WAPA
WISCONSIN ASPHALT PAVEMENT ASSOCIATION

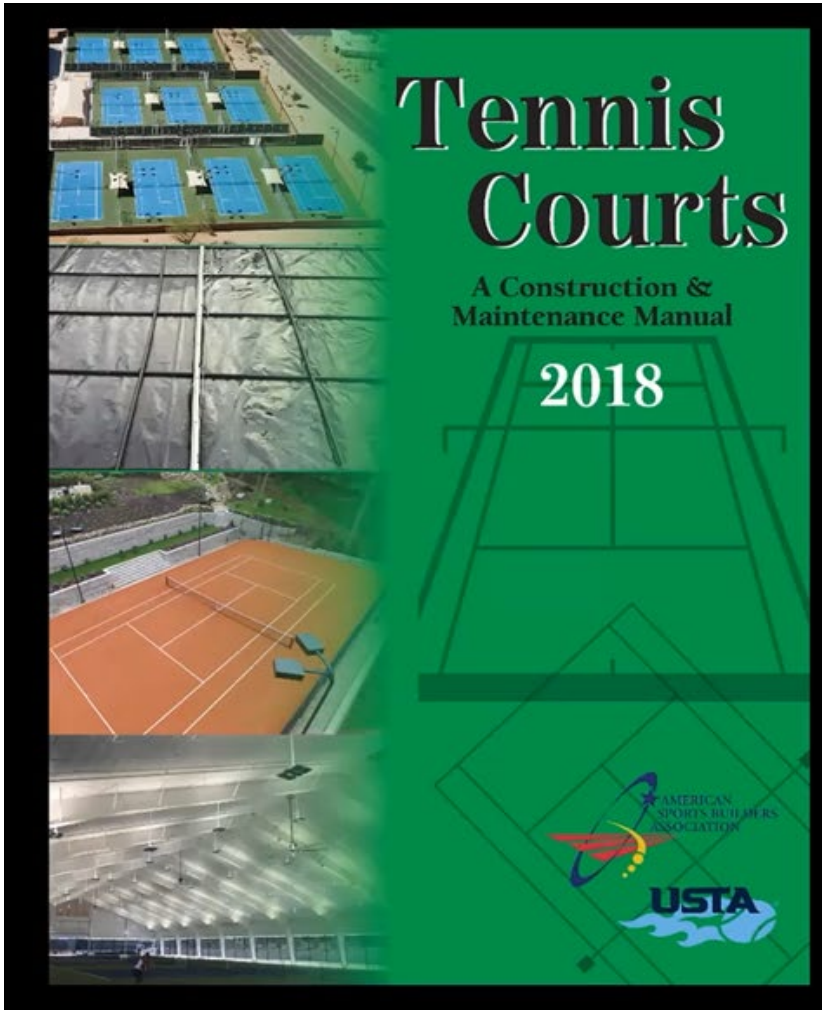
Sport Court
Athletic Asphalt Uses

WAPA 62nd Annual Conference & Business Meeting
November 30, 2021

WAPA
WISCONSIN ASPHALT PAVEMENT ASSOCIATION

Introduction

With the popularity of sport court installation continuing to rise, the Wisconsin Asphalt Pavement Association along with its members felt that guidance would be of benefit



AMERICAN SPORTS BUILDERS ASSOCIATION

A non-profit trade association comprised of builders, designers and suppliers for sports facilities, exists to promote the highest standards of design, construction and maintenance.

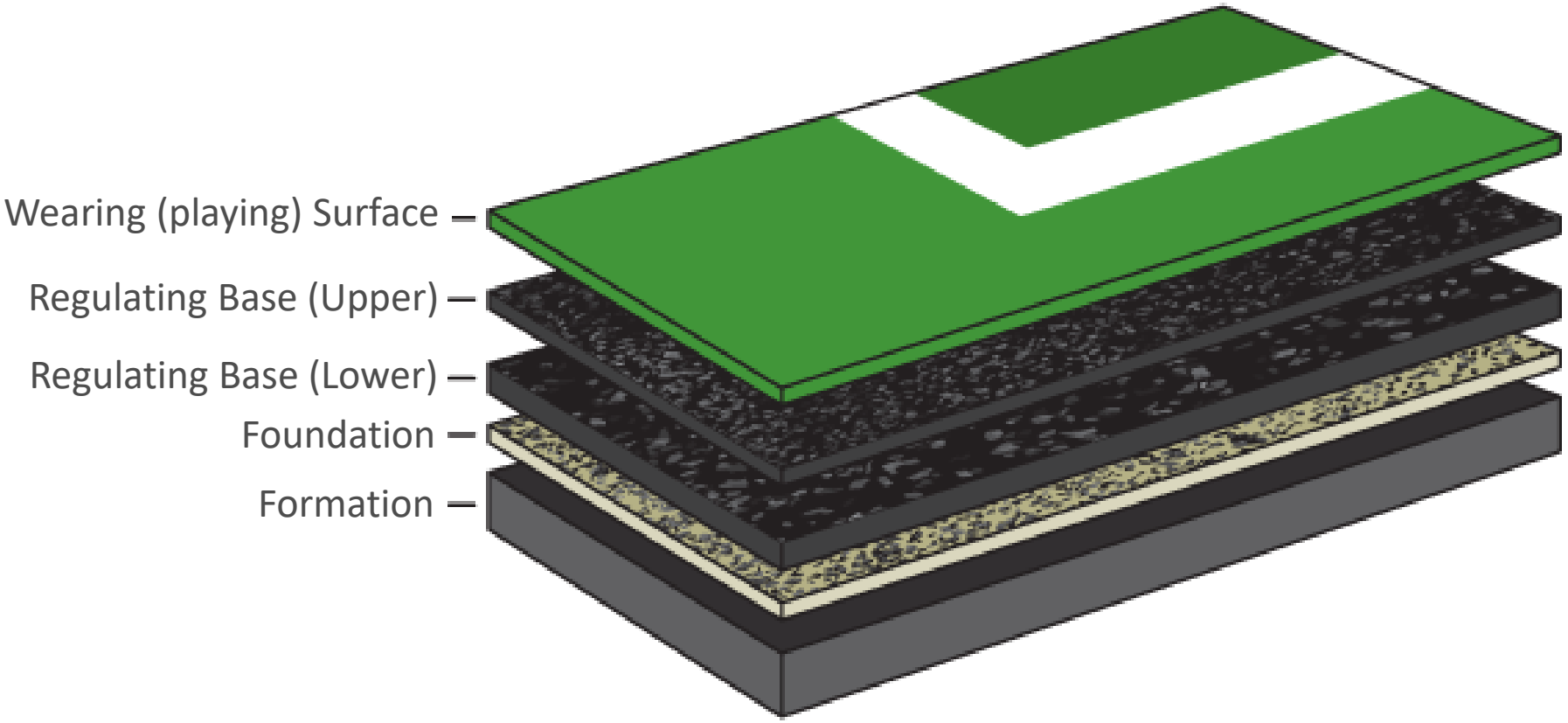
What Are Sport Court Facilities?

