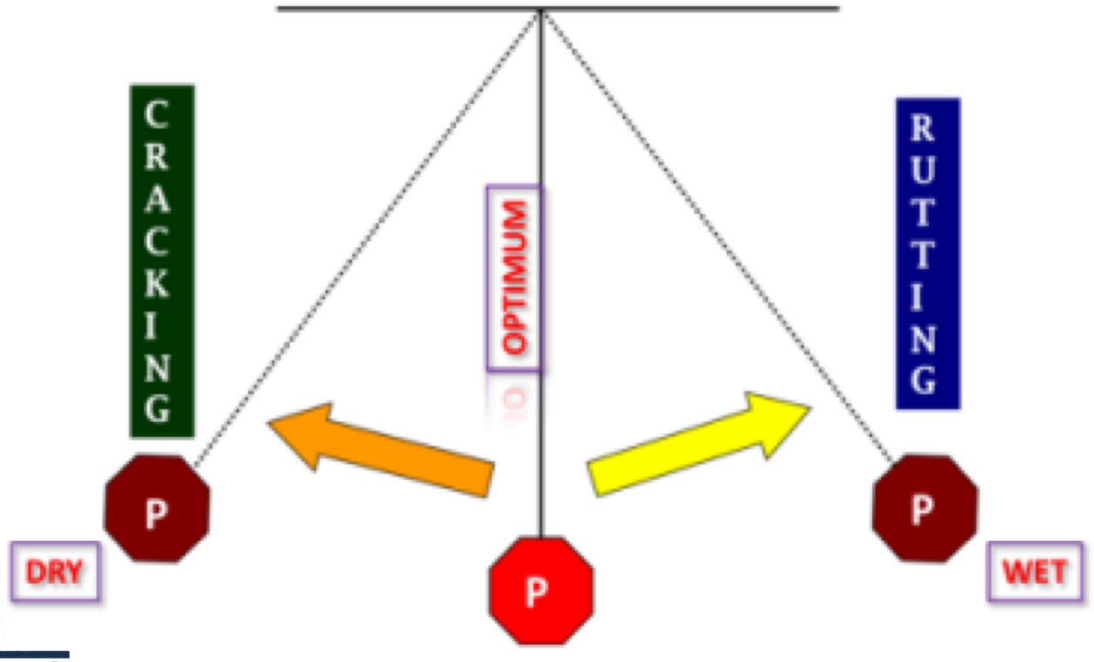
Optimized or Balanced Mix Design

- Crack Resistant
- Rut Resistant
- Resistant to Moisture Damage

Balanced Mix Design: ETG Definition

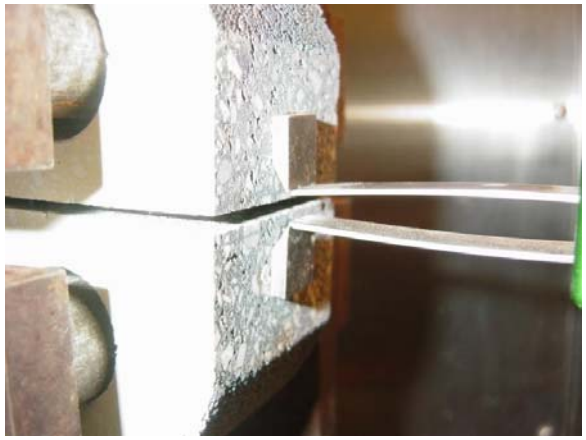
- Asphalt mix design using *performance tests* on appropriately *conditioned specimens* that address *multiple modes of distress* taking into consideration mix aging, traffic, climate and location within the pavement structure

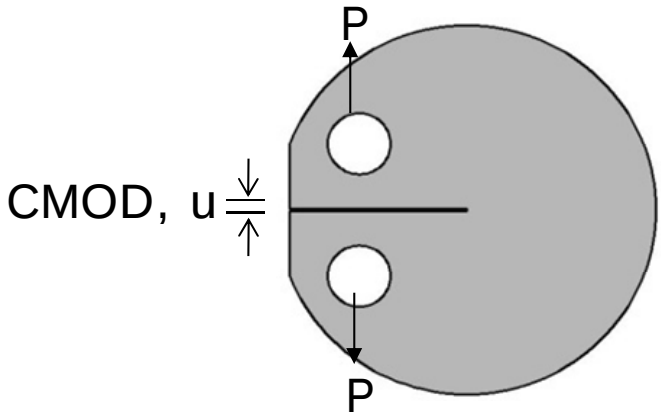


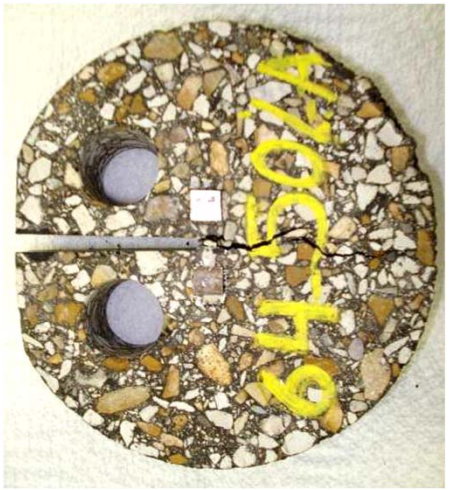
Performance Pendulum (Shane Buchanan, Oldcastle)

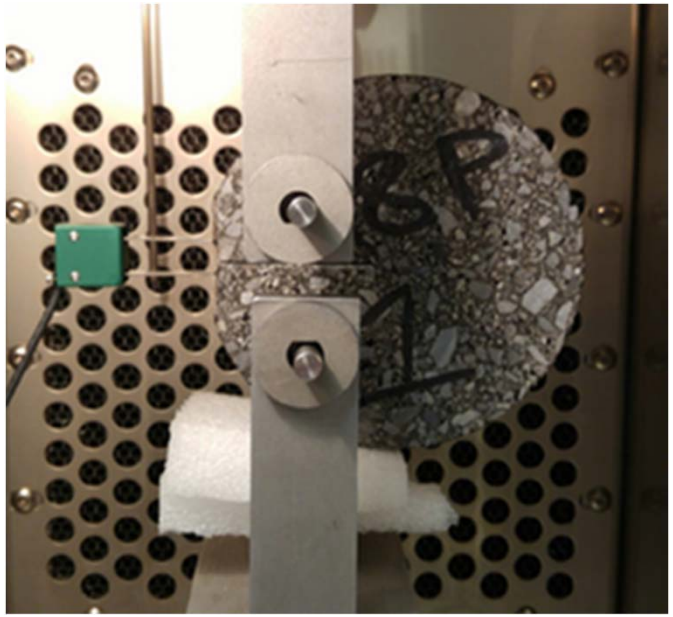
Disk-Shaped Compact Tension (DCT) Test

- ASTM D7313-13
- Loading Rate:
  - Crack Mouth Opening Displacement
  - CMOD Rate = 1.0 mm/min
- Measurements:
  - CMOD
  - Load



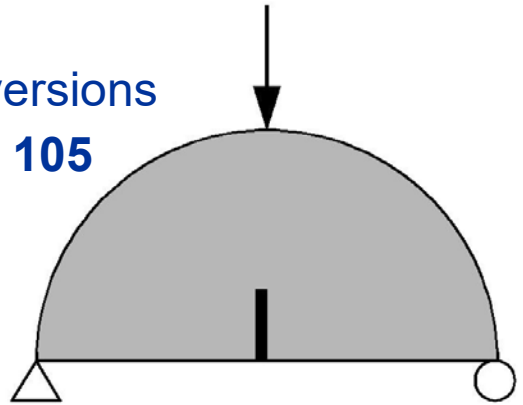


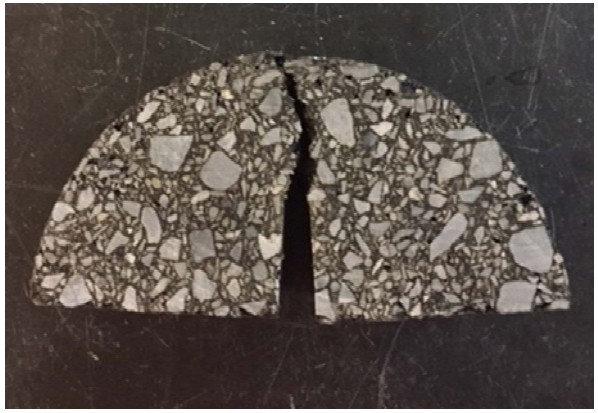


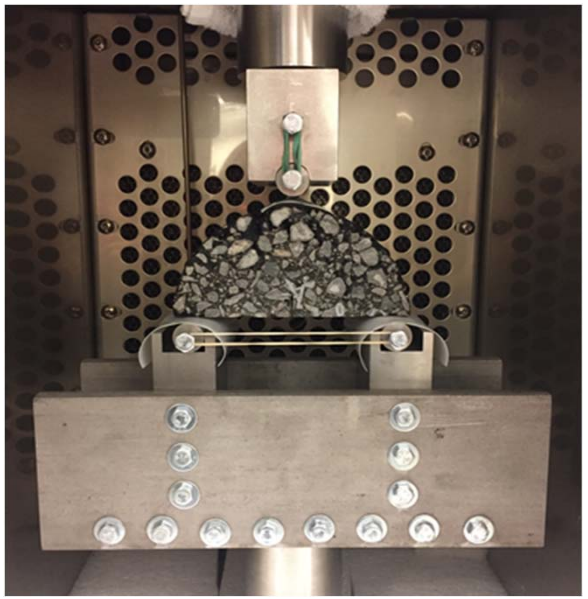


Semi-Circular Bend (SCB) Test

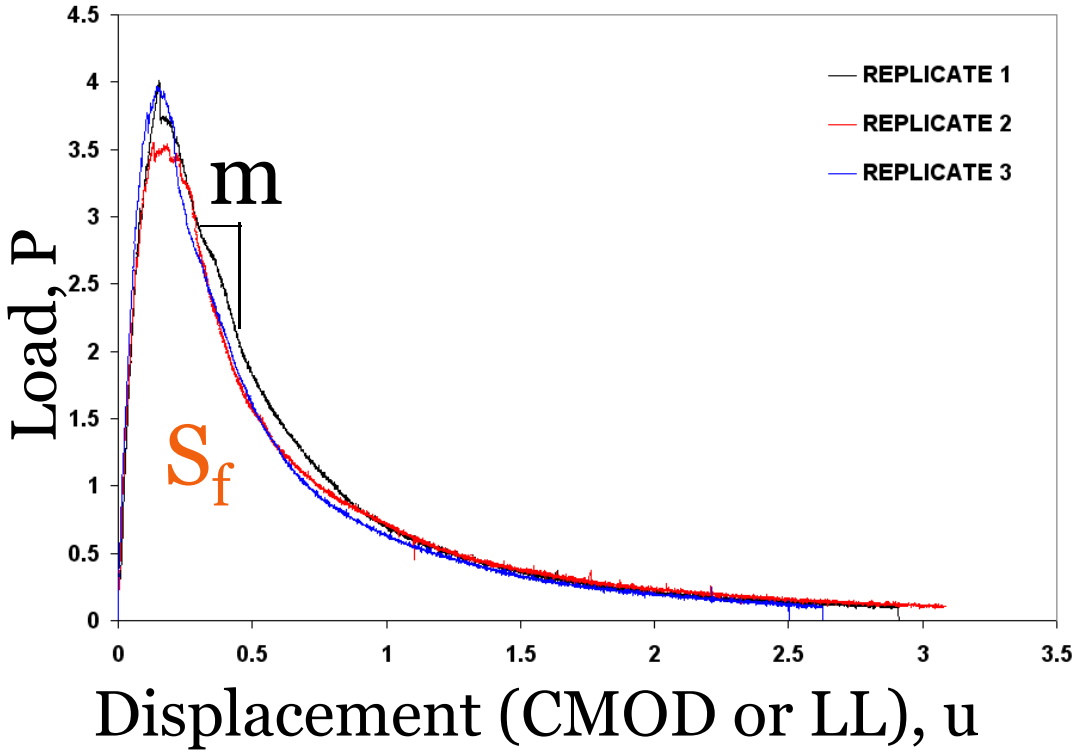
- Multiple variants exist
  - Early work in Europe
  - Simultaneous cold (Marasteanu et al. – MN) and intermediate temperature (Mohamed et al. – LA) versions
  - **Recent work from Al-Qadi et al. (IL) → AASHTO TP 105**
- AASHTO TP 105 (I-FIT)
  - Line load control, loading rate = 50 mm/min
  - Test temperature = 25 deg. C
- Measurements:
  - Displacement
  - Load
- Outcomes
  - Fracture Energy
  - Flexibility Index (FI)

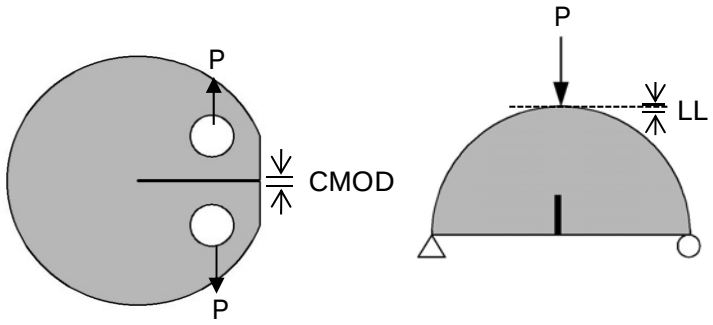






Fracture Parameters





Fracture work: Area under Load-Displacement curve

Fracture Energy, G_f: Energy required to create unit fracture surface

$$G_f = \frac{\text{Fracture Work, } S_f}{\text{Fracture Area}}$$

Flexibility Index, FI:

$$FI = G_f / m$$

DISTRICT 11 WINTER SCHOOL

Crown Plaza, Greentree Feb., 1, 2017

PA Asphalt Pavement Association
Gary L Hoffman, P.E.
Director of Technical Services

Agenda

1. Who we are!
2. PAPA Mission and Goals
3. PWT Implementation- LTS & HOLA
4. Warm Mix Require
5. Anti-Strip Additive
6. Long Life Asphalt Pavements
7. Performance Testing for Mix Optimization
8. Higher RAP/ RAS Mixes
9. Thinlay Special Provision
10. Porous Asphalt Specification
11. New Tack Coat (Sect. 460) Spec.
12. Upcoming PAPA events you may want to attend

Who we are!

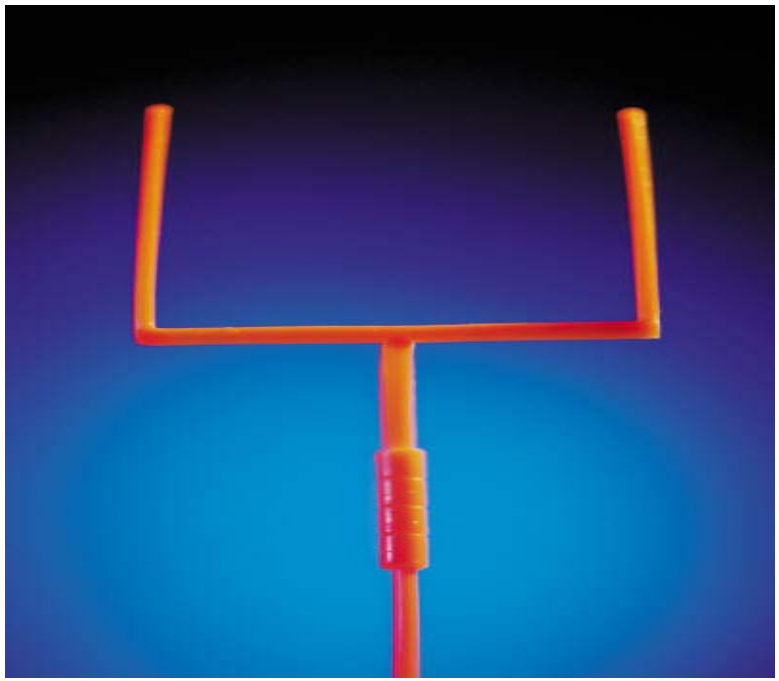
1. Charles Goodhart – Executive Director
   cgoodhart@pa-asphalt.org
2. Gary Hoffman – Director of Technical Services
   gary@pa-asphalt.org
3. Tina Holtzman – Office Administrator
   tina@pa-asphalt.org
4. Millie Lombardi – Manager of Financial Operations
   millie@pa-asphalt.org

PA Asphalt Pavement Association Mission

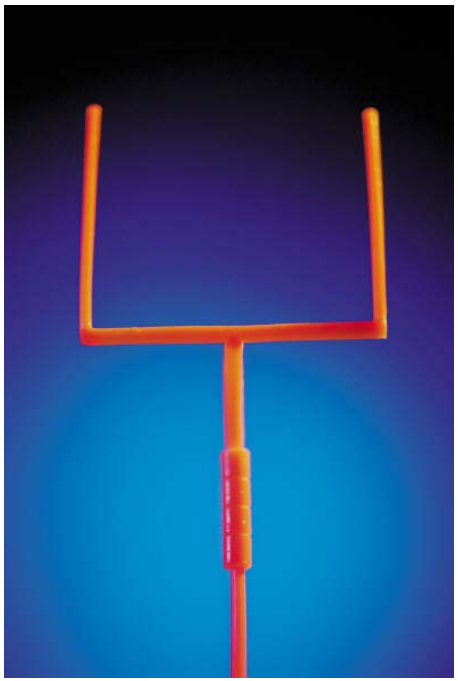
- **"To promote and provide to our customers the best available asphalt pavement technology and to represent and serve the common interests of our members."**

- Goals:
  - *Maintain Cooperative Relationships and Communications*
  - *Ensure Best Quality Products and Pavements*
  - *Support Government Affairs and Strategic Alliances*
  - *Promote and Market Asphalt Pavements*
  - *Promote Innovation and Environmental Awareness*
  - *Ensure Association Viability*

Percent Within Tolerance

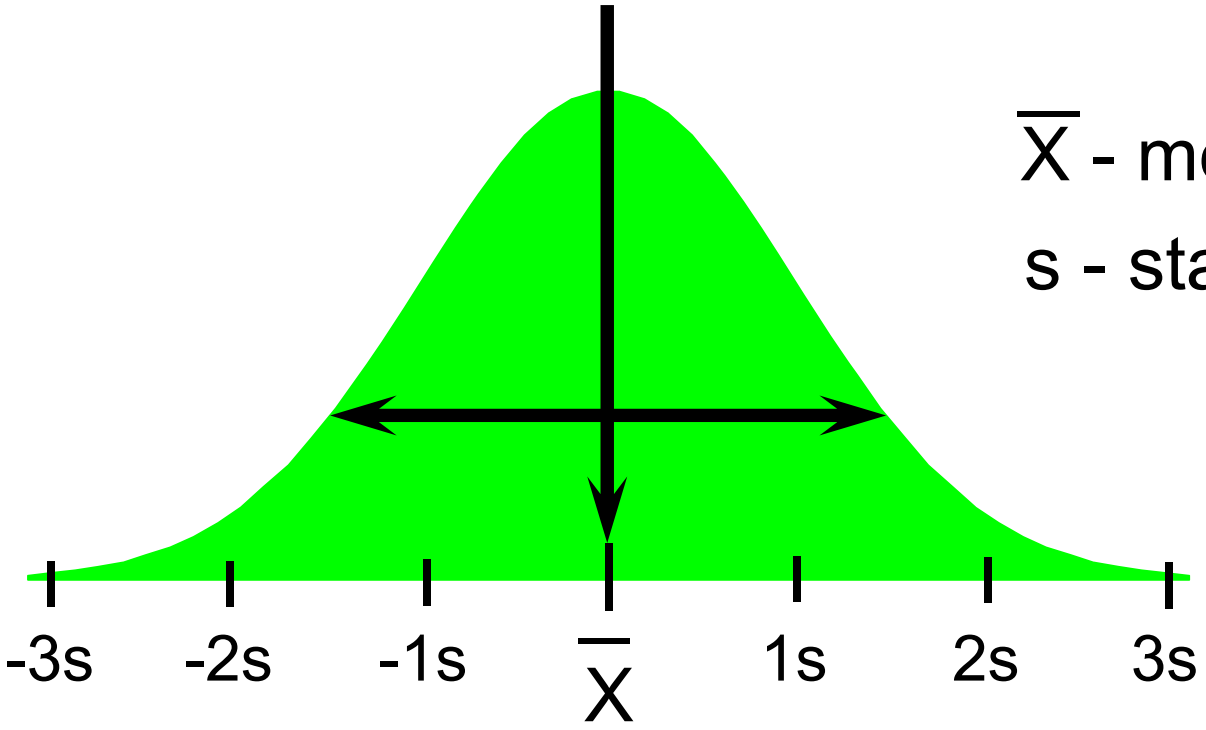


PWT



WHAT's PWT?

