

Module 4-14

HMA Overlays of Rigid Pavements

HMA Overlays

Hot-mix asphalt indicates high-quality asphaltic concrete mixtures produced in a facility

Functional overlays

- Minimum thickness
- Typically 25 to 100 mm (1 to 4 in)

Structural overlays

- Thickness based on projected traffic
- Typically 75 to 200 mm (3 to 8 in)

Considerations for Overlay Selection

Construction feasibility

- Traffic control
- Constructability
- Clearances and elevation changes

Performance period

Reflection cracking

Permanent deformation

HMA Overlay Design Approaches

Mixture

Thickness

- Engineering judgment
- Structural deficiency
- Mechanistic fatigue damage

Reflection Cracking

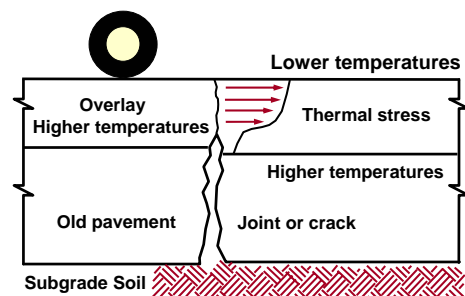
Appears on surface above underlying joints and cracks

Caused by movement at joints and cracks

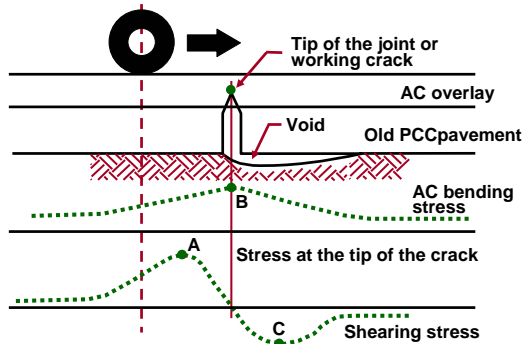
- Low temperatures
- Traffic loads

Initiates at bottom of HMA overlay and propagates upward

Thermal Stress in HMA Overlay



Shearing and Bending Stresses in HMA Overlay



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 repairs
- Fractured slab techniques
- Sawing and sealing joints
- Increased overlay thickness

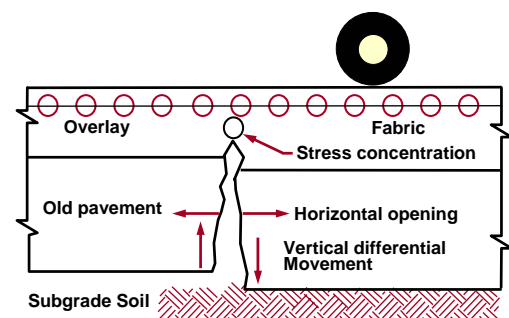
Crack Control Effectiveness

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

Fabrics

- Woven or non-woven synthetic materials
- Provide restraint to resist crack formation
- Most effective with smaller joint movements
 - Longitudinal joints
 - Differential vertical movements between 0.08 and 0.20 mm

Fabrics



Fabric Application



Fabric Application



Influence of Differential Vertical Deflections

Deflection	Fabric	Control
0.00 mm	0	44
0.05 mm	29	54
0.10 mm	88	74
0.15 mm	88	100
0.20 mm	100	100

Stress-Absorbing Interlayers

Dissipates movements and stresses

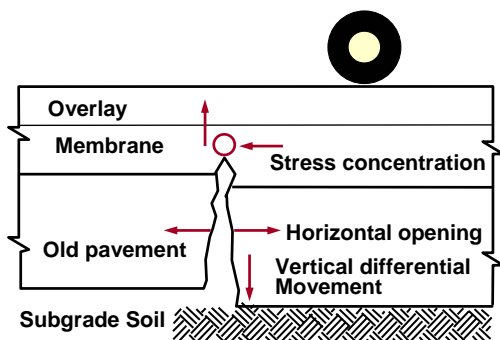
Ineffective for working cracks or large movements

SAMIs

- Spray application of rubber or polymer-modified asphalt
- Sealing of aggregate chips

Proprietary materials available (usually band-aid treatments)

Stress-Absorbing Interlayers



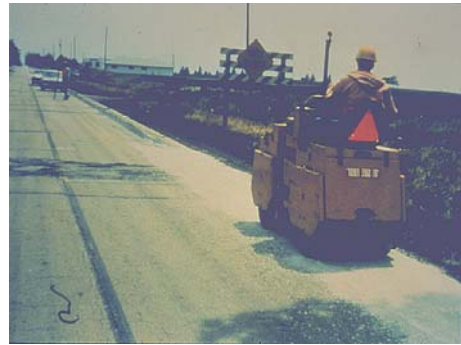
Stress-Absorbing Interlayers



Stress-Absorbing Interlayers



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Stress-Absorbing Interlayers



