ASPHALT

THE SMOOTH QUIET RIDE

ASPHALT 100% RECYCLABLE

2017 Local Roads Workshop

Project Scoping

March 2017

ASPHALT PAVEMENT ASSOCIATION OF MICHIGAN

MICHIGAN RIDES ON US

Asphalt.

Project Scoping

Presentation Outline

- **Mix Selection**
- Rehab of Concrete Pavements
- Preventive Maintenance

Mix Selection – Mix of Fixes

Capital Preventive Maintenance - (Crack Filling, Surface treatments, thin overlays)

Rehabilitation - Conventional overlays, Rubblization, ASCRL, Etc.

Reconstruction - Full depth pavement removal and replacement

Mix of Fixes

Capital Preventive maintenance: Shorter Term Fixes

- 1 ½” HMA Overlay
- Milling and 1 ½” HMA Overlay
- Crack Treatment
- Overband Crack Filling
- Chip Seal
- Micro-Surfacing
- Ultra-Thin HMA Overlay

Mix of Fixes

Rehabilitation: Medium Term Fixes

- Structural HMA Overlay (Multiple Course)
- Mill and Structural HMA Overlay
- In-Place Recycling
  - Crush and Shape
  - Cold-in-Place
  - Hot-in-Place
  - Full Depth Reclamation
- Rubblization
- ASCRL

Mix of Fixes

Reconstruction: Long Term Fixes

- Full depth pavement removal and replacement
- New Construction

Selecting the Right Mix

- Selection of Mix for:
  - Optimum Performance
  - Economics
- Binder Selection Economics
- Lift Thickness vs. Performance
- Use of RAP

Binder Selection

Example:

- 1 ½” resurfacing of existing road
  - 98% reliability binder grade is PG 64-28
- Consider using PG 64-22 ?
  - Reflective cracking

Lift Thickness based on Nominal Maximum Aggregate Size (NMAS)

NMAS – 1 size larger than the first sieve to retain more than 10%

NMAS

Asphalt Pavement Association of Michigan

Table 2: Aggregate Properties

	Mixture No.				
	2C	3C	4C	13A	36A
	Percent Passing Indicated Sieve or Property Limit				
1 1/2 inch	100				
1 inch	91-100	100			
3/4 inch	90 max.	91-100	100	100	
1/2 inch	78 max.	90 max.	91-100	75-95	100
3/8 inch	70 max.	77 max.	90 max.	60-90	92-100
No. 4	52 max.	57 max.	67 max.	45-80	65-90
No. 8	15-40	15-45	15-52	30-65	55-75
No. 16	30 max.	33 max.	37 max.	20-50	
No. 30	22 max.	25 max.	27 max.	15-40	25-45
No. 50	17 max.	19 max.	20 max.	10-25	
No. 100	15 max.	15 max.	15 max.	5-15	

Ex: 4C mix – NMAS is ½”

Local Agency Programs
HMA Selection Guidelines

Local Agency Programs
Hot Mix Asphalt (HMA) Selection Guidelines

Rev: 06/14/2016 - FHWA Approval: 08/29/2016

The following guidelines have been developed at the request of Local Agency Engineers for use on Local Agency projects. These guidelines have been reviewed and approved by the County Road Association of Michigan Engineering Committee. Previous experience and performance shall permit variations from these guidelines as per Section D. Alternative Mixes.

Local Agency Programs
HMA Selection Guidelines

Mixture Type	Marshall Mixture					Superpave Mixture				
	36A	13A	2C	3C	4C	LVSP	3E_	4E1	4E3+	5E_
Min. #/syd	110	165	350	220	165	165 Top or Leveling	330	165	220	165
Max. #/syd	165	275	500	330	275	220 Top 250 Leveling	410	330	275	220

Note: Application Rate of 110#/syd. Per 1 inch Thickness

Lift Thickness vs. Performance

- In-place Density is Critical
  - Initial In-place Air Voids <8%
- Lift Thickness Affects Compaction
  - Consolidation “Room”
  - Cooling Rate

Why Recycle RAP into HMA?

- Best and Highest use
- Same or better performance as virgin mix
- Reduces demand for new materials
- Reduces carbon footprint
- Contains valuable materials
- Save $

Why Recycle RAP into HMA?

- **RAP contains valuable materials :**
  - **Aggregate ~ 94% @ $10/ton**
  - **Asphalt ~ 6% @ $320/ton**
  - **Value = $28.60 /ton (minus processing)**

Economic Savings Example

- Aggregate: $10.00/ton
- Asphalt: $320.00/ton
- RAP: $9.00
- Mix Design AC Content: 6.0%

Material	0% RAP	17% RAP	27% RAP
Aggregate	$9.40	$7.70	$6.70
Asphalt	$19.20	$15.94	$14.02
RAP		$1.53	$2.43
Total	$28.60	$25.17	$23.15
$ Savings		**$3.43**	**$5.45**
% Savings		**12.0%**	**19.1%**

Recommended Practices for Use of RAP (and RAS)

Asphalt Pavement Association of Michigan

Follow best practices for the processing and management of RAP

- Contractor to sample and test RAP during processing

RAP usage specification

- RAP mixes should meet same specs as virgin mixes
- Adjust binder grade appropriately

Approved mix design including RAP

Recommended Practices for Use of RAP

Approved mix design including RAP

Know the properties of the RAP

- **Gradation , binder content ,**
  theoretical maximum specific gravity

Mix design must be done incorporating RAP and taking into account the RAP characteristics

Mix Design Example

Michigan Department of Transportation form 1931

Report of Test
SUPERPAVE ™ HMA Design Mix Formula

File 300 _____

ACCEPTED

Distribution: Project Engineer (1) -- TMI (1) -- Mix Design (1) -- Contractor (1) -- Bit File (1)

Control Section	Job Number	Project Engineer	Engineering Firm	Date
B#6 54038	54321A	R. Steel P.E.	MDOT	8/9/0X

Contractor	Plant Location	Plant No.
General Pavement	BIG RAPIDS	701-01

Mix Type	Mix Design Number	Project Location	Specification
5E3	06MD540		03SP501(F)

% Air Voids	VMA	VFA	P200/P_{be}	AWI	AI
4.0	15.9	74.8	1.1	288	40.9

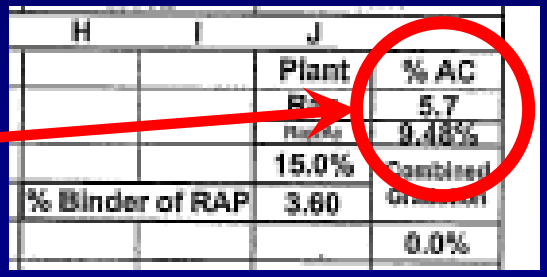
Gmm	Gmb	Gb	Gsb	Gse	Film Thickness
2.457	2.359	1.029	2.644	2.682	7.21