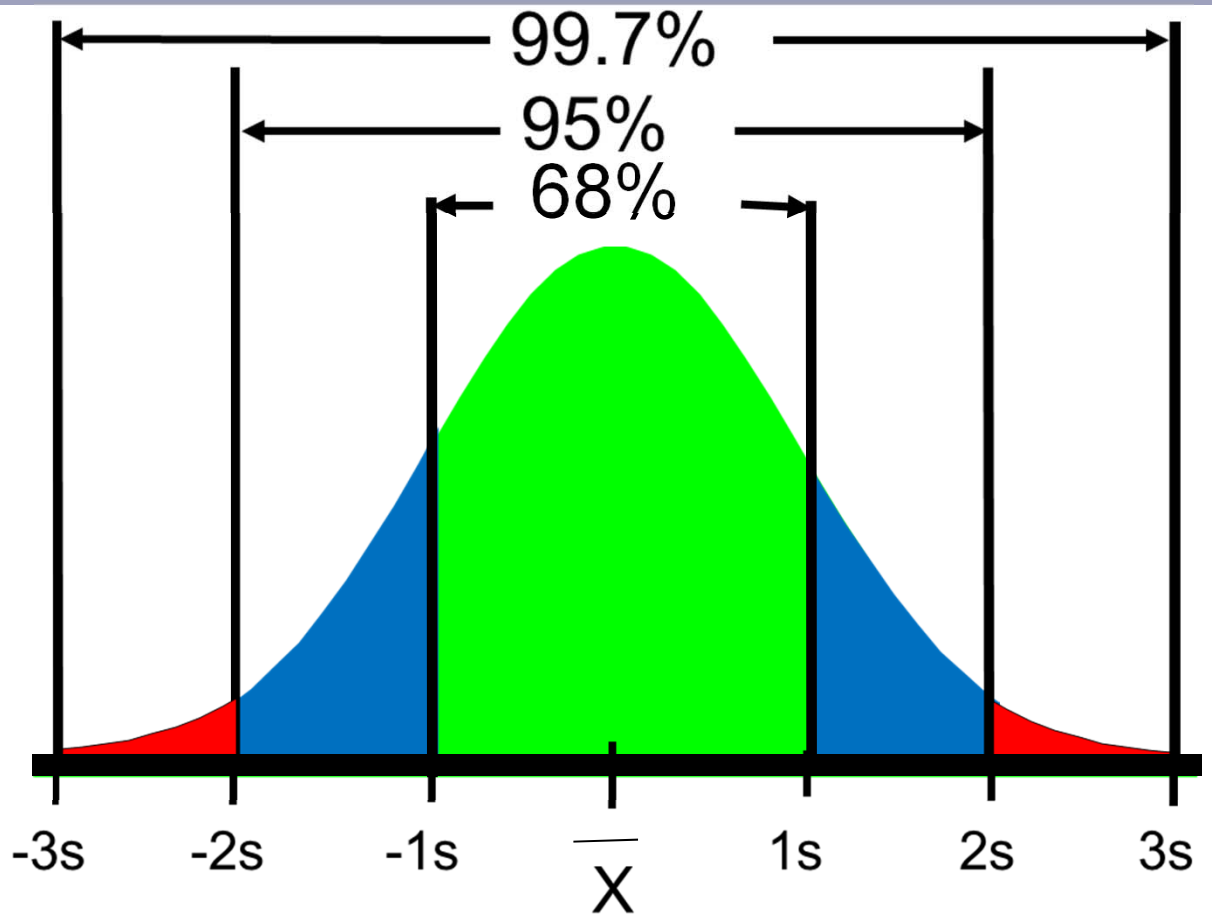
- Efficiently captures mean and standard deviation in one quality measure



$\overline{X}$ - mean

s - standard

Standard Deviation



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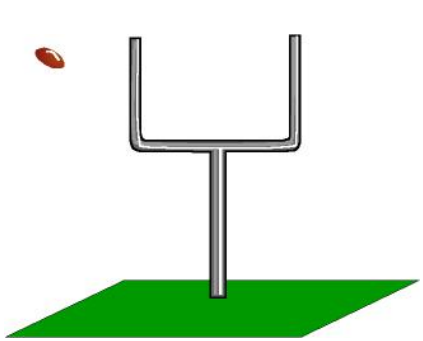
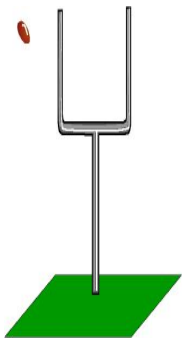
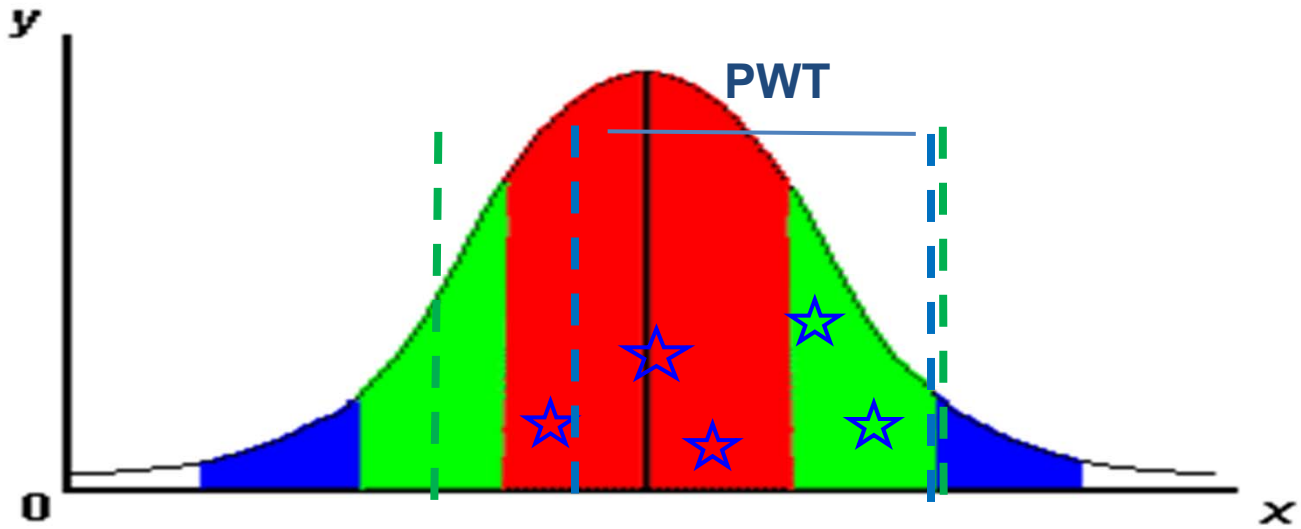
PWT – Think of a Field Goal Kicker





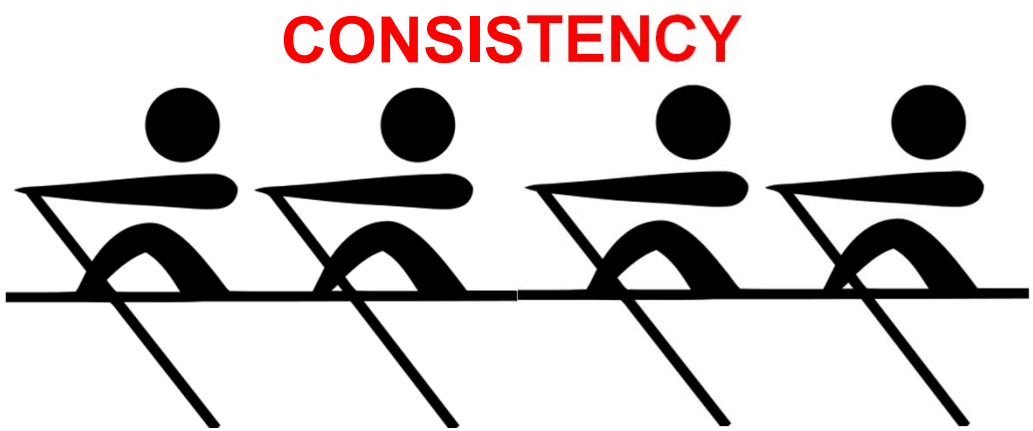


What Does PWT Drive?

- Drives more consistency in materials and construction
- Tighter adherence to producing job mix formula
- Tighter adherence to field density specification requirements

Advantages of PWT

- Well suited for low bids to achieve higher quality
- Contractors = **bonuses** for tighter adherence to targets
- Contractors = **reduced payments** for lesser consistency
- Moves focus to targets (NOT minimums)



What's different with PWT spec?

- Adds **bonus** structure (maximum 4%)
- Adds **mix gradation** (PCS) as part of payment
- Modifies current "goal posts" approach for 100% payment (good or no good) to a more probabilistic and statistical approach

Payment Equation Changes

- **Current** specification (50% mix, 50% density)
  - 25% asphalt content
  - 25% #200 sieve
  - 50% field density
- **PWT** specification (50% mix, 50% density)
  - 30% asphalt content
  - 10% #200 sieve
  - **10% primary control sieve (new)**
  - 50% field density

Common to All PWT Specs

- **Defective lots** can be left in place at 70% pay by DE (previously 50% pay)

- **Allows contractor to terminate lot**
  - Allows contractor to limit risk when early QC results indicate an issue
  - Must stop paving
  - 90% maximum pay
  - Must R&R if defective by test results

Current Status

Two (2) methods :

1. PWT-LTS (Laboratory Testing Section)
    1. Fully approved (includes FHWA)
    2. Acceptance at LTS
    3. PWT-LTS Use Guidelines/District Memo

2. PWT-HOLA (Hands On Local Acceptance)
    1. Fully approved (includes FHWA)
    2. Department Acceptance, Contractor Lab

2016 PWT Summary

158 PWT Projects Let in 2016

District	Total Active Project	SSP included in Advertisement		SSP Used on Project	
		LTS	HOLA	LTS	HOLA
1-0	9	9	0	6	3
2-0	3	2	1	2	1
3-0	8	7	1	7	1
4-0	3	3	0	3	0
5-0	5	5	0	5	0
6-0	1	1	0	0	1
8-0	25	23	1	24	1
9-0	12	5	7	6	6
10-0	6	5	1	4	2
11-0	7	6	1	2	5
12-0	7	7	0	7	0
Total	**86**	73	12	**66**	**20**

Industry Breakdown of Active Projects		
Prime Contractors (ea.)	Suppliers (Plants) (ea.)	Paving Contractors (ea.)
32	**57**	**31**

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2016 PWT Summary
(As of January 6, 2017)

		Overall Lot Payment Averages			Pay Factor Averages			
	Lots	Average Lot Payment	Average Lot Payment (Cores)	Average Lot Payment (Other)	Asphalt Content	#200 Sieve	Primary Control Sieve	Density (Cores/Optimum Rolling/Non-Movement)
Total	452	1.01	1.02	1.01	101.27	101.12	100.25	101.60
PWT-HOLA	121	1.02	1.02	1.01	102.26	101.98	101.03	101.68
PWT-LTS	331	1.01	1.01	1.00	100.89	100.80	99.95	101.58

	Average Density Pay Factor (Cores Only)					
	Total		HOLA		LTS	
	Lots	Pay Factor	Lots	Pay Factor	Lots	Pay Factor
Total	355	102.03	88	102.26	267	101.96
BPN 1	2	103.00	0	N/A	2	103.00
BPN 2	139	101.82	38	100.82	101	101.92
BPN 3	168	102.21	34	103.24	134	101.95
BPN 4	46	102.60	16	103.61	30	102.06

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2016 PWT Summary
(As of January 6, 2017)

	PWT	Sec. 409	PWT-HOLA	PWT-LTS
Bonus Pay Lots	336	N/A	101	235
100% Pay Lots	30	420	8	22
Reduced Pay Lots	80	21	12	68
Defective Lots	6	11	0	6
Terminated Lots	0	N/A	0	0
Total	452		121	331

District	Incentives	Reductions	Δ
1	$163,333.05	-$55,637.69	$107,695.36
2	$46,908.89	-$18,866.20	$28,042.69
3	$66,837.57	-$18,450.16	$48,387.41
4	$83,430.09	$0.00	$83,430.09
5	$88,680.57	-$20,140.30	$68,540.27
6	$0.00	$0.00	$0.00
8	$213,800.95	-$244,046.31	-$30,245.36
9	$104,490.10	-$45,848.47	$58,641.63
10	$156,313.92	-$4,871.88	$151,442.04
11	$144,013.41	-$20,736.51	$123,276.90
12	$100,296.68	-$26,007.13	$74,289.55
Total	$1,168,105.23	-$454,604.65	$713,500.58

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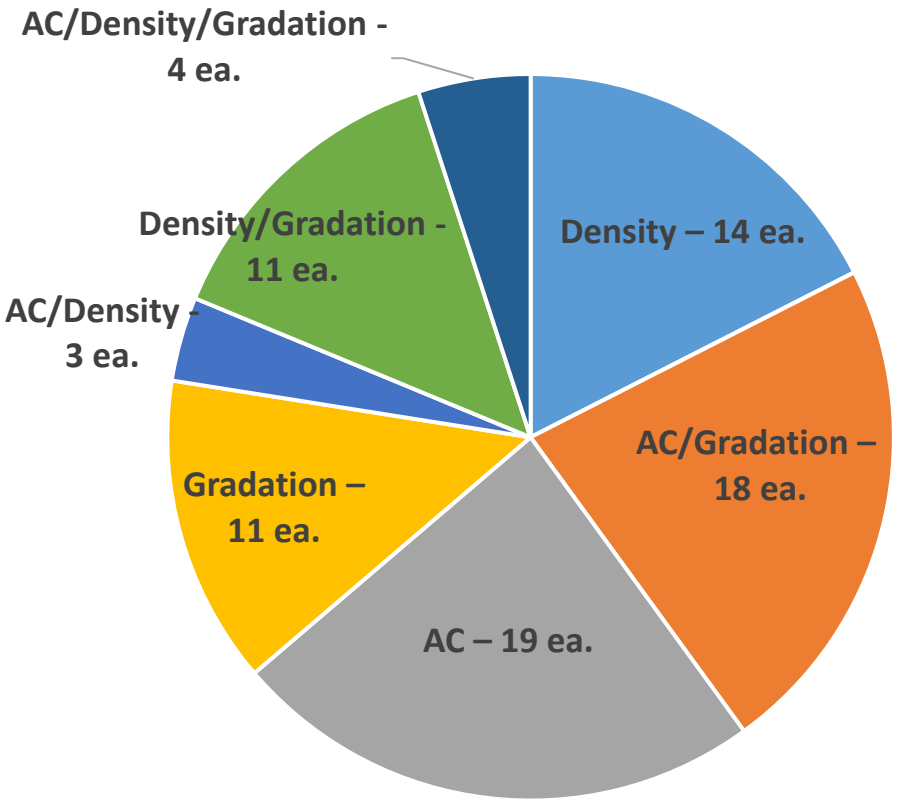
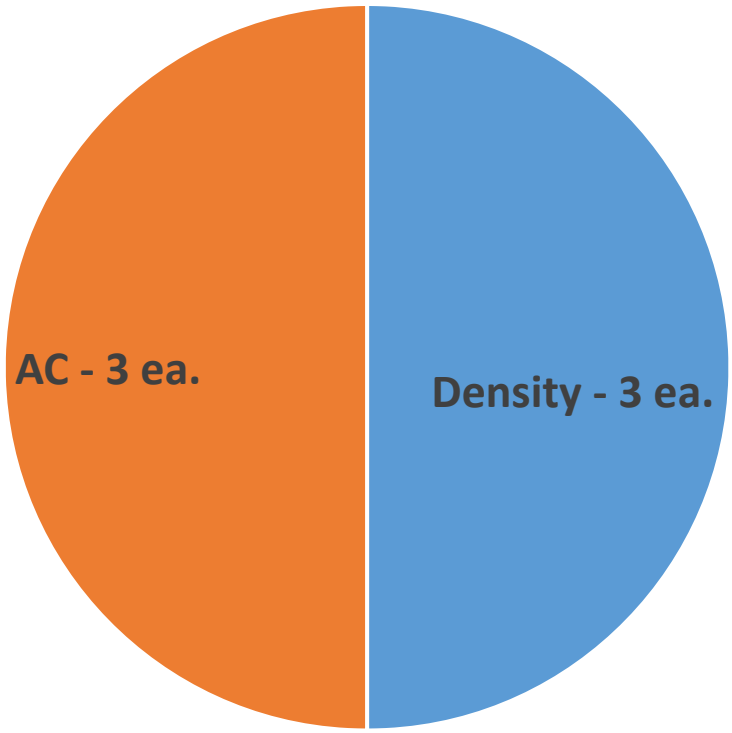
2016 PWT Summary
(As of January 6, 2017)

80 Reduced Pay Lots



6 Defective Lots



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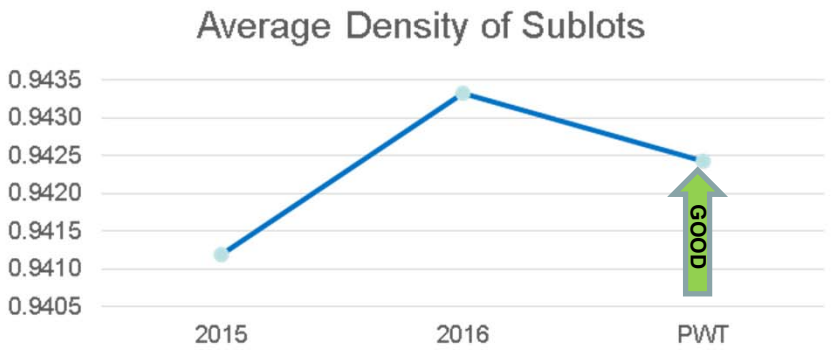
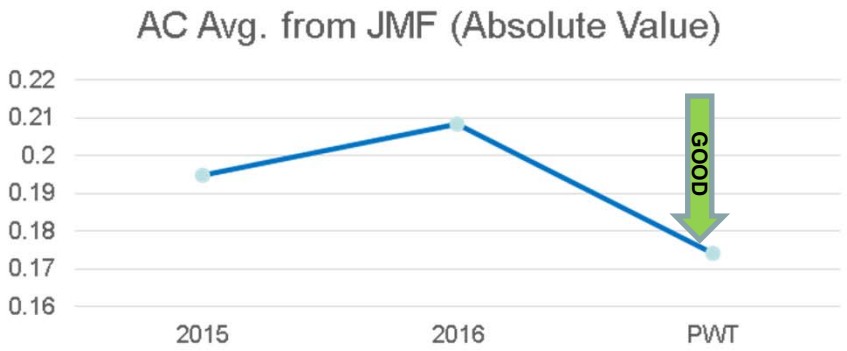
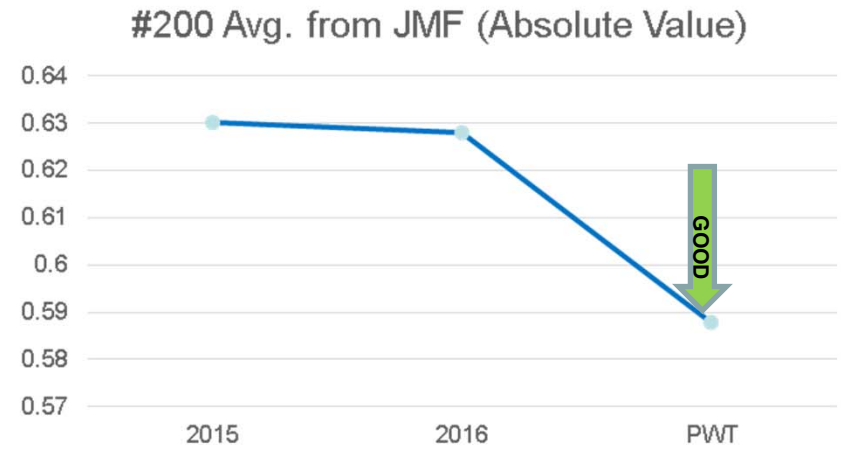
2016 PWT Summary

