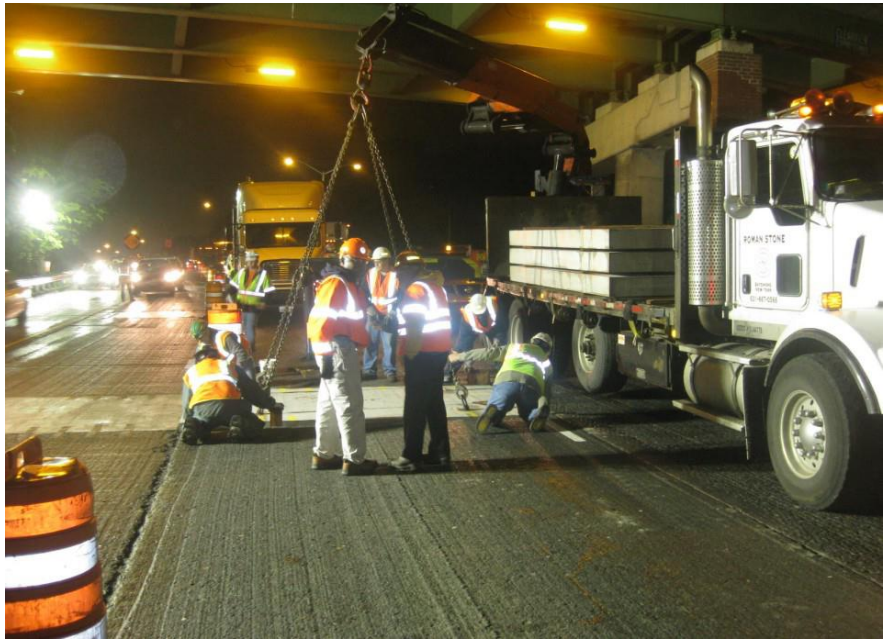
Northeast Pavement Preservation Partnership
Annual Meeting
Burlington, Vermont – April 7-8, 2014

SHRP2 R05 PRECAST CONCRETE PAVEMENT TECHNOLOGY IMPLEMENTATION



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Presentation Outline

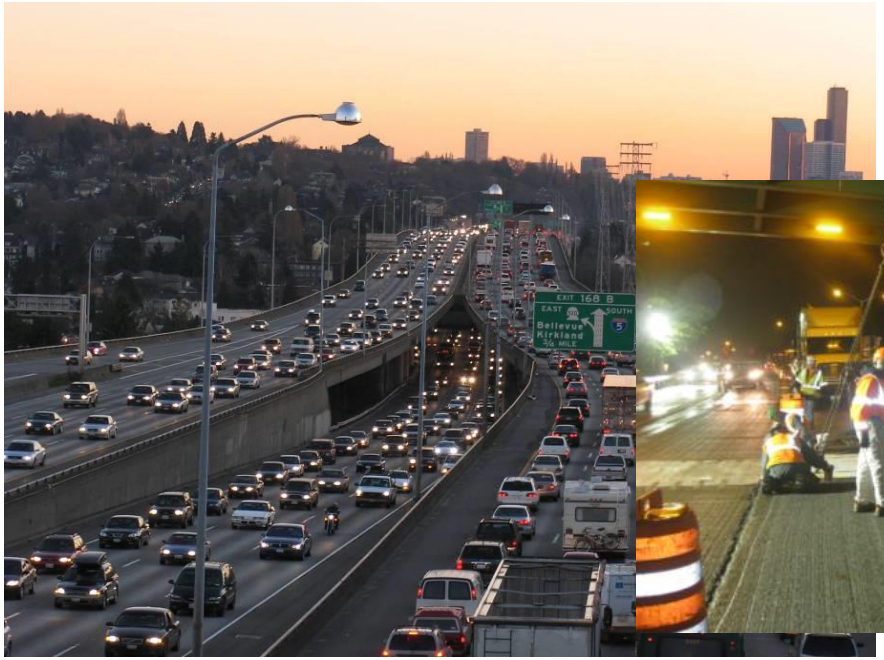
1. Overview of precast concrete pavement technology – SHRP2 Project R05 products.
2. Case studies – Jointed & Posttensioned PCP systems.

