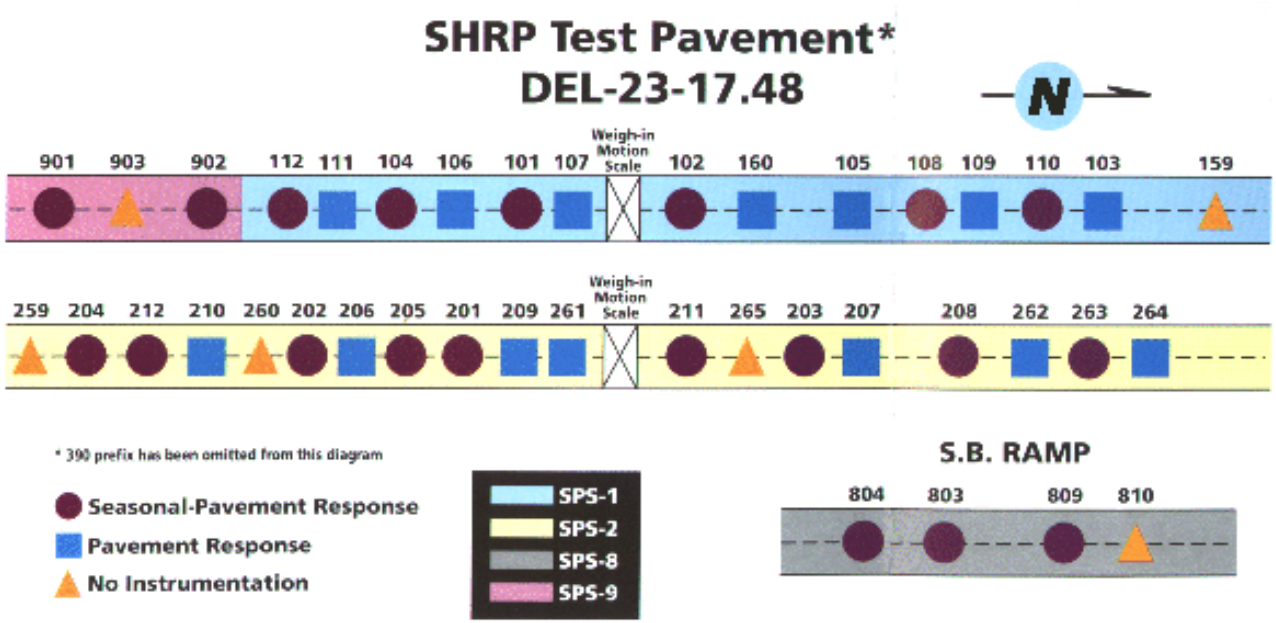


Figure 1 – Layer Configurations of Test Sections

Rational Approach to Base Type Selection



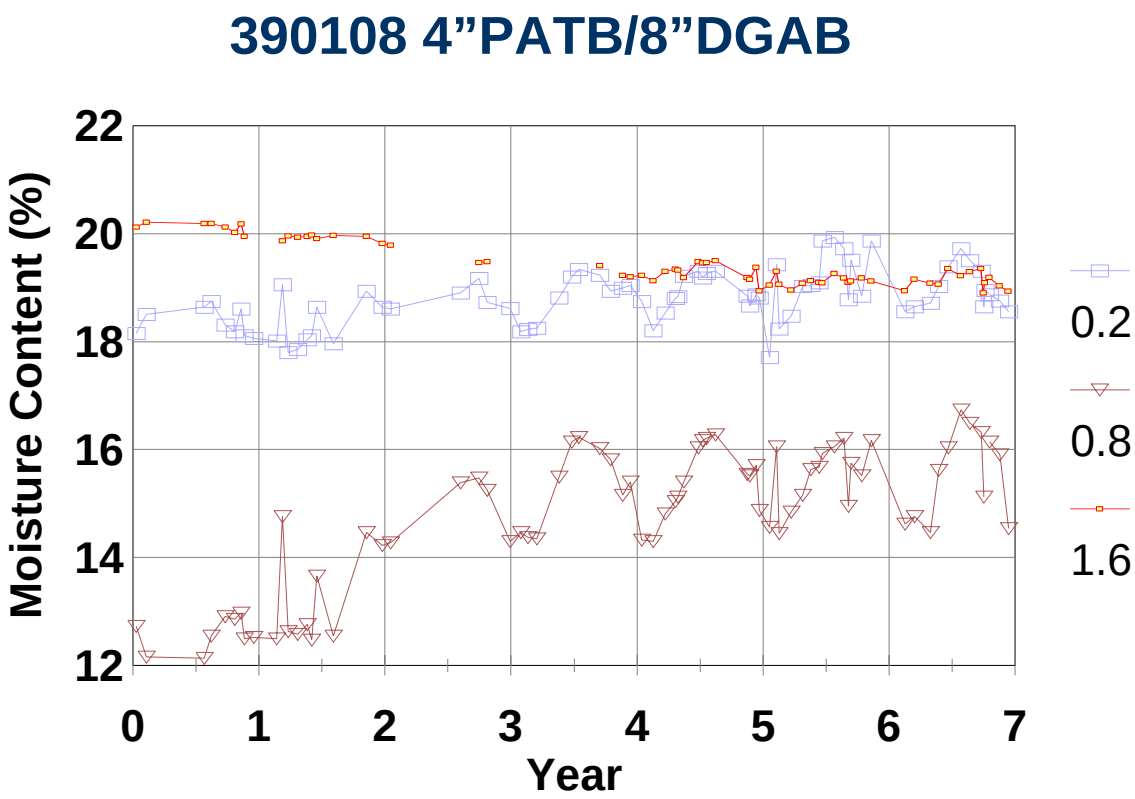
Rational Approach to Base Type Selection

Asphalt Concrete Studies				
SPS-1				
Section	Thickness (in) AC	Thickness (in) Base	Base Type	Drain
390101	7	8	DGAB	NO
390102	4	12	DGAB	NO
390103	4	8	ATB	NO
390104	7	12	ATB	NO
390105	4	8	4"ATB/4"DGAB	NO
390106	7	12	8"ATB/4"DGAB	NO
390107	4	8	4"PATB/4"DGAB	YES
390108	7	12	4"PATB/8"DGAB	YES
390109	7	16	4"PATB/12"DGAB	YES
390110	7	8	4"ATB/4"PATB	YES
390111	4	12	8"ATB/4"PATB	YES
390112	4	16	12"ATB/4"PATB	YES
390159	4	25	15"ATB/4"PCTB/6"DGAB	YES
390160	4	15	11"ATB/4"DGAB	YES
SPS-8				
390803	4	8	DGAB	NO
390804	7	12	DGAB	NO
SPS-9				
390901	4	22	AC-20 12"ATB/4"PATB/6"DGAB	YES
390903	4	22	PG-64-28 12"ATB/4"PATB/6"DGAB	YES
390902	4	22	PG 58-28 12"ATB/4"PATB/6"DGAB	YES

Rational Approach to Base Type Selection

Section	Density (pcf)	Modulus (ksi)
390101	116.8	11.69
390102	124.6	20.37
390103	119.8	15.69
390104	119.7	16.85
390105	117.6	15.54
390106	123.4	17.88
390107	121.3	16.76
390108	117.4	18.95
390109	119.7	11.51
390110	118.0	12.95
390111	121.3	18.08
390112	121.9	13.82
390159	118.9	5.77
390160	123.1	18.63
Average	120.3	15.32
Std. Dev.	2.4	3.87
CV	2%	25%

Rational Approach to Base Type Selection



Rational Approach to Base Type Selection

		Median Moisture Content (%)		
Depth below subgrade surface		9"	36"	72"
section	base type			
101	DGAB	18.7	19.3	20.9
104	ATB	19.3	19.2	20.1
108	PATB/DGAB	19.2	15.6	19.1
110	ATB/PATB	19.8	19.1	20.2
112	ATB/PATB	18.5	17.7	17.8

Rational Approach to Base Type Selection

- Subgrade moisture is not necessary from the surface
- Subgrade density meets specification does not assure uniform subgrade strength
- Base types do not affect subgrade moisture content

