Asphalt Innovations

Dr. R. Buzz Powell, PE
1986 partnership between the NAPA Research and Education Foundation and Auburn University

- Provide innovative, relevant, & implementable research, technology deployment, & education that advances safe and sustainable asphalt pavements

- NCAT Pavement Test Track operational since 2000.
Accelerated Pavement Damage
Innovation Content

- Mix/Materials
- Structural Design
- Construction
- Preservation
- Maintenance
- Rehabilitation
- Reconstruction
Basics

- Asphalt (flexible) pavement
- Hot liquid asphalt binder (glue)
- Coarse/fine aggregates & filler/dust
- Reclaimed asphalt pavement (RAP)
- Recycled asphalt shingles (RAS)
- Premium mix additives (e.g., fibers)
- Hot/warm-mix asphalt pavement.
Mix and Materials

• “Superpave” for better aggregates, binders, mixes
• Optimized use of locally available aggregates
• More recycling while improving performance
• Selective use of polymer modified asphalt binders
• Highly modified asphalt (HiMA) → more “structure”
• Porous pavement for better/safer wet pavement
• Aramid fibers, plastics, epoxies, tire rubber, etc.
• Performance optimized mix design, construction.
Performance Optimization (BMD)

77°F

122°F

IDEAL CT Index

Rutting

Cracking

Min. 5.95%

Max. 6.35%

5.4% 5.6% 5.8% 6.0% 6.2% 6.4% 6.6% 6.8%

Asphalt Content

HWT Passes to 12.5mm Rut Depth

[Graph showing performance optimization data]
Structural Design (Thickness)

- 20 yrs of experience on NCAT Pavement Test Track
- From empirical to mechanistic design/analysis
- “Perpetual” = 24 inches → 9 inches → 5¾ inches...
- Optimizing each layer for the intended purpose
- Reduced contribution of specialty layers/materials
- Accounting for the benefits of advanced materials.
100% RAP Cold Recycle Base (70%)
2021 Track Additive Group Experiment

- Fibers
- Plastics
- Epoxy
- Rubber
- Etc...
- Future!
Construction

- Good materials, designs, effort, inspection
- Preparation, repair of supporting layer(s)
- Balanced mix design testing during construction
- Importance of tack interlayer “glue” quality
- Importance of achieving good compaction
- Keeping water out of supporting layers
- Full depth rapid rebuilds with “surface” mix.
Full Depth Rapid Rebuild
Asphalt Pavement Preservation

Preservation
Select for Lowest Life Cycle Cost
- Crack/fog seal
- Chip/slurry/micro
- Thin overlay

Rehabilitation
- Thick overlay
- Shallow mill/inlay or hot recycle + overlay

Reconstruction
- Deep mill/inlay or cold recycle + overlay(s)
- Reclamation + overlay(s)

Time / Traffic

Pavement Condition

National Center for Asphalt Technology
at Auburn University

MnROAD
at Auburn University
Benefits = $f(\text{Pretreatment Condition})$
Thinlay

Section 19: Virgin thinlay with PG67-22

MAP-21 Cracking
Green = "Good" (<5%)
Yellow = "Fair" (5% ≤ 20%)
Red = "Poor" (>20%)

% Cracking
0 10 20 30 40 50 60 70 80 90 100

Age, Years
0 1 2 3 4 5 6 7

↓ ≈40%
↓ ≈70%
## Implementation (Reduced Cracks Year 5)

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Poor</th>
<th>Fair</th>
<th>Good</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single Micro</td>
<td>16</td>
<td>14</td>
<td>8</td>
</tr>
<tr>
<td>Double Micro</td>
<td>84</td>
<td>39</td>
<td>28</td>
</tr>
<tr>
<td>Single Chip + CS</td>
<td>68</td>
<td>25</td>
<td>28</td>
</tr>
<tr>
<td>Double Chip</td>
<td>60</td>
<td>31</td>
<td>28</td>
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<tr>
<td>Triple Chip</td>
<td>76</td>
<td>38</td>
<td>30</td>
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<tr>
<td>Fiber Chip</td>
<td>72</td>
<td>32</td>
<td>27</td>
</tr>
<tr>
<td>Virgin Thinlay</td>
<td>81</td>
<td>40</td>
<td>34</td>
</tr>
<tr>
<td>50% RAP Thinlay</td>
<td>71</td>
<td>31</td>
<td>23</td>
</tr>
<tr>
<td>5% RAS Thinlay</td>
<td>66</td>
<td>33</td>
<td>23</td>
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</tbody>
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Maintenance and Rehabilitation
Takeaways

• NCAT as neutral party between agencies & industry
• Track as ground truth for perpetual asphalt roads
• MnROAD partnership for nationwide impact
• Investment of Missouri DOT in Track pooled funds
• Advances in mix/materials, structures, preservation
• Best use of available “virgin” and recycled materials
• Utility $ (easy to build, preserve, maintain, rebuild)
• Safe, fast, affordable, sustainable asphalt pavement.
End-of-Cycle Conference for the 2018 NCAT Pavement Test Track and the MnROAD Pavement Research Partnership

April 20-22, 2021
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