Northeast Pavement Preservation Partnership
Annual Meeting
Burlington, Vermont – April 7-8, 2014

SHRP2 R05 PRECAST CONCRETE PAVEMENT TECHNOLOGY IMPLEMENTATION

Elkridge, Maryland – stayabji@ara.com
1. Overview of precast concrete pavement technology – SHRP2 Project R05 products.
2. Case studies – Jointed & Posttensioned PCP systems.

Information presented is based on recently completed SHRP2 Project R05 and several FHWA activities.

SHRP2 Motto: Shorter facility life spans cannot be accepted as the price of rapid renewal.
The Need – Pavement Rehab Under Heavy Urban Traffic

A very serious issue throughout urban US

- Shorter delays, but shorter service life (rapid setting concrete)
- Longer delays & longer service life (conventional concrete paving)
- Shorter delays & longer service life (PRECAST CONCRETE PAVEMENT)
SHRP2 Project R05
Improving Precast Concrete Pavement Technology

- Overall findings.
- Findings based on field testing.
- Guidelines for PCP design.
- Guidelines for PCP fabrication.
- Guidelines for PCP installation.
- Guidelines for PCP project selection.
- Guidelines for PCP system acceptance.
- Model specifications.
- Implementation plan.

http://onlinepubs.trb.org/onlinepubs/shrp2/SHRP2_S2-R05-RR-1.pdf
FHWA is providing technical assistance to highway agencies that want to implement PCP technology:

- Workshops
- Technical briefings
- Technical support – specs/plans
- Open houses, etc.

Five agencies are receiving SHRP2 implementation Assistance Program funding.
Precast pavement systems are fabricated or assembled off-site, transported to the project site and installed on a prepared foundation (existing pavement or re-graded foundation).

The system components require **minimal field curing or time** to achieve strength before opening to traffic.

These systems are application-ready for **rapid repair, rehabilitation and reconstruction** of asphalt and concrete pavements.
PCP Background

- PCP is a recent technology – in use since 2001
- Used primarily for RAPID repair & rehabilitation & longer-lasting treatments
  - Panels fabricated off-site, transported to project site & installed on a prepared foundation; minimal field curing time required
- Typically, night-time work & short work windows
- Typically, repair/rehab along a single lane
  - Multiple-lane repair/rehab possible based on site constraints
Traffic Considerations
(Drives Everything)

➢ Traffic volume – is it heavy enough to preclude other pavement alternatives?
   – If fast-track fixed or slip form paving techniques are possible, use of precast pavement may not be the best option!

➢ Alternate routes
   – If traffic can be staged or detoured, use of precast pavement may not be the best option!

But, if you have only 8 hours or less of lane closures to perform the repair/rehab work, you need to strongly consider precast pavement
Lane Closure Requirements

• An over-riding assumption is that **some level of traffic operation will be maintained (Roadways)**
  – Single-lane repair/rehab – need at least a two-lane closure & at least one lane for traffic
  – Two-lane repair/rehab – need at least a three-lane closure & at least one lane for traffic

• Otherwise, intermittent full traffic stoppage may be necessary
Where to Use Precast Pavement?
(Open to Traffic the Next Morning!!!)

- Primary Applications (90%+ use)
  - Heavily-traveled main line interstate/primary system & urban roadways - A critical need on aging system
  - Interstate/primary system & urban ramps - Often no alternative routes and heavy traffic

- Special Applications
  - Intersections - Where traffic needs to be maintained
  - Bridge approach slabs - A large no. of approach slabs across country need to be rehabilitated under traffic
  - Bus pads - Where alternative bus stop locations are not acceptable, bus pads can be replaced overnight
Precast Pavement Systems - Users

• US/Canada
  – Production use
    • CA, IL Tollway, IA, MI, NJ, NY, UT, VA
    • Ontario, Quebec
  – Demos
    • CO, DE, FL, GA, HI, MN, MO, NV, PA, TX, WI, PANY/NJ, Dulles Airport, US Air Force

• Overseas
  – Russia, Japan, France, the Netherlands, Indonesia

Graphs courtesy of FMC
PCP Applications

Intermittent Repairs
- Panel replace
- Full depth repair at joint

Shorter Length Rehab
- Continuous repair – short length

Longer length, Multi-Lane Rehab
- Continuous repair
PCP Systems

- For intermittent repairs
  - Nominally reinforced panels
  - Prestressed panels

- For continuous Applications
  - Jointed PCP systems (JPrCP)
    - Nominally reinforced panels
    - Prestressed panels
  - Post-tensioned systems (PPCP) - fewer active joints; longer sections

Generic & Proprietary Systems (Components) Available
PCP Systems

Repair Panels

Conventional Jointed PCP System
Intermittent (Repair) Applications

Schematic cross-section of the dowel assembly:
- Precast slab
- Existing slab to remain
- Dowel slot
- Dowel bar
- Graded aggregate base
- Flowable fill or HDP
- 90-mm wide slots cut in existing pavement
- Not to Scale

Existing Pavement

Dowels cast with slab
State of Practice (Jointed Systems)

Roman Stone System

Illinois Tollway Generic System

Fort Miller System

Polyurathane Foam Bedding

Bottom Slots

<<Narrow Mouth Surface Slots
Illinois Tollway Generic System

TYPICAL REINFORCEMENT

STANDARD 12'-6" WIDE PANEL FOR ISOLATED PLACEMENT
Illinois Tollway Trial Installation

- Trial conducted April 1, 2009, full scale installation 2010 on
California Slab Repair System

Barra Glide Load Transfer System & Gracie Lift Device
Developed in 2013; used by Caltrans
PCP Systems

PPCP Systems

PPCP Central Stressing

PPCP End Stressing @ Surface

Gap
Slab

Gap
Slab
Delaware Route 896 PPCP Project

(Posttensioned System – July 2009)