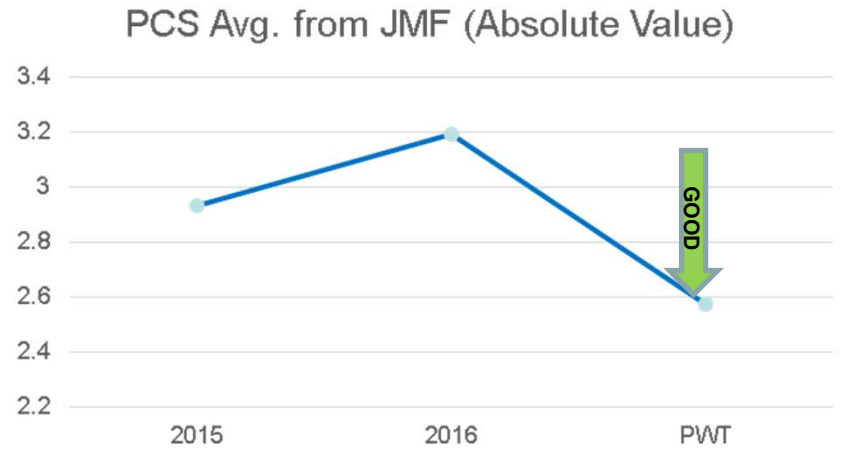
(Data from January 1, 2015 – November 23, 2016)

(Sublot Acceptance Test Results for 9.5mm, 12.5mm, 19mm & 25mm Mixes, excludes SMA)









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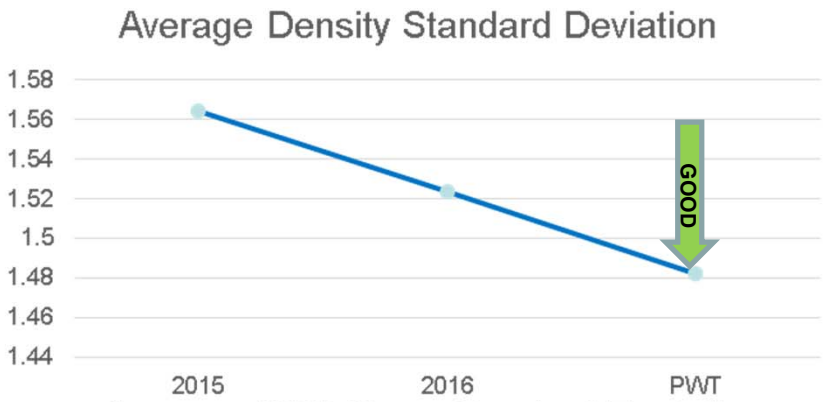
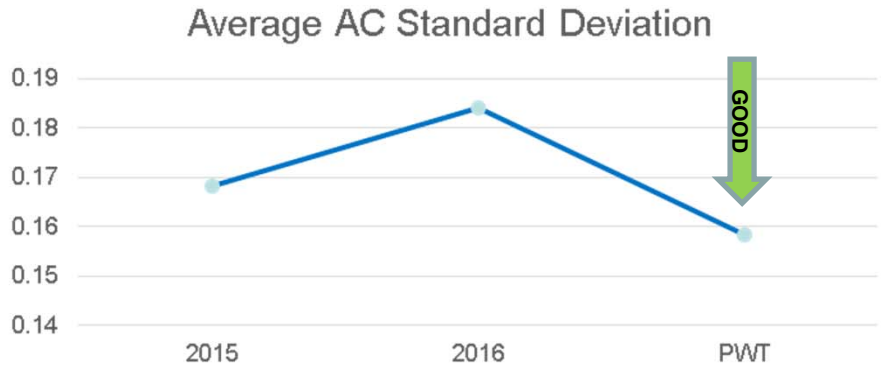
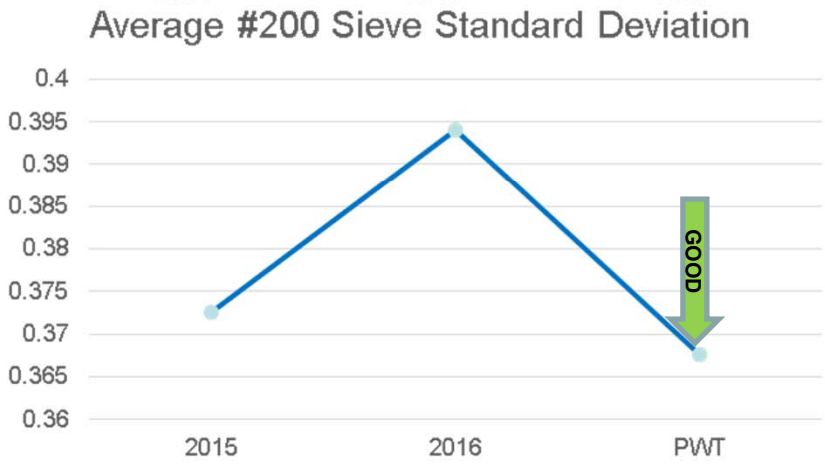
2016 PWT Summary

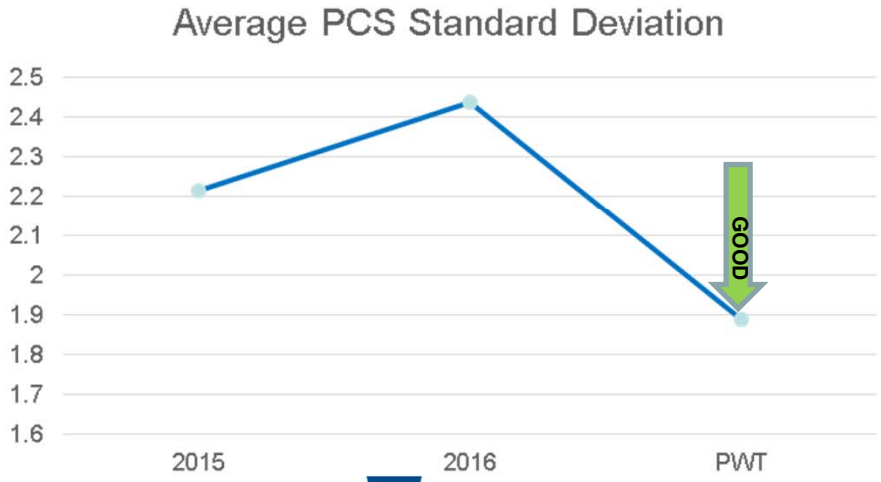
(Data from January 1, 2015 – November 23, 2016)

(Lot Acceptance Test Results for 9.5mm, 12.5mm, 19mm & 25mm Mixes, excludes SMA)









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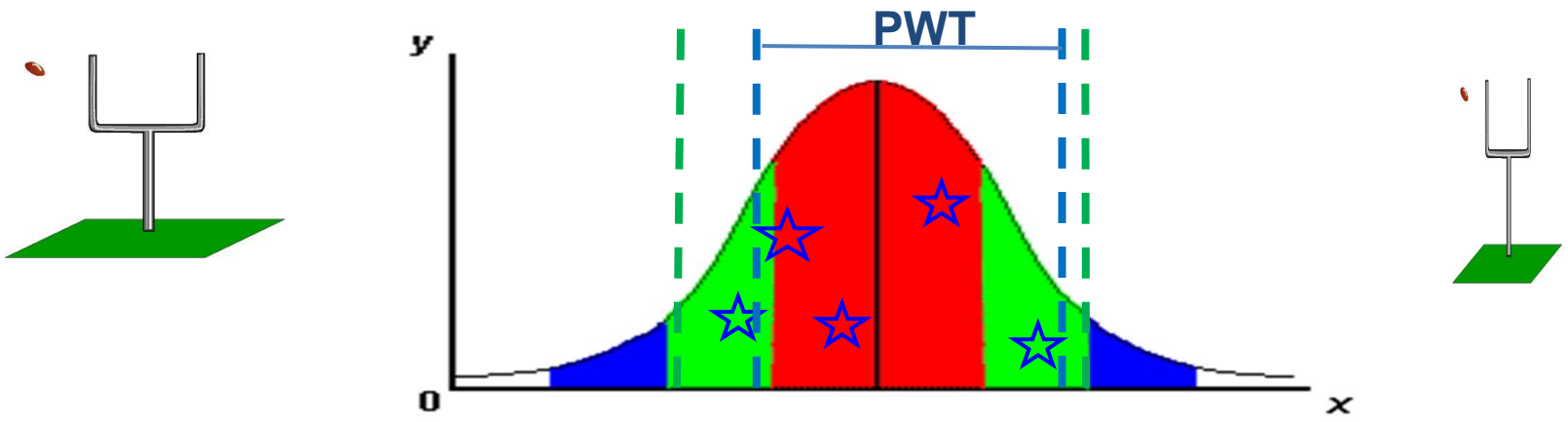
PWT - Any Questions?

- What about municipal projects?
- What type of paving projects (base, pavement design, shoulders, etc.)?



Warm Mix Asphalt

What's WMA ?

- Definition of **W**arm **M**ix **A**sphalt - Warm Mix Asphalt (WMA) is the generic term for a variety of technologies that allow producers of Hot Mix Asphalt (HMA) pavement material to lower temperatures at which the material is mixed and placed on the road. It is a proven a technology that improves the "lubricity" of the binder.

- http://www.fhwa.dot.gov/innovation/everydaycounts/edc-1/wma.cfm

Publication 408

SECTION 411- SUPERPAVE MIXTURE DESIGN, STANDARD AND RPS CONSTRUCTION OF PLANT-MIXED WMA COURSES

411.2 MATERIAL - Section 409.3 with additions and modifications as follows

Table A
Job-Mix Formula
Composition Tolerance Requirements of the Completed Mix
Section 409.2(e), Table A. Revise the Temperature of Mixture (F) requirements as follows:

Temperature of Mixture (F)			
Class of Material	**Type of Material**	**Minimum***	**Maximum***
PG 58-28	Asphalt Cement	215	310
PG 64-22	Asphalt Cement	220	320
PG 76-22	Asphalt Cement	240	330
All other Binders	Asphalt Cement	The higher of 215 or the minimum temperature specified in Bulletin 25 minus 45	As specified in Bulletin 25

Publication 408
SECTION 411- SUPERPAVE MIXTURE DESIGN, STANDARD AND RPS CONSTRUCTION OF PLANT-MIXED WMA COURSES

411.2 MATERIAL - Section 409.3 with additions and modifications as follows

Table A

*The minimum and maximum temperatures shown in Table A for each Class of Material represent the master temperature range for a completed WMA mixture. The Producer must include a smaller production temperature range that does not exceed 50F and does not fall outside the master temperature range in the Producer QC Plan for normal paving.

Benefits of WMA

- Benefits of **W**arm **M**ix **A**sphalt –
  - Improves asphalt mix compaction density
  - Improves consistency of asphalt coating
  - Extends the paving season
  - Allows asphalt mix to be hauled longer distances
  - Improves working conditions by reducing exposure to fuel emissions, fumes, and odors

- http://www.fhwa.dot.gov/innovation/everydaycounts/edc-1/wma.cfm

WMA Implementation by PennDOT

- 2014 – 9 of 11 Engineering Districts WMA
- 2015 – 10 of 11 Engineering Districts WMA
- 2016 – 11 of 11 Engineering Districts WMA
- 2017 – 100% WMA

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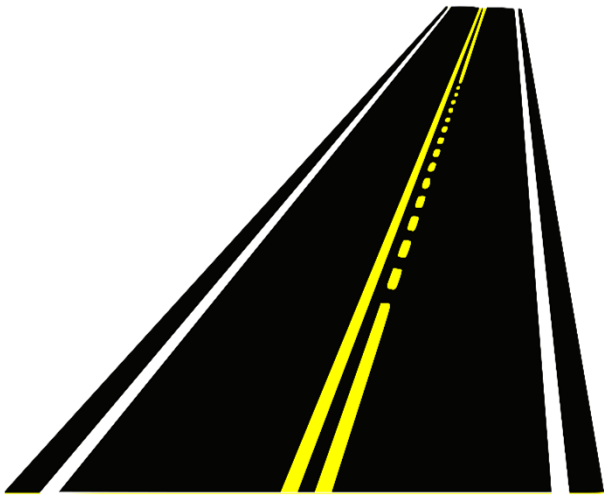

Anti-Strip Additive – WMA & HMA

Asphalt Stripping:
The loss of bond between aggregates and asphalt binder that typically begins at the bottom of the HMA layer and progresses upward. When stripping begins at the surface and progresses downward it is usually called raveling.

Need for Anti-Strip Additive

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"Cost Benefit Analysis of Anti-Strip Additives in Hot Mix Asphalt with Various Aggregates"

FINAL REPORT
May 15, 2015

Donald Christensen
Advanced Asphalt Technologies, LLC

Dennis Morian
William Wang
Quality Engineering Solutions, Inc.

Anti-Strip Additive

- What is an AS Additive?
- Concerns:
  - TSR Testing
  - AS Approval List (What about Evotherm?)
  - Basis for quantity of AS Additive
  - CT S-16-001 Step 2 - Revises Pub. 408-Sect. 411, 311, POM-Sect. C04-02, C04-03, Pub 242-Ch5, Bulletin 27-Chapters 2A & 2B
  - Implement 2017

Need for Anti-Strip Additive

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2017- Put at least .25% AS in all mixes

Long Life Asphalt Pavements

Longer Life Asphalt Pavements

TQI TECHNICAL TEAM GOAL - Develop LLAP Specifications – Identify Best-in-Class Practices for Pavement Design, Materials Mix Design, Materials Testing, Construction Practices, & QA - QC

- Limited initially to Interstate Highways & Look-a-Likes
- Totally new requirement will be Performance Testing for Crack Resistance and Rutting.
- Eventually incorporate into PUB 408 & other Publications

TQI - LLAP Specification Work Group Schedule

- PennDOT, PTC, FHWA, Industry Coordination Meeting – October 2015
- LLAP Spec Draft for APQIC – January 2016 (Completed)
- CT Step 1 for Review – April 2016 (Completed)
- CT Step 2 for Review – June 2016
- Request Candidate Pilot Projects (2017 Construction Season) – November 2016

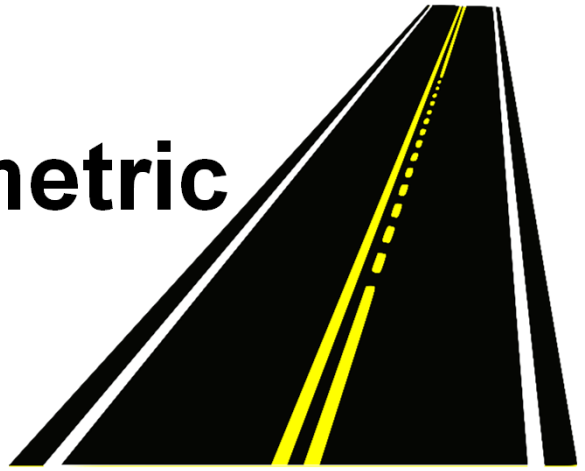
LLAP – To get the initiative moving, the team assembled a large list of Best Practices. These Best Practices are incorporated into a series of Standard Special Provisions which were approved. SOL was sent to the Districts requesting pilot projects. Three projects have been submitted to date.

Long - Life Asphalt Pavements (LLAP)
Pavement Design

- **Use Guidelines**
- **PavementME (April Training)**
- **Perpetual Pavement Design**
- **Limiting Strain Design**

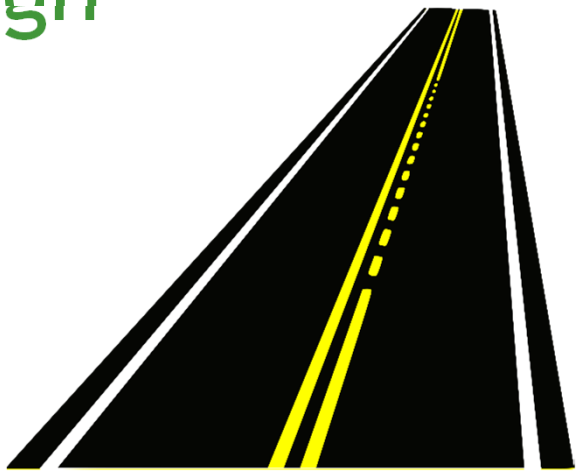
Long - Life Asphalt Pavements (LLAP)
Asphalt Mix Design

- **Minimum Effective AC Content (P_{be})**
- **SuperPave Design Volumetric Adjustments**
- **Binder Modification (i.e. polymer, GTR, Fiber, etc.)**



Long - Life Asphalt Pavements (LLAP)

Asphalt Mix Design



- **SMA ON INTERSTATES**
- **FULL DEPLOYMENT OF WMA**
- **USE OF ANTI-STRIP ADDITIVE**
- **ASPHALT RICH BASE**
- **Optimized Mix Design (i.e. Performance Testing)**

Long - Life Asphalt Pavements (LLAP)
Construction Specifications

- **Longitudinal Joint Density Specification**
- **Ride Specification**
- **MTV Required**
- **Tack Coat Requirements (New Specification)**

  % Within Tolerance (PWT) Acceptance

- **Incentivize Critical Elements (i.e. Mat Density)**

Optimized or Balanced Mix Design

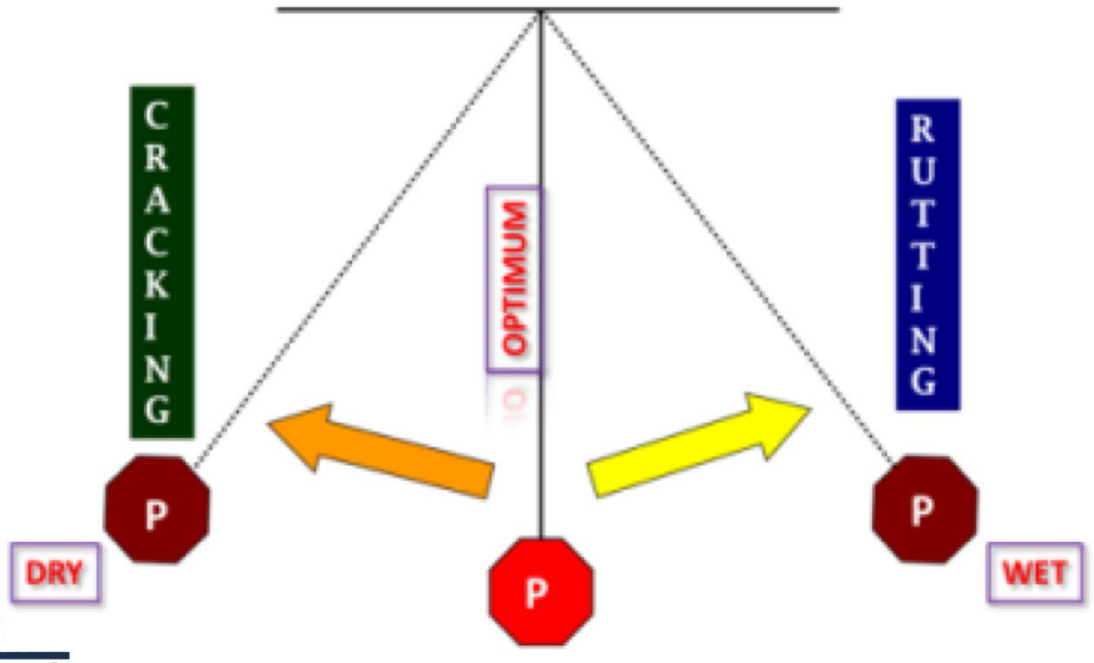
- Crack Resistant
- Rut Resistant
- Resistant to Moisture Damage

PAPA Proposed Crack Performance Testing

- Virgin vs. 15% RAP mix
- Design Binder vs. +0.5% AC
- Lab mix vs. Production mix
- Short-term vs. long-term aging
- 16 cells in matrix