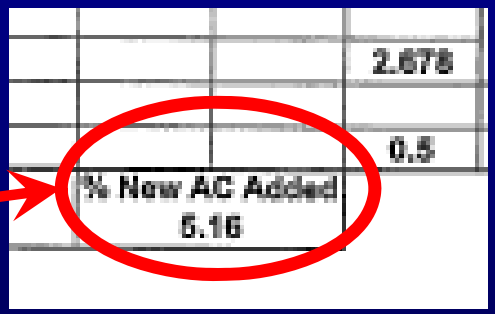
	A	B	C	D	E	F	G	H	I	J	
Pit Number	54-101	54-101	95-76	95-76						Plant	% AC
Aggregate Type	Sand FSU	Slag Sand	5/16 FSU	Sand	DNF					Rap	5.7
Blend %	10.0%	15.0%	26.0%	33.0%	1.0%					15.0%	Combined
Sieve Size	GRADATION							% Binder of RAP		3.60	Gradation
1 1/2" - (37.5mm)											0.0%
1" - (25.0mm)											0.0%
3/4" - (19mm)											0.0%
1/2" - (12.5mm)	100.0%	100.0%	100.0%	100.0%	100.0%					100.0%	100.0%
3/8" - (9.5mm)	100.0%	100.0%	100.0%	100.0%	100.0%					87.5%	98.1%
#4 - (4.75mm)	91.3%	91.7%	65.0%	99.9%	100.0%					67.9%	83.9%
#8 - (2.36mm)	69.9%	59.6%	39.7%	79.9%	100.0%					50.2%	61.1%
#16 - (1.18mm)	52.4%	38.7%	29.2%	66.2%	100.0%					40.8%	47.6%
#30 - (0.80mm)	36.8%	26.3%	23.8%	54.9%	100.0%					33.6%	38.0%
#50 - (0.30mm)	11.8%	18.0%	17.2%	24.9%	100.0%					20.8%	20.7%
#100 - (0.1mm)	3.6%	11.7%	11.7%	2.5%	100.0%					10.6%	8.6%
#200 - (0.075mm)	2.5%	7.7%	9.0%	0.4%	85.0%					7.4%	5.8%
1 FACE CRUSH %	30.0%	100.0%	100.0%	30.0%						75.0%	88.6%
2 FACE CRUSH %											-
L.A. ABRASION & YEAR	22-03	25-02	22-03								
Angularity Index	37.8	48.8	43	38							40.90
AWI FACTOR	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	
AWI VALUE #16	225	401	300	240						240	288
COMBINED Calc. Gsb	2.601	2.720	2.610	2.648						2.675	2.648
#4+ COARSE BULK S.G.			2.621								
#8 COARSE BULK S.G.		2.702	2.582								
FINE BULK S.G.	2.601	2.73	2.619	2.648						2.678	
FLAT & ELONGATED %											
SOFT PARTICLES %	0.1		0.5	0.5						0.5	

Asphalt Binder	Grade	A.C. Supplier I.D. #	% New AC Added
	PG 64-28	ABS 1005	5.16

REMARKS:

Bituminous Engineer





Ability to Meet Volumetrics

- Treat RAP as mix component
- Challenges: VMA and dust/asphalt ratio
  - Good processing practices and quality control can be used to overcome this issue

Recommended Practices for Use of RAP (and RAS)

Asphalt Pavement Association of Michigan

Test the produced Mix:

- (Binder, Gradation)
- Contractor Quality Control Tests
- Owner Quality Assurance / Acceptance tests

If you have performance concerns:

- Consider testing/monitoring other properties
- Mix volumetrics (Air Voids, VMA)
- Fines to Effective Binder Ratio

Presentation Outline

- Mix Selection
- **Rehab of Concrete Pavements**
- Preventive Maintenance

Rehabilitation of Concrete Pavements

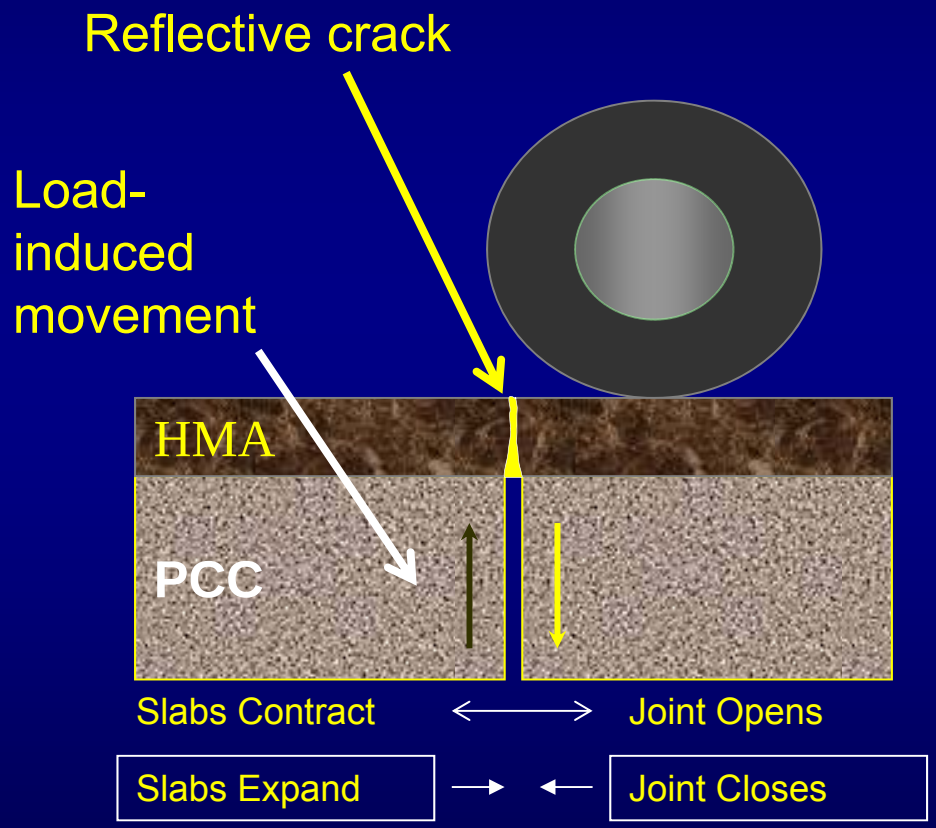
- Improve ride quality
- Correct surface defects
  - improve surface drainage
  - increase surface friction
- Delay/prevent structural deterioration
- Strengthen pavement structure (rehabilitation)

Rehabilitation Design Factors

- Condition of existing pavement
  - Drainage
  - Distress
  - Response to load
- Foundation strength/stiffness
  - Subbase
  - Subgrade
- Future traffic loading
- Additional corrections (safety, capacity, etc)