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
http://www.trb.org/StrategicHighwayResearchProgram2SHRP2/Pages/R05-Model-Specifications-718.aspx

FHWA SHRP2 Project R05 Products Implementation Support Project

Scop
imple ler
the S e
Pave
FHW DC
Con , Inc.
ARA

FHWA is providing technical assistance to highway agencies that want to implement PCP technology:

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

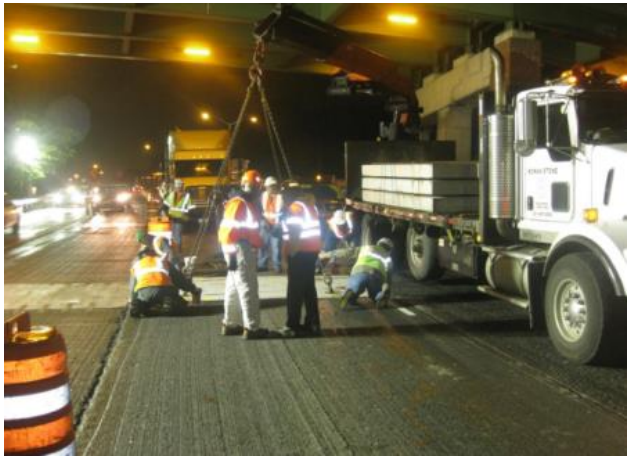
Five agencies are receiving SHRP2 implementation Assistance Program funding

Precast Concrete Pavement Systems - A Definition

- 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

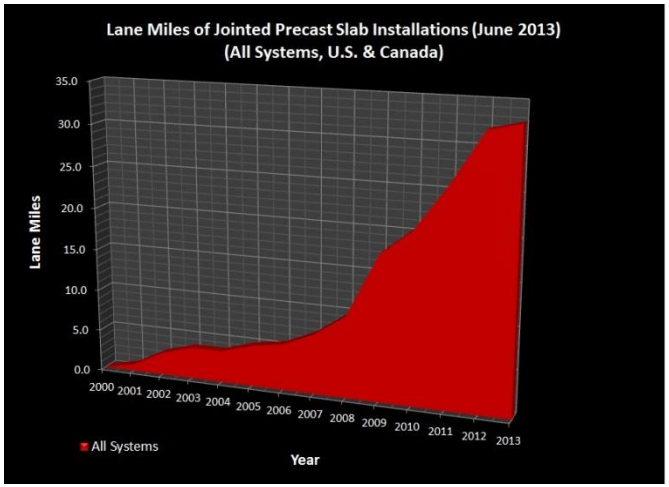
- An over-riding assumption is that <u>some level of traffic operation will be maintained (Roadways)</u>
  - Single-lane repair/rehab – need at least a two-lane closure & at least one lane for traffic
  - Two-lane repair/rehab – need at least a three-lane closure & at least one lane for traffic
- Otherwise, intermittent full traffic stoppage may be necessary

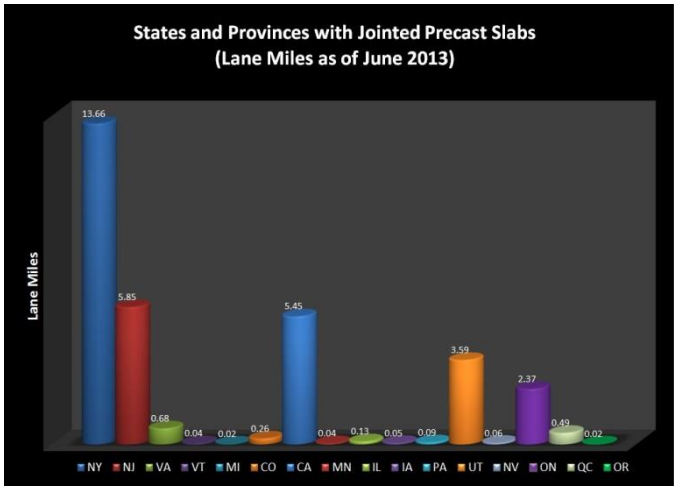
Where to Use Precast Pavement?
(Open to Traffic the Next Morning!!!)