Balanced Mix Design: ETG Definition

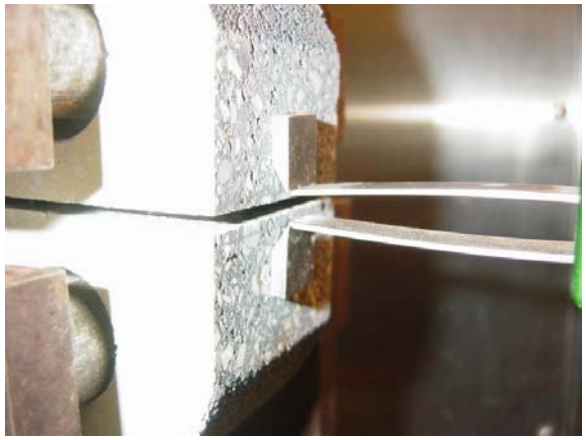
- Asphalt mix design using *performance tests* on appropriately *conditioned specimens* that address *multiple modes of distress* taking into consideration mix aging, traffic, climate and location within the pavement structure

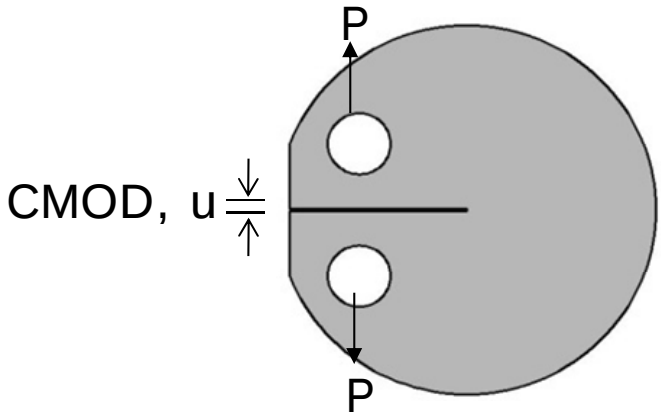


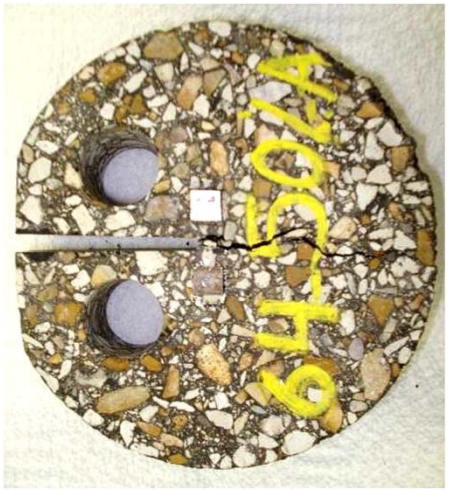
Performance Pendulum (Shane Buchanan, Oldcastle)

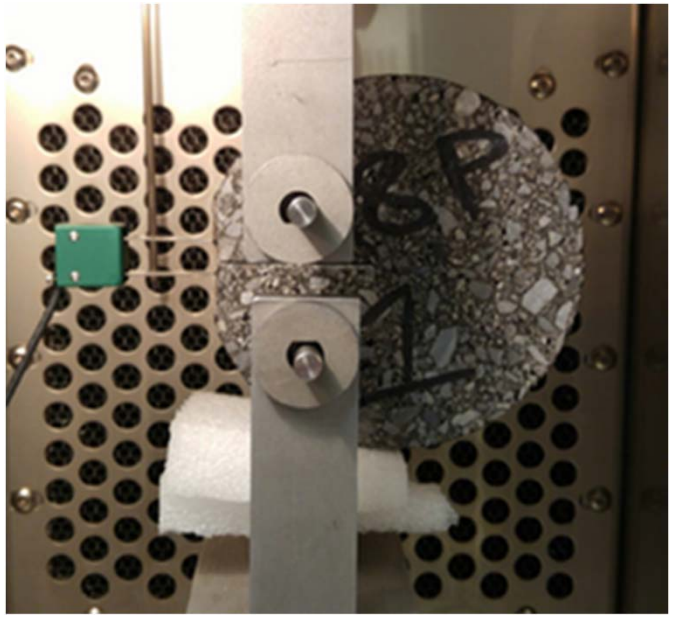
Disk-Shaped Compact Tension (DCT) Test

- ASTM D7313-13
- Loading Rate:
  - Crack Mouth Opening Displacement
  - CMOD Rate = 1.0 mm/min
- Measurements:
  - CMOD
  - Load



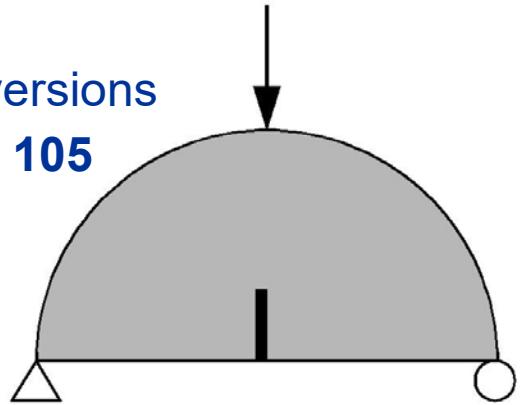


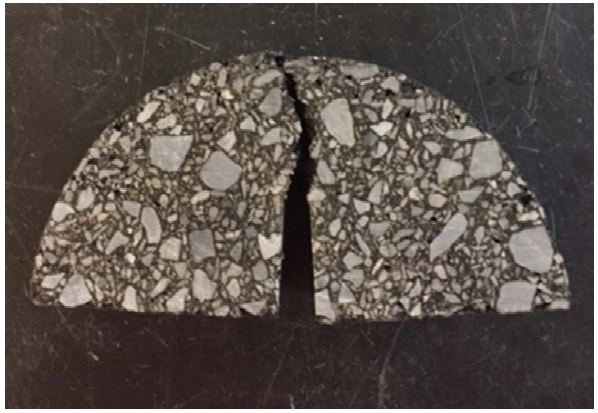


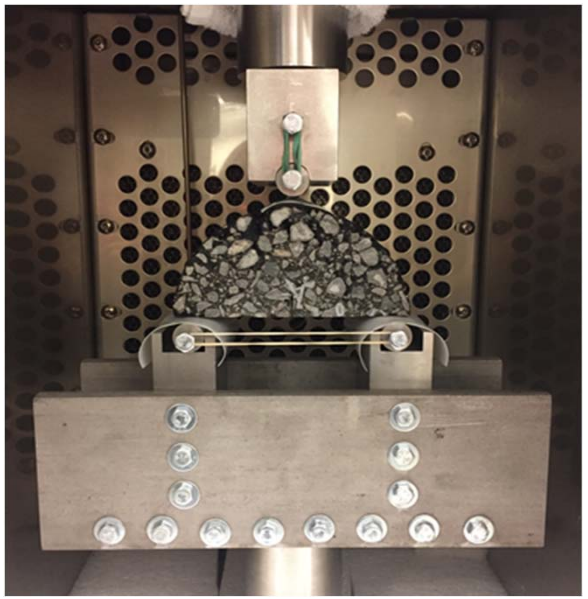


Semi-Circular Bend (SCB) Test

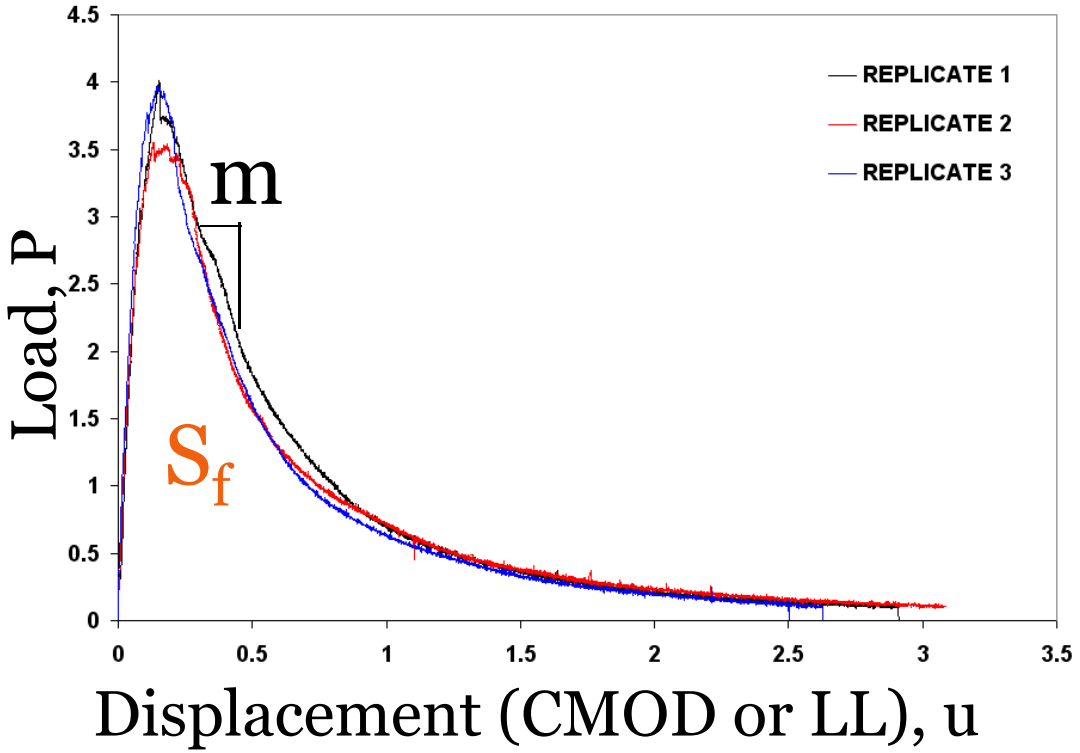
- Multiple variants exist
  - Early work in Europe
  - Simultaneous cold (Marasteanu et al. – MN) and intermediate temperature (Mohamed et al. – LA) versions
  - **Recent work from Al-Qadi et al. (IL) → AASHTO TP 105**
- AASHTO TP 105 (I-FIT)
  - Line load control, loading rate = 50 mm/min
  - Test temperature = 25 deg. C
- Measurements:
  - Displacement
  - Load
- Outcomes
  - Fracture Energy
  - Flexibility Index (FI)

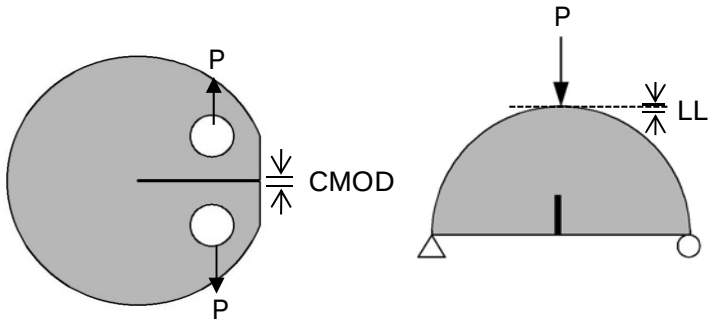






Fracture Parameters





Fracture work: Area under Load-Displacement curve

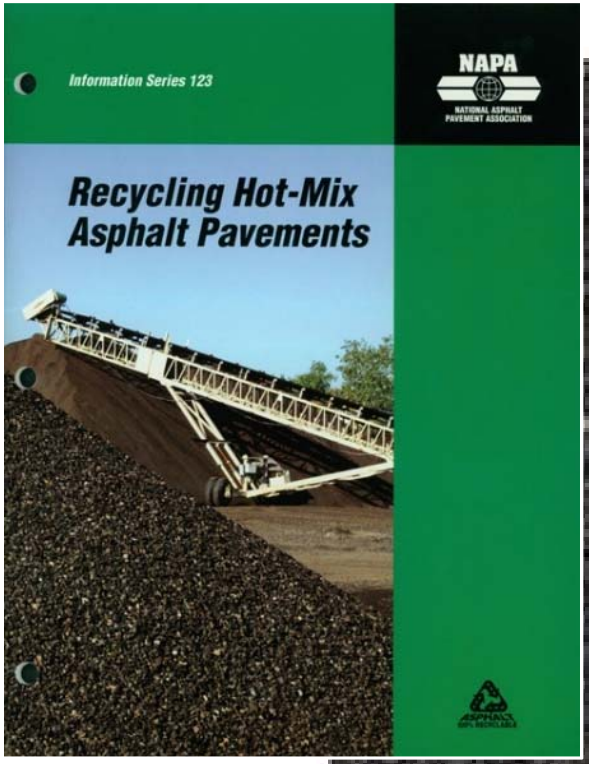
Fracture Energy, G_f: Energy required to create unit fracture surface

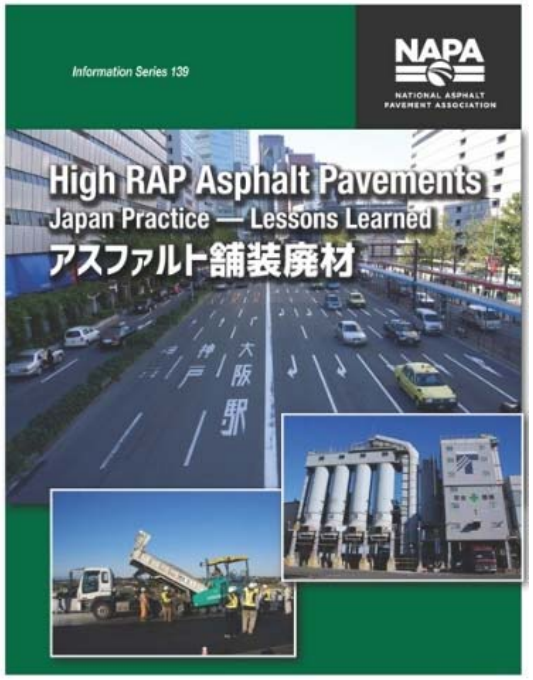
$$G_f = \frac{\text{Fracture Work, } S_f}{\text{Fracture Area}}$$

Flexibility Index, FI:

$$FI = G_f / m$$

Higher RAP Mixes





http://www.asphaltpavement.org/

Higher RAP Mixes

- **NCHRP Report 752 (Project 9-46)**
- **STIC Materials TAG Initiative**
- **PSU - LTI Task Order #10**
- **CT S 015-15 Issued**
- **PAPA had many Questions - Suggestions**

Higher RAP Mixes

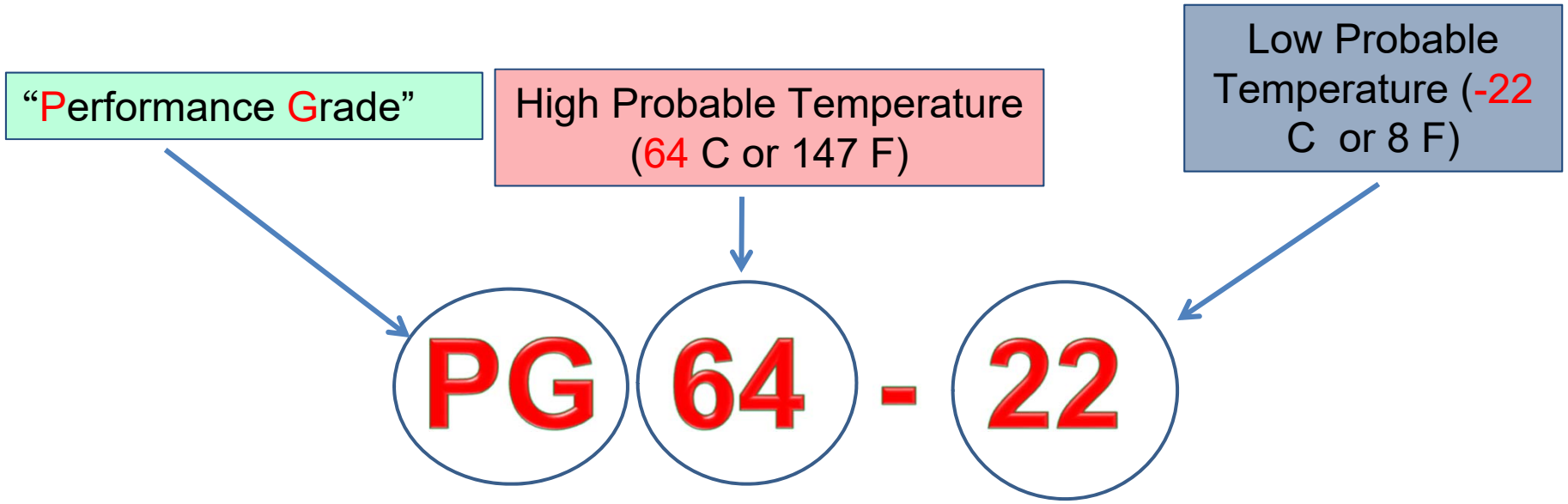
- **Meeting/PennDOT, FHWA and PAPA**
- **Outcome of Meeting:**
  - **Move to Replacement Binder Ratio (RBR)**
  - **Change from 2 Tiers to 3 Tiers**
  - **Tier 1 – no change (0.20 ≤ 19 mm, 0.25 > 19mm)**
  - **Tier 2 – consensus properties of aggregate**
  - **Tier 3 – aggregate and binder testing**
  - **Standard deviations of RAP properties**
- **CT Step 2 responses to comments out**
- **Possible CT 3**

HMA WMA Pavement Materials

Asphalt Binders – "Neat" and Modified

Asphalt – the liquid

- The glue that binds the aggregate
- Must be heated to use
- Modified with additives to enhance high temperature performance (e.g.: to improve rutting resistance or cracking)
- Chosen based on climate



The **P**erformance **G**rade of a binder is based on the climate where the pavement is being constructed and describes the probable high and low temperatures the pavement can be expected to reach, in Celsius. In Pennsylvania, that range is primarily 64 C down to minus 22 C but some areas in PA may PG 76-22.

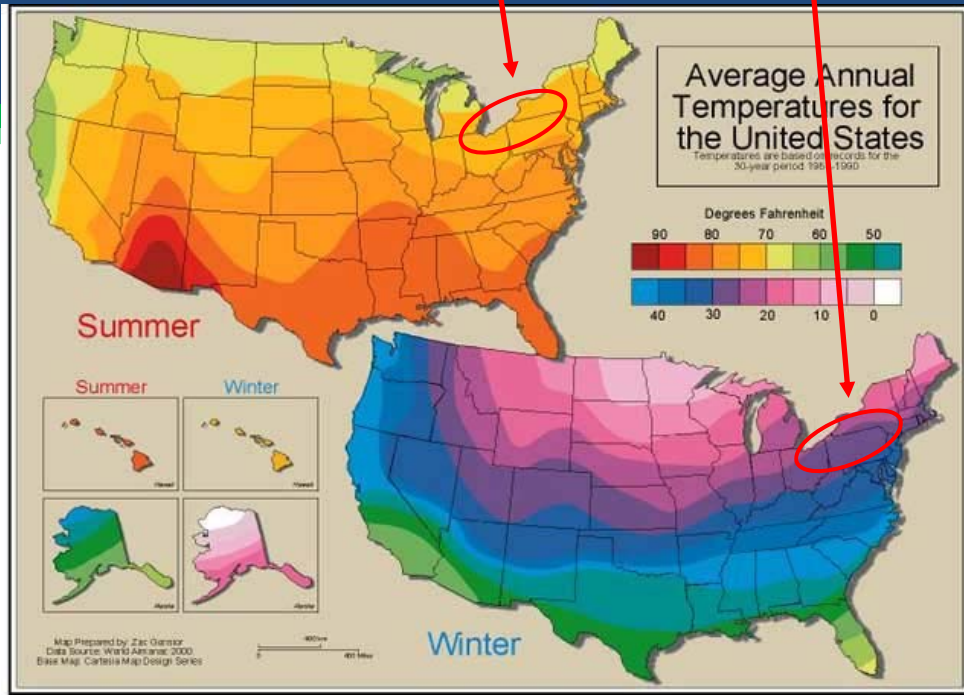
PG 64 - 22

Low Temperature, °C \ High Temperature, °C	52	58	64	70	76
-16	52-16	58-16	64-16	70-16	76-16
-22	52-22	58-22	64-22	70-22	76-22
-28	52-28	58-28	64-28	70-28	76-28
-34	52-34	58-34	64-34	70-34	76-34
-40	52-40	58-40	64-40	70-40	76-40

= Crude Oil

= High Quality Crude Oil

= Modifier Required



RAP Impact on Performance Grade

- RAP is Reclaimed Asphalt Pavement
- Asphalt in RAP is aged (oxidized) and typically harder compared to virgin asphalt
- For higher amounts of RAP in mixture (greater than RBR=0.25) will need to verify PG of RAP binder and determine required PG of virgin binder.

