Quick-Fix, Fast Track Road Crossing Renewals Using Panelized Asphalt Underlayment System

By

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Goals and Attributes
Rail/Highway Crossing Management

- Cost Effective Crossing
  - Safe
  - Smooth
  - Servicable
  - Long life

- Stable and Smooth
  - No costly disruption
  - Can be skipped over

- Accomplish
  - Minimum of time
  - 4-hour train curfew
  - 8 to 12-hour highway closure

- Utilize Cooperative Approach
  - Railroad company (contractor)
  - Local highway/governmental agency
Panel System
Premium Materials
Planning Meeting

• All Entities Must:
  – Select a date
  – Assign responsibilities
  – Share cost
<table>
<thead>
<tr>
<th>Local Highway/Governmental Agency</th>
<th>Railroad Company</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Public Announcements</td>
<td>• Remove and Replace the Track and Crossing</td>
</tr>
<tr>
<td>• Traffic Control</td>
<td></td>
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<tr>
<td>• Asphalt Paving</td>
<td></td>
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</tbody>
</table>
Renewal Activities

Preparations

- Obtain Railroad Curfew
- Notify Public of Road Closure
- Arrange for Highway Traffic Control and Detours
- Deliver Track Panel, Ballast, Crossing Surface, and Other Track Materials
- Assemble Equipment, Labor Forces, and Miscellaneous Supplies
- Arrange for Delivery of Asphalt at Prescribed Times
- Saw Pavement Approach - 7 Feet from Rail on Both Sides
- Saw and Bolt Rails at Specified Distance Beyond Immediate Crossing Surface (Optional)
## Actual Work Items

<table>
<thead>
<tr>
<th>Time (hours)</th>
<th>Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>↑</td>
<td>Remove existing crossing surface and track panel (panel will be longer than crossing surface)</td>
</tr>
<tr>
<td>2.0 – 2.5</td>
<td>Excavate trackbed material to approximately 30 in. below top-of-rail</td>
</tr>
</tbody>
</table>
| ↓            | Evaluate subgrade support, determine action—  
|              | No additional activity needed, subgrade is firm and compact  
|              | Compact subgrade to densify it  
<p>|              | Add ballast and compact subgrade if subgrade is soft |
| ↑            | Dump, spread, and compact 6 to 8 in. of asphalt underlayment |
| 1.0 – 1.5    | Dump, spread, and compact 8 to 10 in. of ballast to grade |
| ↓            | Position new track panel on compacted ballast and bolt or weld joints |
|              | Railroad Open |</p>
<table>
<thead>
<tr>
<th>Time Range</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0 – 2.0</td>
<td>Add cribbing ballast, tamp, raise (if desired), and surface track</td>
</tr>
<tr>
<td>2.0 – 3.0</td>
<td>Place crossing surface</td>
</tr>
<tr>
<td></td>
<td>Pave asphalt trenches along both sides of track</td>
</tr>
<tr>
<td></td>
<td><strong>Highway Open (pave highway approaches the following day if required)</strong></td>
</tr>
<tr>
<td>0.0 – 3.0</td>
<td>Pave asphalt highway approaches the same day (optional)</td>
</tr>
<tr>
<td></td>
<td><strong>Highway Open (no further paving required)</strong></td>
</tr>
<tr>
<td>6.0 – 12.0</td>
<td><strong>Highway Open (cont.)</strong></td>
</tr>
</tbody>
</table>
Removing old crossing

Lifting out old panel

Excavation

Compacting roadbed
Compacting asphalt

Compacting placement of asphalt

Compacting ballast

Positioning wood tie panel
Dumping cribbing rock

Surfacing track

Placing concrete surface

Finished crossing
Excavating trackbed and checking grade

KY 3 Condition prior to rebuild

Removing old crossing 08:30

Began excavating

Excavating trackbed and checking grade
Dumping and spreading ballast

Spreading asphalt

Compacting asphalt and dumping ballast

Dumping and spreading ballast
3 weeks later

Compacting hand-spread approaches

Regulating ballast 12:40

Finished compacting asphalt approaches 16:50

3 weeks later
Benefits of Asphalt Base (Underlayment)

- Strengthened Support Layer
- Waterproof and Confining Underlying Layer
- Impermeable Layer
- Confine Ballast Layer
- Resilient Layer
- All-weather, Uniform Stable Base
Dense-Graded Highway Base Mix

- 1 – 1 1/2 in. Maximum Size
- 0.5%+ Asphalt Content
- Minimal Oxidation and Hardening
- Minimal Temperature Changes
- Consistent Stiffness
- Optimum In-situ Moisture Contents
Quantities

6 in. thick, 12 ft. wide, 140 lb/ft$^3$

0.42 tons/track foot (0.50 tons/ft.)