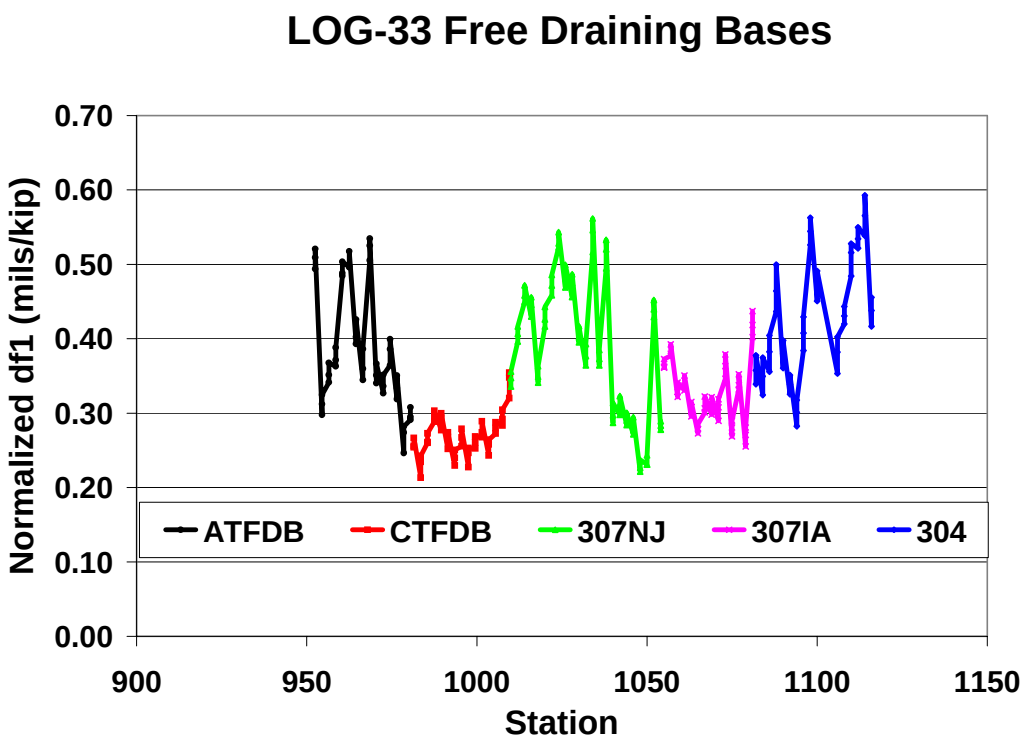
Rational Approach to Base Type Selection

- Purpose of base
  - Construction platform
  - Add protection against frost action
  - Increase load-supporting capacity of the pavement by providing added stiffness
  - Distribute load
  - Provide drainage

Rational Approach to Base Type Selection

	Permeability (ft/day)					
	304	IA	NJ	CE	Cement	Asphalt
Fine	206	873	2234	2654	25345	25061
Median	1417	2277	3824	3703		
Coarse	5443	8210	7850	8720		

Rational Approach to Base Type Selection



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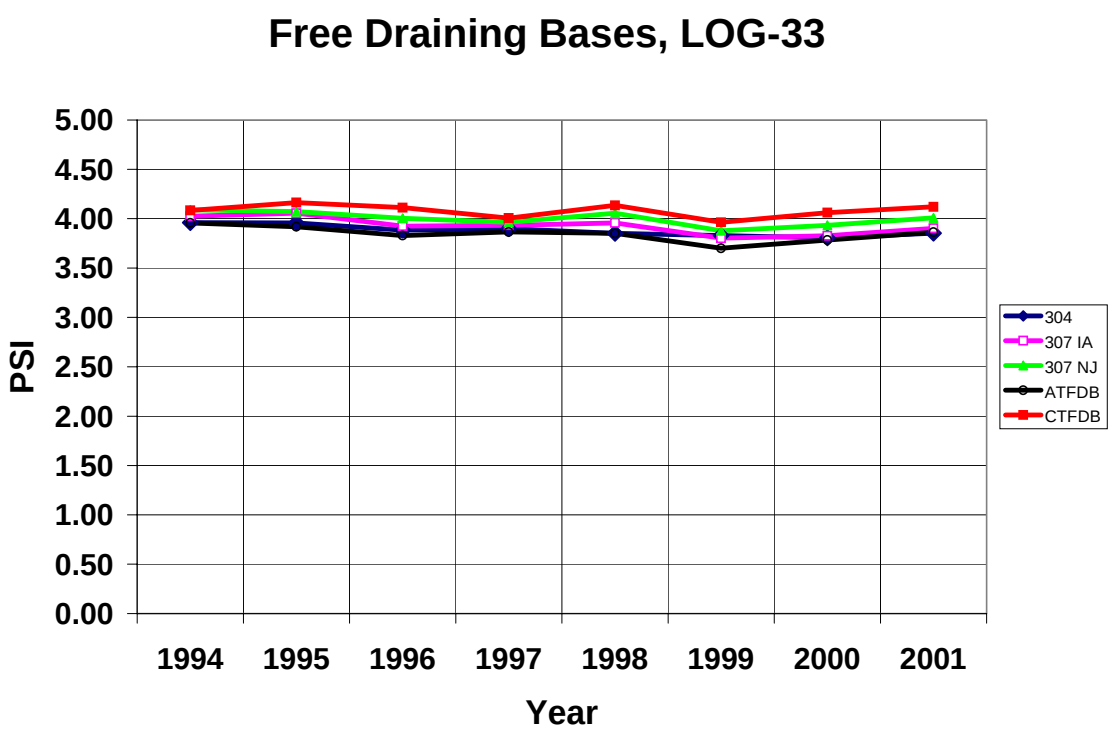

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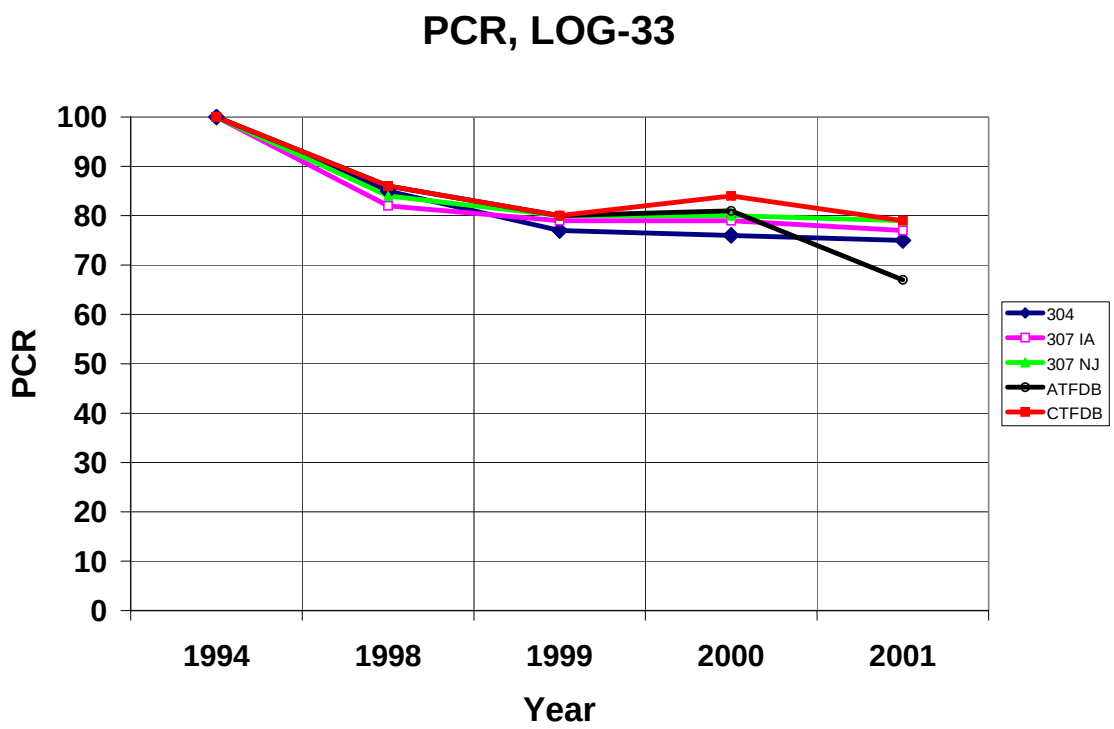
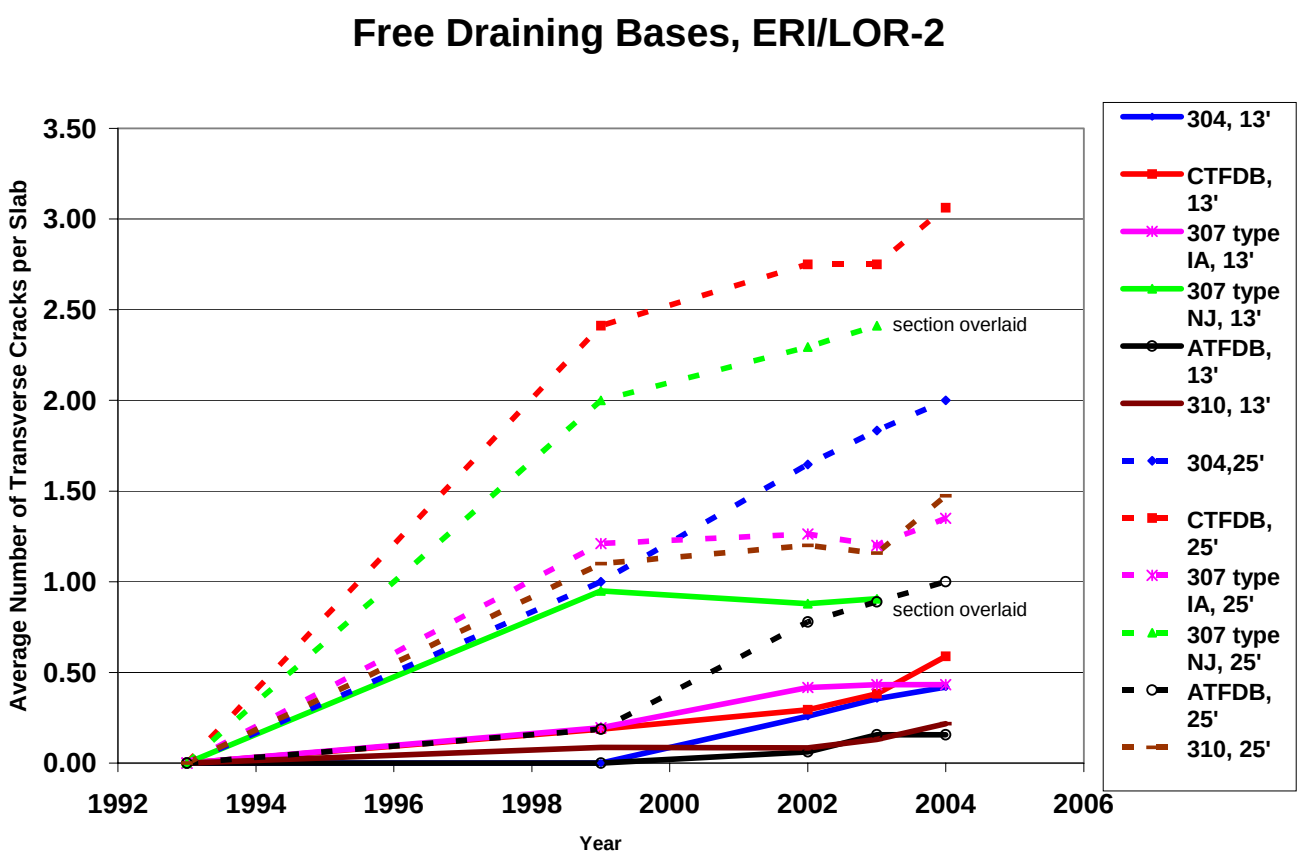