Sport Facilities consist of more than parking lots and roadways

WAPA
WISCONSIN ASPHALT PAVEMENT ASSOCIATION

Court Design

Traditional sport courts are comprised of 4 different layers



WAPA
WISCONSIN ASPHALT PAVEMENT ASSOCIATION

Court Design Layers

- Formation Layer
  - Barrier between the ground and court
  - Subgrade blocking roots and organic matter
  - Provides flat soil base
- Foundation Layer
  - Protect from frost damage and allows for drainage
  - Subbase (1 ¼” DGB is typical)

Court Design Layers

- Regulating Base Layer
  - Stable and flat surface for the wearing layer
  - Can be multiple HMA layers
- Wearing/Playing Layer
  - Surface layer seen when looking at sport court
  - Many different options for playing surfaces

Why choose asphalt?

Asphalt is the preferred foundation (regulating base) for sport court construction projects in the US and specifically the Midwest, due to our varying climate (heat and cold/moisture and dryness/etc.). However it offers additional advantages as well, such as:

- The softness of the asphalt offers orthopedic benefits and puts less stress on joints
- Offers excellent adhesion for many surface types (wearing layers, playing surfaces, color coating and sealants) for multi-sport court capabilities
- Asphalt is weather resistant to both hot and cold weather
- Maintains paint longevity over time and multiple applications
- Asphalt is economical and easy to maintain
- Proven durability

WAPA
WISCONSIN ASPHALT PAVEMENT ASSOCIATION

HMA Basics

Asphalt 101

WAPA
WISCONSIN ASPHALT PAVEMENT ASSOCIATION

What is HMA made of?

- Aggregates
  - Load bearing components
    - Skid resistance, stability, workability
- Asphalt Binder
  - Glue/muscle that holds everything together
    - Flexibility, durability
- Air
  - Accommodates particle alignment
    - Allows proper compaction for the pavement to remain flexible

WAPA
WISCONSIN ASPHALT PAVEMENT ASSOCIATION

Aggregates

WAPA
WISCONSIN ASPHALT PAVEMENT ASSOCIATION

Aggregates

High Quality Aggregates

- Local sources on state DOT's approved list
- No deleterious materials
  - Wood or vegetation
    - Shale
    - Pyrite
    - Clay balls (friable particles)
- No slags, contain metals; are highly absorptive; coatings won't stick
- High natural sand contents (>20%) may be more sensitive to moisture susceptibility

Reclaimed Asphalt Pavement (RAP)

- 10-15% is acceptable
- Processed over ½” screen
- Be careful about deleterious materials and slag

Other Materials

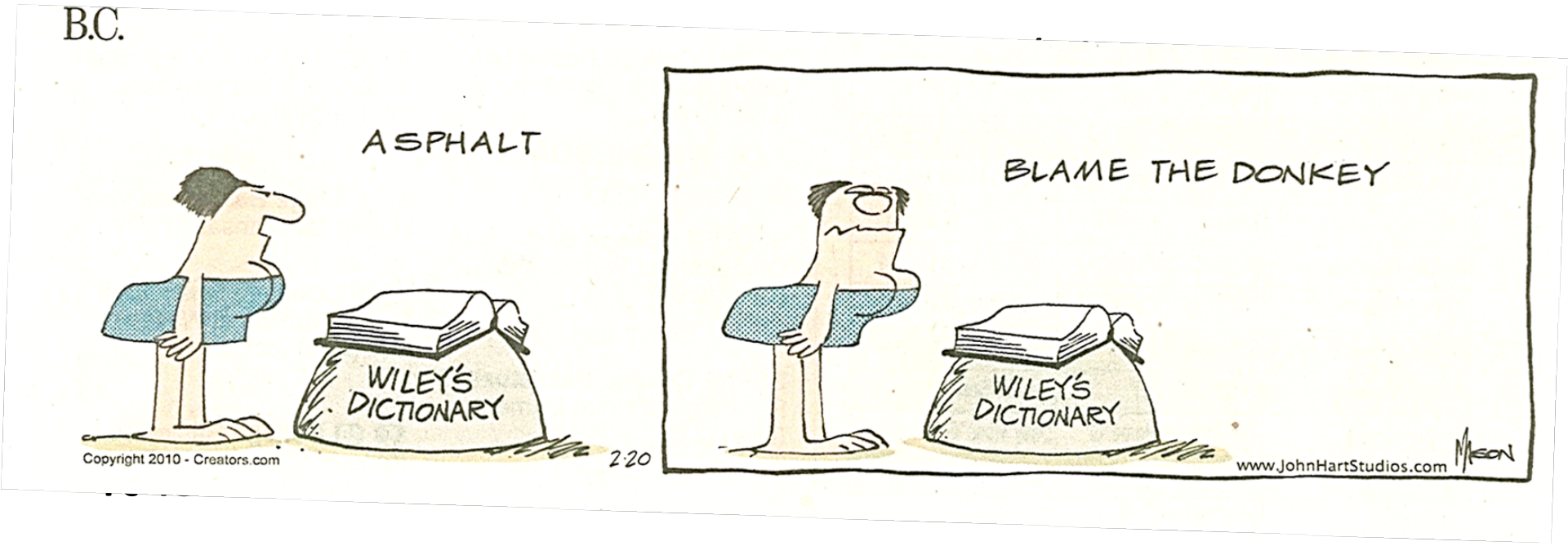
- Recycled Asphalt Shingles (RAS) - NO
- Polymer modified binder – not needed
- Ground tire rubber – not needed
- Fibers – not needed
- Warm Mix Additives – as needed
- Antistrip Additives – as needed (TSR)