- 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

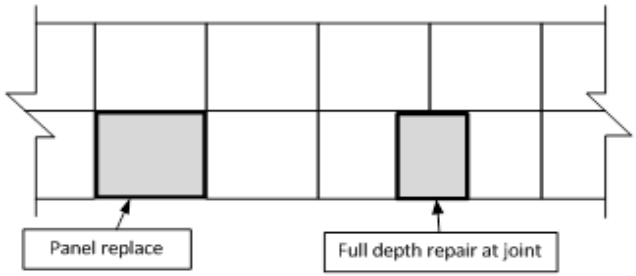


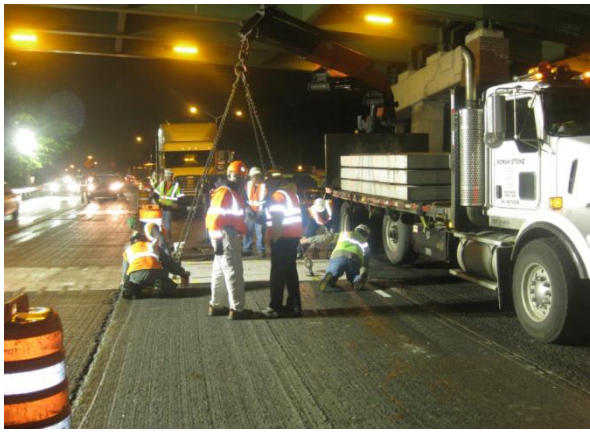


Graphs courtesy of FMC

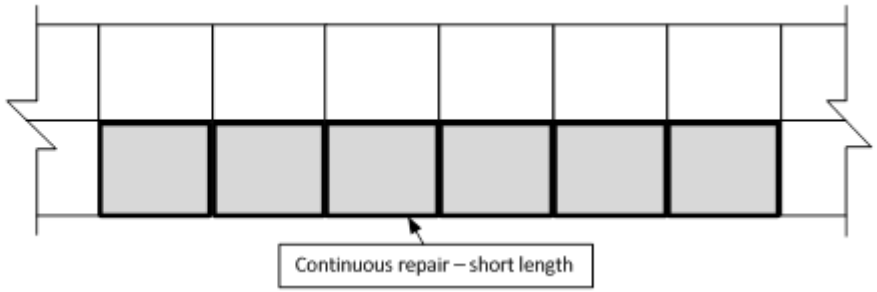
PCP Applications

Intermittent Repairs

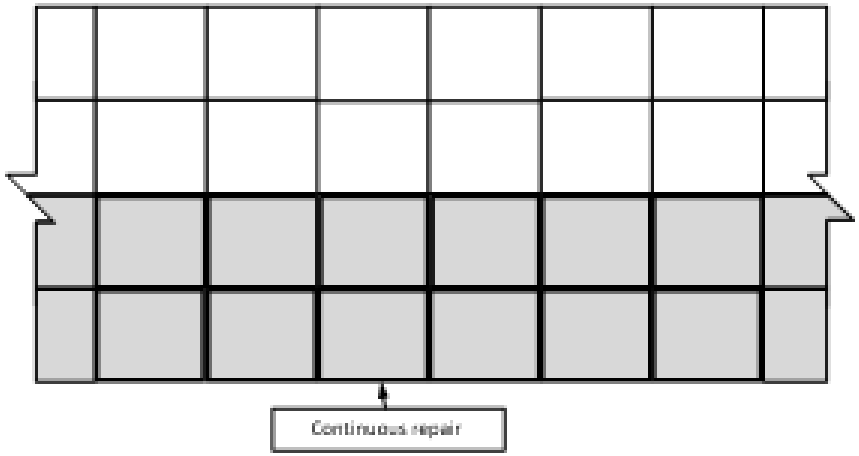




Shorter Length Rehab

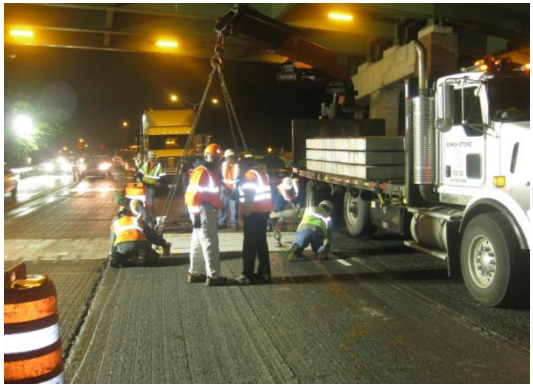


Longer length, Multi-Lane Rehab



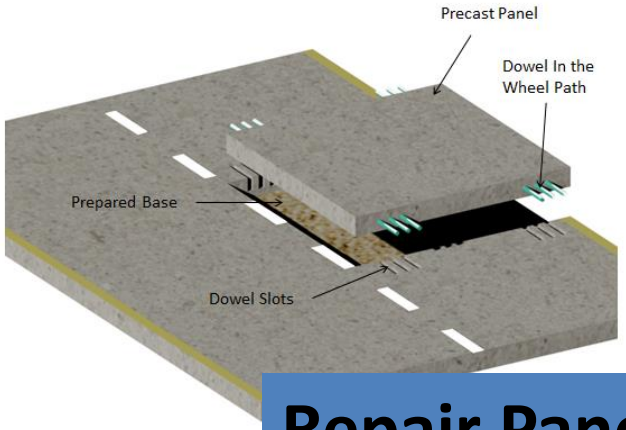
