SR28 A55 Pavement Design
Let 11/2/2017

Thomas S. Adams, PE – District 11 Pavement Engineer
SR28 A55 Pavement Design Solution

• 13.7 Miles of 1984 Reinforced Concrete Pavement
  – 2009 CPR
  – 2004 CPR
- **Scope?**

<table>
<thead>
<tr>
<th>Method</th>
<th>Paving Policy Estimate</th>
<th>Engineered Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patch &amp; Overlay</td>
<td>$30,000,000</td>
<td>$30,000,000</td>
</tr>
<tr>
<td>Break &amp; Seat/Rubbilization</td>
<td>$50,000,000</td>
<td>$35,000,000</td>
</tr>
<tr>
<td>Unbonded Concrete Overlay</td>
<td>$50,000,000</td>
<td>$40,000,000</td>
</tr>
<tr>
<td>Reconstruction</td>
<td>$50,000,000</td>
<td>Same</td>
</tr>
</tbody>
</table>
• Patch & Overlay
  – Complex joint pattern
    • Difficult to match underlying joints with sawcut.
    • Subsequent projects have increasing likelihood of missed sawcuts.
    • Risks undercuts
### SR28 A55 Pavement Design Solution

#### Method Paving Policy Estimate

<table>
<thead>
<tr>
<th>Method</th>
<th>Paving Policy Estimate</th>
<th>Engineered Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patch &amp; Overlay</td>
<td>$30,000,000</td>
<td>$30,000,000</td>
</tr>
<tr>
<td>Break &amp; Seat/Rubbilization</td>
<td>$50,000,000</td>
<td>$35,000,000</td>
</tr>
<tr>
<td>Unbonded Concrete Overlay</td>
<td>$50,000,000</td>
<td>$40,000,000</td>
</tr>
<tr>
<td>Reconstruction</td>
<td>$50,000,000</td>
<td>Same</td>
</tr>
</tbody>
</table>
SR28 A55 Pavement Design Solution

- Break & Seat/Rubbilization
  - Resolves complex joint pattern problem.
  - Saves money versus reconstruction.
## SR28 A55 Pavement Design Solution

<table>
<thead>
<tr>
<th>Rubbilization</th>
<th>Break &amp; Seat</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Recommended for reinforced concrete</td>
<td>• Not recommended for reinforced concrete</td>
</tr>
<tr>
<td>• NOT recommended for poor subgrade</td>
<td>• Less affected by poor subgrade</td>
</tr>
<tr>
<td>• Increased construction variability</td>
<td>• Less to go wrong during construction</td>
</tr>
<tr>
<td>• Fail proof-roll</td>
<td>• Less expensive ($2/SY)</td>
</tr>
<tr>
<td>• Exposed rebar must be removed</td>
<td>• Stronger structure</td>
</tr>
<tr>
<td>• More expensive ($4/SY)</td>
<td></td>
</tr>
<tr>
<td>• Weaker structure</td>
<td></td>
</tr>
</tbody>
</table>
• Pub 242 wants a **16.0” bituminous overlay!**

<table>
<thead>
<tr>
<th>Existing Materials to be Overlaid:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Cement Concrete (Good condition, &lt; 5% patching)</td>
<td>0.40</td>
</tr>
<tr>
<td>Cement Concrete (Fair condition, &lt; 10% patching)</td>
<td>0.30</td>
</tr>
<tr>
<td>Cement Concrete (Failed - no patching or &gt; 10% patching)</td>
<td>0.25</td>
</tr>
<tr>
<td>Cracked/Break and Seated Cement Concrete</td>
<td>0.25</td>
</tr>
<tr>
<td>Bituminous Concrete</td>
<td>0.30</td>
</tr>
</tbody>
</table>

AASHTO 93 suggests layer coefficient between 0.20 to 0.35

Use 0.35

Overlay thickness 16.0” to 13.0”
SR28 A55 Pavement Design Solution

• Other help
  – Frost heave
  – Subgrade Resilient Modulus adjustment
    • CBR*1500 instead of CBR*1000
    • Lab testing showed in-situ density similar as that used for CBR test

• 8.5” Bituminous Overlay

Is this going to be OK???
SR28 A55 Pavement Design Solution

- AASHTO 93’ Method
- Pavement-ME

Fig. 1, D-11 PME
• Overlay thickness?
  - NAPA Rubbilization Design Guide

![Graph showing HMA Overlay Thickness vs. Subgrade Modulus](image)

**8.0”**
• Break and seat on reinforced concrete?
  – Illinois SR 97, reflective cracking survey of 3” bituminous overlay of reinforced concrete pavement
SR28 A55 Pavement Design Solution

- Initial:
  - C&S w/16.0” Bituminous Overlay; Cost est. $50,000,000

- Actual:
  - C&S w/8.5” Bituminous Overlay; Cost act. $35,000,000

$15 Million DIFFERENCE
Structural Coefficient
Break & Seat
Subgrade Modulus Correlation
Crack and Seat with Asphalt Overlay

Greg Tomon, QC Manager
Lindy Paving
C&S with Asphalt Overlay

• Lindy’s performed 12 C&S projects since 1999
• The projects variety from:
  – Interstates
  – 3 and 4 digit SR’s
  – City busways
C&S with Asphalt Overlay

7 Major interstates:

- SR 60 Section B16 paved in 1999
- SR 80 Section A04 paved in 2000
- SR 79 Section A12 paved in 2005 & 2006*
- SR 60 Section B27 paved in 2006
- SR 51 Section B31 paved in 2006
- SR 79 Section 35M paved in 2007 & 2008*
- SR 28 Section A55 paved in 2018

*Won the Sheldon G Hayes Award
C&S with Asphalt Overlay

Other projects:

– SR 4035 Section B01 paved in 2009
– SR 910 Section A20 paved in 2010
– Martin Luther King Busway from downtown Pittsburgh to Wilkinsburg paved in 2010
– SR 366 Section 20R paved in 2015
C&S with Asphalt Overlay

SR 910 Section A20 – Harmar Township

*Picture taken in 2019
C&S with Asphalt Overlay

What do all these project have in Common?