Reflective Cracking

- By far, the biggest issue in HMA overlays of PCC pavement
- Caused by movement at PCC joints and cracks



Design Issues

- Rate of propagation through overlay
- Number of reflected cracks
- Rate of deterioration of reflected cracks
- Amount of water that can infiltrate through the cracks

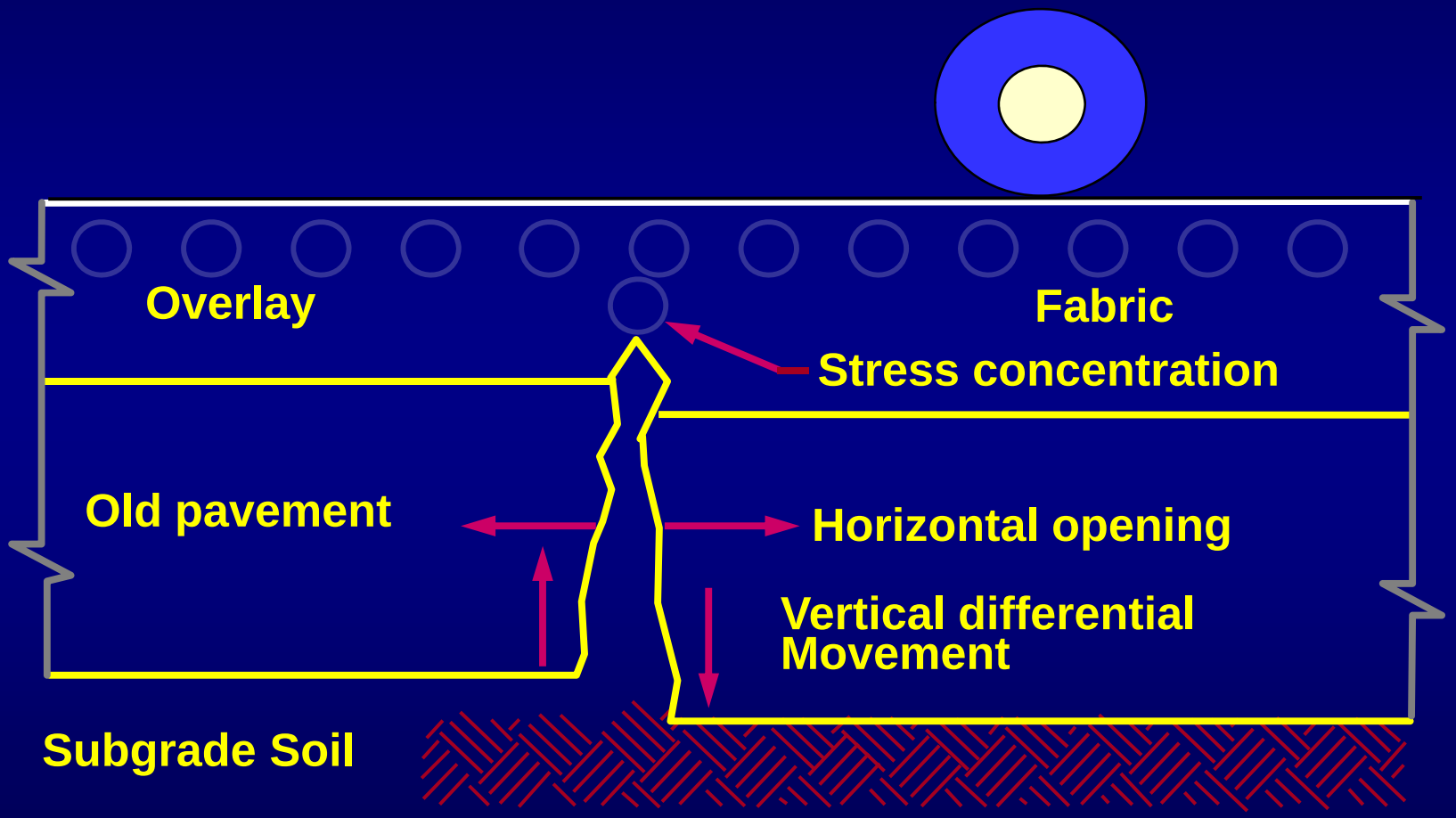
Reflection Crack Control Measures

- Fabrics
- Stress-relieving interlayers
- Crack-arresting interlayers
- Pre-overlay treatments
- Slab repair or replacement
- Sawing and sealing joints
- Increased overlay thickness

Crack Control Effectiveness

- Delay the occurrence of cracking
- Reduce the number of cracks
- Control the crack severity
- Provide other benefits
  - Reduce overlay thickness
  - Enhance waterproofing capabilities

Fabrics


Overlay
Fabric
Stress concentration
Old pavement
Horizontal opening
Vertical differential
Movement
Subgrade Soil

Fabric Application

Pre-overlay Repairs

- Slab stabilization
- Fractured slabs
- Slab repair / replacement
- Load transfer restoration

