Use of Local Aggregates in SMA

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Illinois Tollway – Key Statistics

- 286-mile system comprised of four tollways
- Opened in 1958 as a bypass around Chicago to connect Indiana and Wisconsin
- Carries more than 1.4 million vehicles per day
- User-fee system
- No state or federal gas tax dollars used for maintenance and operations
Tollway SMA

- Used for all mainline overlays
- 2008-2009 – Full-depth asphalt – Jane Addams Memorial Tollway (I-90) in Rockford area
- 2015 – Reagan Memorial Tollway (I-88) Rehabilitation
  - 2005 – Rubbilized I-88 – Rochelle to Rock Falls
  - 6-inch asphalt overlay – Stage construction
  - 2015 – Remove 2-inch surface, replace with 6-inches of WMA, including a 2-inch warm-mix SMA surface
Coarse Aggregates for Tollway SMA

- Friction surface SMA –
  - High traffic pavements and curves
  - Coarse aggregate: crushed steel slag, quartzite, granite or diabase / trap rock

- Binder SMA and surface SMA
  - Coarse aggregate: typically crushed gravel. (Also quartzite, granite, diabase / trap rock; crushed steel slag – surface only).
  - 2008 Friction evaluation – OK for Tangents
Coarse Aggregates for Tollway SMA

- Friction aggregates – non-Illinois sources
- Crushed gravel – southern Wisconsin
- I-88 opportunity – evaluate local crushed gravel sources for use in SMA surface
Local Aggregates for Tollway SMA

- **Evaluation approach**
  - Identify potential sources
  - Aggregate breakdown
    - Micro-Deval testing
    - Gyratory compaction to $N_{\text{max}}$
Aggregate Source Selection

- Proximity to Tollway and/or I-88
- Aggregate products and gradations
- Willingness to participate
Aggregate Sources

- **Control**
  - Rock Road: Lathers crushed gravel (CM-14 and CM-16)
  - Michels: quartzite (CM-13 and CM-14)

- **Crushed Gravel**
  - Beverly Elgin (CM-14 and CM-16)
  - Lafarge Elburn (CM-14 and CM-16)
  - Meyer Algonquin (CM-16 and CM-11-scalped)
  - Thelen Antioch (CM-16 and CM-11-scalped)
Aggregate Sources

■ Dolomite

- Vulcan Sycamore (CM-16 and CM-11-scalped)
- Lafarge Fox River (CM-16 and CM-11-scalped)
- Riverstone Osborn (CM-11-scalped)
- Riverstone Milan (CM-16)
- Macklin Rochelle (CM-16 and CM-11-scalped)
- Hanson Thornton (CM-16 and CM-11-scalped)
Micro-Deval of Coarse Aggregates

- AASHTO T327
  - Aggregate breakdown (percent loss) in presence of water
  - Good identifier of pavement performance
  - “Mini” L.A. Abrasion
  - Repeatable test
  - Some agencies use in lieu of soundness
Micro-Deval Loss – Dolomite

Lathers 14: 8.4 9.3 13.5 11.8 11.0 11.9
Lathers 16: 12.1
Vulcan Sycamore 11: 7.9
Vulcan Sycamore 16: 14.4
LaFarge Fox River 11: 13.7
LaFarge Fox River 16: 8.8
Riverstone Osborn 11: 9.7
Riverstone Milan 16: 8.8
Macklin Rochelle 11: 14.4
Macklin Rochelle 16: 13.7
Hanson Thornton 11: 8.8
Hanson Thornton 16: 9.7
Degradation Evaluation

- Aggregate substituted into an existing mix design at optimum asphalt content
- Samples gyrated to $N_{\text{max}} = 225$ gyrations
- Voids analysis
- Extraction gradation
- Hamburg of $N_{225}$ samples - 20,000 cycles
# Degradation Evaluation

## Control Aggregates

<table>
<thead>
<tr>
<th></th>
<th>Michaels Quartzite</th>
<th>Lathers Crushed Gravel</th>
</tr>
</thead>
<tbody>
<tr>
<td>N(_{80}) Voids</td>
<td>3.5</td>
<td>3.8</td>
</tr>
<tr>
<td>N(_{225}) Voids</td>
<td>2.2</td>
<td>2.0</td>
</tr>
<tr>
<td>P200, Loose</td>
<td>8.1</td>
<td>7.7</td>
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### Degradation Evaluation

#### Crushed Gravel

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<td>3.2</td>
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Degradation Evaluation

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Degradation Evaluation

- Samples gyrated to $N_{\text{max}} = 225$ gyrations
- Hamburg of $N_{225}$ samples – 20,000 cycles
- Inconclusive results – all mixes (quartzite, crushed gravel, dolomite) had rut depths between 2.52 and 3.17 mm
Spec - Crushed Gravel for SMA

- L.A. Abrasion – less than 28 percent loss
- Micro-Deval loss
  - Single source: less than 12.0 percent
  - Coarse Aggregates: Design weighted average < 9.5 percent (includes coarse FRAP) – AOK, proceed with mix design
  - If design weighted average 9.5 to 11.9 percent:
    - Conduct mix design – optimum AC @ 3.5 percent Air Voids
    - Air voids at optimum AC and $N_{225} \geq 2.0$ percent
How does this compare?

- **NCHRP 557 (aggregate tests for HMA)** –
  - M-D: Max loss of 15 recommended

- **AASHTO T327 (M-D for coarse aggregate)**
  - 17-18 for HMA surface course (Max 21 for lower courses)

- **AASHTO M325 (Standard for SMA)**
  - Max L.A. Abrasion = 30*
  - * higher values have been successful
Longitudinal Joint Performance
Longitudinal Joint Performance
Acknowledgements

- Steve Gillen – Tollway Materials Manager
- S.T.A.T.E. Testing
Thank You