WAPA
WISCONSIN ASPHALT PAVEMENT ASSOCIATION

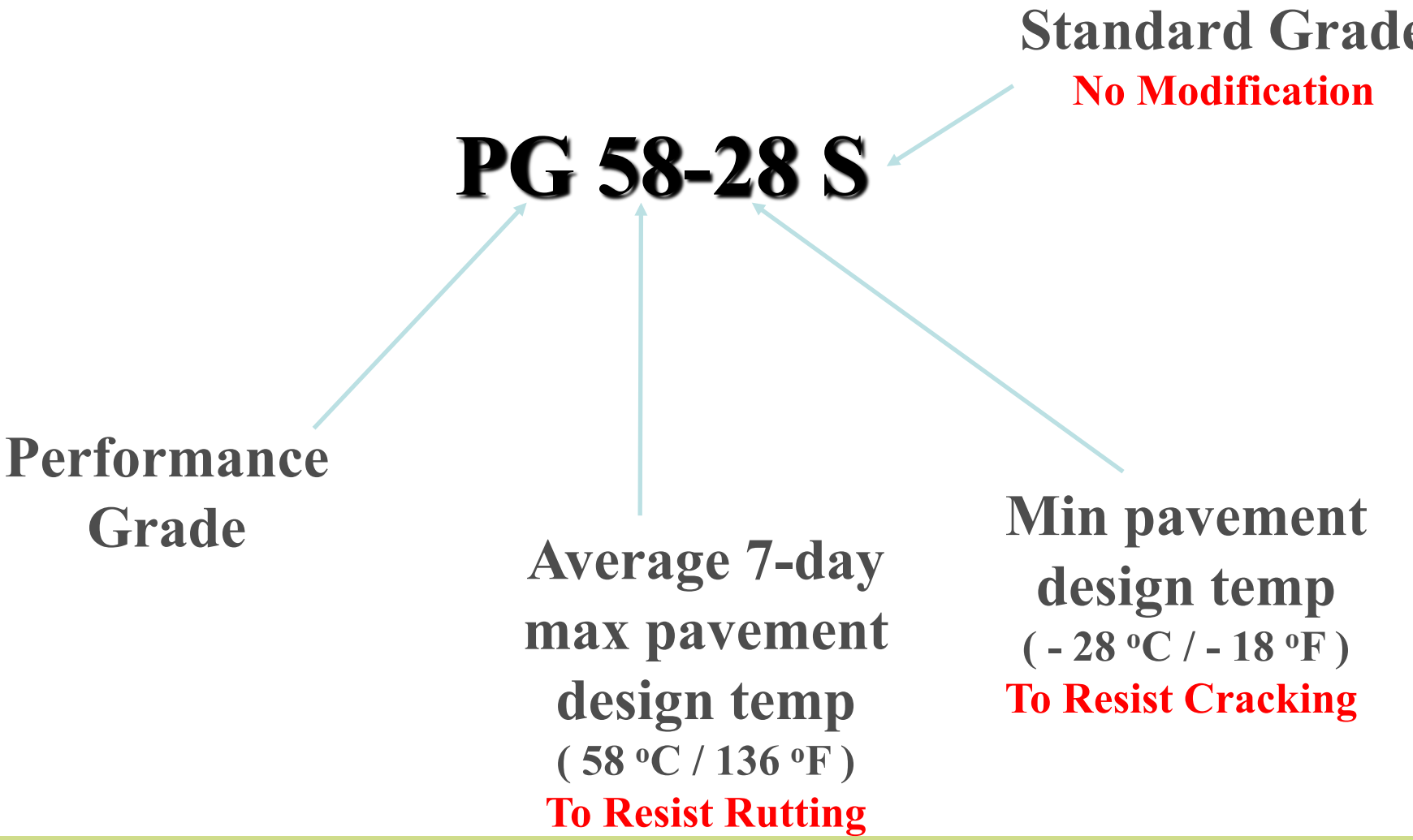
Asphalt Binders

WAPA
WISCONSIN ASPHALT PAVEMENT ASSOCIATION

Asphalt Binder

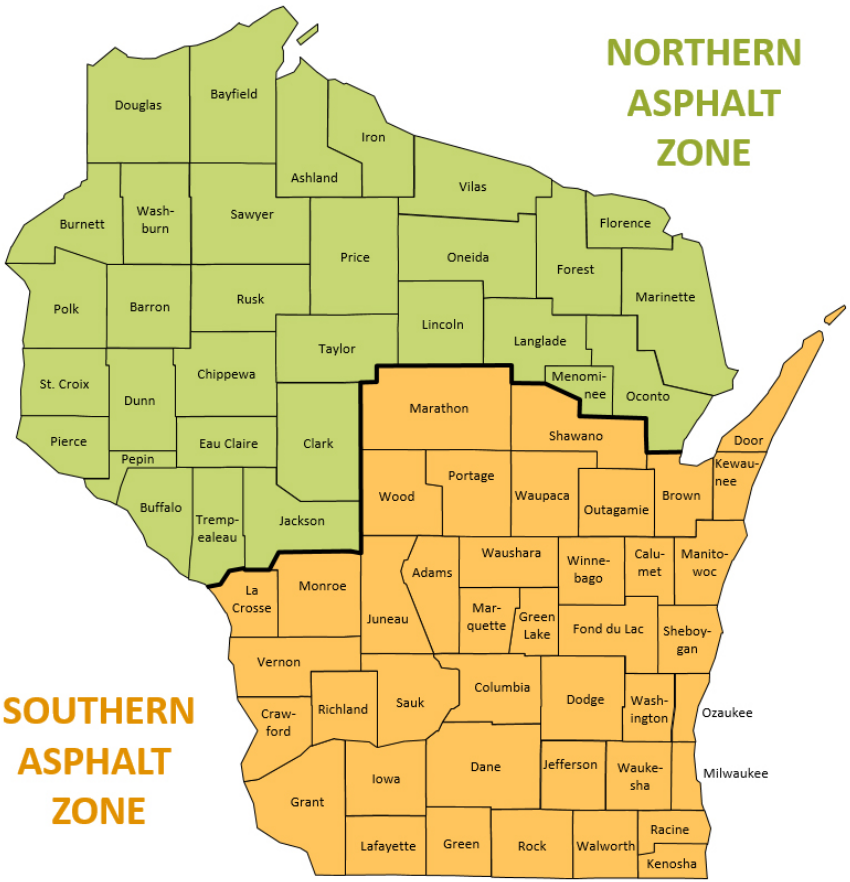


Asphalt Binder



WisDOT Asphalt Mixture Selection

Step 1		Step 2		Step 3	Step 4	
Gradations (Nmas)		Traffic Level		Asphalt Binder	Designation Level	
3	19.0 mm	LT	Low Traffic Vol. (40 gyrations)	58-34	S	Standard
4	12.5 mm			58-28		
5	9.5 mm					



4 LT 58-34 S

WAPA
WISCONSIN ASPHALT PAVEMENT ASSOCIATION

WAPA

WISCONSIN ASPHALT PAVEMENT ASSOCIATION

HMA Mix Designs

WAPA

WISCONSIN ASPHALT PAVEMENT ASSOCIATION

Highway Pavements ≠ Sports Facility

- Sports facility pavements
  - Surface tolerance is critical
  - No significant loading
  - Resistance to cracking
- Selection of materials (ingredients) and Mix Design (recipe) for the asphalt layers must consider those differences

Mixture Gradations

Aggregate Gradation Master Range And VMA Requirements			
Sieve	Percents Passing Designated Sieves (Nominal Size)		
	No. 3 (19.0 mm)	No. 4 (12.5 mm)	No. 5 (9.5 mm)
25.0mm	100		
19.0mm	90-100	100	
12.5mm	90 max	90-100	100
9.5mm	--	90 max	90-100
4.75mm	--	--	90 max
2.36mm	23-49	28-58	32-67
1.18mm	--	--	--
0.075mm	2.0-8.0*	2.0-10.0*	2.0-10.0*
% VMA	13.0 min	14.0 min	15.0 min

It is recommended that lower layer mixes have a minimum of 45% passing the 4.75mm sieve

It is recommended that upper and leveling layer mixes have a minimum of 45% passing the 2.36mm sieve

* These values should include additional amount of anticipated breakdown during production

Mix Gradations

9.5 mm (#5)

Upper Layers

12.5 mm (#4)

12.5 mm (#4)

Lower Layers

19.0 mm (#3)

WAPA
WISCONSIN ASPHALT PAVEMENT ASSOCIATION

