Precast Concrete Pavement – Rapid Repair and Rehabilitation of High Traffic-Volume Concrete and Asphalt Pavements

Arizona Pavements/Materials Conference
November 15-16, 2018
Tempe, Arizona

Samuel Tyson, P.E.
Federal Highway Administration
Headquarters – Washington, DC
States and Provinces with Under 1 Lane-Mile of Jointed Precast Slabs (6 Lane-Miles as of September 30, 2018)

<table>
<thead>
<tr>
<th>States and Provinces</th>
<th>Lane-Miles</th>
</tr>
</thead>
<tbody>
<tr>
<td>AK</td>
<td>0.02</td>
</tr>
<tr>
<td>AL</td>
<td>0.20</td>
</tr>
<tr>
<td>CT</td>
<td>0.05</td>
</tr>
<tr>
<td>DE</td>
<td>0.40</td>
</tr>
<tr>
<td>GA</td>
<td>0.88</td>
</tr>
<tr>
<td>IA</td>
<td>0.05</td>
</tr>
<tr>
<td>KS</td>
<td>0.65</td>
</tr>
<tr>
<td>LA</td>
<td>0.46</td>
</tr>
<tr>
<td>MI</td>
<td>0.54</td>
</tr>
<tr>
<td>MN</td>
<td>0.04</td>
</tr>
<tr>
<td>MO</td>
<td>0.03</td>
</tr>
<tr>
<td>NV</td>
<td>0.06</td>
</tr>
<tr>
<td>OR</td>
<td>0.02</td>
</tr>
<tr>
<td>PA</td>
<td>0.50</td>
</tr>
<tr>
<td>RI</td>
<td>0.06</td>
</tr>
<tr>
<td>TX</td>
<td>0.50</td>
</tr>
<tr>
<td>VA</td>
<td>0.68</td>
</tr>
<tr>
<td>VT</td>
<td>0.04</td>
</tr>
<tr>
<td>WV</td>
<td>0.35</td>
</tr>
<tr>
<td>QC</td>
<td>0.49</td>
</tr>
</tbody>
</table>
States and Provinces with Over 1 Lane-Mile of Jointed Precast Slabs (107.5 Lane-Miles as of September 30, 2018 - Compared to Other States & Provinces).

- CA: 51.69
- HI: 3.57
- IL: 7.36
- IN: 1.73
- NJ: 7.06
- NY: 28.03
- UT: 3.24
- WI: 1.60
- ON: 3.22
- OTHER: 6.00
Precast Concrete Pavement (PCP)

- High Traffic Volumes
- Alternate Route Availability
- Rapid Renewal
- Lane-Closure Times
- Work-Zone Safety
- Opening to Traffic
- Concrete Quality
- Long-Life Performance
Reinforcement & Prestressing

- Nominal reinforcement (0.12-0.15 %) for handling stresses & to control potential cracking.
- Pre-tensioning by fabricator allows reduced panel thickness.
- Pre-tensioning also for wider and longer panels (e.g., two-lane width).
- Post-tensioning applied on site to connect a series of panels.
Bedding Support for PCP Systems

Uniform support key to PCP performance

- Existing base graded & re-compacted
- New base material
  - Cement-treated or granular
  - Rapid-setting lean concrete
- Undersealing
  - Rapid-setting grout
  - Polyurethane
Trimmed base with 0.5-inch (12-mm) bedding layer of cemented fine-grained granular material
Panel Leveling

• Trimming of Stabilized Base – Time-consuming activity.
• Thin Shims – Typically requires lifting of panels to adjust shims.
• Polyurethane Foam Injection – Specialized equipment required.
• Fast-Setting Lean Concrete – Partial removal of base and screeding.
• Leveling Bolts – Rapid and accurate.
Typical Leveling Bolts
Leveling Bolt & Grout Ports During Concrete Placement
Load Transfer Slots & Dowels for Jointed PCP Systems
Continuous Applications – Jointed

Dowel slots top/bottom for load transfer
Post-Tensioned Continuous

Florida DOT – Precast Concrete Overlay on US 92
Delaware DOT – Outside Lane and Shoulder/Right-Turn Lane

Left-Turn Lane
Virginia DOT – 3 Lanes and Outside Shoulder/Rush-Hour Lane
Typical Uses/Nighttime Work

• Principal Uses –
  o Heavily-trafficked interstate & primary roadways.
  o Interstate & urban ramps with no convenient alternate routes.
  o Intersections – Resists rutting/shoving.
  o Bridge approaches – Smooth transition from pavement to bridge.
  o Bus pads – Avoid disruption of service.
  o Airfields – A developing application.
Hawaii DOT – Full-Depth Repair of 5 Lanes and Outside Shoulder/Right-Turn Lane on H-1
Virginia DOT – Outside Lane of Exit Ramp from I-66
Alabama DOT – Replace Asphalt Ramp from I-165
Texas DOT – Reconstruction of Asphalt Industrial Intersection in Energy Sector
Louisiana DOTD – Access Ramp to I-20
Florida DOT – Bridge Approach Slabs on I-10
Connecticut DOT Bus Pad
Continuity of longitudinal steel in repair of continuously reinforced concrete pavement (CRCP)

Precast concrete panel on left with 18 inches of threaded No. 10 bars

Existing CRCP on right with grouted threaded No. 10 bars (0.8% steel)

Illinois Tollway

Fiber-Reinforced Ultra High-Performance Concrete (UHPC) 4,000 psi at 4 hours
Panel Fabrication/Installation Rates

• Panel fabrication rate –
  – Inside plant; 10 panels/day.
  – Pre-stressing bed; 30 panels/day.

• Panel installation rate –
  – Repair; 20 panels/night.
  – Continuous; 50 panels/night.

• Inventory – Several weeks (or months) of panel production is needed before installation on project can begin.
Precast Panel Fabrication

Typical Reinforced Panel Production

Outdoor Prestressing Bed for Multiple Panel Production
Experience in the USA with PCP systems is limited to 17 years.

PCP systems are rapidly installed.

PCP systems provide long-term performance following satisfactory design, fabrication and installation.

Fabricators & contractors having no prior experience are producing and installing panels satisfactorily.