Rational Approach to Base Type Selection

- CTFDB had much higher M_R than other bases
- NJ, IA, 304 about equal
- ATFDB had the lowest M_R
- Roughness – all sections generally similar
- Pavement condition – all sections generally similar
  - Decline in rating for ATFDB in 2001
- ATFDB cores showed evidence of some stripping of asphalt from aggregate
- March, 2001 moratorium on free draining bases.

Rational Approach to Base Type Selection



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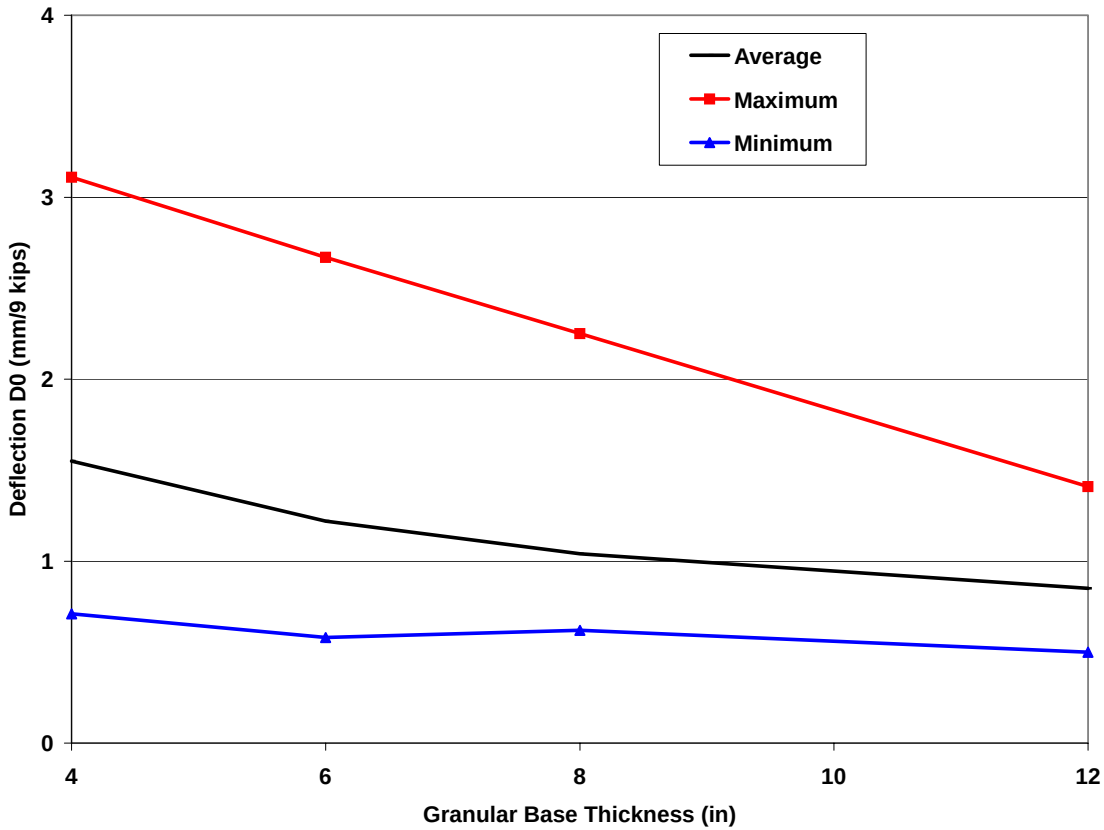

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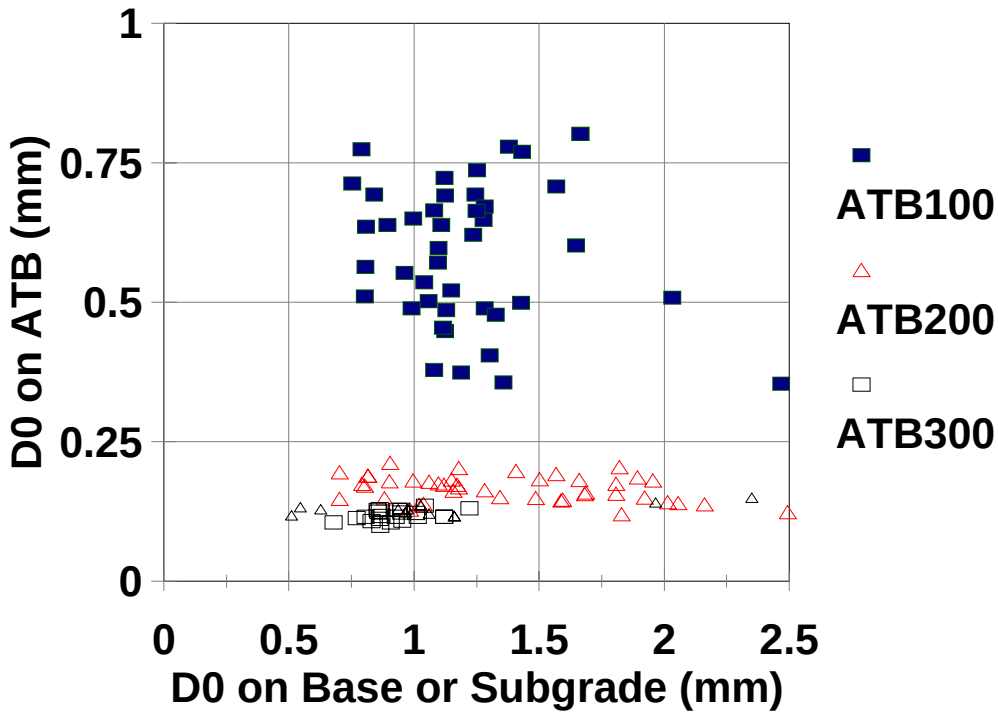

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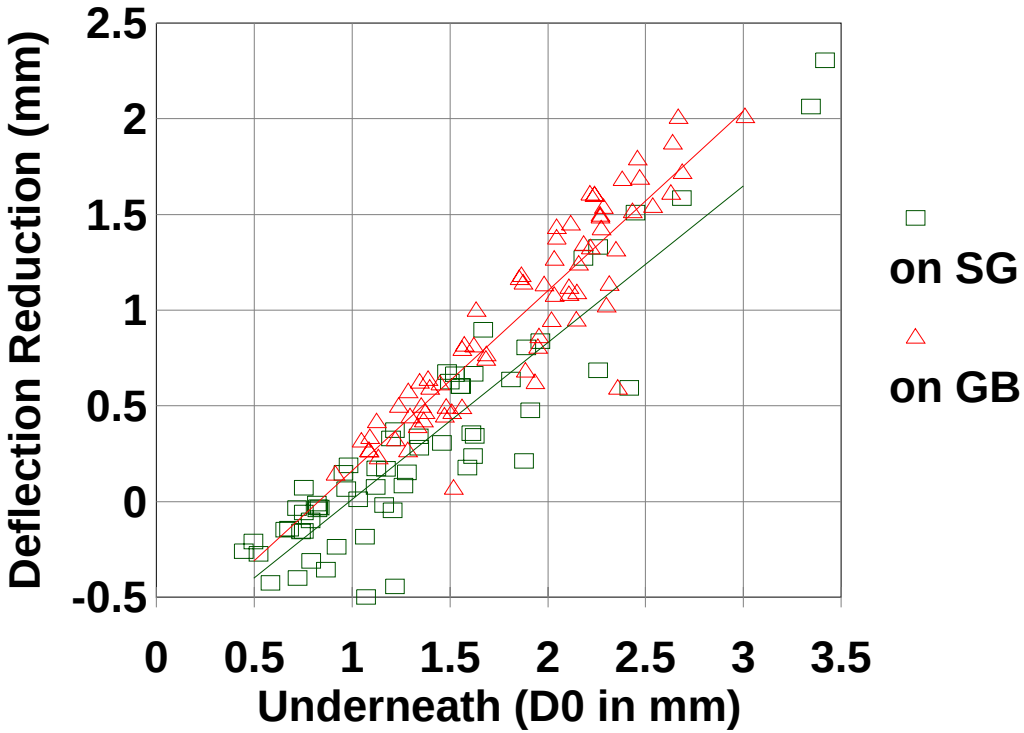