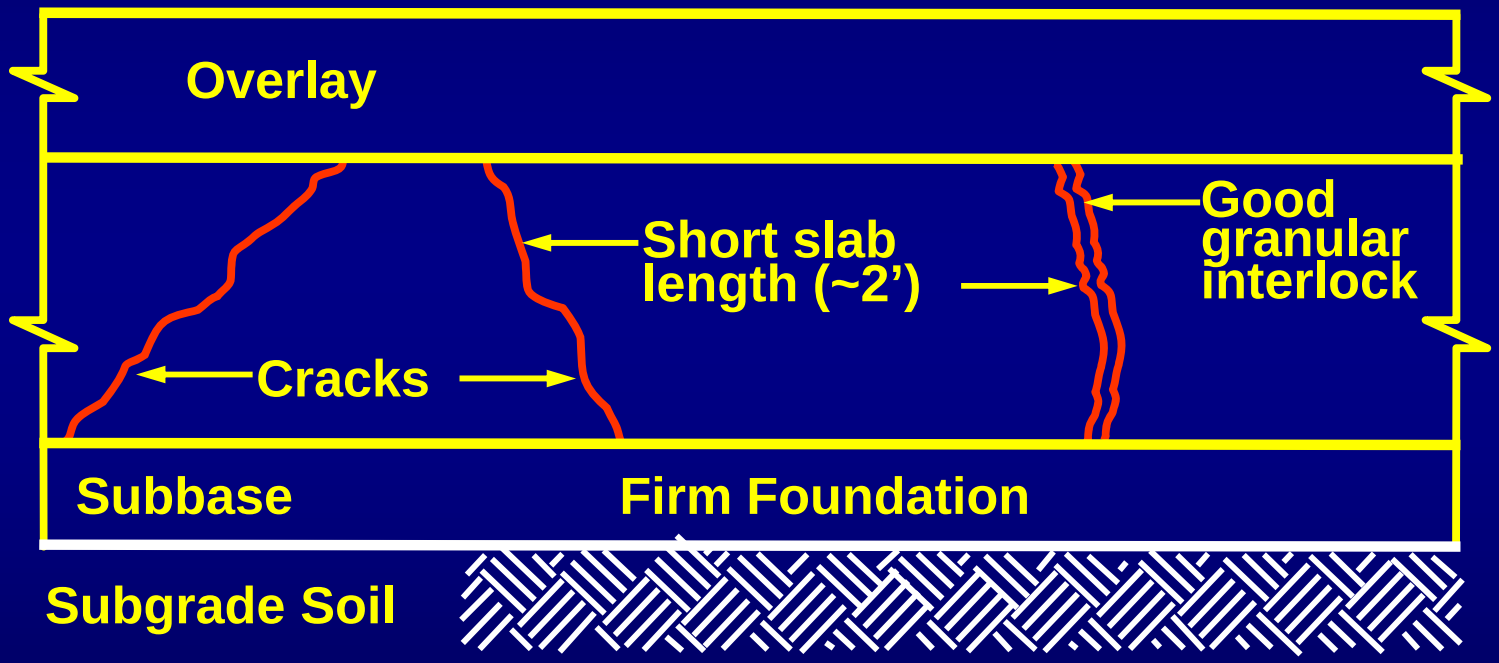
Fractured Slab Techniques

- Crack and seat (JPCP)
- Break and seat (JRCP)
- Rubblize (JPCP, JRCP, CRCP)

Cracking and Seating

- Shortens effective slab length
- Standard practice in many States
- Not "generally" recommended for use on poor subgrades
- Design methods (overlay thickness)

Cracking and Seating



Cracking and Seating

Cracking and Seating

Rubblization

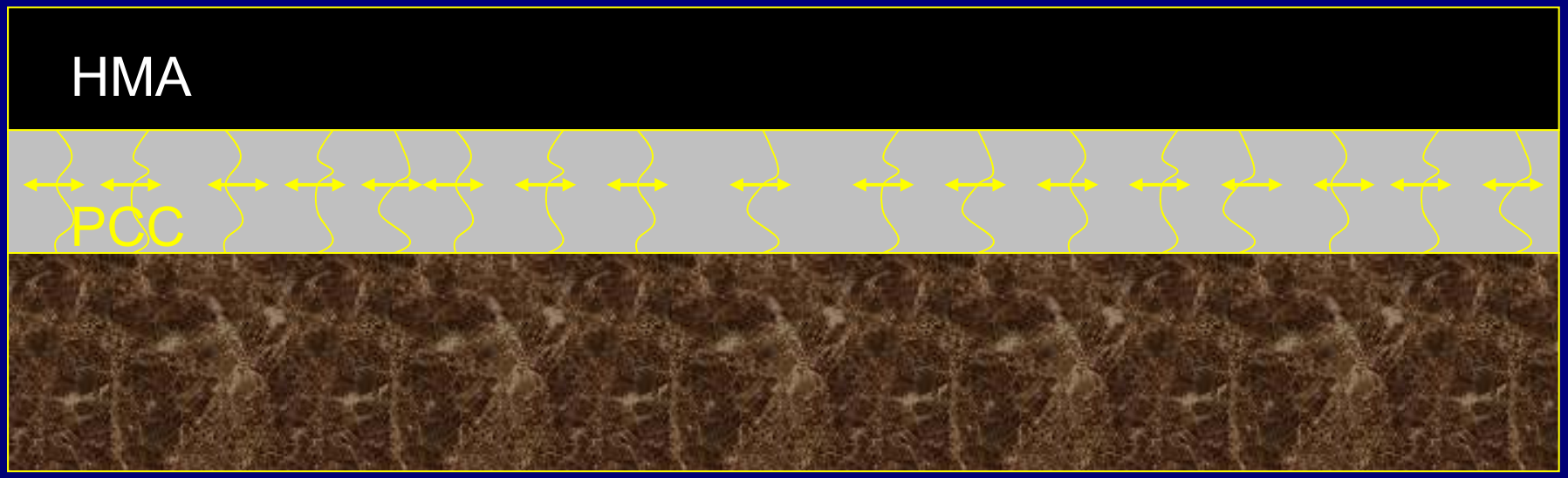
- **Fracturing:**
  - **Eliminates slab action**
  - **Destroys bond between concrete and steel**
- **Rubblized base responds as a tightly keyed, interlocked high-density, unbound layer**
  - **Layer cannot crack; already fractured**

Why Rubblize?

- Fracturing PCC to segments less than 9” precludes reflection of:
  - Joints
  - Cracks
  - Faults
- Production Rates up to 1 lane-mile/day

Rubblization

Smaller Pieces = Smaller Movement = No Cracking



Rubblization - Equipment

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When to Rubblize

- Patching ≥ 10%.
- Severe D-cracking.
- Severe ASR or ACR cracking.
- Dowel bar locking
- Severe joint deterioration
- Persistent faulting.

