Thin Overlays

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Pavement Preservation

NJDOT
• Increasing need to repair and maintain rapidly deteriorating infrastructure leads to:
  – More work zones
  – More public dissatisfaction with work zone traffic congestion, delay and safety
  – Facing the challenge of balancing essential roadway repairs and maintenance with mobility and safety concerns
  – Non-traditional construction methods to balance essential roadway repairs and maintenance with mobility and safety
Presentation Outline

• Focus shift from pavement rehabilitation to pavement preservation

• Public may wonder why we are fixing good pavements, outreach needed

• Types of thin HMA surfacings
  – Dense-graded systems (HPTO)
  – Open-graded systems (OGFC & AR-OGFC)
  – Gap-graded systems (SMA & SMAR)
  – Ultra-thin systems (Novachip)
Pavement Design Life

Year of Last Treatment

Excellent

Good

Fair

Poor

Very Poor

Current Year

RSL

Terminal Value

= Measured

Years

Years of Last Treatment

Terminal Value

Excellent

Good

Fair

Poor

Very Poor

Years
Concept of Pavement Preservation ($P^2$)

- **Original Pavement**
- **Optimal Timing**
- **Preventive Trigger**
- **Rehabilitation Trigger**
- **Time / Traffic**

The diagram illustrates the concept of Pavement Preservation ($P^2$) with emphasis on optimal timing, preventive and rehabilitation triggers, and the relationship between pavement condition and time/traffic.
ASCE's % of Major Roads in Poor or Mediocre Condition

Source: ASCE, 2005 Report Card for America's Infrastructure
• Several treatments are available for pavement preservation including:
  – Cold surface seals
  – Thin HMA overlays

• Purpose of PP treatments include:
  – Extending pavement life
  – Improving ride quality
  – Correcting surface defects
  – Improving safety characteristics
Background (cont.)

- Overlays for pavement preservation
  - Thin < 1.5 inch
    - HPTO, OGFC, 9.5 SMA, 9.5 HMA
  - Ultra thin < 1 inch
    - Microsurfacing, Novachip, Chip Seal
Purpose

• Describe the various thin lift maintenance treatments

• Discuss the materials used, mix design techniques, construction practices, performance history and cost factors for each treatment
Types of Thin HMA Surfacings

- Dense-graded mixes
  - Continuously graded, Superpave
  - High Performance Thin Overlay (HPTO)
- Open-graded mixes
  - 15-22% voids, fibers and polymer or crumb rubber
  - Used to reduce splash and spray, improve high speed friction and reduce tire noise
- Gap-graded systems
  - SMA and SMAR mixes (9.5mm & 12.5mm)
  - Ultra-Thin systems (Novachip)
Microsurfacing Route 29
(Preventive Maintenance)
Microsurfacing

• Also used as an interlayer, can eliminate the need for milling
• Also used to fill raveling longitudinal joints, ruts and/or rumble strips
• Cold mix of asphalt emulsion, latex, cement and aggregate
• Cures by chemical reaction called breaking, requires warmer weather
• Compaction and tack coat optional
Considerations for Each System

- General
- Materials and mix design
- Construction
- Performance
- Cost
• **Thin HMA - General**
  – Used throughout USA for maintenance and/or rehabilitation
  – Mixes can be continuously graded or screening mixtures
  – Often used as a compromise between surface treatments and structural HMA
Dense-Graded Systems (cont.)

• Thin HMA - material/mix design considerations
  – Quality aggregates
  – Generally use a softer asphalt binder
  – Mix design procedures similar to structural mixes

• Construction considerations
  – Weak areas must be removed and replaced
  – Thin layers cool more quickly; hence, must have sufficient rollers to achieve compaction
  – Layer thickness/aggregate size > 2.5 mm
  – Vibratory rollers may cause damage to overlay
Dense-Graded Systems (cont.)

- Thin HMA - Performance information
  - Expected life 5-10 years
  - Varies with traffic, existing pavement condition, environmental conditions and quality of materials and workmanship

- Cost information $/sy/inch
  - High quality mixes 3 – 5
  - Lower quality mixes 1.5 – 2.5
Open-Graded Systems

• OGFC - General
  – Used widely in USA for improved wet weather properties and to reduce noise
  – Also referred to as open-graded friction courses or porous pavement

• Materials/mix design considerations
  – Use high quality aggregates
  – Use modified binders – polymers, cellulose or crumb rubber (wet process)
  – Mix design procedures consider film thickness, drain down and voids
Open-Graded Systems (cont.)