Rational Approach to Base Type Selection

- GB > 200mm (8”) increase subgrade stiffness and uniformity
- Thicker GB increase both stiffness and uniformity
- ATB of 200mm (8”) thick is much more uniform than 100 mm (4”)

Rational Approach to Base Type Selection

- Summary
  1. Base type has little impact on subgrade moisture and initial pavement performance
  2. Choice of base type depends chiefly on three requirements
     - appropriate stiffness
     - sufficient permeability
     - good constructability

Rational Approach to Base Type Selection

- Recommendations
  - For uniformly weak or highly variable subgrades, bases with high stiffness or very thick granular base is recommended. Soil stabilization may be used to improve subgrade stiffness.
  - For strong, uniform subgrades, granular base and ATB are suitable choices

Rational Approach to Base Type Selection

- Technical Notes Published
  - Evaluation of Base Materials under Flexible Pavement (ORITE-8)
    - LOG 33
  - Pavement Design Feature Effects on Subgrade Volumetric Moisture Content (ORITE-9)
    - DEL 23

Fractured Slab Techniques – Break & Seat

- Effectiveness of Breaking and Seating of Reinforced PCC Pavement before Overlay FHWA/OH-95/023
- Long Term Monitoring of Broken and Seated Pavement
  - FHWA/OH-2002/024
  - Drs. Minkarah and Arudi
  - University of Cincinnati
- Investigation of Pavement Cracking on SR4 and Demonstration of the Multihead Breaker in Fracturing Reinforced Concrete Pavement before Asphalt Overlay FHWA/OH-2006/12
  - Dr. Arudi
  - Inframe
- FHWA Special Project 202

Fractured Slab Techniques – Break & Seat

- Major rehabilitation technique for jointed reinforced concrete pavement
  - break pavement into small slabs (18”)
  - retards reflective cracking
- 1992 moratorium on break & seat
  - non uniform break pattern
  - partial debonding of steel

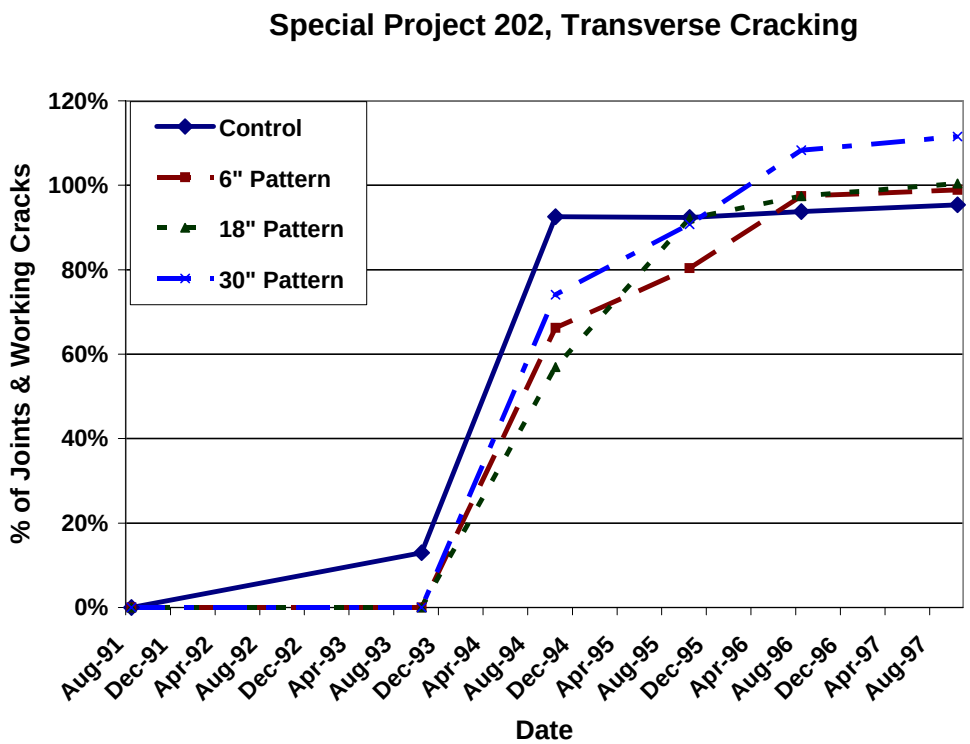
Fractured Slab Techniques – Break & Seat

- **Special Project 202**
  - **MUS-70**
    - **control, 6” pattern, 18” pattern, 30” pattern**
    - **guillotine pavement breaker**
    - **7” asphalt overlay on all sections**
    - **constructed in 1991**

Fractured Slab Techniques – Break & Seat

- University of Cincinnati & Inframe studies
  - FAY/MAD-71
    - control, 18” break pattern
    - guillotine pavement breaker
    - 8 ½” asphalt overlay on all sections
    - constructed in 1992
  - GRE/MOT-4
    - control, 18” break pattern
    - pile hammer pavement breaker
    - 6 ½ “ asphalt overly on all section
    - constructed in 1993

Fractured Slab Techniques – Break & Seat



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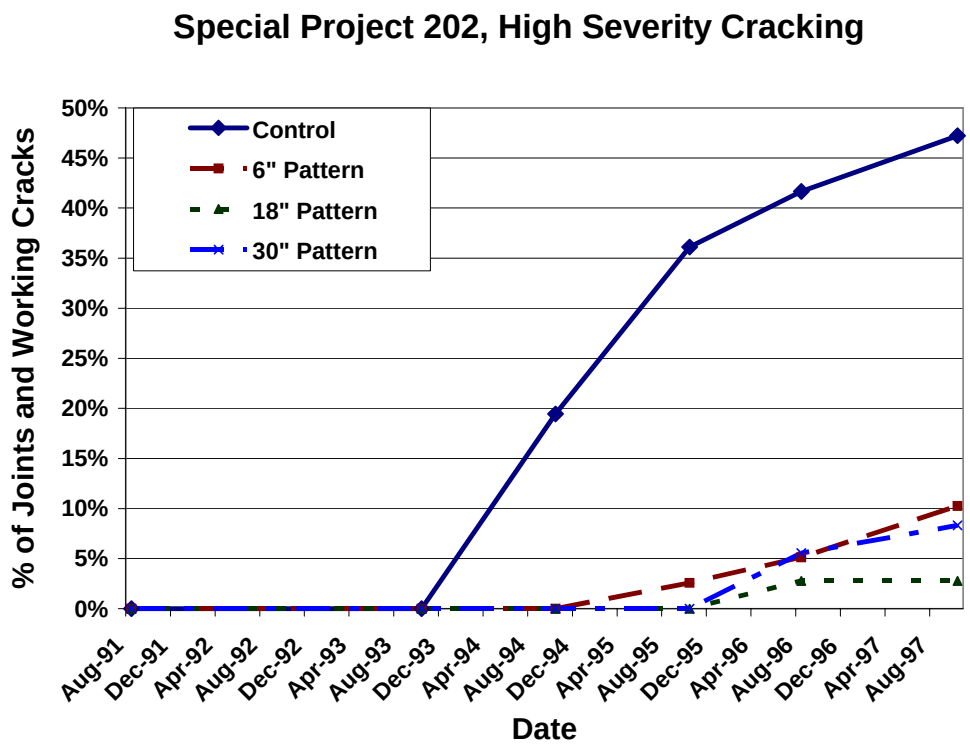
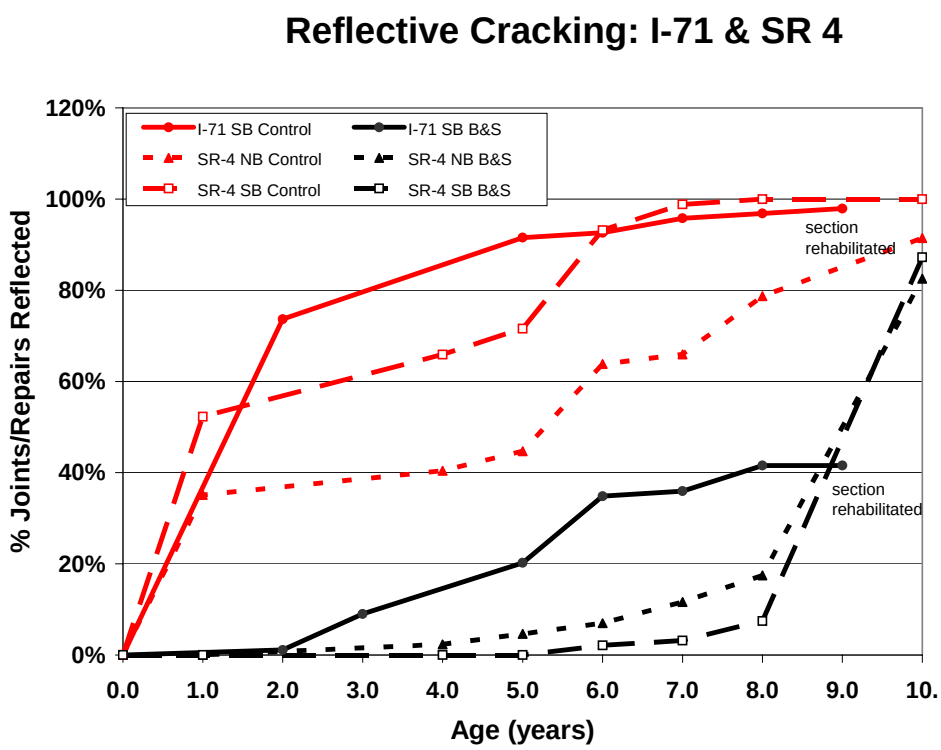