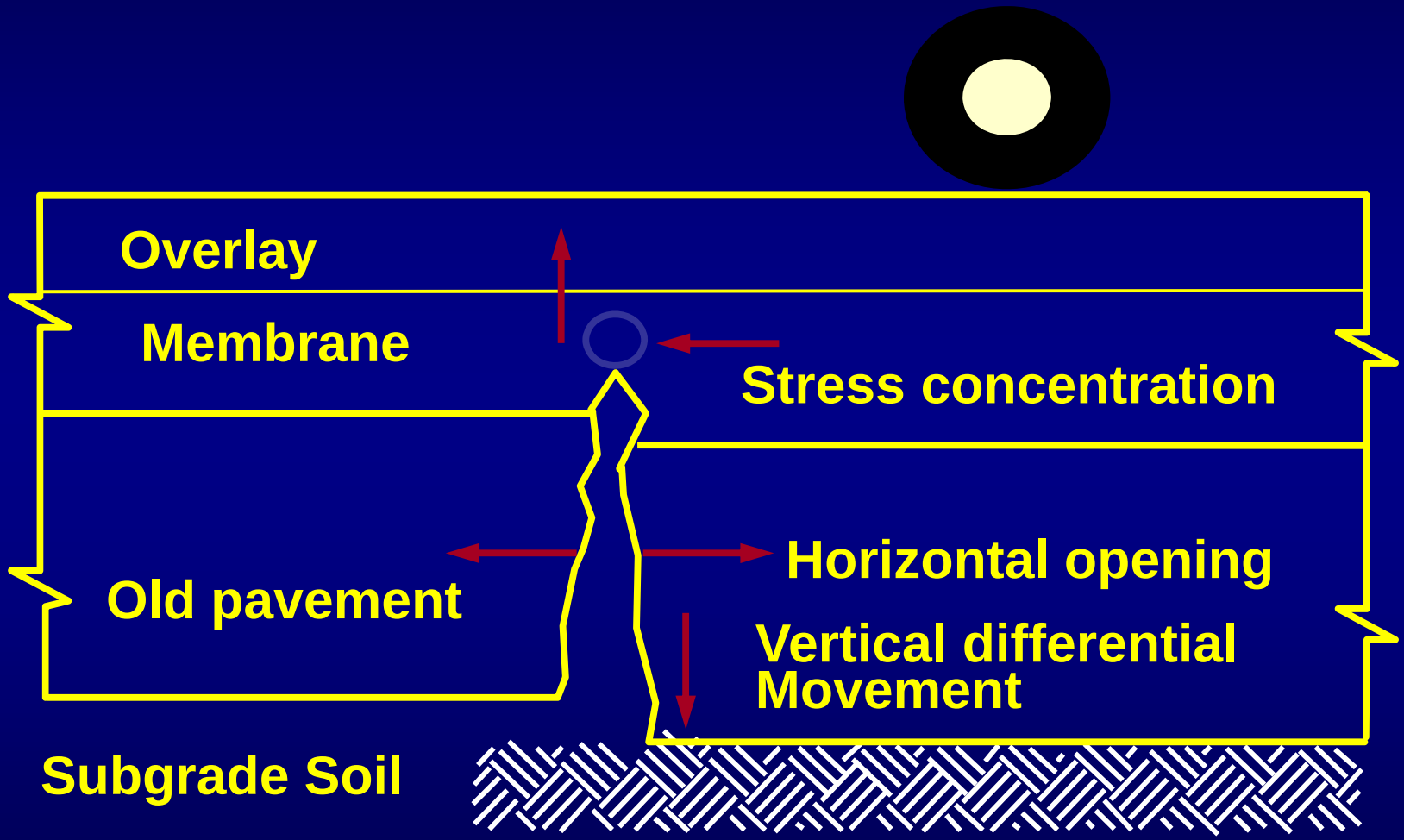
Precaution

- Weak soils may make construction difficult.
- Option 1
  - Adjust breaking pattern (12 - 18”) in soft areas.
  - Use normal seating rolling.
  - Resume smaller pattern after weak area.

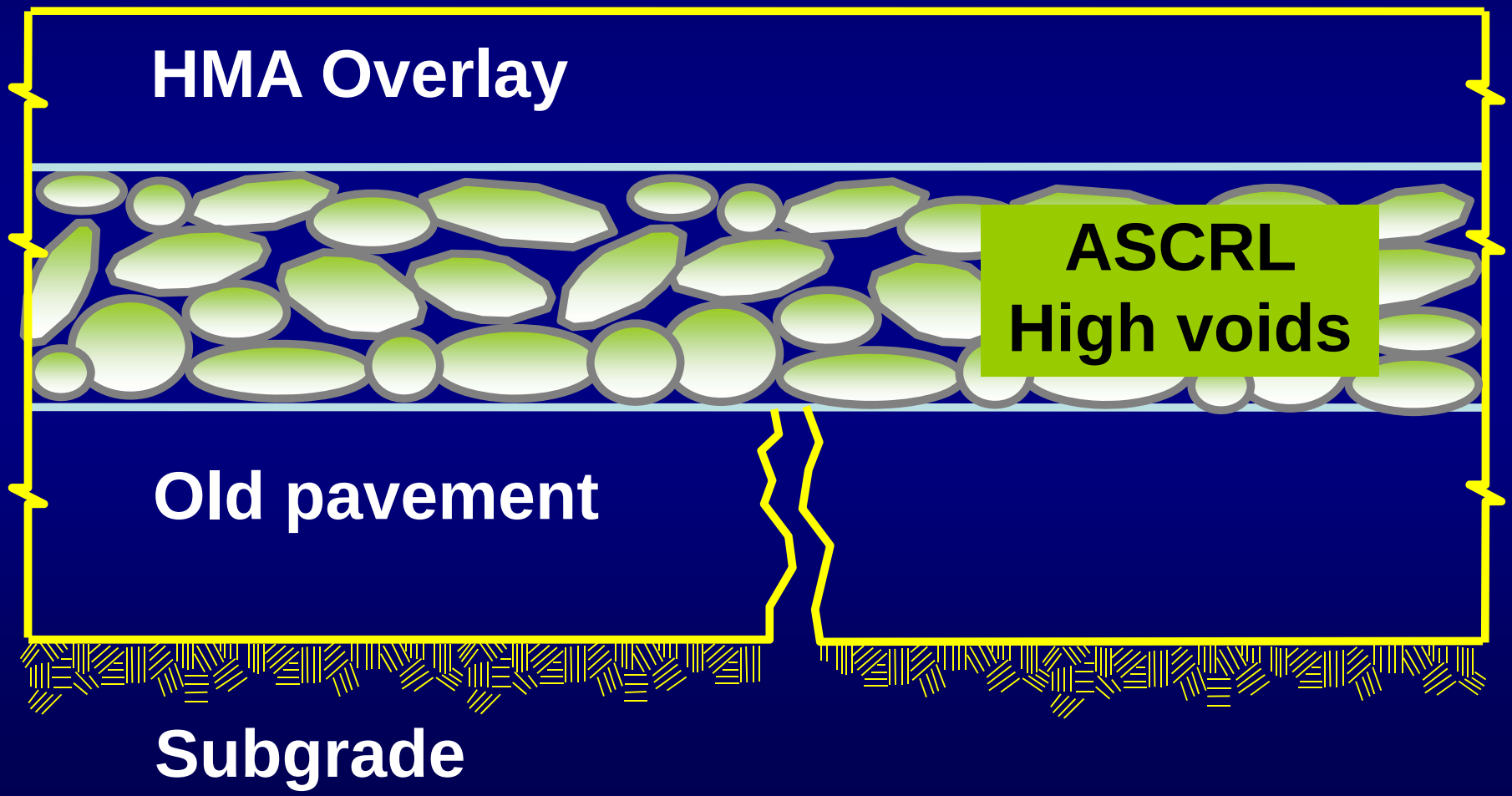
Precaution

- Option 2
  - Cease rubblization
  - Define weak area
  - Remove/replace problem material
  - Resume normal operations when past weak area
- Perform a good soils evaluation prior to construction

Stress-Absorbing Interlayers



Asphalt Stabilized Crack-Relief Layer (ASCRL)