Aggregate Properties

Test or Parameter	Superpave WisDOT Method	Marshall	Hveem
Aggregate Properties			
LA Wear (AASHTO T-96)			
100 revolutions (max % loss)	13	13	13
500 revolutions (max % loss)	50	50	50
Soundness (AASHTO T-104) sodium sulfate max. % loss	12	12	12
Fractured Faces (ASTM D5821 as modified in CMM 860) 1 face/2 faces, (% by count)	65*	85/75	85/75
Flat & Elongated (ASTM D4791) (max %, by weight)	5 5:1 ratio	5 5:1 ratio	5 5:1 ratio
Fine aggregate angularity (AASHTO T-304, method A, min)	40	40	40
Sand equivalency (AASHTO T-176, min)	40	40	40
Clay Lumps and Friables Particle in Aggregate (AASHTO T-112)	≤1%	≤1%	≤1%

* 85/75 fracture count is recommended if designed per Asphalt Institute MS-2

Mixture Properties

Test or Parameter	Superpave	Marshall	Hveem
Mixture Properties	**WisDOT Method**		
Stability (lbs.)	n/a	1200 min	30 min
Flow (0.01 in.)	n/a	8 to 16	n/a
Swell (in.)	n/a	n/a	0.030 max
Air Voids at optimum AC with 2 hour aging	4.0%[1]	3.50%	3.50%
Compactive Effort	Gyrations	Blows	Traffic
Nini	6	n/a	n/a
Ndes	40*	50	Low Volume
Nmax	60	n/a	n/a
Voids filled with Binder (VFB or VFA)	73 to 80	73 to 80	73 to 80
Dust to Binder Ratio (% passing 0.075mm/Pbe)	0.7-1.3	0.7-1.3	0.7-1.3
Tensile Strength Ratio	80% min[2][3]	80% min[2]	80% min[2]

* 50 gyrations if designed per Asphalt Institute MS-2

[1] Determine the target JMF asphalt binder content for production from the mix design data corresponding to 3.0% air voids (97% Gmm) target at the design number of gyrations (Ndes). Add liquid asphalt to achieve 3.0% air voids.

[2] Eliminates freeze-thaw conditioning cycles from the TSR test procedure

[3] Run TSR at asphalt content corresponding to 3.0% air void regressed design using distilled water for testing