Fractured Slab Techniques – Break & Seat

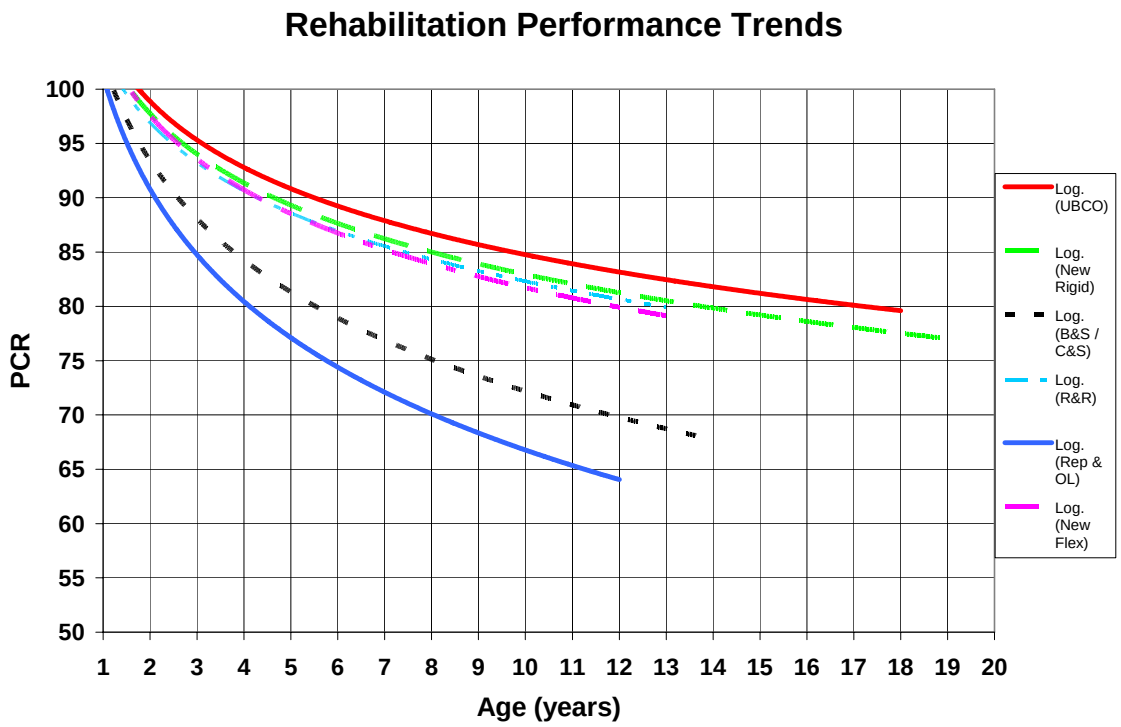


Fractured Slab Techniques – Break & Seat

Fractured Slab Techniques – Break & Seat

- MHB and Pile Hammer do not produce a uniform breaking pattern throughout the depth of concrete slab
- Considerable variability exists in the extent of breaking
- Steel debonding is not consistent
- After 11 years being in service, most of the joints on SR-4 B/S sections reflected; however, their severity is NOT as extensive as that of control sections

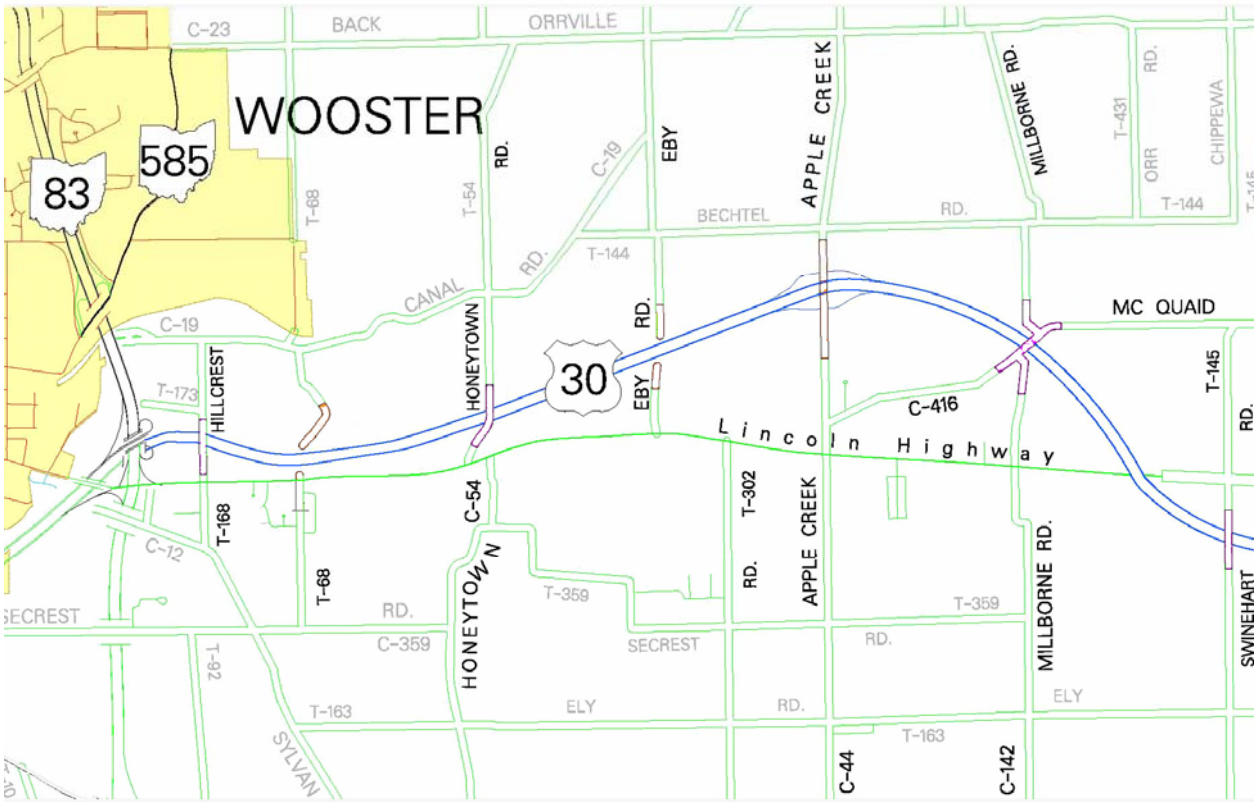
Fractured Slab Techniques – Break & Seat



Fractured Slab Techniques – Break & Seat

- Not recommended as a major rehabilitation for JRCP in Ohio
- Not recommended for high type routes
- Viable for minor rehabilitation
- Guillotine hammer is not recommended for breaking the pavement
- A minimum overlay thickness of 6” is recommended