TR-448A (6-15)

pennsylvania
DEPARTMENT OF TRANSPORTATION

JOB MIX FORMULA REPORT

PennDOT Mix Design Designation

Year	Number
2015	H11

Supplier JMF/Design Number (Optional): 9535

Supplier Code	HIM46H41
Material Class	SR9.5
Design ESAL Range	0.3 to < 3 Million
Aggregate Skid Resistance Level	H
Mixure Final PG Binder Grade	PG6422
Asphalt Mix Type	HMA
Gradation Classification	Coarse-Graded
Original Approval Date	
JMF Status	Approved

Supplier Name	Highway Materials Inc.	Location	PLYMOUTH MEETING PLT # 2		
ECMS Number		Purchase Order No.		408 Spec	
SR & Section		Plant Type	AD	Plant Size	05
Contractor		Location			

Mix Time	
Dry(s)	Wet(s)

Material Supplier	Material Code - Class	Product Name	% Material	Spec. Grav.	% Absorption
HMC46B14	207 (Aggregate Fine) - B3		26.200	2.808	0.74
AXON3 15	1 (Asphalt Cement) - PG5828		4.300	1.031	
HIM46G41	17 (Hot Rap Design) - RAP		25.000	2.800	0.00
HMC46A14	207 (Aggregate Fine) - B1		14.100	2.645	1.24
HMC46B14	203 (Aggregate) - A8		30.400	2.828	0.49
PBFH0 15	1 (Asphalt Cement) - PG5828			1.030	
SUIT3 15	1 (Asphalt Cement) - PG5828			1.030	

JOB MIX FORMULA AND DESIGN

A.C. / Sieve Size	A.C%	#200	#100	#50	#30	#16	#8	#4	3/8"	1/2"				
Design Target	5.5	5.0	7	10	15	24	40	65	95	100				

% Virgin A.C.	4.3	% Reclaimed A.C. from RAP	1.20	Total % Asphalt (Pb)	5.5
Virgin A.C. PG Binder Grade	PG5828	% Reclaimed A.C. from RAS		% Eff. Asphalt Binder (Pbe)	5.1
Calc. Asp. Film Thickness		Total Reclaimed Binder Ratio	0.22	Fines / Asphalt (F/A) Ratio	1.0

MIX CHARACTERISTICS (GYRATORY)

Design ESAL Range	Mold Diameter (mm)	# Gyrations at Ninitial	# Gyrations at NDesign	# Gyrations at NMaximum	Voids in Mineral Aggregate (VMA)	Theoretical Max. Sp. Grav. (Gmm)	Bulk Sp. Grav. of Mixture (Gmb)
0.3 to < 3 Million	150	7	75	115	16.2	2.573	2.470
Bulk Sp. Grav. of Combined Aggr.(Gsb)	**Mixture Mass to Compact**	**% Air Voids at Ninitial**	**% Air Voids at NDesign**	**% Air Voids at NMaximum**	**Voids filled with Asphalt (VFA) %**	**Theoretical Max. Density (lbs/ft3)**	**Bulk Density of Mixture (lbs/ft3)**
2.787	4,930.0	14.9	4.0	2.5	75.0	160.2	153.7

ASPHALT CONTENT TEST METHOD

A.C. Test Method	External Party Oven Make/Model	Furnace Temp (°C)	Sample Size for C.F.	Asphalt C.F.	200 C.F.
PTM No. 757	GILSON/HM-378	538.0	1,300.0	0.42	0.30

MOISTURE SUSCEPTIBILITY DATA

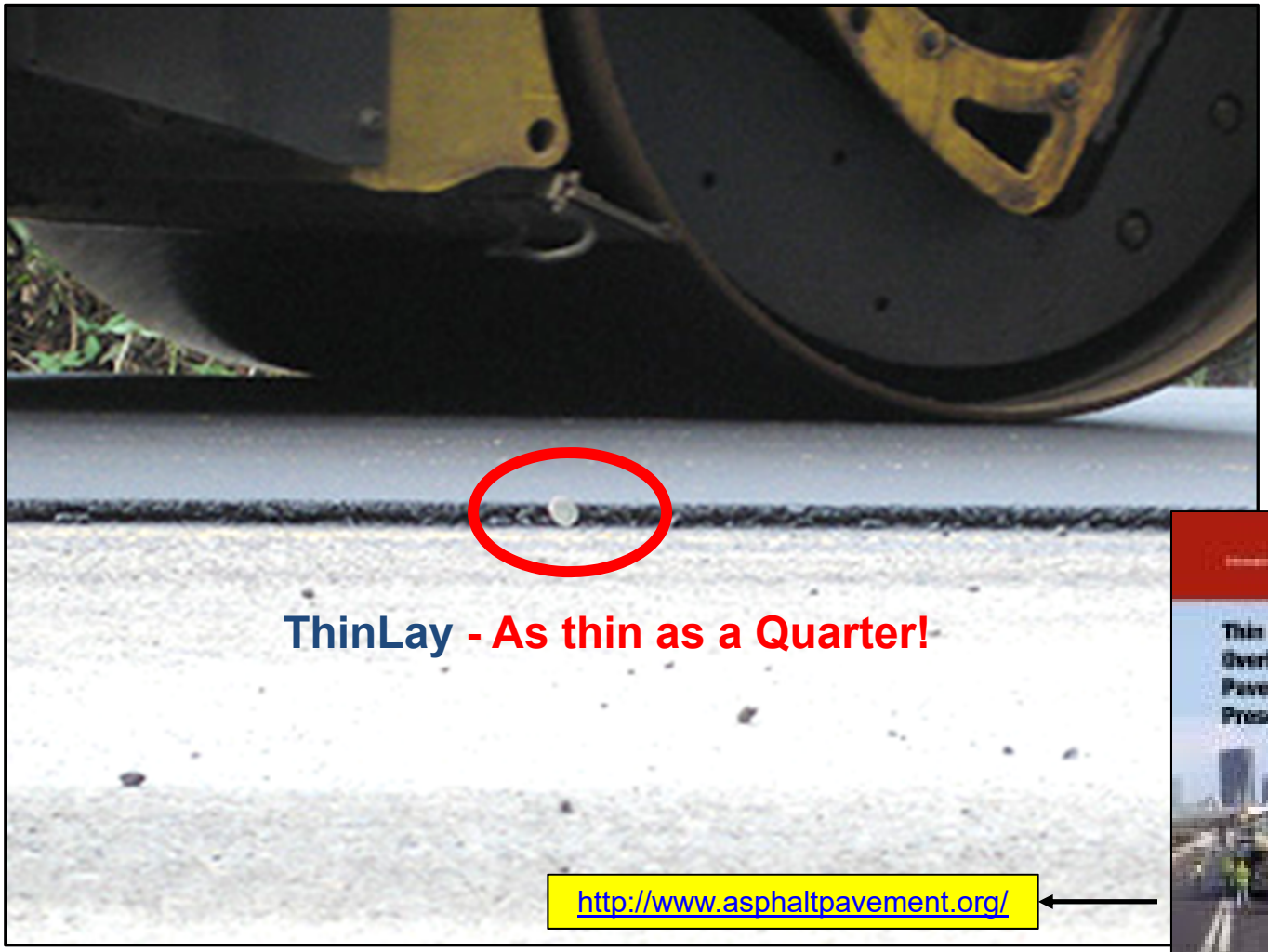
A.C. Supplier	Name	Dry PSI Strength	Wet PSI Strength	TSR Value	Date of TSR Test	Date of Boil Test
PBFH0 15						2/1/13
AXON3 15		89.8	103.1	0.87	2/27/15	
SUIT3 15						2/1/13

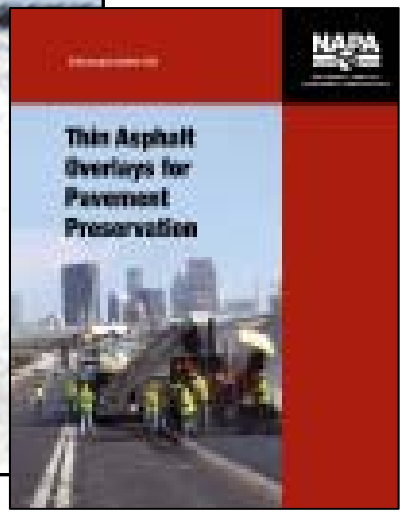
COMBINED AGGREGATE CONSENSUS PROPERTIES

AASHTO T 176 Sand Equivalency (%)	AASHTO T 304 Fine Aggr. Angularity Uncompacted Voids (%)	ASTM D5821 - Coarse Aggregate Angularity		ASTM D4791 Flat / Elongated Particles		Total % Reclaimed Agg. From RAP and / or RAS
		% 1 Face Crush	% 2 Face Crush	5:1	3:1 SMA only	
96.0	48.7	100.0	100.0	1.2	2.0	75.0

Designed By :	Christopher Boyle	Designed By Certification ID :	2015	Designed Date :	3/16/15
Submitted By :	John Savastio	Submitted By Certification ID :	252	Submitted Date :	4/22/15
Approved By :	John D Mccall	Approved By Certification ID :	1918	Approved Date :	4/30/15

ThinLay


ThinLay - As thin as a Quarter!
http://www.asphaltpavement.org/


Thin Asphalt Overlays for Pavement Preservation

ThinLay

DESCRIPTION – This work is the construction of a thin lift wearing course (Called **ThinLay**) of plant-mixed, dense-graded WMA, **6.33** mm (1/4 inch) Nominal Maximum Aggregate Size (NMAS), on a prepared surface using a volumetric mixture design developed with the Superpave Gyratory Compactor.

ThinLay 6.33 mm WMA wearing course is a preservative treatment used to extend the service life of a pavement without significantly improving the pavements structural capacity. It is intended for use on existing pavements with minor surface distresses like raveling and low-severity cracking and with no structural distresses.

ThinLay 6.33 mm WMA Wearing Course is a virgin mixture design with high asphalt content, placed at 1” or > in depth.

ThinLay Special Provision

- 6.3 mm – 100% passing 3/8 in.
- Dense –graded (6 sieve sizes) - SRL
- PG 76-22 polymer modified asphalt
- N design = 75 gyrations
- Design voids = 4.0%
- Min. VMA = 16.5
- No RAP or RAS
- Place at greater than 50 F
- Optimum Rolling Pattern

Use Guidelines

- Only on structurally sound pavement
- Substitute for micro-surfacing
- For correcting surface distresses only
- Consider grinding PCC first

Compaction

- **Due to 1” + overlay, mat cools quickly.**
- **Rollers**. Use an adequate number of static steel-wheel rollers as specified in Section 108.05(c)3 to keep up with the continuous paving operation and having a manufacturer’s certified metal weight of not less than 10 tons.
  - Operate rollers according to manufacturer's recommendations. Use rollers equipped with a watering or soapy watering system that prevents material from sticking to the rollers. **Do not use pneumatic-tire rollers.**
- **Do not use rollers in vibratory mode** unless it can be demonstrated during the trial demonstration specified in Section III.(p) of this special provision and to the satisfaction of the Inspector in Charge that no detrimental effect to the pavement structure results from the vibration.

ThinLay

- PennDOT conducted a study of 4 ThinLay projects over the past three years. A final research report has been drafted and awaiting approval.
- A CT of proposed specifications was out for review and comment.
- A SSP should be available soon for use in projects and incorporation in PUB 408, PUB 272, etc. by next spring.
- Any asphalt producer will be able to make this product.

ThinLay

Thin overlays are an added solution to pavement preservation. They are economical, long-lasting, and effective in treating a wide variety of surface distresses to restore ride quality, skid resistance, and overall performance. https://www.youtube.com/watch?feature=player_embedded&v=Udk8DTh4rJI

Porous (Permeable) Asphalt Pavements In PENNSYLVANIA

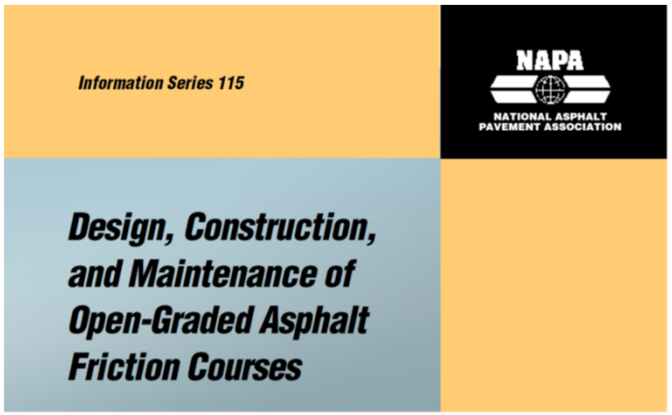
J.D. Eckman Parking Lot, Atglen, PA

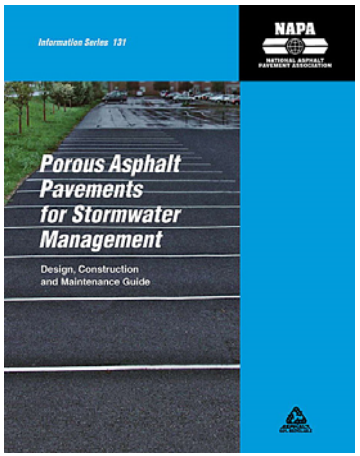
PA Porous (Permeable) Asphalt Pavements

- More stringent Stormwater Mgt. Ordinances
- % Impervious Surfaces
- Various BPM's
- Unique Specifications for Porous Pavements

PA Porous (Permeable) Asphalt Pavements

- Reference Material Utilized
  - NAPA – IS-115 & IS-131
  - UNH Stormwater Center - Design Specifications for Porous Asphalt Pavements –
  - MNDOT – Porous Asphalt Pavement Performance in Cold Regions



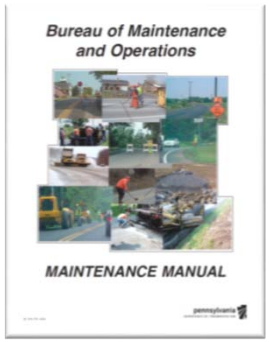


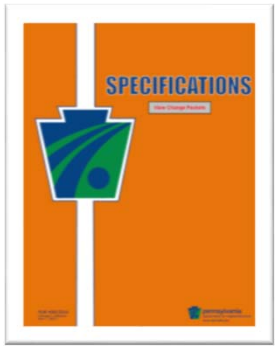
PA Porous (Permeable) Asphalt Pavements

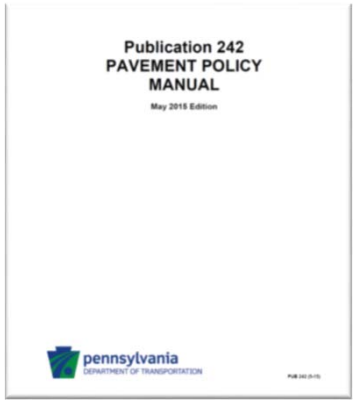
- Advantages Identified
  - Reduced Surface Run Off
  - Recharge Ground Water
  - Replace “Open” Retention Basins
  - Allow for Additional Parking Space

PA Porous (Permeable) Asphalt Pavements

- Results From STIC TAG Spec Project
  - PUB 408, Section 420 – Pervious Bituminous Pavement System
  - PUB 242, Appendix M – Pervious Surface Course Design
  - PUB 594, Chapter 14.7 – Pervious Pavement
  - PUB 23, Maintenance Manual