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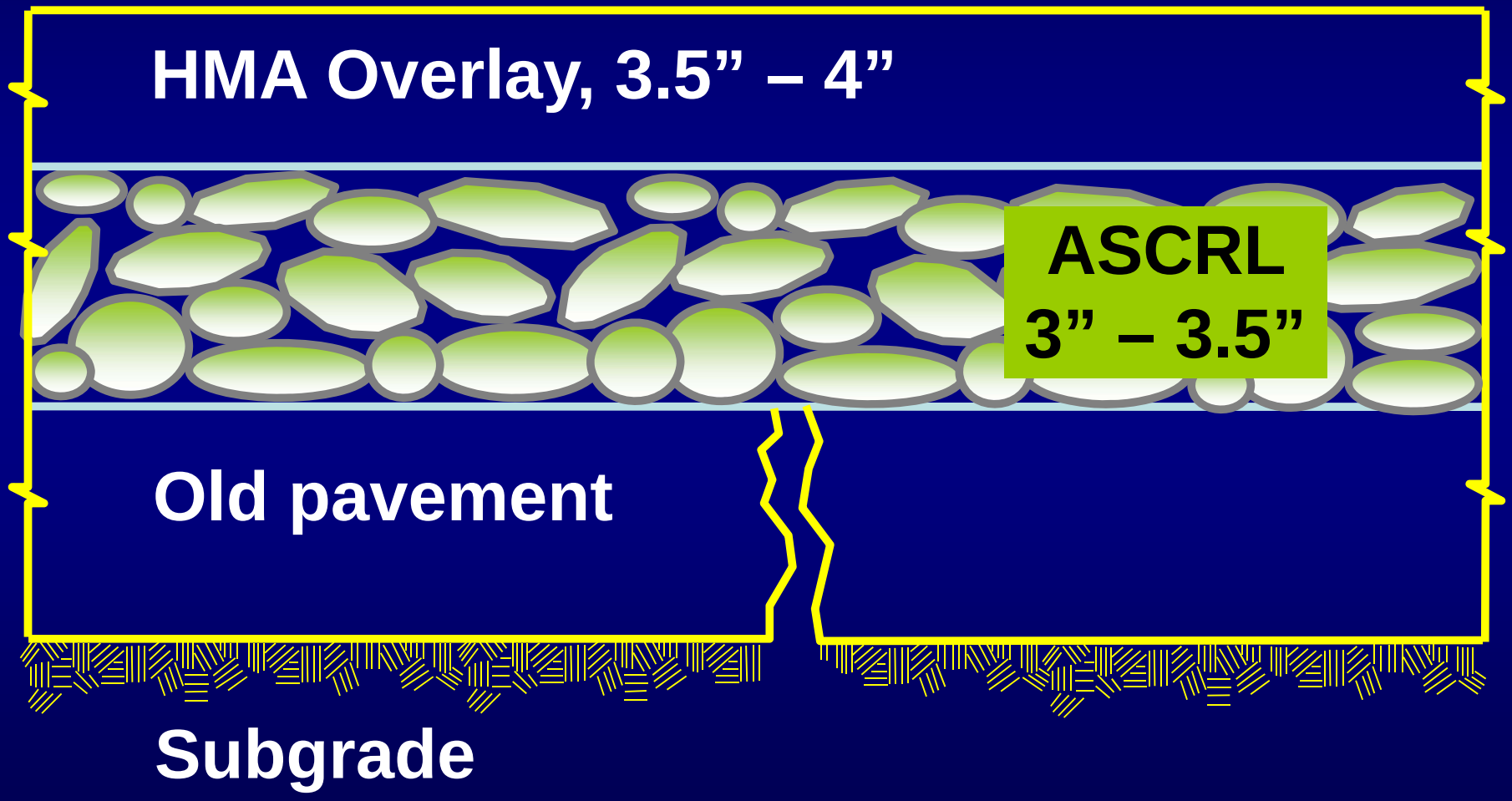

Asphalt Stabilized Crack-Relief Layer (ASCRL)

MICHIGAN
DEPARTMENT OF TRANSPORTATION

SPECIAL PROVISION
FOR
ASPHALT STABILIZED CRACK RELIEF LAYER

C&T:GMM 1 of 4 C&T:APPR:JB:CJB:04-03-04

a. Description. Furnish, place and compact an asphalt stabilized crack relief layer (ASCRL) on a prepared pavement base according to the details shown on the plans or as directed by the Engineer. The HMA mixture will be provided according to the requirements of the 2003 Standard Specifications for Construction, except where modified herein.

b. Materials. The aggregate materials used to prepare the ASCRL shall meet the following requirements.

The coarse aggregate shall originate geologically only from natural sources. Crushed concrete or reclaimed asphalt pavement cannot be used in the ASCRL mixture.

Table 1 Aggregate Specifications

Gradation Requirements						
Sieve Size (inch)	1 1/2	1	1/2	No. 4	No. 30	No. 200 (LBW) (a)
Percent Passing	100	90-100	30-60	10-25	5-15	3-5
Physical Requirements						
Crushed Material, Min. (MTM 117) % (b)	95					
Loss, max., Los Angeles Abrasion (AASHTO T96) %	35					
Soft Particle (max) % (c)	5.0					

a. Loss by Washing shall be by MTM 108. Mineral filler may used to meet the required percentage.
b. The percentage of crushed material will be determined on that portion of the sample retained on all sieves down to and including the No. 4 sieve.
c. The sum of aggregate particles retain on the No. 4 sieve identified as shale, siltstone, clay ironstone and particles which are structurally weak or are found to non-durable in service.

c. Mix Design. The Contractor shall provide a mix design in accordance with the criteria herein. The following are the requirements for the testing, documentation, and material samples for a mix design verification. Submittal of the Mix Design and samples shall be made to MDOT,

Asphalt Stabilized Crack-Relief Layer (ASCRL)

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Asphalt Stabilized Crack-Relief Layer (ASCRL)

Mix Design

- Asphalt Binder – PG 64-28 with 0.5% liquid antistrip additive
- Asphalt content – 3 to 4 %
- Surface Coating – 100 % without excessive draindown (max 0.30 %)
- Minimum Asphalt film thickness - 9.0 microns
- Moisture sensitivity (AASHTO T283)

Asphalt Stabilized Crack-Relief Layer (ASCRL)

Construction

- Placed in a single layer
- Compaction – steel – wheeled tandem roller (1.0 ton per foot of drum length)
  - Static mode only
  - Minimum of three passes (down and back)
  - Compaction test strip may be required (minimize breakage of Agg.)