Perpetual Pavement



This map is taken from Ohio DOT website

Perpetual Pavement

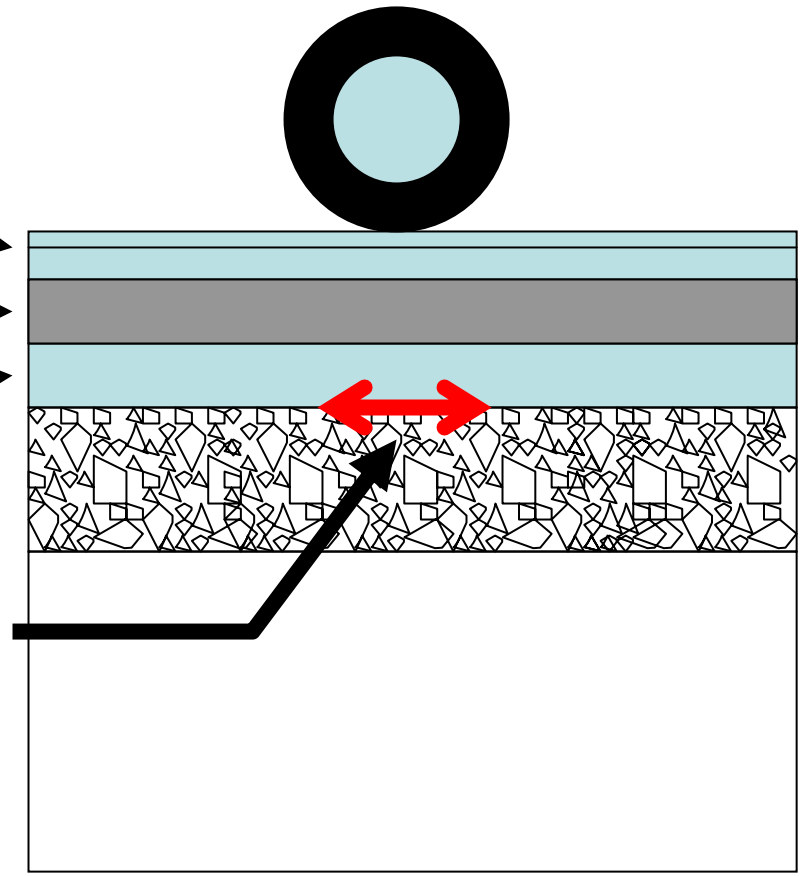
Perpetual Pavement

Perpetual Pavement

Surface: High Performance

Base: Economical & Durable

Fatigue Resistant Layer



Maximum Tensile Strain for Fatigue Crack

Tensile Strain < 70 me

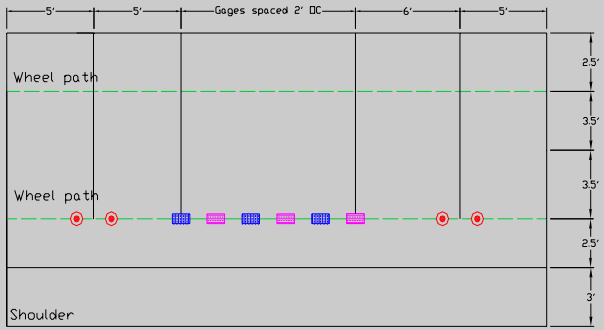
Design Input: Material's Properties

SMA	E = 500,000 psi	PR = 0.35
19 mm SUPERPAVE	E = 500,000 psi	PR = 0.35
Intermediate (302)	E = 500,000 psi	PR = 0.35
Fatigue Resistant Layer (302)	E = 500,000 psi	PR = 0.35
Aggregate Base (304)	E = 20,000 psi	PR = 0.40
Subgrade	CBR = 4, 5, and 6	PR = 0.45

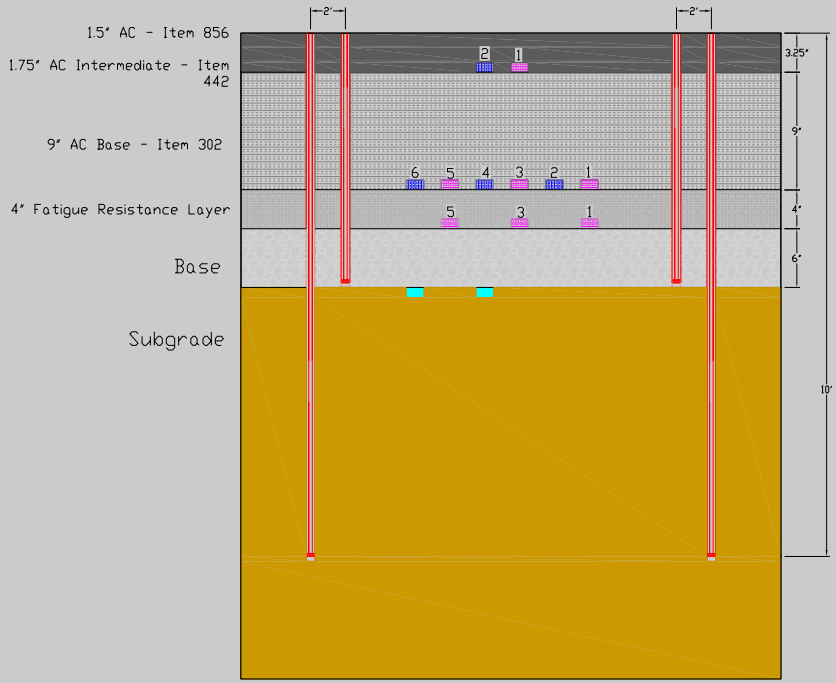
Perpetual Pavement

Thickness (inches)	Material	Design Air Voids (%)	PG Binder	Target Density (%)
1.50	(443) Stone Matrix Asphalt Concr, 12.5mm	3.5	76-22M	93-97
1.75	(442) Asphalt Concrete Inter. Course, 19mm Type A	4.0	76-22M	93-97
9	(302) Asphalt Concrete Base	4.5	64-22	93-96
4	(302) Special Fatigue Resistant Base Layer	3.0	64-22	94-97
6	(304) Aggregate Base			

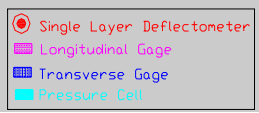
AC Section A



Plan View

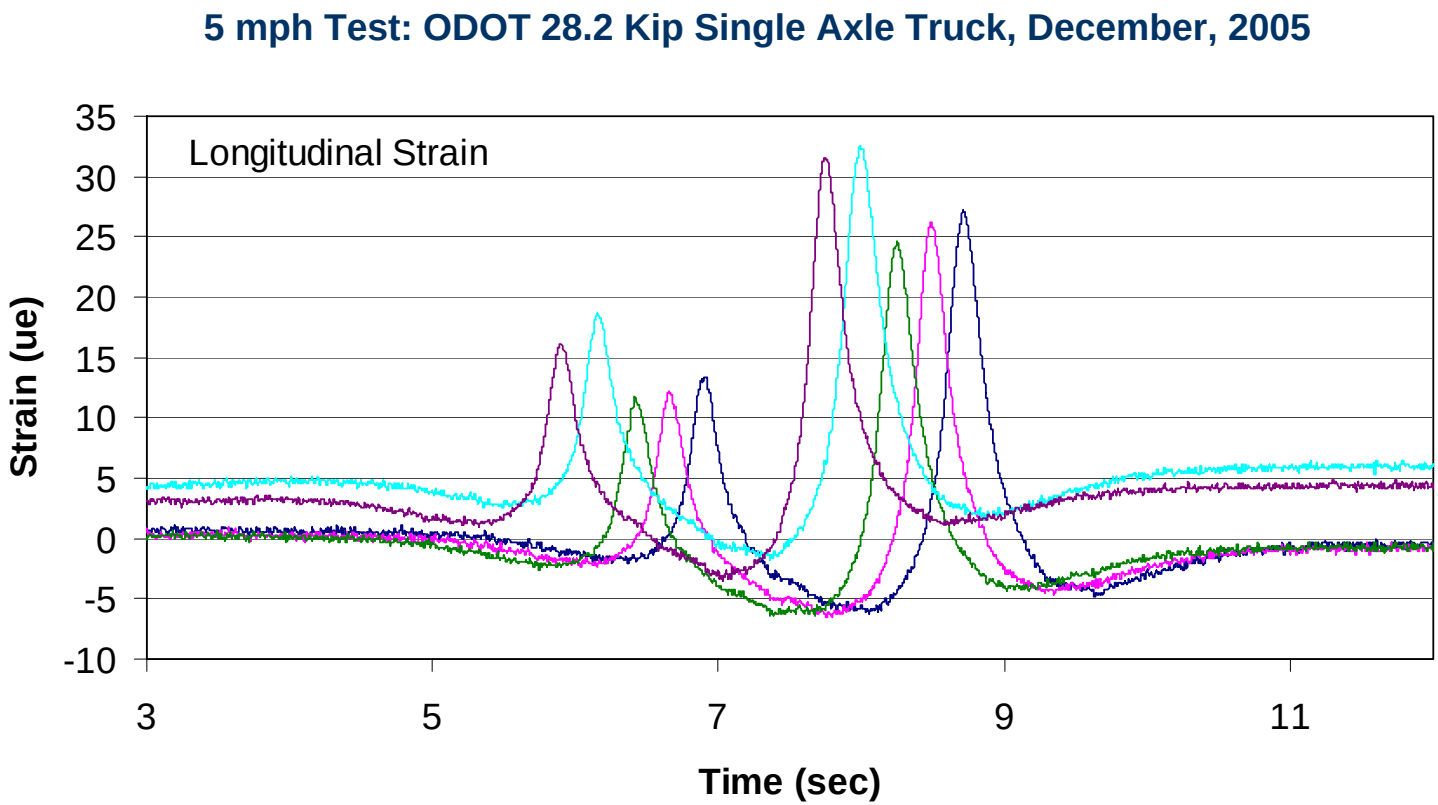


PROFILE VIEW (NTS)