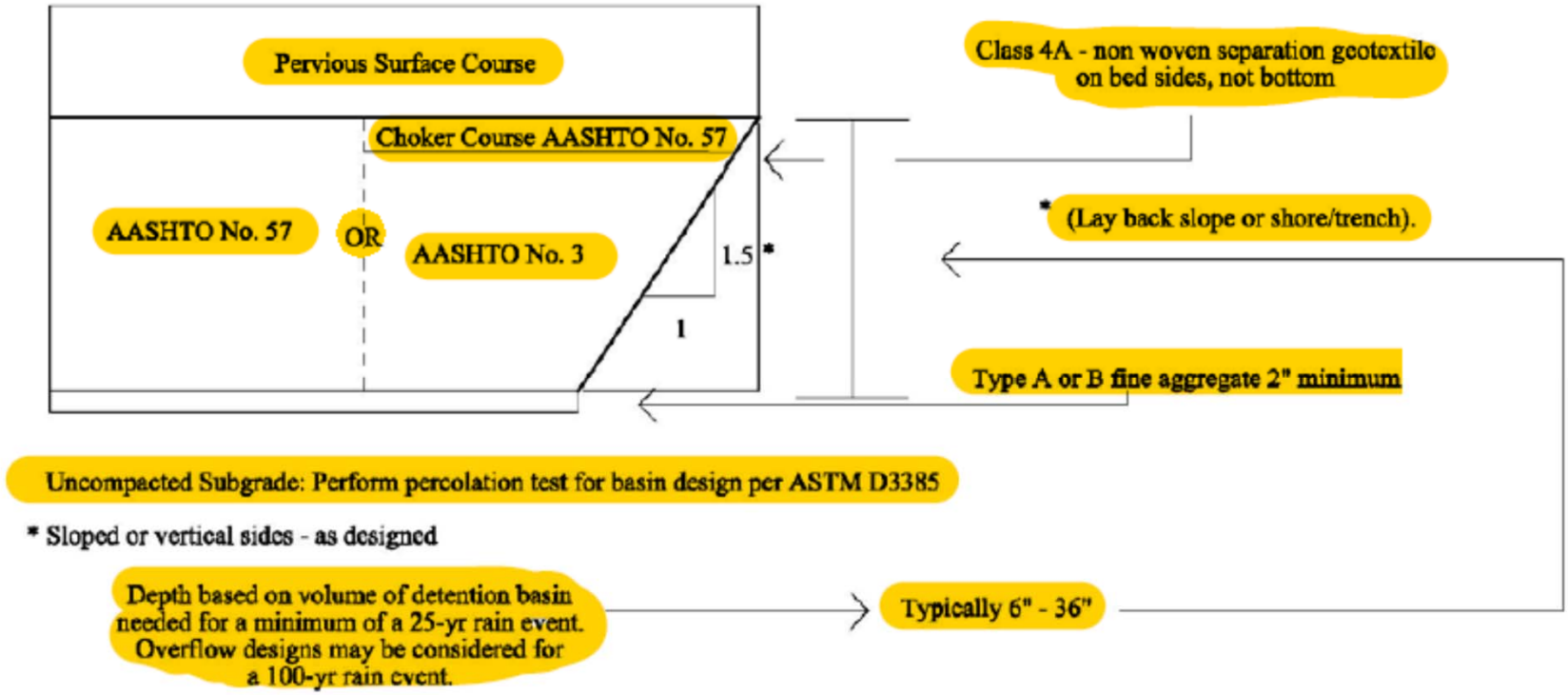


PAPA

PA Porous (Permeable) Asphalt Pavements

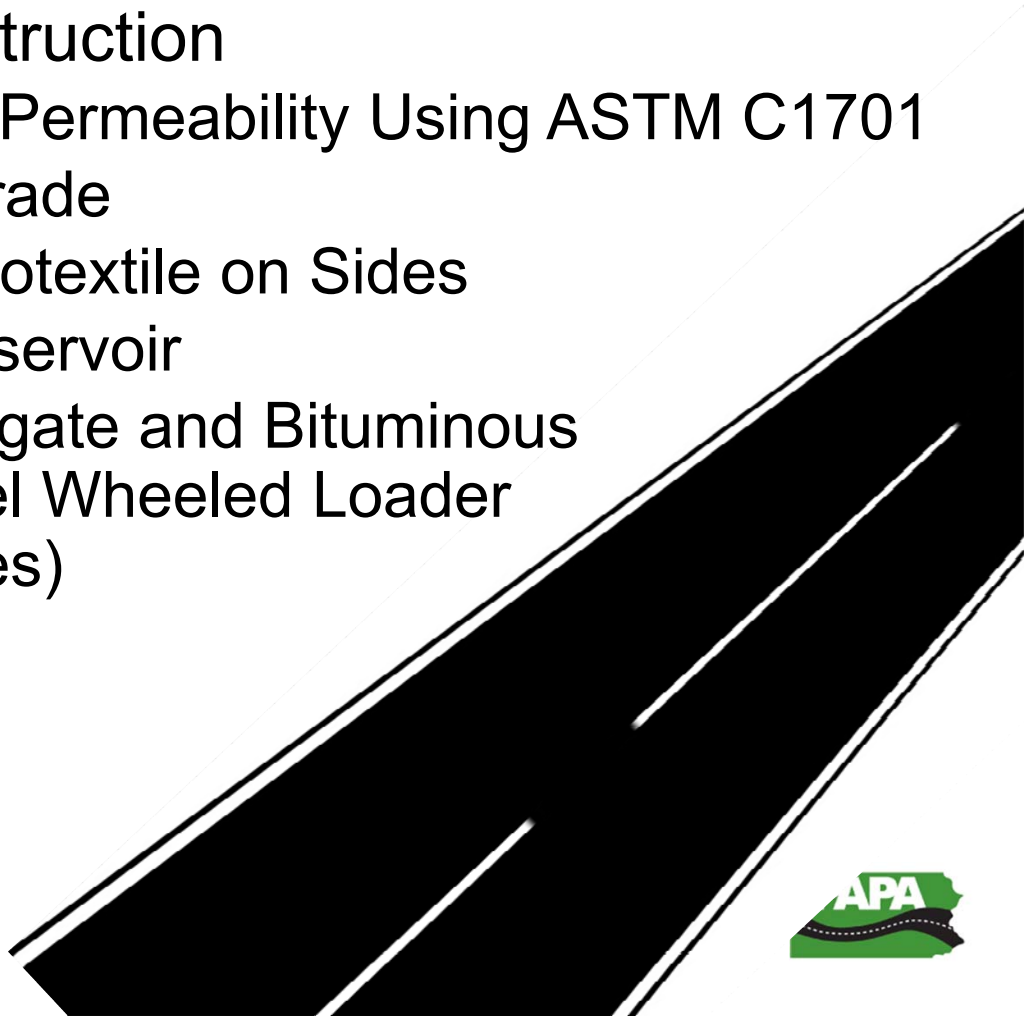
- Pervious System Design

FIGURE K.1
PERVIOUS SYSTEM DESIGN



PA Porous (Permeable) Asphalt Pavements

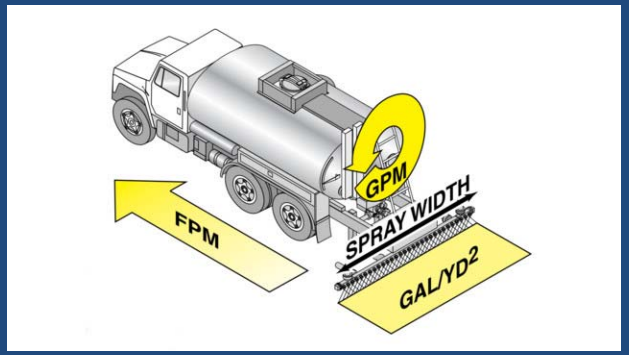
- Pervious Pavement Construction
  - 2 Test Sections – Check Permeability Using ASTM C1701
  - DO NOT Compact Subgrade
  - Sand Bottom/Class 4 Geotextile on Sides
  - 6”-36” Crushed Rock Reservoir
  - Compact Crushed Aggregate and Bituminous Layers Using 10 Ton Steel Wheeled Loader in Static Mode (1-4 Passes)



PA Porous (Permeable) Asphalt Pavements

- Pervious Pavement Maintenance Requirements
  - DO NOT Use Sand or Anti-Skid
  - Pressure Wash and/or Vacuum Surface Annually
  - Monitor or Test Permeability Periodically
  - DO NOT Surface Seal

New Tack Coat Specification Requirements Section 460



Tack Coat

- CSS-1h tack coat (60% residue)
- 0.06 Gal/SY tack application rate
- 0.04 Gal/SY min residue on pave

Change in Tack material

- New Tack is similar to CSS-1h emulsified asphalt.
  - The Minimum residual asphalt is 57% instead of 28%
  - The application temperature is 90F to 150F (AET - 75F to 140F)
- Non-tracking Tack is also an option now.
  - Minimum residual asphalt is 50%.

Change to Application Rate

Surface Type	Uniform Asphalt Residue Rate (RR) (Gallons per square yard)
New Bituminous Paving	0.03 to 0.05
Existing Bituminous Paving	0.04 to 0.07
Milled Surface (Bituminous & PCC)	0.04 to 0.08
Portland Cement Concrete	0.04 to 0.07

Test Section

- The specification includes a test section.
  - 100 Ft. test section required to ensure the proper application is being applied.

Happenings – www.pa-ashalt.org

- **Feb. 2-9 Mid-Atlantic QAW**
- **March 15 PAPA Central Regional Tech Mtg**
  March 14 PAPA Western Regional Tech Mtg
  March 16 PAPA Eastern Regional Tech Mtg
- **Aug. 1-2 PAPA/DOT Bus Tour-District 6**

Please Contact Tina Holtzman @ 717-657-1881 or tina@pa-asphalt.org for more Information!

Questions?? Thank you!!

To contact .....

Pennsylvania **A**sphalt **P**avement **A**ssociation
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Gary L Hoffman, P.E. Director of Technical Services – gary@pa-asphaslt.org

Committed To:
Safe, Smooth, Sustainable, Long Lasting Pavements!

PaveXpress

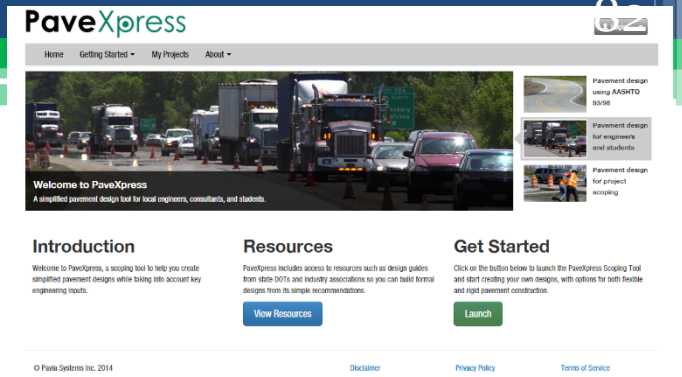
A FREE Simplified Pavement Design Tool

What Is PaveXpress?

"A free, online tool to help you create simplified pavement designs using key engineering inputs, based on the AASHTO 1993 and 1998 supplement pavement design process."

- Accessible via the web and mobile devices
- Free — no cost to use
- Based on AASHTO pavement design equations
- User-friendly – Drop down menus
- Share, save, and print project designs
- Interactive help and resource links

Brief Overview

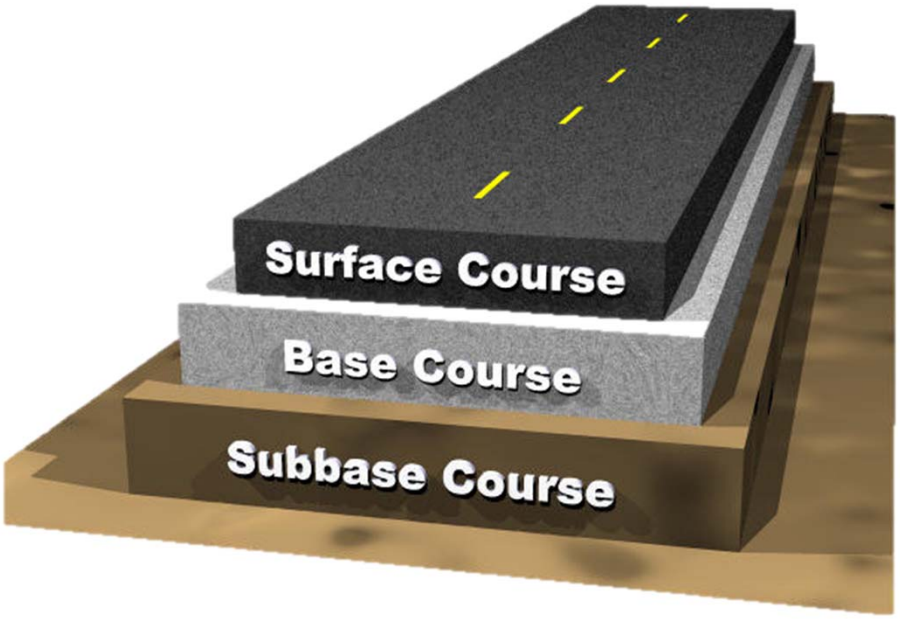


- **Software developed & updated by NAPA**
- **Provide FREE online tool to develop technically sound pavement designs for roadway pavements**
- **Provide a user-friendly, visually appealing, pavement design tool accessible to users on a variety of devices**
- **Provides a FREE alternative to ACPA Streetpave**
- **Provide resources to enhance understanding and comfort with asphalt pavement design**

PaveXpress

Provides technically sound pavements designs using:

- Flexible: AASHTO ’93
- Rigid: AASHTO ‘93 w/ ‘98 Supplement
- Parking lot guidance (Flexible only)



AASHTO has developed MEPDG software (PavementME) for high volume roads, but a gap has developed for local roads and lower volume roads. Thus the impetus for PaveXpress

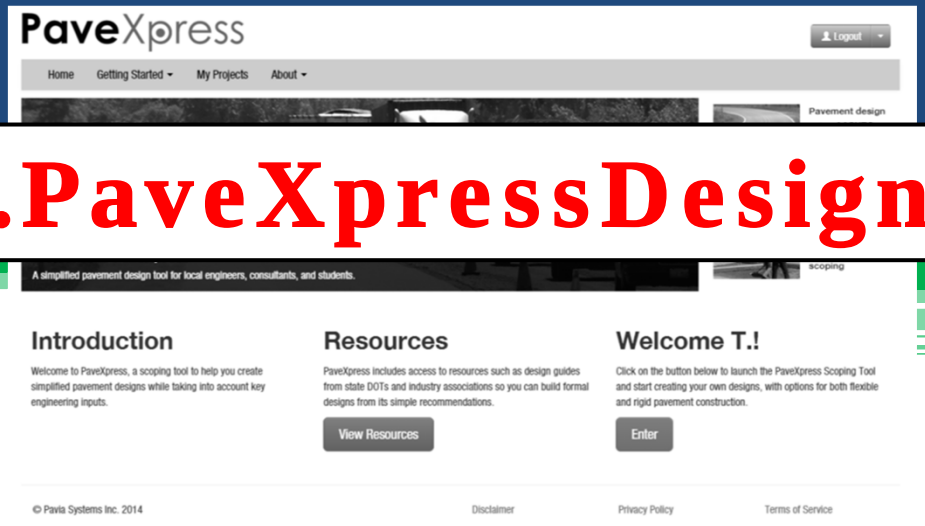
PaveXpress

A FREE Simplified Pavement Design Tool

- **Utilize for new pavement designs (several DOTs testing)**
- **Utilize for design of overlay projects (Version 2)**
- **Municipal Engineering Consultants are utilizing**
- **Utilize as a comparator for pavement designs**

PaveXpress

A Free Simplified Pavement Design Tool



www.PaveXpressDesign.com

MEPDG – Pavement ME

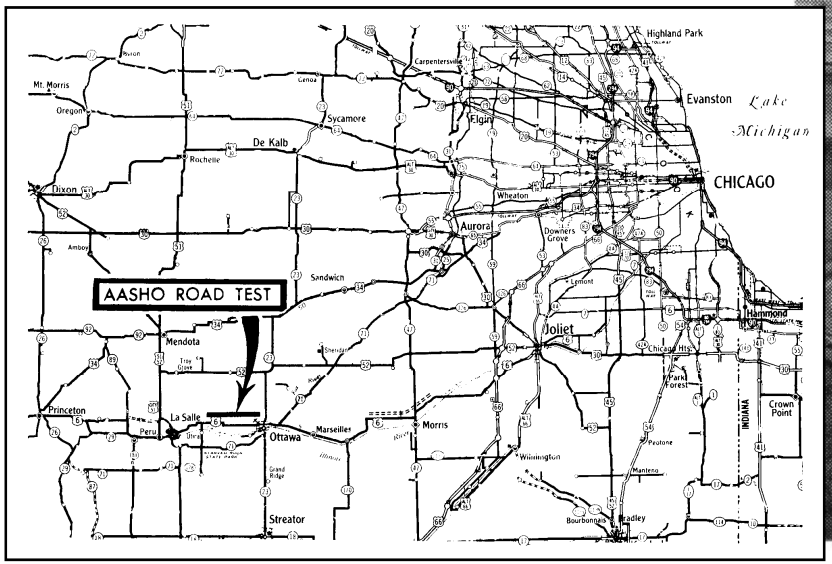
AASHTOWare Pavement ME Design (Version 2.2)

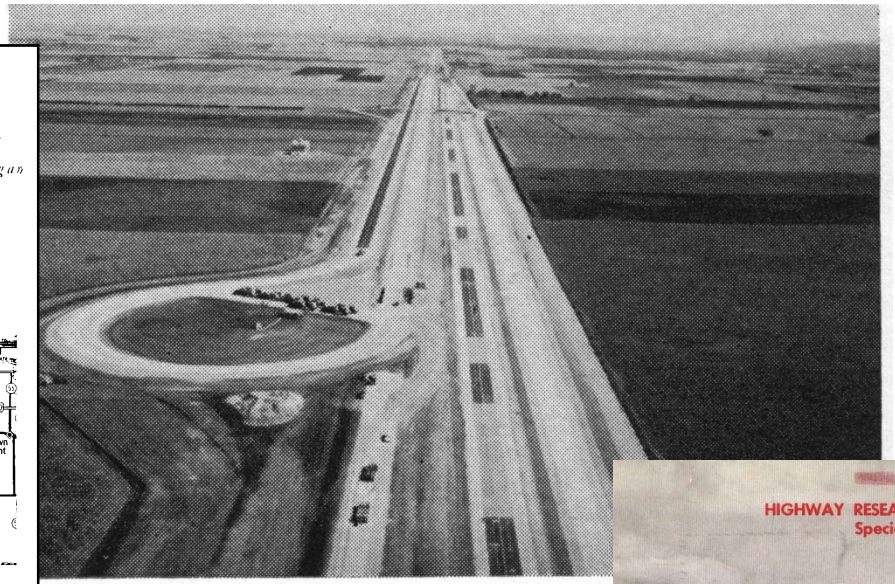
- Pavement ME Design is the next generation of AASHTOWare® pavement design software, which builds upon the mechanistic-empirical pavement design guide, and expands and improves the features in the accompanying prototype computational software. ME Design supports AASHTO's Mechanistic-Empirical Pavement Design Guide, Interim Edition: A Manual of Practice. ME Design is a production-ready software tool to support the day-to-day pavement design functions of public and private pavement engineers.

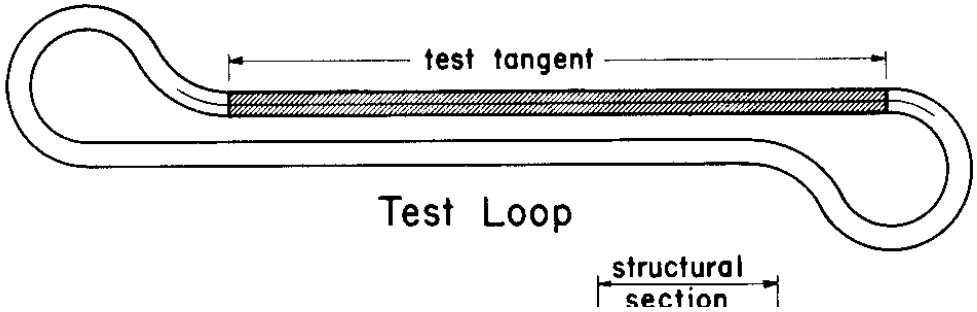
Effects of PennDOT Implementation of the AASHTO ME

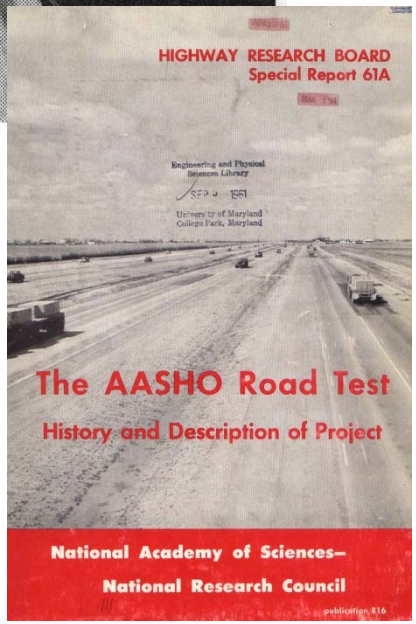
- Development of the MEPDG
  - How the Pavement Design got to where it is at this time (from AASHTO 1961 to Present)
  - *AASHTO Road Test 1958-60*
  - *Procedures used for 40 years*
  - *PennDOT to implement this year*

AASHO Road Test (late 1950's)



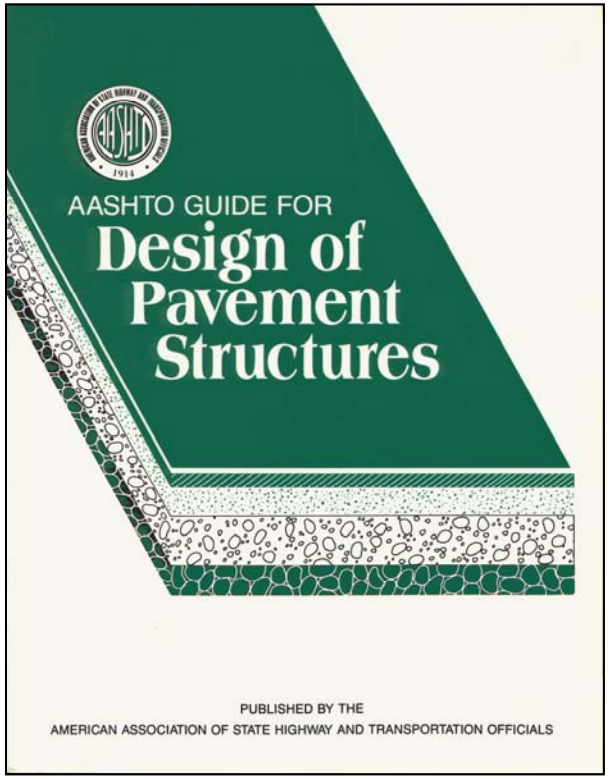






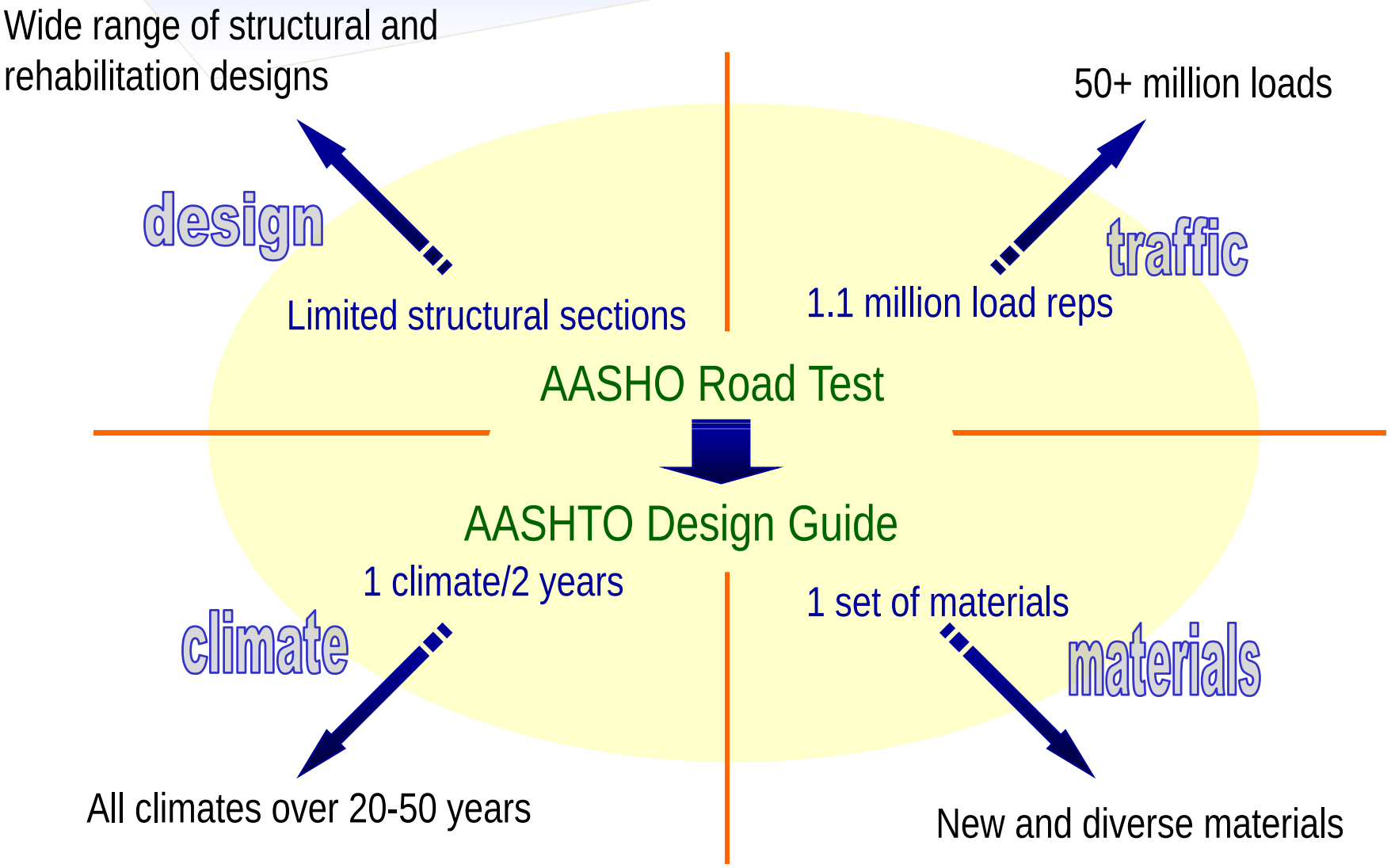
(AASHO, 1961)

AASHTO Pavement Design Guide



- Empirical methodology based on AASHO Road Test in the late 1950's
- Several versions:
  - 1961, 1972 (Interim Guide)
  - 1986, 1993 (Same equation, additional inputs)
- Many deficiencies after 40 years!