WAPA
WISCONSIN ASPHALT PAVEMENT ASSOCIATION

Air Void Regression

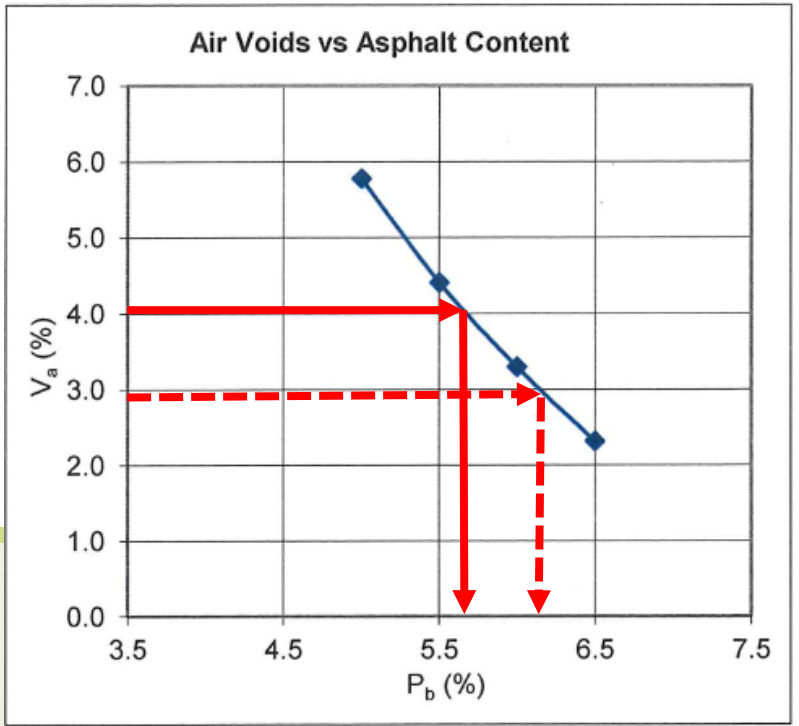
WAPA
WISCONSIN ASPHALT PAVEMENT ASSOCIATION

Why air void regression?

- Wisconsin is confident with the dense graded aggregate structure they currently utilize
- We wanted virgin asphalt binder to be added, not recycled binder
- This was a quick, scientific, calculated way to positively improve the mix right away without redesigning hundreds of mixes

Air void regression 101

- All asphaltic mix designs will remain at 4.0%
- Looking at the mix design, the AC needed to achieve 3.0% air voids is determined
  - Values are established @ 3.0% for:
    - Gmm
    - Gmb
    - Va
    - VMA



Original Optimum %AC = ~ 5.7

Regressed Optimum %AC = ~ 6.1

WAPA
WISCONSIN ASPHALT PAVEMENT ASSOCIATION

Air void regression benefits

- Addition of virgin asphalt binder (approx. 0.3-0.4%)
- Increased durability, increased asphalt film thickness
- Increased in place density/decreased permeability
- Improved workability

WAPA
WISCONSIN ASPHALT PAVEMENT ASSOCIATION

WAPA

WISCONSIN ASPHALT PAVEMENT ASSOCIATION

WAPA

WISCONSIN ASPHALT PAVEMENT ASSOCIATION

Highway Pavements ≠ Sports Facility

- Hot Mix Asphalt Producer
  - Approved WisDOT labs
  - Use a WAPA member
  - Quality Control program

- Paving Contractor
  - Experience with paving athletic facility projects
  - Proper staff and good communication

WAPA
WISCONSIN ASPHALT PAVEMENT ASSOCIATION

Quality Control Testing

- Mix Gradation
- Asphalt Content
- Volumetrics
  - Air Voids (Gmm/Gmb)
  - VMA
- In-place Density
  - WisDOT approved nuclear density gauge
  - Cores (outside of playing area)

WAPA
WISCONSIN ASPHALT PAVEMENT ASSOCIATION

Construction

WAPA
WISCONSIN ASPHALT PAVEMENT ASSOCIATION

Types of Drainage Systems

- *Since water is the most common causes of surface failures, adequate drainage is one of the most important considerations is selecting a site, and in selecting proper drainage system to move water away for the site*
  - Subsurface drainage is primarily a french drain
  - Surface drainage systems include:
    - Precast channel drains
    - Open pan drains
    - Swales (with or without catch basins)
    - Catch basins

Drainage

Formation & Foundation Construction

WAPA
WISCONSIN ASPHALT PAVEMENT ASSOCIATION

Good compaction starts here

Tips for Paving the Regulating Base Layer(s)

- Proper tack application
- Offset joints a minimum of 6” between lifts of asphalt
- Allow positive drainage towards drainage outlets
- Minimize all segregation
- No broadcasting material
- Smoothness deviation no greater than ¼” in 10’ lower layer and 1/8” in 10’ for upper
- Protect HMA prior to coating placement

WAPA
WISCONSIN ASPHALT PAVEMENT ASSOCIATION

Sensitive to weather events/time of year
Pavement must cure prior to surfacing

Paving Thickness

Density/Compaction

- Use vibratory/oscillary rollers
- Focus on paving seam/joints
- No starving of joint
- Shorter pulls/truck schedule
- No additional consolidation from traffic
- Keep joints hot (220°F is a good target)
- Pave all same day if possible

- Overlap mat by 1” ± ½” (leave high)
- Target 94% density
- No check cracking

WAPA
WISCONSIN ASPHALT PAVEMENT ASSOCIATION

Levelling/Slopes/Grades

WAPA
WISCONSIN ASPHALT PAVEMENT ASSOCIATION

Courts require a minimum slope of 1” in every 10’ on a true plane from side to side, end to end, or corner to corner

Birdbaths/Ponding

WAPA
WISCONSIN ASPHALT PAVEMENT ASSOCIATION

Control Joint for Contraction

Asphalt over time will shrink
Asphalt will crack at its weakest point
Let's tell it where we want it to crack