AC STN 876 SECTION A LABELING

Perpetual Pavement



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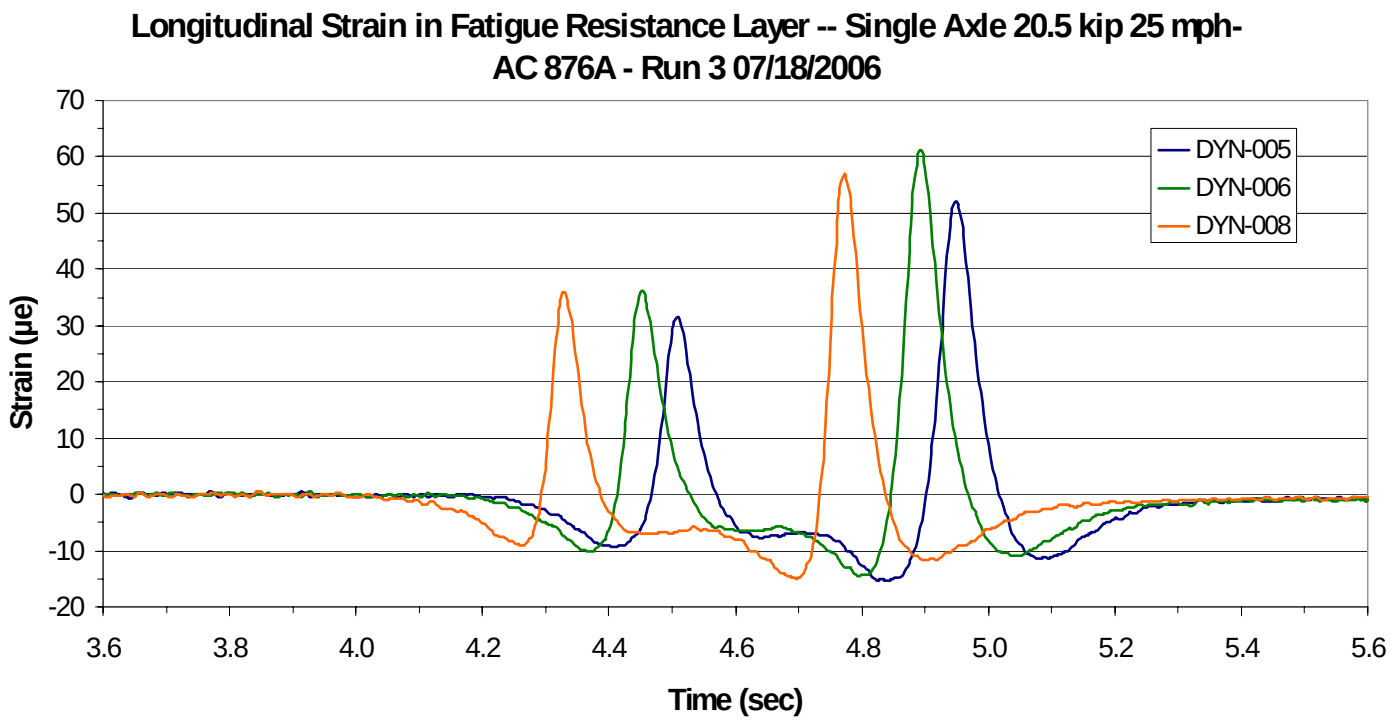

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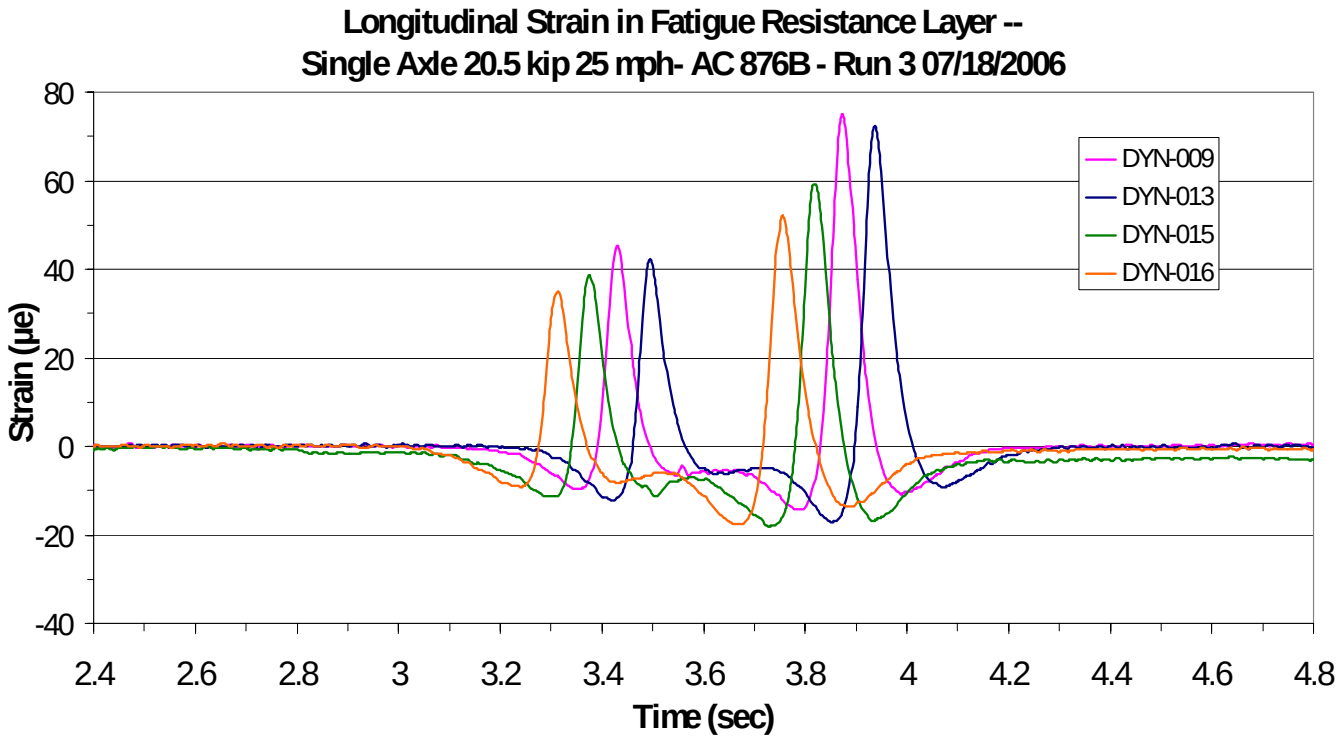

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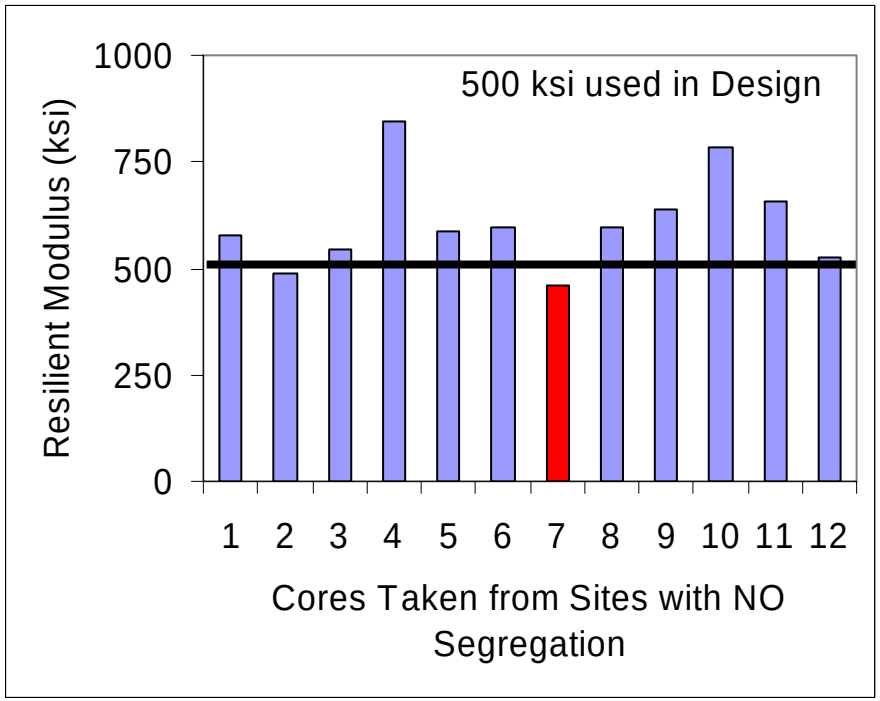