Current AASHTO vs. Current Needs

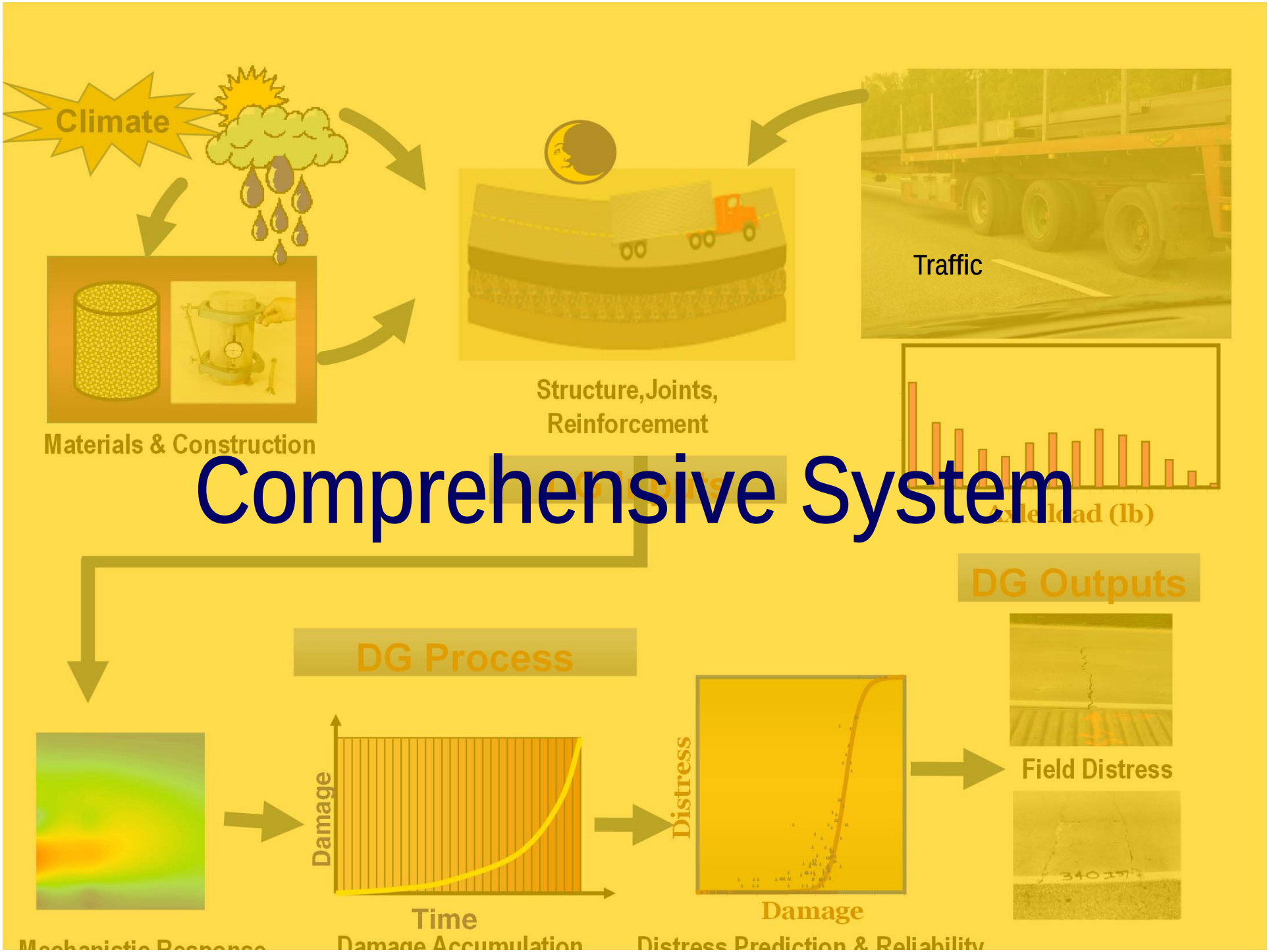


AASHTO MEPDG

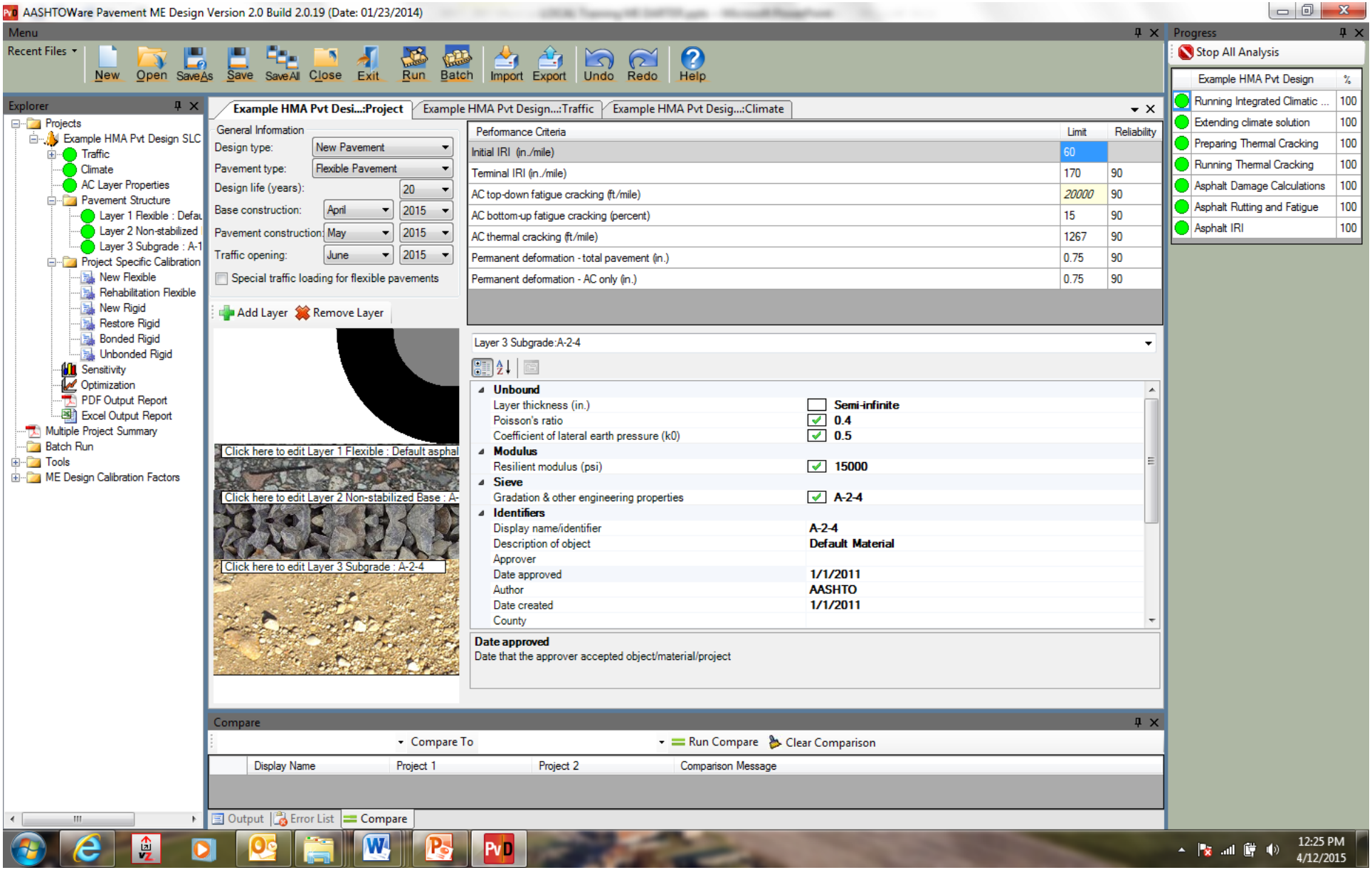
- **Development of the MEPDG**
  - The MEPDG is based on mechanistic empirical design concepts.
    - **Mechanistic:** Design procedure calculates pavement responses such as stresses, strains, and deflections under axle loads and then accumulates the damage over time.
    - **Empirical:** Damage is correlated with actual performance of pavements.
    - **MEPDG vs. AASHTO '93.**

Some Specific Advantages: HMA

Old AASHTO 1960-93	New AASHTO ME Design
• Structural design provides only SN, not HMA thickness! • No connection of asphalt binder grade to performance • HMA & base layer coefficients not accurate • ESALs used for traffic • Climate not considered • Rehab does not consider reflection cracking	• Directly provides HMA thickness to prevent fatigue cracking & rutting • Asphalt binder grade directly related to fatigue cracking, rutting, and low temp cracking • HMA dynamic modulus & creep compliance meas. • Actual axle loads & types • Climate directly considered • Rehab directly considers reflection cracking


Climate
Traffic
Structure,Joints,
Reinforcement
Materials & Construction
Comprehensive System
DG Outputs
DG Process
Damage
Time
Damage Accumulation
Distress
Damage
Distress Prediction & Reliability
Field Distress

AASHTO ME Input Screen



AASHTO ME Basics

- MEPDG Basics Design options within the software
  - New or reconstructed AC pavement
  - New or reconstructed Jointed Plain Concrete Pavement (JPCP)
  - AC Rehabilitation - AC overlay on existing AC
  - AC Rehabilitation - AC overlay on existing JPCP
  - JPCP Rehabilitation - Concrete Pavement Restoration (CPR diamond grinding) and Unbonded JPCP overlay on an existing JPCP

AASHTO ME Basics: Some Details

- MEPDG Basics
  - Guidance to perform pavement design using the software. Iterative process and including the following steps:
    - Trial design input.
    - Analysis by the software, including key distresses, and IRI.
    - Predicted performance is compared to the design performance criteria at a desired level of reliability. Modified designs are reentered into software and analysis is performed again.

Improved Engineering Design

- Due to its comprehensive development & calibration to local pavement performance, the new AASHTO ME provides far **more accurate design!** This translates into **lower construction & maintenance/rehab costs over time.**
- Then, **design reliability** is then used to provide a safety factor in structural design. Higher traffic typically requires higher design reliability.
- **Certain distresses**, such as bottom up fatigue cracking can justify higher design reliability also, due to its importance in good performance and high maintenance/rehab requirements.

MEPDG – Pavement ME

PennDOT IS IMPLEMENTING Pavement ME

- Software developed by AASHTO
- Updated via NCHRP Projects
- Hired Firm, ARA, to assist with implementation 2015
- Fall 2015 started to calibrate software
- Spring – started training for users
- July 1, 2016 – begin designing pavements with Pavement ME

http://www.aashtoware.org/Pavement/Pages/default.aspx

MEPDG – Pavement ME

Cost of Pavement ME License

Individual Workstation License

Description	**Annual License Fee**
Individual Workstation	**$5,000**

Site License

Description	**Annual License Fee**
Site License – Up to 9 concurrent users	**$20,000**
Site License – Up to 14 concurrent users	**$30,000**
Site License – Up to 20 concurrent users	**$40,000**

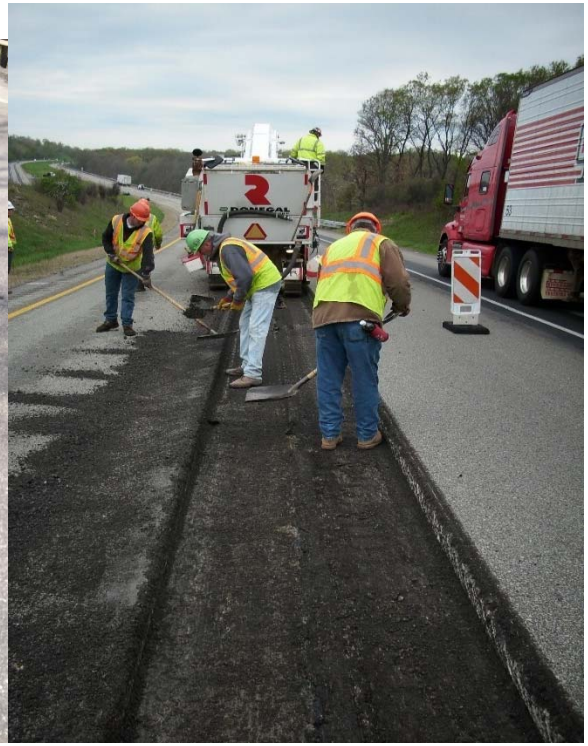
Getting Quality Pavement Joints

Longitudinal Joint Specification Performance

Goal – Better Densities

- Our focus has been on getting better joint density due to performance issues of under compacted material.



Goal – Better Densities

"The amount of air voids in an asphalt mixture is probably the single most important factor that affects performance throughout the life of an asphalt pavement."

- E. Ray Brown, NCAT Report 90-3

"Compaction is the most important factor in the performance of an HMA pavement."

- HMA Paving Handbook, US Army Corps of Engineers

Result – Better Densities

PA DOT Longitudinal Joint Data Summary		
Year	***Min. Spec. Limit***	***Avg. Joint Density***
2008	N/A	88.9%
2009	N/A	89.2%
2010	N/A	88-90%
2011	≥ 89%	91.0%
2012	≥ 89%	91.6%
2013	≥ 89%	91.4%
2014	≥ 90%	92.3%
2015	≥ 90%	92.6%

On our RPS and NHS routes we have gained in terms of density.

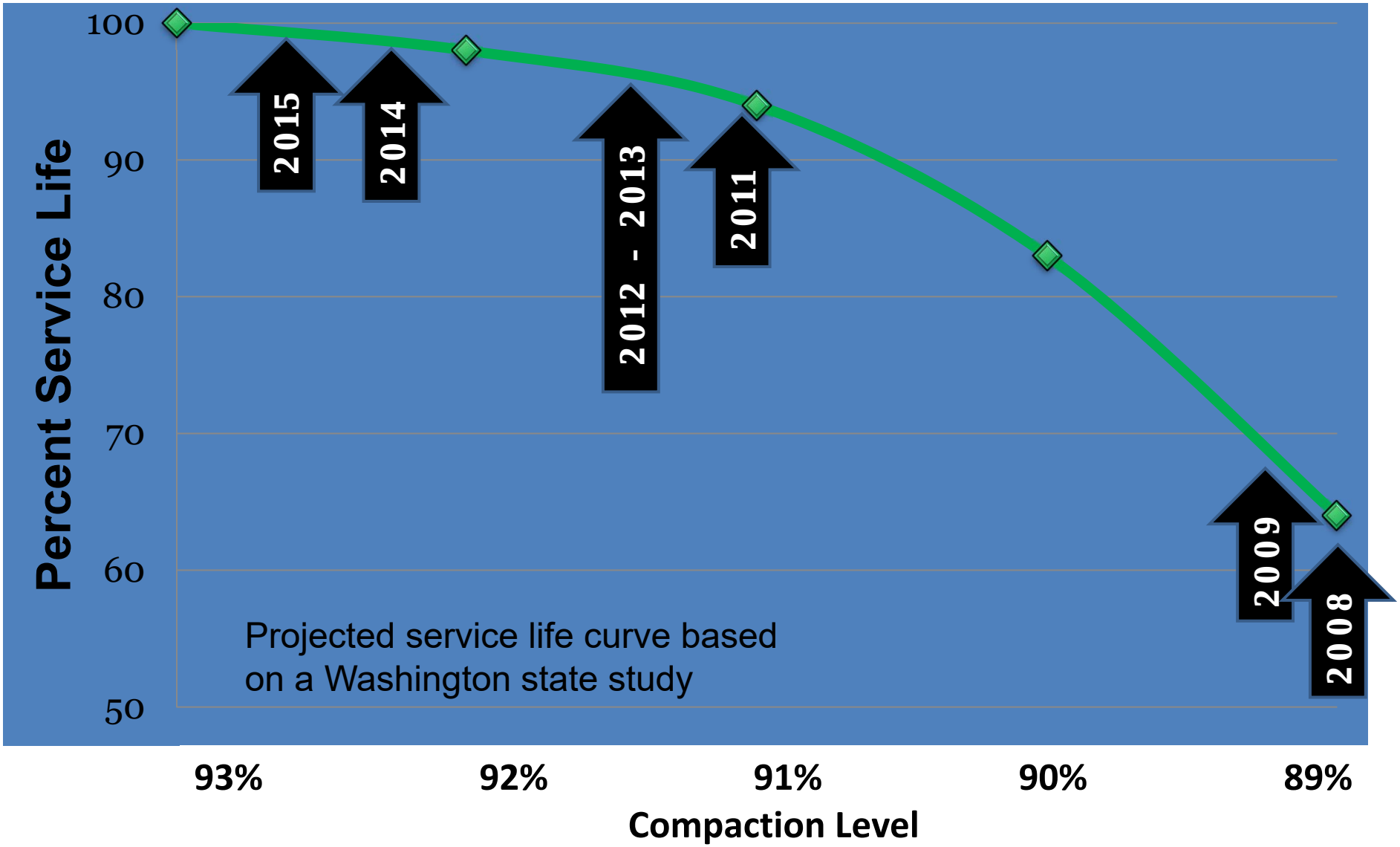
Longitudinal Joints

- 124 Projects with Specification
- 493 Total Lots (2464 cores) approx. 1167 miles
- Raised min. spec. limit to ≥ 90% density for 2014 construction (Pub. 408 2011/Change 5)

2015 Longitudinal Joint Density Projects Incentive/Disincentive Summary

Pay Adjustment	Total $
Bonus	$1,620,868
Negative Adjustment	$149,851

Increased Projected Life of Joints Due to Improved Densities in PA, 2008 thru 2015



Joint Density Up

- We have done well in raising the density at our joints. This will pay off.