- NO substructure failures since the original crack and seat operation was performed!

Picture of SR 79 Sec. 35M taken in 2019, – 11 years old!!
Benefits of C&S

• Reduction of overall project time and cost
• Enhanced Safety: no open excavation for traveling public and project personnel
• No joint reflection in surface course
• Eliminates saw and seal in overlying pavement with eliminates exposure to silica
Benefits of C&S (cont’d)

• Virtually Eliminates Undercuts
• Easier to Maintain
• Crack and Seat with SMA surface will increase the Life Cycle expectancy of the pavement in excess of 15 years!
• Reduce the need for crossovers
• A positive perception by traveling public
Benefits of C&S

Reduction of Overall Project Time and Cost

SR 79 Section A12 – Kirwan Heights
Benefits of C&S

Reduction of Overall Project Time and Cost

SR 79 Section A12 – Kirwan Heights

• Originally designed as a full depth reconstruction

• Would have had to expose the questionable sub-grade
  – Decreased the need for undercuts
  – Tremendous time savings for the project
Benefits of C&S

Reduction of Overall Project Time and Cost

SR 28 Section A55 – Tarentum

• Originally bid as weekend closures with full detours
  – Higher than average precipitation that year
  – Decreased the need for undercuts
  – Tremendous time savings for the project
  – A positive perception by traveling public
C&S Process

• Sawcut at one third points to a depth sufficient to sever mesh reinforcing steel. Provide sawcuts such that the spacing of existing joints and/or sawcuts is approx. 20 feet.

• Typically a Guillotine Breaker is Utilized in the Fracturing Effort as per Test Section Results – Typical breaking pattern of 18” to 24” apart

• Seat the Cracked Pavement Using a 50 Ton Pneumatic Roller
C&S Process (cont’d)

• Establish Overlay Thickness using Acceptable Design Methodology

• Overlay Cracked and Seated Pavement as Per Typ. Sections
SR 28 Typical Section

**TYPICAL BREAK & SEAT SECTION**

<table>
<thead>
<tr>
<th>Material</th>
<th>STA (miles)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SR 028 SB</td>
<td>1063.40 to 1074.60</td>
<td>Long Life Asphalt Pavement (LLAP), SMA mix design, WMA wearing course, RPS, PG 64-22, 3 to &lt;10 Million ESALs, 5.5% mix, 1½&quot; depth, SRL-L</td>
</tr>
<tr>
<td>SR 028 SB</td>
<td>1059.36 to 1064.40</td>
<td>Superpave Design, WMA binder course, RPS, PG 64-22, 3 to &lt;10 Million ESALs, 5.5% mix, SRL-L</td>
</tr>
<tr>
<td>SR 028 SB</td>
<td>1056.00 to 1059.36</td>
<td>Superpave Design, WMA wearing course, PG 64-22, 3 to &lt;10 Million ESALs, 5.5% mix, 1½&quot; depth, SRL-L</td>
</tr>
<tr>
<td>SR 028 SB</td>
<td>1054.00 to 1056.00</td>
<td>Superpave Design, WMA binder course, RPS, PG 64-22, 3 to &lt;10 Million ESALs, 5.5% mix, SRL-L</td>
</tr>
<tr>
<td>SUBBASE</td>
<td>STA 1059.36</td>
<td>Subbase 8” depth (No. 2A)</td>
</tr>
</tbody>
</table>

**LEGEND**

- A: Long Life Asphalt Pavement (LLAP), SMA mix design, WMA wearing course, RPS, PG 64-22, 3 to <10 Million ESALs, 5.5% mix, 1½” depth, SRL-E (Item No. 9000-6130)
- B: Long Life Asphalt Pavement (LLAP), Superpave Design, WMA binder course, RPS, PG 64-22, 3 to <10 Million ESALs, 5.5% mix, 1½” depth, SRL-L (Item No. 9000-6140)
- C: Long Life Asphalt Pavement (LLAP), Superpave Design, WMA Base course, PG 64-22, 3 to <10 Million ESALs, 5.5% mix, SRL-L (Item No. 9000-6150, MIN. DEPTH 3½’)
- D: Superpave Asphalt Mixture Design, WMA wearing course (Scratch), PG 64-22, 3 to <10 Million ESALs, 5.5% mix, 1½” depth, SRL-L
- E: Superpave Asphalt Mixture Design, WMA wearing course, PG 64-22, 3 to <10 Million ESALs, 5.5% mix, 1½” depth, SRL-L
- F: Superpave Asphalt Mixture Design, WMA binder course, RPS, PG 64-22, 3 to <10 Million ESALs, 5.5% mix, SRL-L
- G: Superpave Asphalt Mixture Design, WMA binder course, PG 64-22, 3 to <10 Million ESALs, 5.5% mix, SRL-L
- H: Subbase 8” depth (No. 2A)
- I: Paved Shoulders, Type 1-Sp
C&S – S.R. 28
C&S – S.R. 28
C&S – S.R. 28

50 ton cart pulled by a tractor or dozer
C&S – S.R. 28
Thank You!