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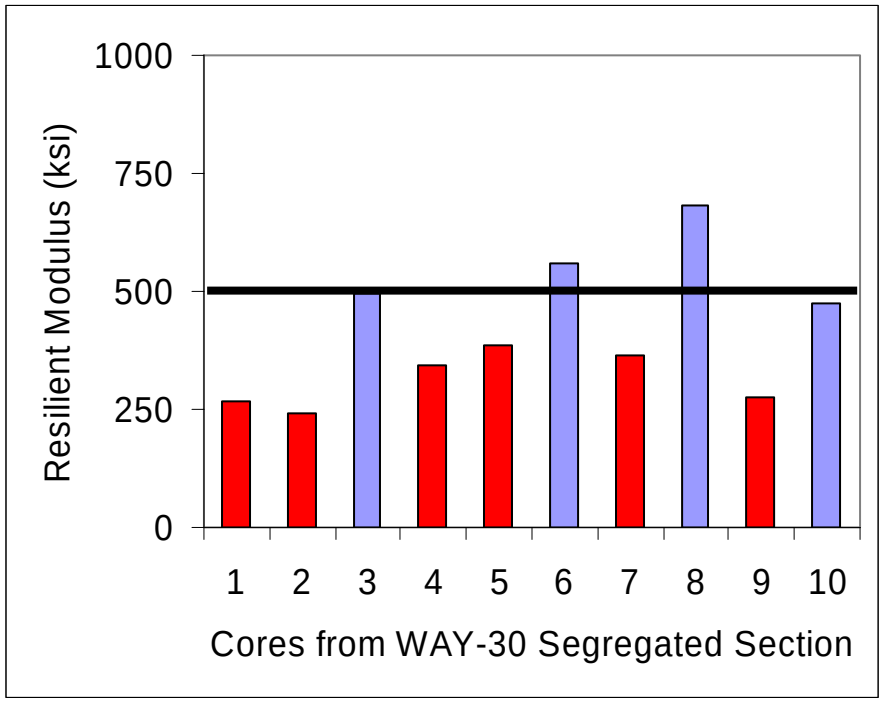

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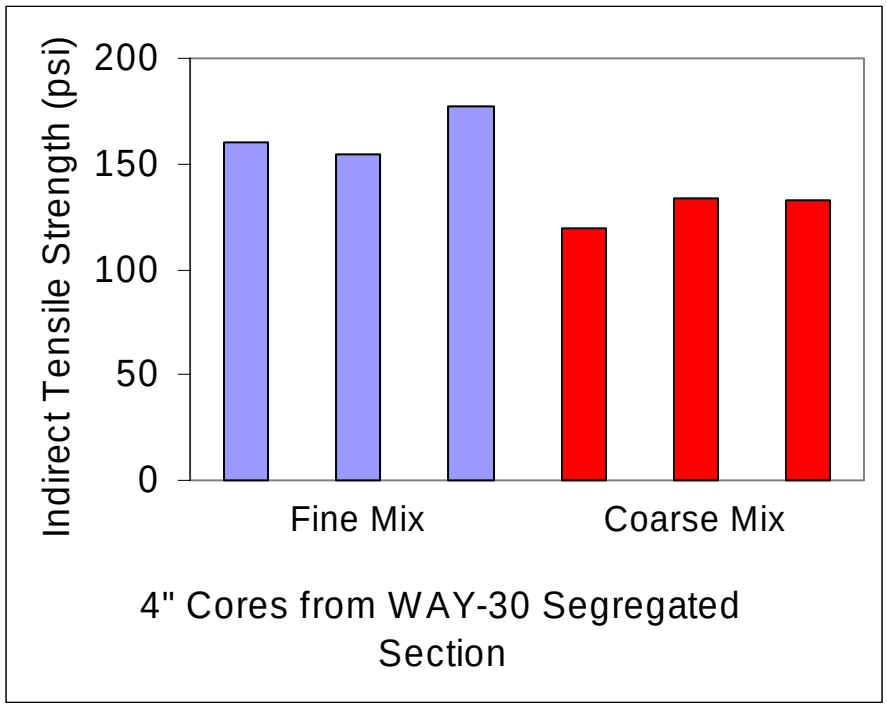

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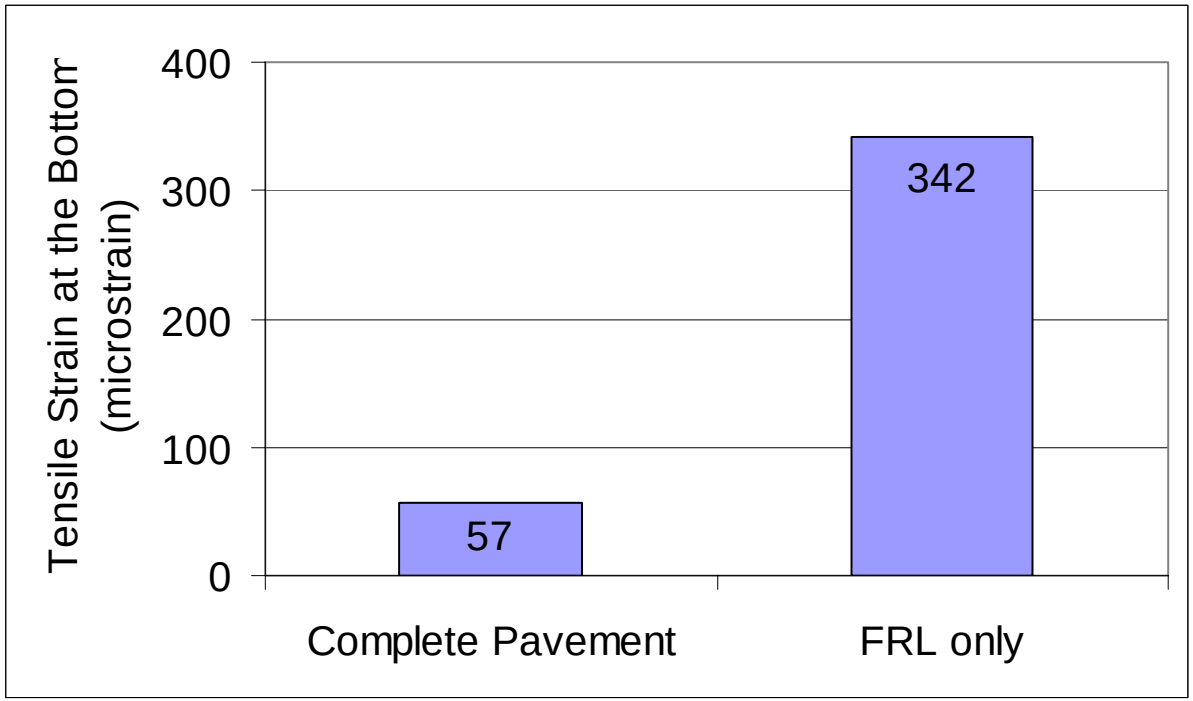

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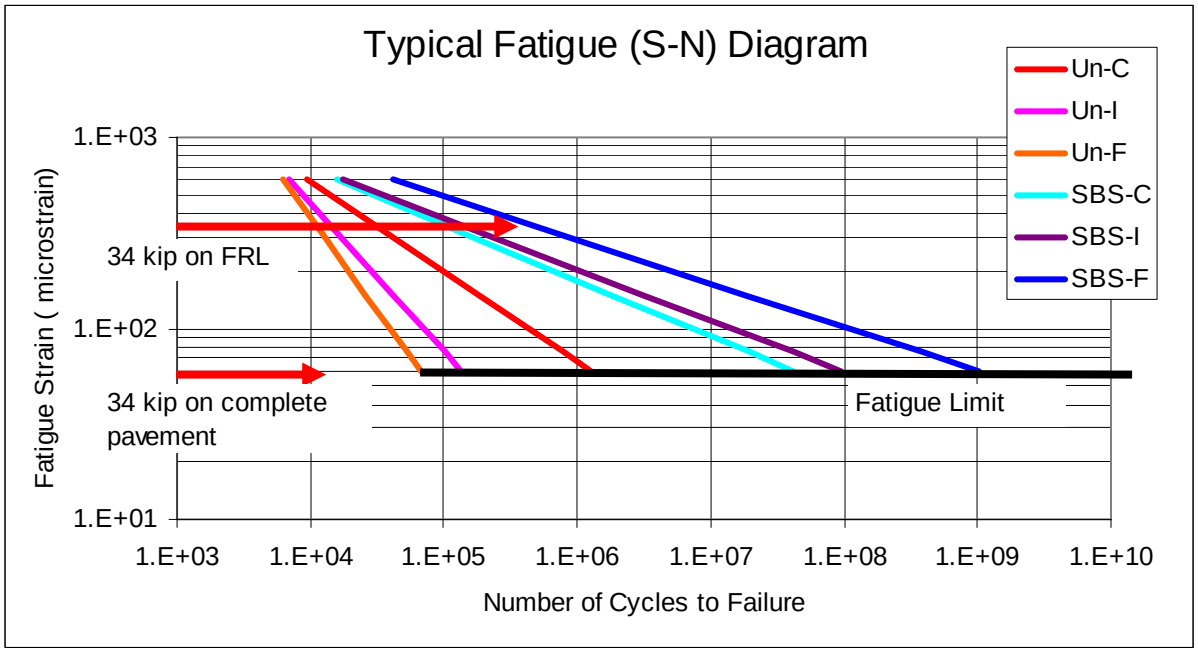

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