Panel t: 8 in.; Width: 12 or 24 ft; length: 9 ft 10 in.
No. of panels posttensioned: 12, 13, or 14
Delaware Route 896 PPCP Project
(Posttensioned System – July 2009)
## Precast Concrete Pavements

### Jointed versus Prestressed: Highlights

<table>
<thead>
<tr>
<th></th>
<th>Precast Jointed</th>
<th>Precast Prestressed</th>
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<tbody>
<tr>
<td><strong>Thickness</strong></td>
<td>Conventional – 10 to 14 in.</td>
<td>Thinner – 8 to 10 in.</td>
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<tr>
<td><strong>Active Joint Spacing</strong></td>
<td>15 ft, typical</td>
<td>150 to 250 ft</td>
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<tr>
<td><strong>Joint Width, typical</strong></td>
<td>0.25 to 0.35 in.</td>
<td>0.5 to 2.0 in.</td>
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<tr>
<td><strong>Joint Load Transfer</strong></td>
<td>Dowel Bars</td>
<td>Dowel Bars</td>
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<tr>
<td><strong>Support Needs</strong></td>
<td>Good support</td>
<td>Very Good Support</td>
</tr>
<tr>
<td><strong>Base/Panel Interface</strong></td>
<td>Panels placed over finished base &amp; bedding layer, if needed</td>
<td>Smooth base needed. Typically, use of a polyethylene sheet over well graded (stabilized) base</td>
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</tbody>
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Production Rates/Closure

- Typical (current) production rates/nighttime closure
  - Repairs: 15 to 20
  - Continuous:
    - 30 to 40 panels for jointed application (up to 600 ft)
    - Up to 600 ft for posttensioned (prestressed) system
  - Higher rates possible with larger crews/better planning
Bridge Approach Slabs

- Thousands of distressed approach slabs exist
  - Exhibited by classic “bump” at bridge end/approach
- Causes of failure
  - Settlement of underlying soils
  - Erosion of embankment materials
- Difficult to replace
  - Limited room for staging – narrow shoulders
  - Often repaired with “band-aid” materials
- Precast panels - a good fast and permanent repair
  - Full-depth replacement allows opportunity to repair underlying embankment
  - Can be installed in over night or over-the-weekend work windows
Example: Approach Slab on Existing Bridge Abutments

Cross Section at End of Existing Bridge

Placing panel Over Anchor Rods

Placing panels In One Lane

Source: The Fort Miller Co., Inc.
**Case Study Projects**

- **Intermittent Repairs**
  - New Jersey – I-295 & I-280 (Fort Miller system)
  - New York – I-495 near JFK Airport (Roman Stone System)

- **Continuous applications - Jointed**
  - New York – Tappan Zee Toll Plaza – First project (2001) (Fort Miller system)

- **Continuous PPCP**
  - California I-680 (generic with proprietary prestressing components)
NJ I-295 (June 2008)
Intermittent Repairs using the Super Slab System

• Process:
  – Sawcut repair boundaries in advance
  – Night of repair – remove damaged panel; prepare base; drill dowel holes in existing panels; insert dowel bars; install precast panel
  – Next night – patch dowel slots; underseal panel

Panel thickness: 8.75 in. (existing JRCP thickness – 9 in.)
Panel dimensions: length – variable (8, 10, 12 ft); Width – 12 ft
Vpd: 140,000
NJ I-295 (June 2008)
Intermittent Repairs

FIRTST NIGHT

NEXT NIGHT
NYS I-495, Near JFK Airport (2011)
Intermittent Repairs using the Roman Road System

• Details:
  – 4 miles (both directions) full depth repairs
  – Over 800 panels – Panels mostly 8 ft long by 12 ft wide, some 10 ft long; t = 9 in.
  – Bedding: Uretek HD polyurethane foam
  – Load transfer: Full DBR
  – Traffic: 200,000 vpd

• Process:
  – Mill existing AC overlay
  – Sawcut repair boundaries in advance
  – Night of repair – remove damaged panel; prepare base; install precast panel; inject urethane foam to raise panel
  – Next night – Cut dowel slots; install dowel bars (DBR)

• Performance - Good
NYS I-495, Near JFK Airport (2011)
Intermittent Repairs using the Roman Road System

Installation under Heavy Traffic – at Night
Tappan Zee Jointed (Oldest - 2001)

• Project details
  – Precast pavement system: Fort Miller’s Super Slab system
  – Panel thickness: 10 in.
  – Panel dimensions: length –18 ft; Width – 10 ft (toll plaza drive lanes; 12 lanes)
  – Number of panels installed: 1,071
  – Base: existing granular base (top 2 in. removed) with 1.5 in. leveling stone dust
  – Joints: Doweled transverse joints; longitudinal joints tied
  – Total project area: over 40,000 y² (both sides of the toll booths)
  – Traffic level: Heavy commuter traffic (New York city area) with large number of trucks per day (eastbound through toll plaza - 72,000 vpd)

• Performance - Good
Tappan Zee Jointed (Oldest - 2001)
CA I-680 Precast Posttensioned System
Up to 36 ft long panels over new Rapid Set LCB, 2011
Two tendons/duct; Duct spacing – 36 in.
Summary

- Although experience with PCP systems is limited, less than 11 years, performance to-date indicate that well-designed and well-constructed PCP systems can be installed rapidly and can be expected to provide long-term service.

- Precast concrete pavement technology for rapid repair and rehabilitation of high volume highways is an implementable technology and continues to evolve.

- The need for the technology is obvious – rapid construction and longer-lasting solutions.

- A viable PAVEMENT PRESERVATION TOOL for extending the service life of existing pavements.

Precast pavement technology is ready for implementation/production use.
Thank You!