Stress-Absorbing Interlayers



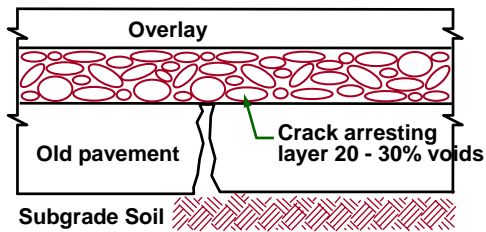
Stress-Absorbing Interlayers



Effect on Reflection Cracking

<u>Material</u>	<u>Trans.</u>	<u>Long.</u>
Polyguard 665	35 %	0.3 %
Royston #108	90 %	0 %
Royston #10AR	35 %	0 %
PavePrep	5 %	2 %
Roadglas	29 %	0 %
Biuthene H.D.	50 %	0 %
Petrotac	30 %	0 %

Crack Arresting Interlayers



Preoverlay Repairs

- Slab stabilization
- Grinding/milling
- Full- and partial-depth repairs
- Slab replacement
- Load transfer restoration
- Retrofitted subdrainage

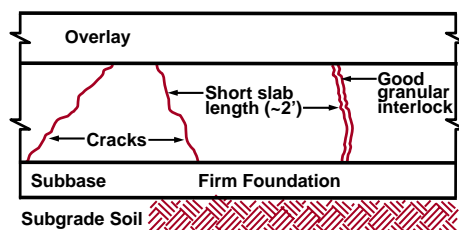
Fractured Slab Techniques

- 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 recommended on poor subgrades
- Design methods (overlay thickness)

Cracking and Seating



Favorable Conditions for Cracking and Seating

- Seriously faulted joints and cracks
- Working cracks
- Rocking slabs
- Patch deterioration
- Lane separation
- Durability distress
- Corner breaks

Important Factors

- Quality of subgrade
- Severity of deterioration
- Size of broken pieces
- Full-depth cracks
- Weight of roller

Types of Equipment

- Modified pile drivers
- Guillotine hammers
- Whip-hammers
- Impact hammers

Equipment - Guillotine Hammer



Fractured Slabs from Guillotine Hammer



Equipment - Heavy Roller



Breaking and Seating

Additional issues (by contrast with crack and seat)

- Break bond between concrete and steel
- Effect on underlying structures

Rubblization

Break existing rigid pavement into small pieces - high quality aggregate base

Equipment - Resonant Frequency Pavement Breaker



Equipment



Sawing and Sealing

Concede appearance of reflection cracking

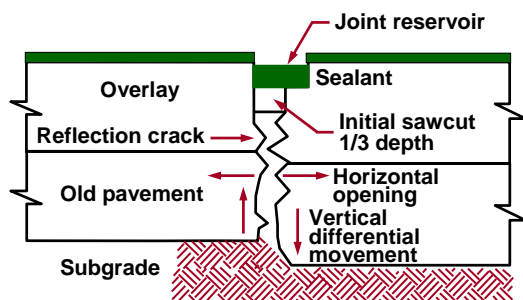
Objective: control rate of deterioration

Reduces spalling of reflection cracks

Candidates should have well-defined joints

Sawcut must be directly above the underlying joint

Sawing and Sealing



Sawing and Sealing



Sawing and Sealing



Sawing and Sealing



Recommended Sawcut Dimensions

Slab Length	Width	Depth
< 15.2 m	13 mm	16 mm
15.3 – 18.9 m	16 mm	16 mm
18.9 – 22.9 m	19 mm	16 mm
19.0 – 26.5 m	22 mm	19 mm
26.5 – 30.5 m	25 mm	22 mm

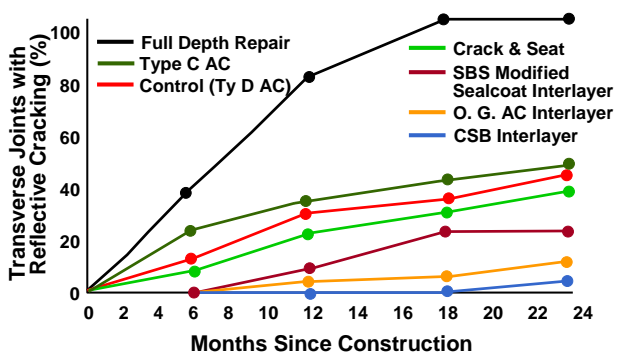
Increased Overlay Thickness

Delays the occurrence of reflection cracking

Cracks propagate about 25 mm per year

Reduces temperature fluctuations in underlying pavement

Comparison of Reflection Crack Control Methods



Summary

Reflection cracking is a major concern, but perhaps more in terms of crack severity and moisture infiltration

Balance between preoverlay repairs and overlay thickness

Many control methods are available

Best method based on:

- Pavement type
- Joint movements
- Level of deterioration
- Cost effectiveness