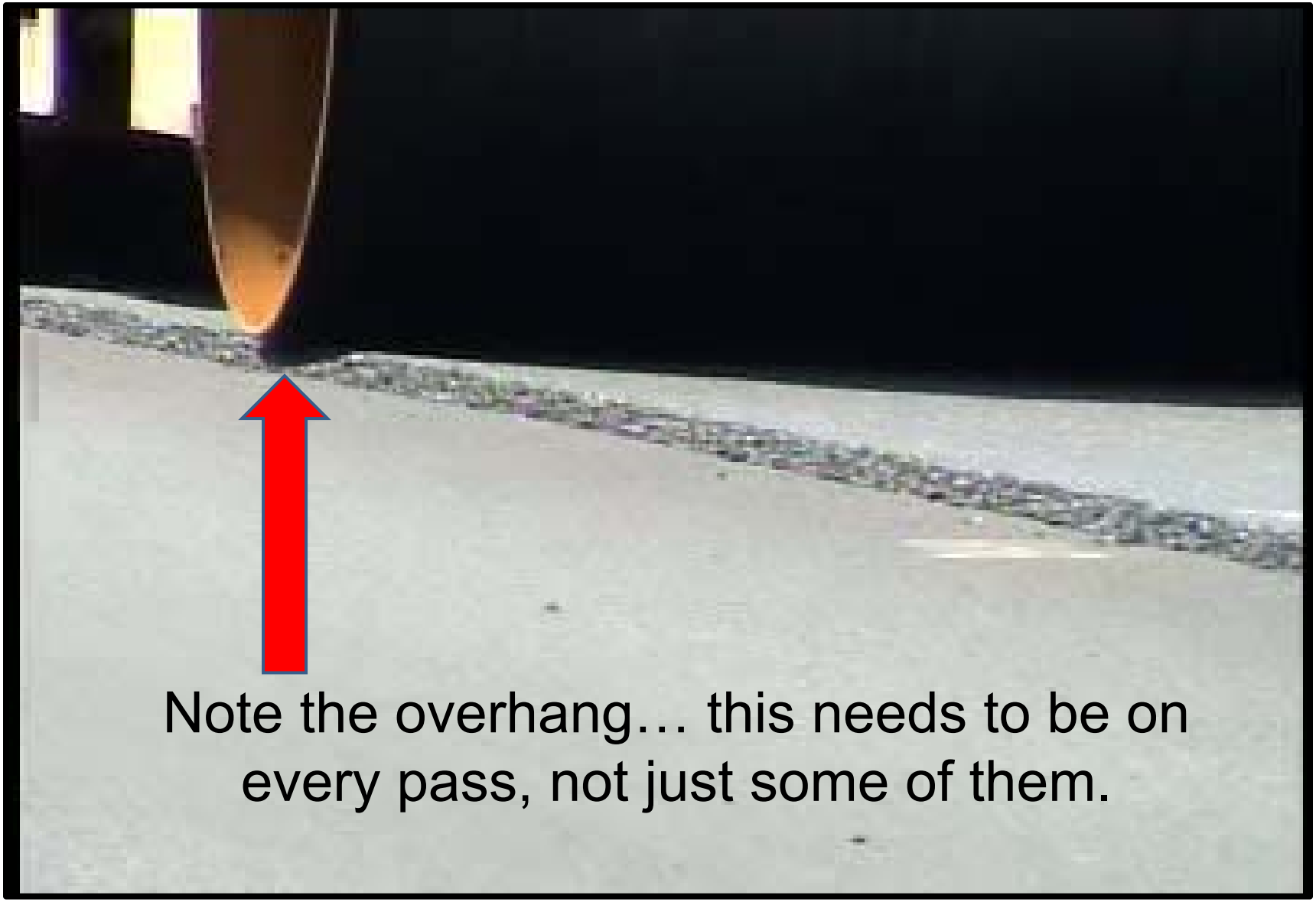
- Now let's focus on making sure we get the density without causing cracking.

Goal – Dense Joints that Don't Crack

- Better densities mean more roller passes

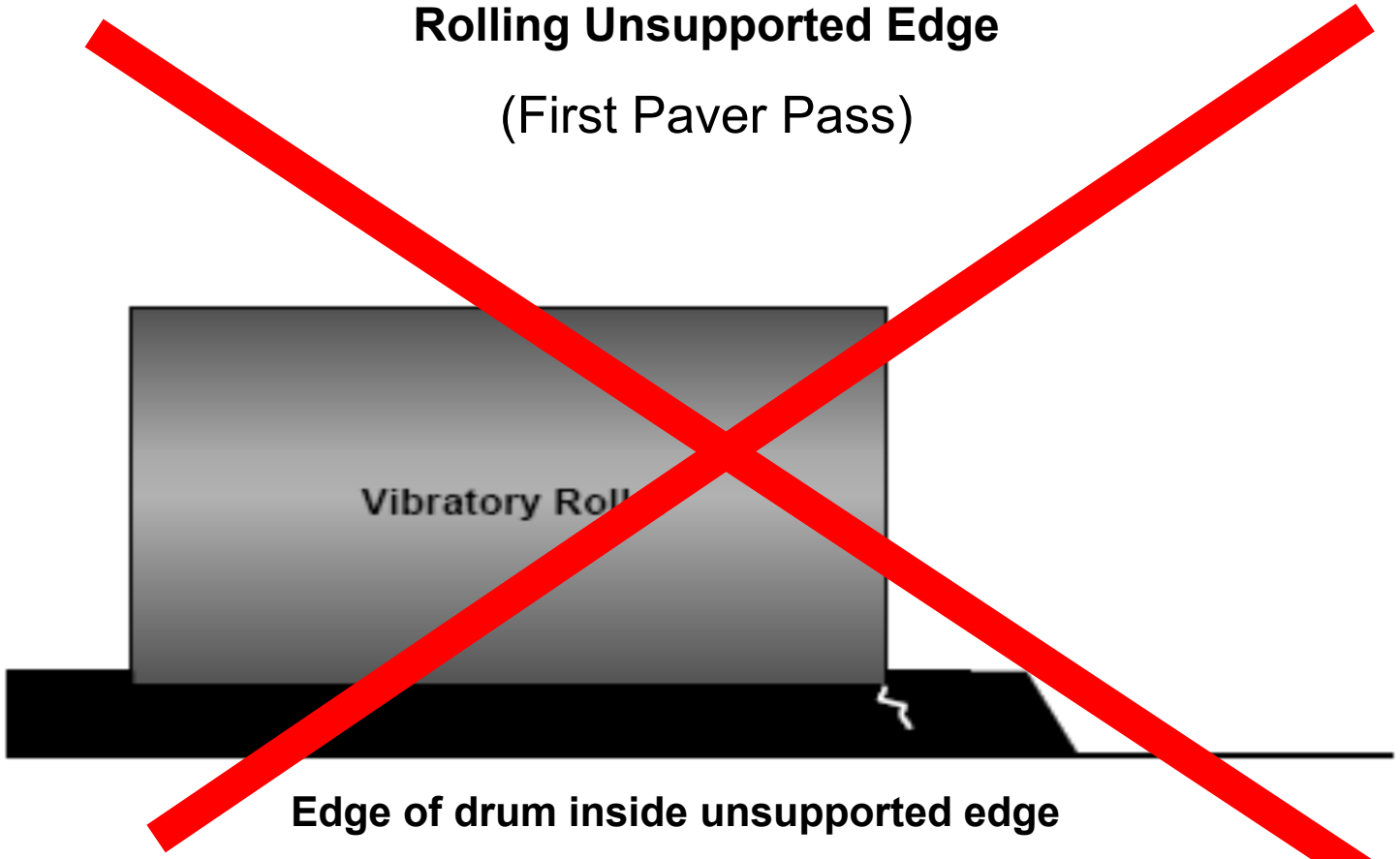
- More roller passes mean more chance to crack the pavement in the area of the joint

- Tender mixes will make this tendency worse. Be on your guard to ensure you are not creating cracking.


Note the overhang… this needs to be on every pass, not just some of them.

Rolling Unsupported Edge

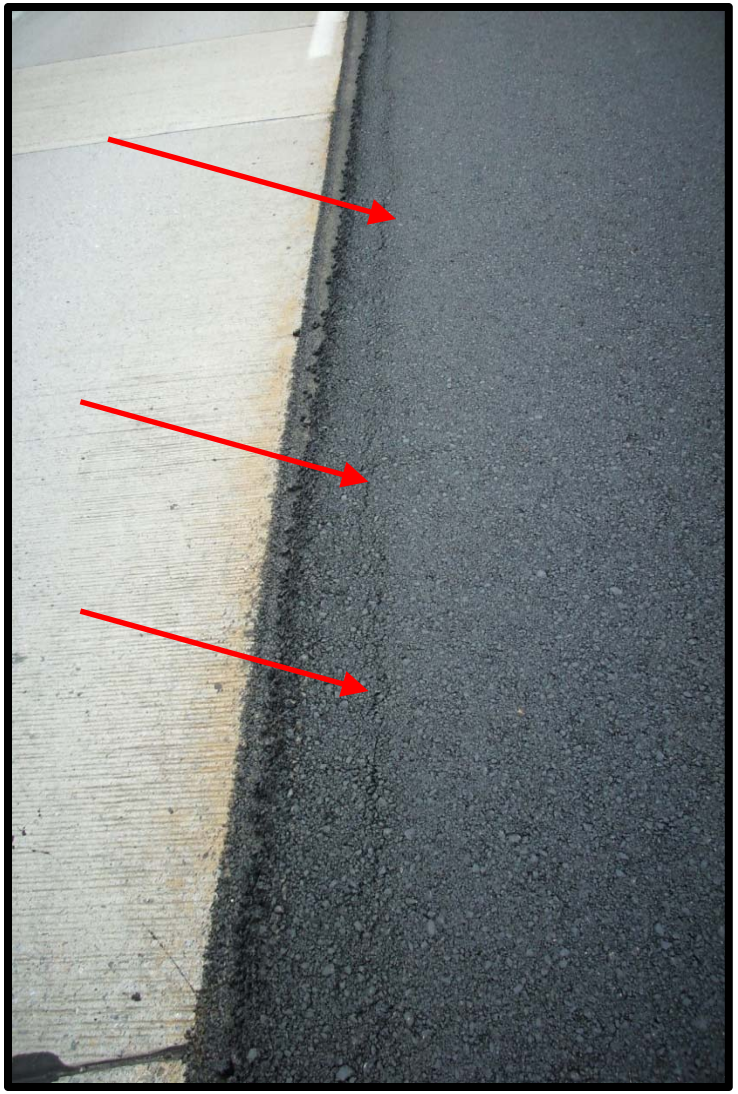
(First Paver Pass)



Edge of drum inside unsupported edge

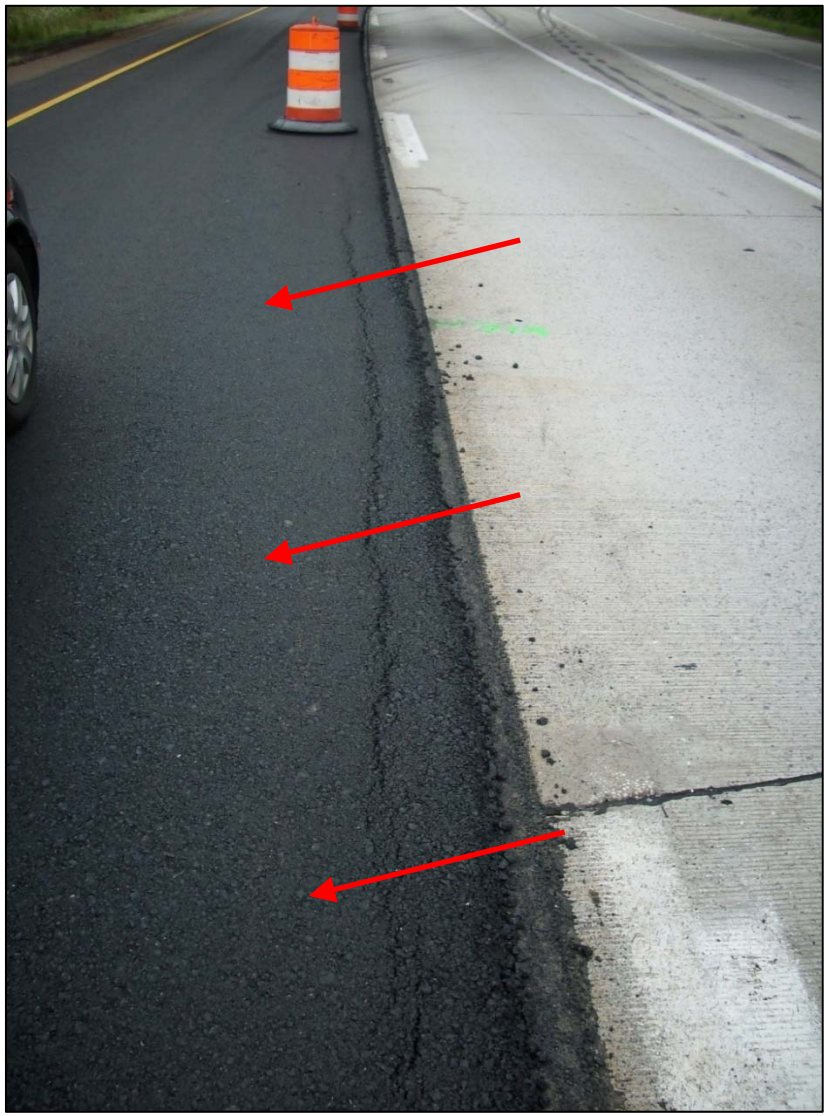
Can cause cracking near the edge and lateral mix movement at the unsupported edge (especially on tender mixes)

What We Don't Want



- Note the crack that formed at the unsupported edge.
- This illustrates why rolling just inside of the edge is not desirable.
- This mix had a tender zone and cracks formed at the edge of the roller drum.

Make sure rollers overhang edges



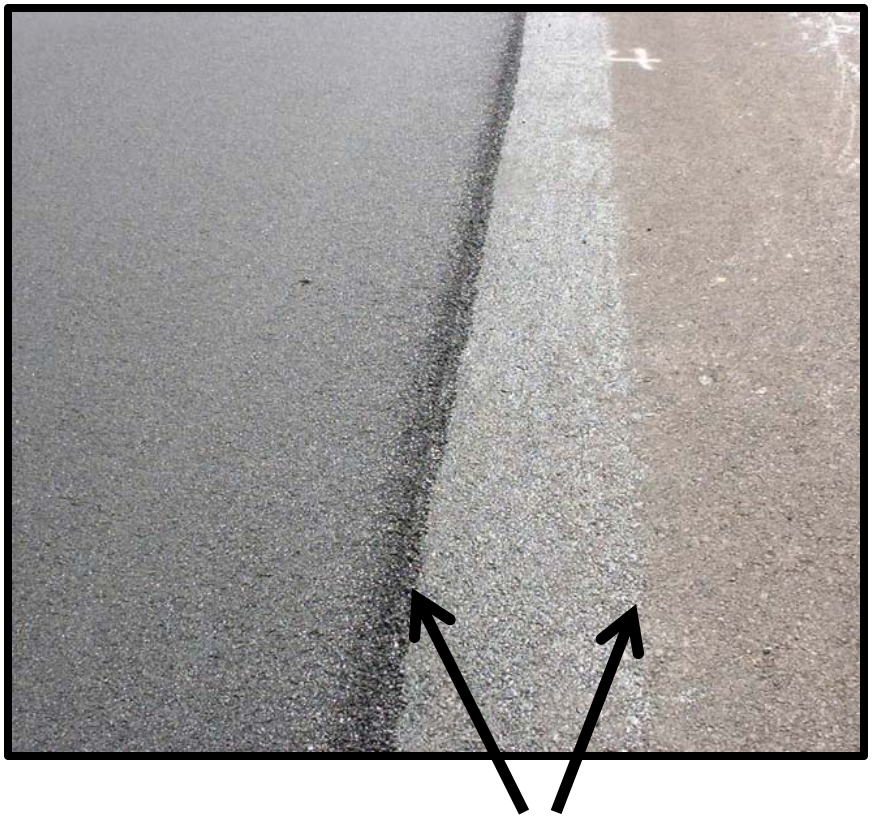
Watch what is Going on at the Screed

Project:

- Paved June 2015
- Wedge Joint
- No joint spec
- Paver leaving shadow in mat about 3” from joint
- Next winter?

- **Often watching the mat closely can pick up an issue that could be corrected**

Tack at Unsupported Edges



Extra Tack Coat Width

- Apply tack coat slightly beyond the edge of the lane to be paved

You Want to See Tack Coat

Note the extra
6 inches of tack

Overlap Paver Screed 1” (to 1 ½”)

- Consistent proper overlap is key
- Operate paver so that the edger plate on the screed overlaps the previously placed pavement by 1 inch (to 1 ½ inches)

Conclusion

- **Density is important, so get it**
- Watch details so cracking doesn't happen
  - Roller passes, overhang
  - Roller speed
  - Stay out of tender zone
  - Tack application
  - Watch the screed
  - Use your eyes to look for issues

Implementation

- CT1 comments addressed.
- CT 2 should be out in a week or 2
- Specification should be approved by July 1.
- Change should be in Change 1 of 2016 Pub. 408.
  - Change 1 effective date is October 7, 2016.
  - In contracts effective December 16, 2016

Tack Coat Specification

ASPHALT PAVEMENT DISTRESS

TYPES & REPAIRS

TYPES OF PAVEMENT DISTRESS

- Cracking
  - Fatigue
  - Transverse
  - Block
  - Edge
- Potholes
- Surface Deformation
  - Rutting
  - Corrugation/ Shoving
  - Slippage Cracks
- Surface Defects
  - Raveling
  - Bleeding
  - Polishing

Select Appropriate Repairs for Observed Distresses

- **Non-Structural vs. Structural Problems**

Specific Methods of Bituminous Repairs

- Patching
- Crack Sealing
- Surface Treatment
  - Seal Coat
  - Slurry Seal
  - Micro-surfacing
  - Non-structural overlay
  - ThinLay
- Full Depth Reclamation
- Structural Overlay

Late Season Paving

SOL 495-15-08 Issued August 17, 2015

SUBJECT: Asphalt Weather Restrictions/Requests to Extend the Paving Season

- **POLICY & PROCEDURE TO REVISE PUB 408, SECTION 409.3(B) – WEATHER LIMITATIONS**
- **ISSUED AS A STANDARD SPECIAL PROVISION (SSP)**
- **SSP INCLUDED IN ALL PROJECTS LET AFTER 08-14-2015**
- **WILL BE INCLUDED IN NEXT PUB 408 UPDATE**

SOL 495-15-08 What changed?

SUBJECT: Asphalt Weather Restrictions/Requests to Extend the Paving Season

- **Extension Time Period – March 15 to April 1 & October 31 to November 20**

- **Submit written request to DE**
  - **Provide justification with a work schedule - paving plan**
  - **Use Warm Mix Asphalt**
  - **Agree to supply WMA at or below HMA unit price**
  - **Agree to no additional costs for means, methods, or materials**
  - **Complete work by approved completion date**

- **A Final Acceptance Certificate will not be issued to May 1 of the following year for November work**

What still needs to change?

Asphalt Weather Restrictions/Requests to Extend the Paving Season

- **ELIMINATE ALL DATE RESTRICTIONS**
  - **A NUMBER OF STATE DOT'S HAVE MOVED TO "NO DATE" SPECIFICATION (MD, KS, CA, NJ & OK)**
- **RETAIN WET SURFACE RESTRICTION & AIR AND PAVEMENT SURFACE TEMPERATURE OF 40^0 F – 35^0 F IF WMA USED**

Urban RAP

NAPA
High RAP Asphalt Pavements
Japan Practice — Lessons Learned
アスファルト舗装廃材

Urban RAP Opportunity

- **More RAP Being generated than recycled**
- **2.9 + Million Tons in D 6 – NJ has over 11 Million Tons**
- **Will become a bigger issue in future**
- **What do we do?**
- **PAPA Proposal to PAG**
  - **Generate less RAP – ThinLay**
  - **Higher RAP Mixes**
  - **100% RAP Mixes**
  - **FDR Projects**
  - **Logistics Study**
  - **Suggestions**
- **Task Force to be formed to study – make recommendations**