Asphalt Stabilized Crack-Relief Layer (ASCRL)

MDOT Projects to Date

Project	# of Jobs	Length (miles)
ASCRL	44	150

Started in 1999

- All are performing very well

Asphalt Stabilized Crack-Relief Layer (ASCRL)

M-21, Before Construction

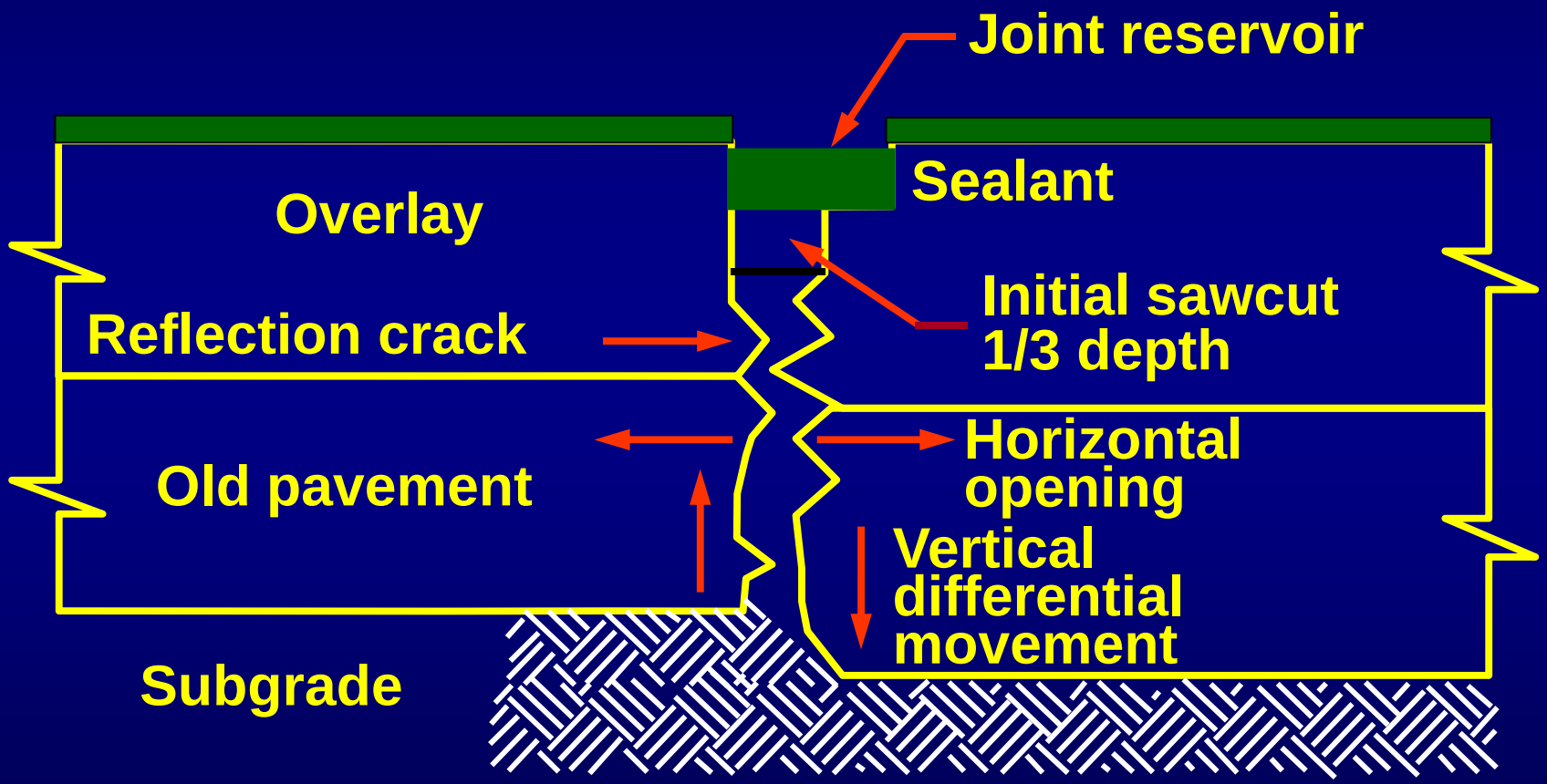
Asphalt Stabilized Crack-Relief Layer (ASCRL)

M-21, 3 years old

Sawing and Sealing Joints

- Concede appearance of reflection cracking
- Objective: control rate of deterioration
- Reduces spalling of reflection cracks
- Candidates should have well-defined joints
- Sawcut must be directly above underlying joint

Sawing and Sealing Joints



Sawing and Sealing Joints

Increased Overlay Thickness

- Delays occurrence of reflection cracking
- Cracks propagate about 1 in. per year
- Reduces temperature fluctuations in underlying pavement

Presentation Outline

- Mix Selection
- Rehab of Concrete Pavements
- **Preventive Maintenance**

Preventive Maintenance

WHAT EXACTLY *IS* YOUR PREVENTIVE MAINTENANCE PROGRAM PREVENTING?

Preventive Maintenance

Asphalt Pavement Association of Michigan

Preventive maintenance is a planned strategy of cost effective treatments to an existing roadway system and its appurtenances that preserves the system, retards future deterioration, and maintains or improves the functional condition of the system without substantially increasing structural capacity.

Preventive Maintenance

Standard Capital Preventive Maintenance Treatment
Pavement Seal

- HMA Crack Treatment
- Overband Crack Fill- Pretreatment
- Chip Seals
- Micro-surfacing
- Ultra-Thin HMA Overlay-Low & Medium Volume (<1″ thick)
- Shoulder Fog Seal
- Paver Placed Surface Seal

Preventive Maintenance

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Crack Treatment

Preventive Maintenance

Asphalt Pavement Association of Michigan

Chip Seal

Preventive Maintenance

Micro-surfacing

Preventive Maintenance

Asphalt Pavement Association of Michigan

HMA Ultra-Thin

High Value Pavement Enhancement

Extends pavement life
Protects pavement structure
Restores pavement smoothness

HMA Ultra-Thin

¾” to 1” Thickness

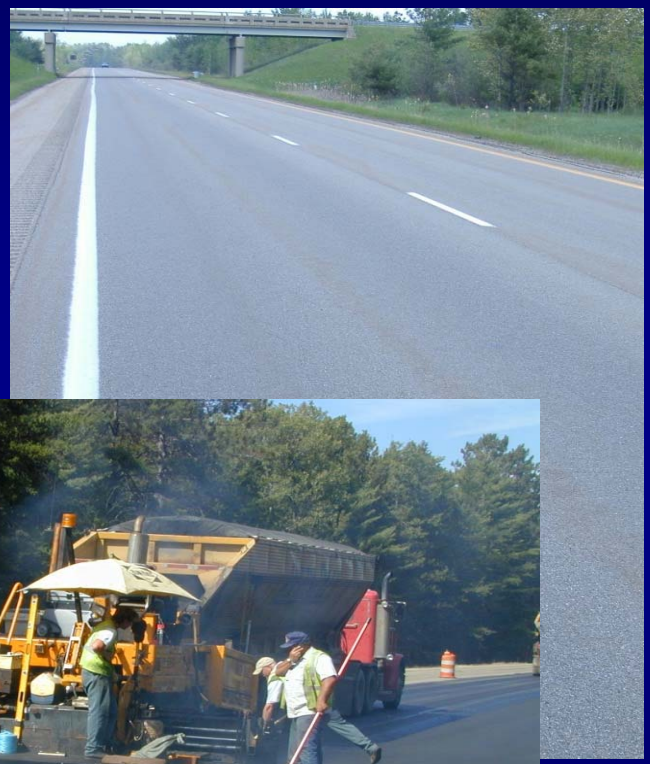
Asphalt Pavements – America’s Most Recycled Product