WAPA
WISCONSIN ASPHALT PAVEMENT ASSOCIATION

The most stress on an asphalt court is due to the tension from the net cable

Finished Product

WAPA
WISCONSIN ASPHALT PAVEMENT ASSOCIATION

WAPA
WISCONSIN ASPHALT PAVEMENT ASSOCIATION

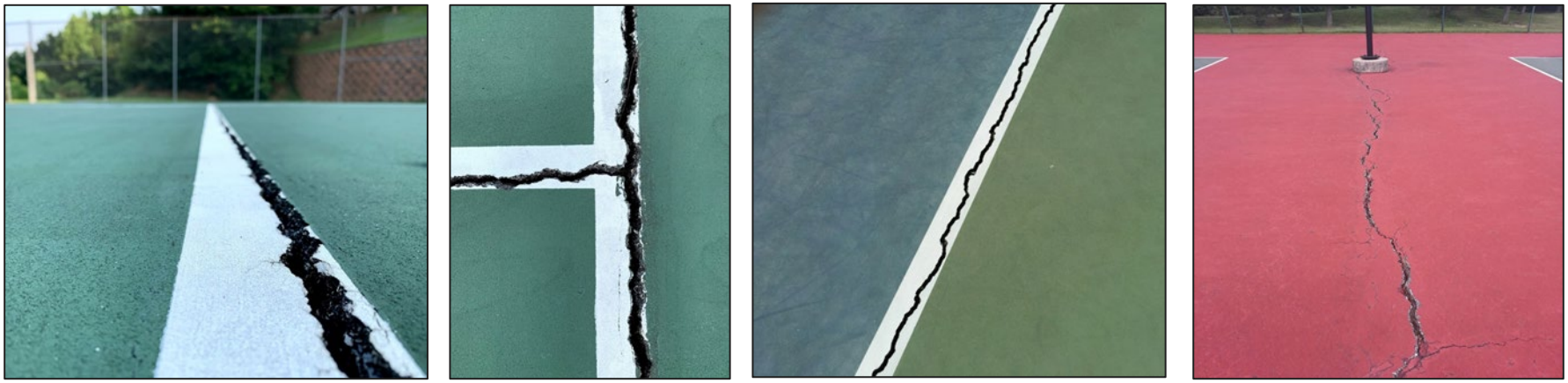
Issues/Concerns

WAPA
WISCONSIN ASPHALT PAVEMENT ASSOCIATION

Delamination

The surface coating bond can be impacted by moisture, curing, or thermal expansion and separates from the asphalt layer

Cracking



Most likely due to contraction during rapid temperature drops

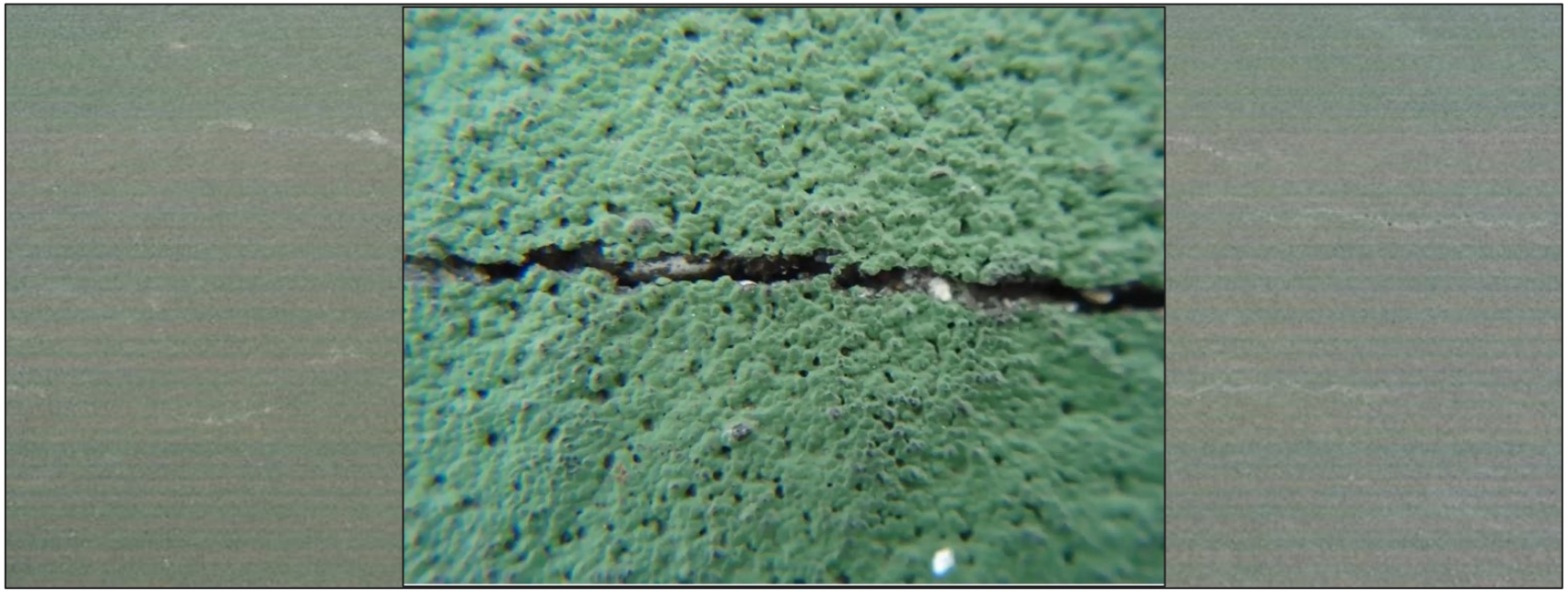
Stripe reflects light. Asphalt mix below is colder; discontinuity in thermal properties

Asphalt aging (oxidation) is minimized by surface coatings

What about block cracking?

Block cracking (top-down cracking) tends to come from mix related issues like high dust content, hard ac, low density, high air voids, etc.

Asphalt Stripping



A breakdown in the adhesive bond (by moisture) between the aggregate and the asphalt binder