- **OGFC - Construction considerations**
  - Mix temperatures must be controlled to minimize drain down
  - Paving accomplished with conventional equipment
  - Placement is easy but hand work difficult
  - Seating performed with steel wheeled rollers
  - Importance of tack coat, residual asphalt
  - No coring for air voids
Open-Graded Systems

- Performance information
  - Pavement life similar to dense mixes when modified binder is used
  - Polymer/fiber and CRM mixes used in NJ have performed extremely well
  - Clogging of voids can reduce the splash and spray benefits
  - Winter maintenance more difficult
Gap-Graded Systems

• **SMA - General**
  - Used in parts of USA as
    • Coarse matrix – high binder mixes
    • SMAR mixes
  - SMA mix concept imported from Europe

• **Materials/mix design considerations**
  - High quality aggregates
  - Modified binders
  - Superpave procedure used to design mixes
Gap-Graded Systems (cont.)

• Construction considerations
  – Manufactured using conventional equipment
  – Productivity can be impacted because of higher fines content used
  – Aggregate quality and gradation - very important - this may effect cost
  – Drain down can also be a problem as in open-graded mixes
  – Hand work and compaction can be difficult
Gap-Graded Systems (cont.)

- **SMA - Performance information**
  - Good overall to date
  - Major issue is fat spots caused by segregation and/or drainage

- **Cost information (% higher than conventional dense mixes)**
  - CMHB: 5-10%
  - AR: 25-50%
  - SMA: 23-70%
Ultra-Thin Systems

• Special thin mix - General
  – Requires special equipment to mix or place
  – May require licenses to apply
  – Novachip® is an example

• Novachip® is a gap-graded HMA placed on a heavy application of a polymer modified membrane
Gap-Graded Systems (cont.)
The Self-Priming Paver
The Self-Priming Paver

Emulsion tank insulated against loss of heat

Worm conveyors

Worm conveyors accommodated in removable troughs heated electrically. Separate drive and control provided for each worm conveyor.

Spray bar

Augers
## NOVACHIP Ultra-thin Friction Course

<table>
<thead>
<tr>
<th>Gradation</th>
<th>Depth Min</th>
<th>Yield range *</th>
</tr>
</thead>
<tbody>
<tr>
<td>¼ in. (A)</td>
<td>3/8 in.</td>
<td>45 to 65 lbs/sy</td>
</tr>
<tr>
<td>3/8 in. (B)</td>
<td>5/8 in.</td>
<td>55 to 75 lbs/sy</td>
</tr>
<tr>
<td>½ in. (C)</td>
<td>¾ in.</td>
<td>65 to 85 lbs/sy</td>
</tr>
</tbody>
</table>

* If proper profile
Ultra-Thin Systems (cont.)

• Special thin mix - Materials/mix design considerations
  – Very high quality aggregate; top size can be 4.75, 6.3, 9.5 mm
  – Modified binders – polymers
  – No standard mix design procedure
  – Performance tests conducted using wheel tracking equipment
  – Mixes typically placed ¾” to 1” thick
Ultra-Thin Systems (cont.)

• **Novachip - Construction considerations**
  - Requires special paver with an integrated spray bar and emulsion tank, higher maintenance
  - Conventional batch or drum plants can be used to produce the HMA
  - Can be opened to traffic quickly

• **Performance information**
  - First project placed in 1992
  - Over 20,000,000 sy placed since, primarily in Southeast
  - Expected life is 10 years
  - Reduces spray and increases friction
  - Seals the pavement surface
Ultra-Thin Systems (con’t)

• Cost information
  – Highly variable to date
  – Typically 50% greater than dense-graded HMA
  – Novachip patent expires summer 2010, cost should go down but more QA will be necessary
Summary

- Thin dense-graded mixes are widely used, primarily for pavement preservation.
- Thin open-graded mixes are widely used, primarily for improving wet weather driving conditions and to reduce noise.
- Gap-graded mixes containing modified binders have been used by several agencies since the late 1980s.
- Ultra-thin systems such as Novachip® are being used.