SMOOTH | DURABLE | SAFE | QUIET

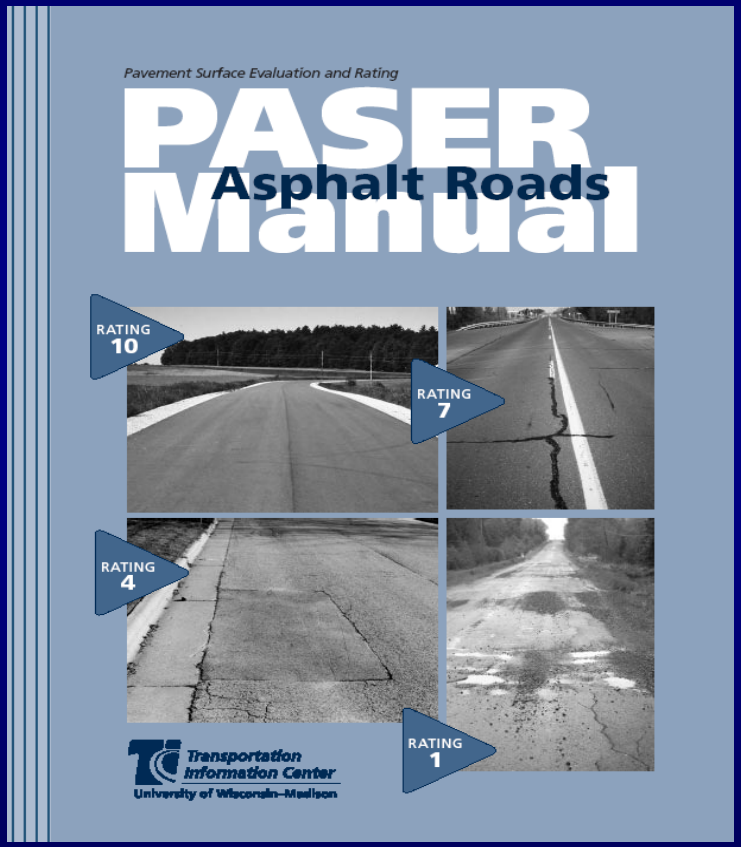
HMA Ultra-Thin

BENEFITS

- 5-9 year life extension
- Seals pavement to delay further deterioration
- Improve ride quality
- Minimize or eliminate structure adjustments
- Reduce noise
- Improve drainage
- Ease of construction, standard paving operation
- Minimal construction time



HMA Ultra Thin



4 – 6 Paser rating

HMA Ultra-Thin Performance

MDOT Projects - Statewide

UT Type	# of Jobs	Length (miles)	Avg. Age (end service)	Avg. Age (in service)	Avg. Age (overall)
Ultra-thin low	52	483	7.6 (20)	9.8	8.6
Ultra-thin med	41	339	5.5 (4)	8.6	6.6
Ultra-thin high	16	89	5.3 (3)	7.3	6.4

HMA Ultra-Thin Statewide

Preventive Maintenance Treatment Cost Comparison

Treatment	$/syd	Cost/mile (24' wide)	MDOT Life extension range (years)*	MDOT Life extension range average (years)*	Cost/mile* per year
Double chip seal	$3.18	$44,773	3-5	4	$11,193
Micro-surface	$2.61	$36,747	3-5	4	$9,187
Ultra-thin low	$2.51	$35,339	5-9*	9*	**$3,927**
Ultra-thin med	$2.87	$40,408	5-9*	8*	**$5,051**
Ultra-thin high	$3.29	$46,321	5-9*	7*	**$6,617**

*Average Life Extension estimated by APAM
Unit Prices based on MDOT Information (thru Jan. 2016)

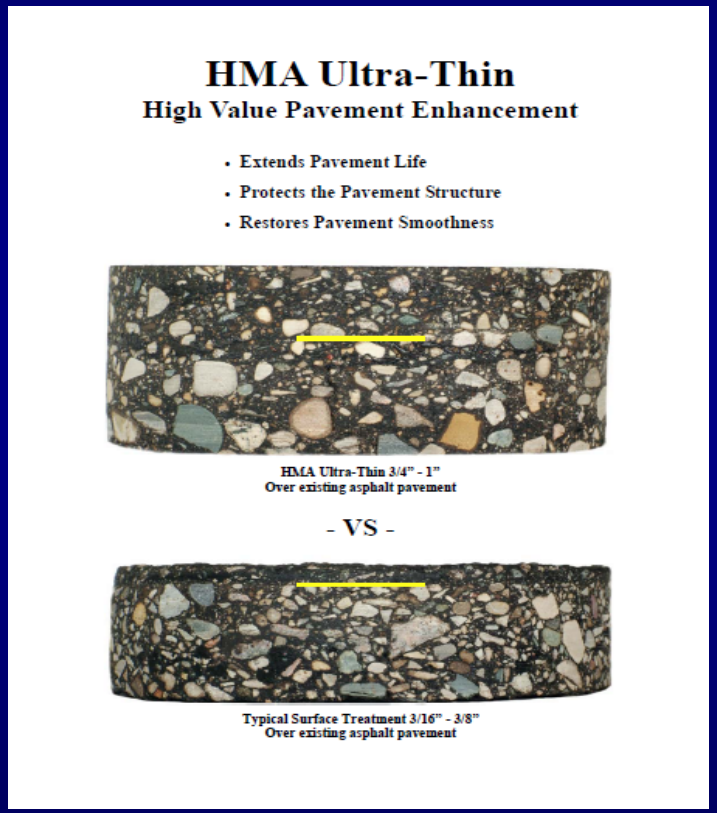
HMA Ultra-Thin

	HMA UT	Chip Seal	Microsurfacing
Increase skid resistance	✓	✓	✓
Minimizes curb loss	✓	✓	✓
Corrects surface distress	✓	✓	✓
Can be applied in one pass	✓	✓	
Increases structural strength	✓		
Improves ride quality	✓		
Improves pavement draining	✓		
Corrects minor rutting	✓		✓
Eliminates dust, loose aggregate	✓		✓

HMA Ultra-Thin

Advantages:

- Adds structural value
- Very smooth riding surface
- Improved ride quality
- No excess stone buildup
- No broken windshields from loose aggregate



Project Scoping

Questions?