Generates at the bottom of asphalt layer and works upward

Cracks then form as the entire structure weakens & disintegrates

Symptoms of stripping are short hairline cracks & puckering

Blistering

Moisture trapped in asphalt

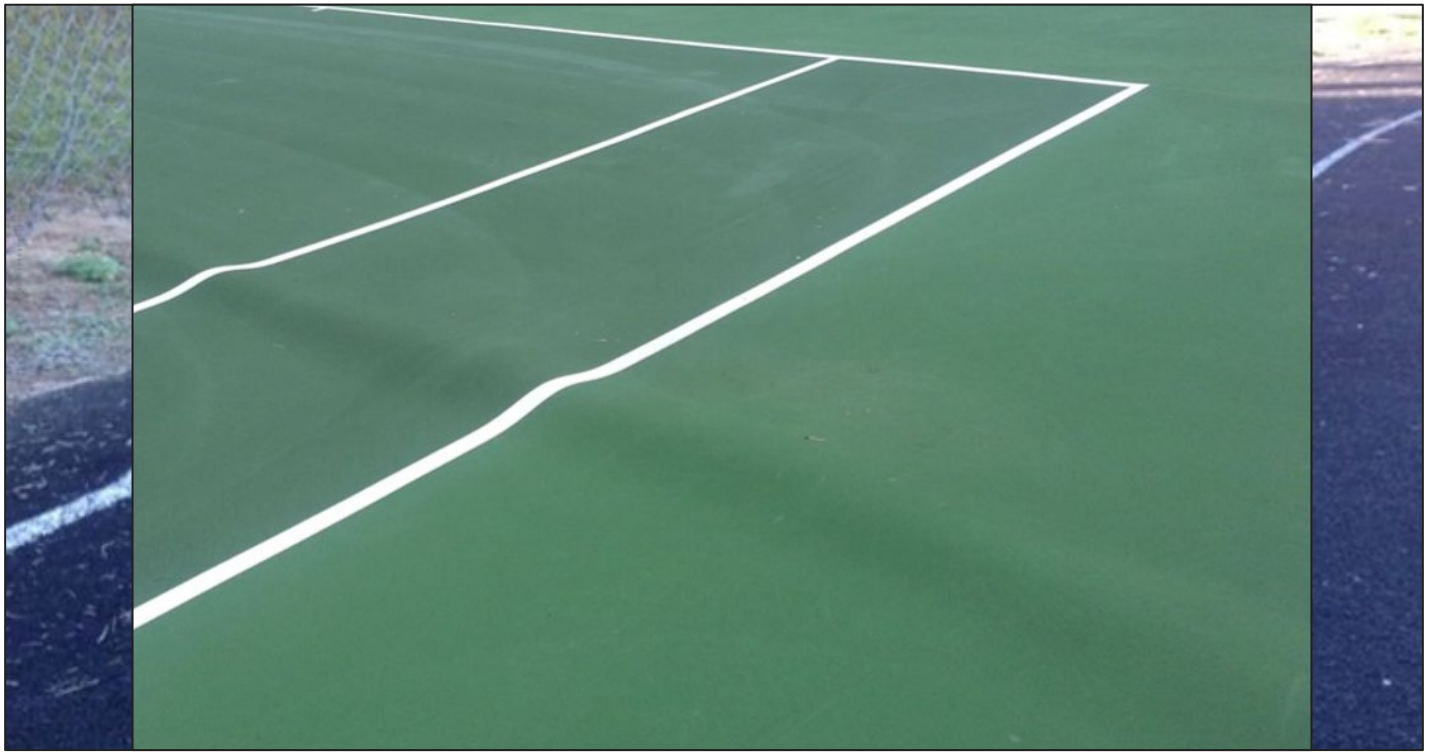
Thermal gradient – hottest at surface

Asphalt has low tensile strength at higher temps

Vapor pressure > strength of asphalt

WAPA
WISCONSIN ASPHALT PAVEMENT ASSOCIATION

Blistering



Do not apply coatings too thick or apply too many maintenance cycles of coating surfaces

Install good drainage systems

Install proper base construction (foundation) under asphalt

Properly prepare the asphalt for coatings or surface

Properly let asphalt cure (roughly 30 days)

WAPA
WISCONSIN ASPHALT PAVEMENT ASSOCIATION

Rust stains from aggregate

Typically from pyrite mineral, clay balls in aggregate, or metals in slag

What's happening here?

WAPA
WISCONSIN ASPHALT PAVEMENT ASSOCIATION

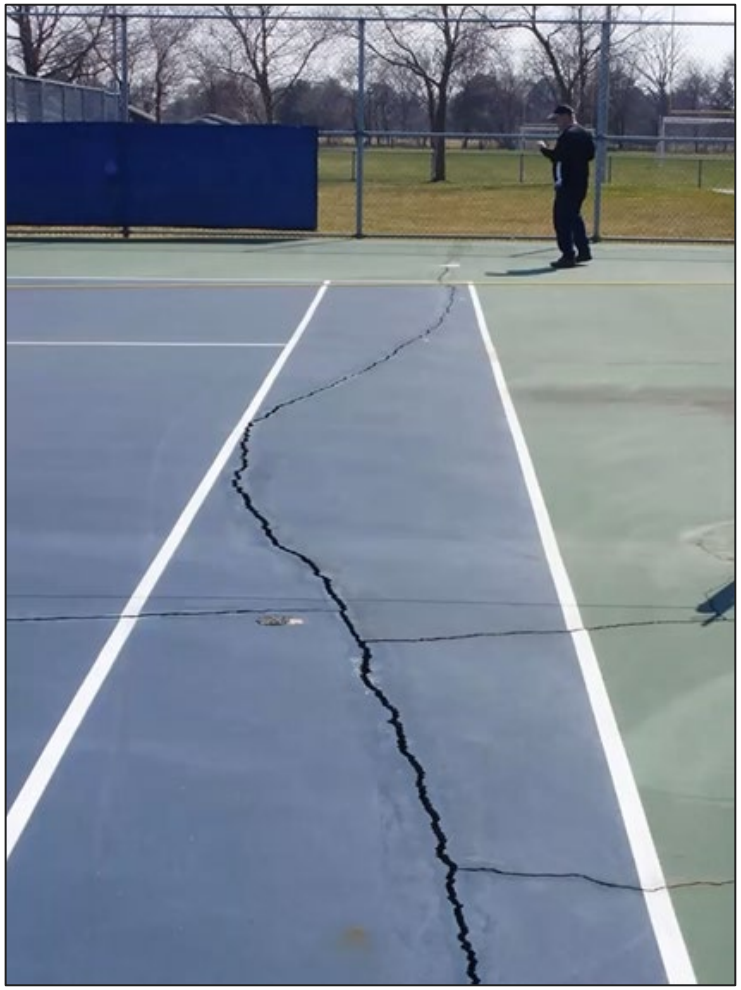
Possibly too many coating layers (same thing that happens with coal tar sealants)

What's happening here?