$30/\text{ton} = $15/\text{track foot}$
Pressure Cell

- Geokon Model 3500-2
- 9 in. Diameter
- Strain Gage
- Snap-Master
- Thermistor
Cell Placement on Asphalt
Cell Location at Richmond
Loaded Coal Train at Richmond

P-Cell 819 Beneath Rail in Crib

P-Cell 820 Beneath Rail and Tie

P-Cell 821 C/L Track in Crib

P-Cell 822 C/L Track and Tie

Pressure (psi)

Time (s)
Loaded Auto Train at Richmond

P-Cell 819 Beneath Rail in Crib
- 1 6-Axle Loco
- 1 4-Axle Loco
- Initial 2 Cars

P-Cell 820 Beneath Rail and Tie
- 1 6-Axle Loco
- 1 4-Axle Loco
- Initial 2 Cars

P-Cell 821 C/L Track in Crib
- 1 6-Axle Loco
- 1 4-Axle Loco
- Initial 2 Cars

P-Cell 822 C/L Track and Tie
- 1 6-Axle Loco
- 1 4-Axle Loco
- Initial 2 Cars

Time (s)
Pressure (psi)
Loaded Concrete Truck at Richmond

P-Cell 820 Beneath Rail and Tie

Pressure (psi)

Time (s)
Cell Location at Lackey

High Rail

Low Rail
Empty Coal Train at Lackey

P-Cell 510 Beneath High Rail and Tie

Pressure (psi)

2 6-Axle Locomotives
Initial 2 Cars

Time (s)

P-Cell 511 Beneath High Rail and Tie

Pressure (psi)

2 6-Axle Locomotives
Initial 2 Cars

Time (s)

P-Cell 806 C/L Track and Tie

Pressure (psi)

2 6-Axle Locomotives
Initial 2 Cars

Time (s)

P-Cell 207 Beneath Low Rail and Tie

Pressure (psi)

2 6-Axle Locomotives
Initial 2 Cars

Time (s)
Flat Wheel on an Empty Coal Train at Lackey

P-Cell 511 Beneath Rail and Tie

2 6-Axle Locomotives
95 Empty Cars
Loaded Coal Truck at Lackey

P-Cell 510 Beneath High Rail and Tie
Top of Asphalt Temperature vs Time

Richmond

- 7-Day Average Ambient Temp
- Top of Asphalt Temperature
- 7-Day Max Air Temp
- 7-Day Min Air Temp

Date

Temperature (F)

09/21/00
10/22/00
11/22/00
12/23/00
01/23/01
02/23/01
03/26/01
04/26/01
05/27/01
06/27/01
07/28/01
08/28/01
09/28/01
10/29/01
11/29/01
12/30/01
01/30/02
03/02/02
Findings and Conclusions

- **Asphalt Underlayment Crossings**
  - Very Smooth and Serviceable
- **Fast-Track Renewal**
  - Minimum of Time
- **Pre-Compaction of Subgrade/Asphalt/Ballast**
  - Important
- **Cooperative Effort**
- **Peak Pressures**
  - Under Rail/Tie Interface
- **Pressures on Asphalt**
  - Heavily Loaded = 14.5 to 29 psi
  - Lightly Loaded = 3 to 10 psi
Findings and Conclusions (cont.)

• Flat Wheels
  – Impact Pressures Significant
• Higher Pressures under Low Rail in Curves
• Heavy Truck Pressures
  – Smooth Crossings - 5 psi
• Passenger Car Pressures
  – Smooth Crossings - < 0.5 psi
• Temperature Extremes Minimized in Trackbed
• Moisture Content of Subgrade/Roadbed
  – Near Optimum
• Minimal Oxidation of Asphalt/Long Fatigue Life