Balanced Mix Design (BMD): Alabama County Experience

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Content

- Background
- Specification development
- Mix design
- Mix production
- Performance to date
- Takeaways
BMD for Rutting & Cracking Resistance
Background
Track BMD Production Testing

77°F

122°F
IDEAL-CT (Cracking Test)

\[ CT_{index} = \frac{t}{62} \times \frac{G_f}{m_{75}} \times \frac{l_{75}}{D} \times 10^6 \]

\( l_{75} \) displacement is most influential on CT-Index

IDEAL-CT

77°F

Hot-IDT

122°F

(Road and Materials, 2019)
Track Validation Study

Cracking Group Study (2015-2021)
Background

- Counties’ need for better “PO mix” cracking performance
- NCAT’s response for a request for assistance by counties
- ALDOT’s long-term plan to implement a BMD spec
- Shadow projects, trial projects, and annual PO mix.
Specification Development

• NCAT research
• Track experiences
• Implementation options
• Proposed specification.
## Alternate BMD Approaches

<table>
<thead>
<tr>
<th>BMD Approach</th>
<th>Volumetric Requirements</th>
<th>Innovation Potential</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Volumetric Design with Performance Verification</td>
<td>All existing criteria retained</td>
<td>Low</td>
</tr>
<tr>
<td>2. Volumetric Design with Performance Optimization</td>
<td>All existing criteria retained before $P_b$ optimization</td>
<td>Low-Medium</td>
</tr>
<tr>
<td>3. Performance-modified Volumetric Design</td>
<td>Some existing criteria relaxed or eliminated</td>
<td>Medium</td>
</tr>
<tr>
<td>4. Performance Design</td>
<td>All existing criteria eliminated</td>
<td>High</td>
</tr>
</tbody>
</table>
BMD Mix Design

- Instrotek Smart Jig – CT Index

- Pine 850 test press – Hot IDT
BMD Mix Design

• Used existing mixes as starting point
  – Low CT Index (Crack), Higher Hot IDT (Rut)
  – Lower RAP mixes performed better

• Wanted to maximize Recycle usage

• Tried blends more closely resembling Marshall (411 or 416) than Superpave
  – Higher binder content (0.5%-0.8%)
BMD Mix Design

• Longer time to get results
  – One point = one day
• More attention to detail
  – Times, temperatures, technology
Mix Production

• A new System
  – Not your Daddy’s QC
  – Wanted BMD Test results, but also need to know AC, Gmm, Gradation, and Air Voids
  – Time/Oven Management
• RAP binder quality is of utmost importance
Mix Production

• Differences in Design and Production
  – Higher CT values/Lower Hot-IDT Values
• Double the time to get results
  – Conditioning time
• Oven upgrade
  – Temperature control
Mix Production

• More workability in the field
• Lower compactive effort to achieve density than Superpave
Production Results

• Houston Co PO 2020 – Dothan Plant

<table>
<thead>
<tr>
<th>Material</th>
<th>% Binder</th>
<th>CT index</th>
<th>Ht IDT</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>12.5mm</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Design</td>
<td>6.20</td>
<td>57</td>
<td>23</td>
</tr>
<tr>
<td>Average</td>
<td>6.06</td>
<td>68</td>
<td>23</td>
</tr>
<tr>
<td>StDev</td>
<td>0.18</td>
<td>20.95</td>
<td>8.19</td>
</tr>
<tr>
<td><strong>9.5mm</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Design</td>
<td>6.20</td>
<td>58</td>
<td>26</td>
</tr>
<tr>
<td>Average</td>
<td>6.03</td>
<td>64</td>
<td>21</td>
</tr>
<tr>
<td>StDev</td>
<td>0.19</td>
<td>17.06</td>
<td>5.69</td>
</tr>
</tbody>
</table>

20,000 tons

9,000 tons
# Production Results

- Barbour CR 9 – Eufaula Plant

<table>
<thead>
<tr>
<th></th>
<th>12.5mm</th>
<th>% Binder</th>
<th>CT index</th>
<th>Ht IDT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design</td>
<td>6.40</td>
<td>50</td>
<td>38</td>
<td></td>
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<tr>
<td>Average</td>
<td>6.23</td>
<td>73</td>
<td>32</td>
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</tr>
<tr>
<td>StDev</td>
<td>0.13</td>
<td>18.30</td>
<td>13.56</td>
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</tbody>
</table>

8,000 tons
Geneva County Feedback

- 28 of 31 total PO mix miles using BMD spec in 2020
- From 20 to 35 percent RAP, \(~0.4\) more total AC
- IDEAL-CT from 120-150 to 80-90, Hot-IDT ran 20-30
- Very pleased with both construction and performance
- Plan to use again for the 2021 paving season
- Several other counties have since adopted.
Takeaways

- Potential for higher life cycle value from BMD
- More innovation without volumetric boundaries
- Learning curve from new county specification
- Contractors are enthusiastic about innovation
- Counties are pleased with results (so far), growing
- State is collecting shadow BMD data.
Thanks!

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