Possible roller cut mark that occurred over the winter

WAPA
WISCONSIN ASPHALT PAVEMENT ASSOCIATION

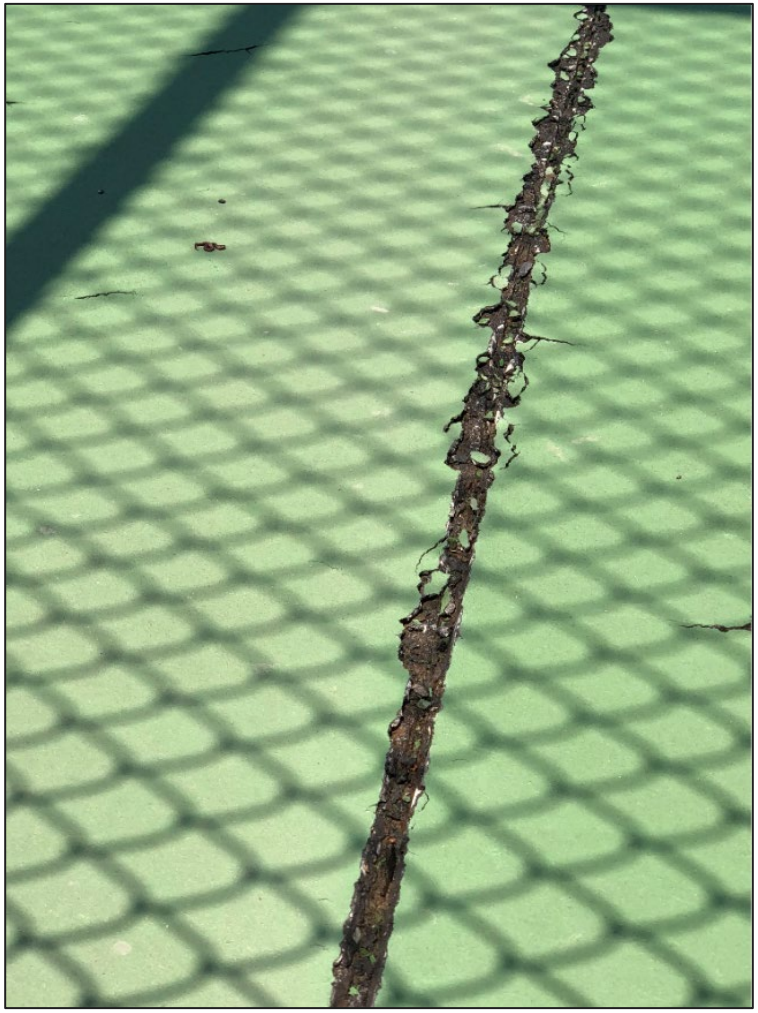
What's happening here?



WAPA
WISCONSIN ASPHALT PAVEMENT ASSOCIATION

This is not an asphalt issue, this is structural from underneath the pavement

What's happening here?



WAPA
WISCONSIN ASPHALT PAVEMENT ASSOCIATION

Moisture…paving seam is opening up

What's happening here?

WAPA
WISCONSIN ASPHALT PAVEMENT ASSOCIATION

Coating too thick? Delamination, improper curing

WAPA
WISCONSIN ASPHALT PAVEMENT ASSOCIATION

So what's next….

Sport Court guidance document from WAPA

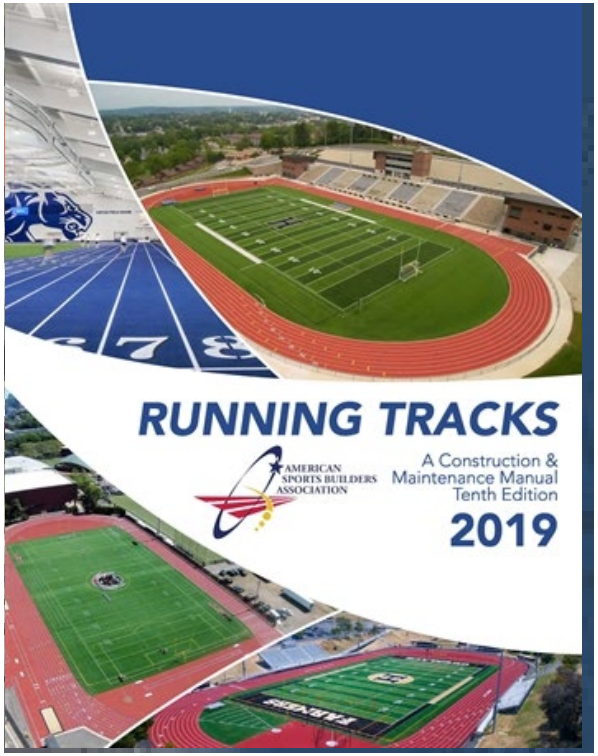
WAPA
WISCONSIN ASPHALT PAVEMENT ASSOCIATION

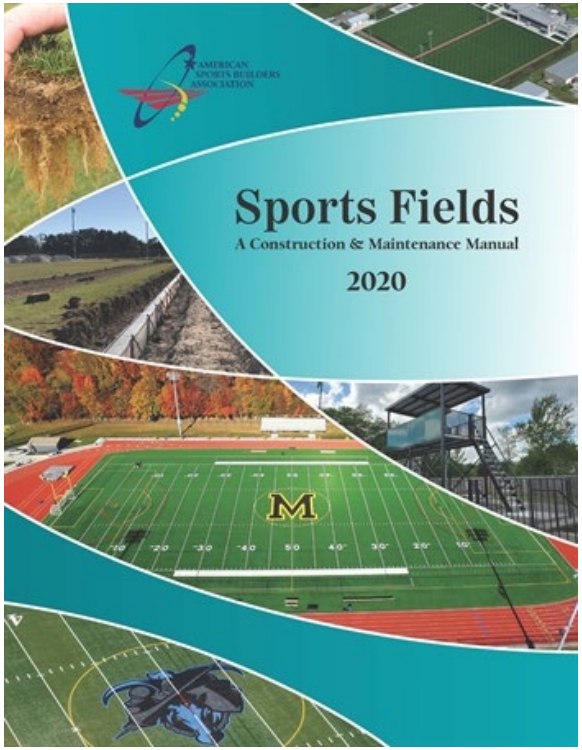
Rehab time

WAPA
WISCONSIN ASPHALT PAVEMENT ASSOCIATION

Maintenance & Care

- American Sports Builders Association [Construction & Maintenance Manuals]





Contacts

- WAPA
  - www.wispave.org
    - 608-255-3114
  - Brandon Strand
    - strand@wispave.org
  - Deb Schwerman
    - deb@wispave.org

WAPA
WISCONSIN ASPHALT PAVEMENT ASSOCIATION