PCP Systems

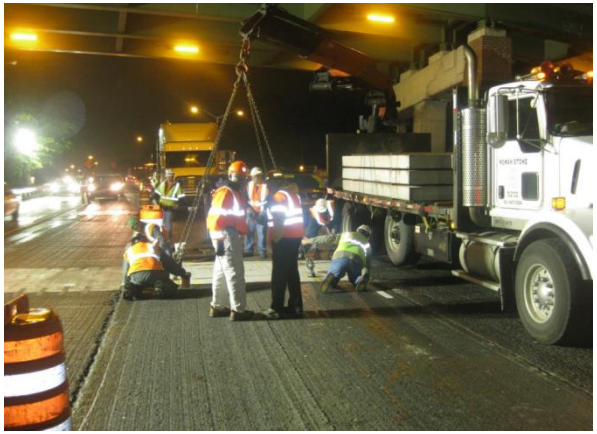
- For intermittent repairs
  - Nominally reinforced panels
  - Prestressed panels
- For continuous Applications
  - Jointed PCP systems (JPrCP)
    - Nominally reinforced panels
    - Prestressed panels
  - Post-tensioned systems (PPCP) - fewer active joints; longer sections



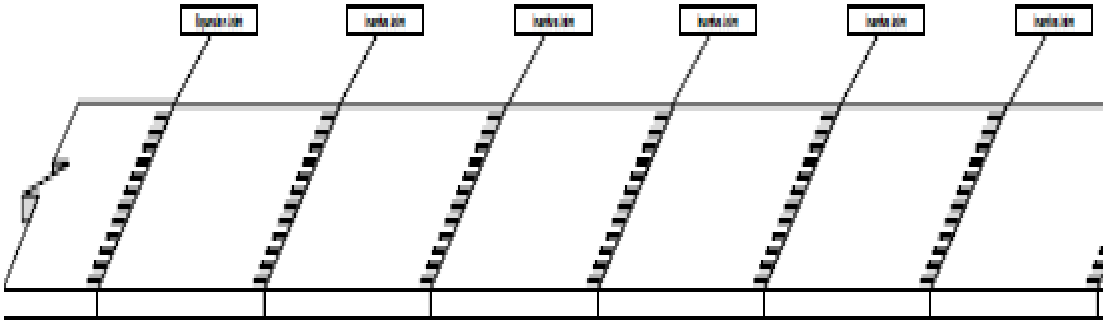
Generic & Proprietary Systems (Components) Available

PCP Systems



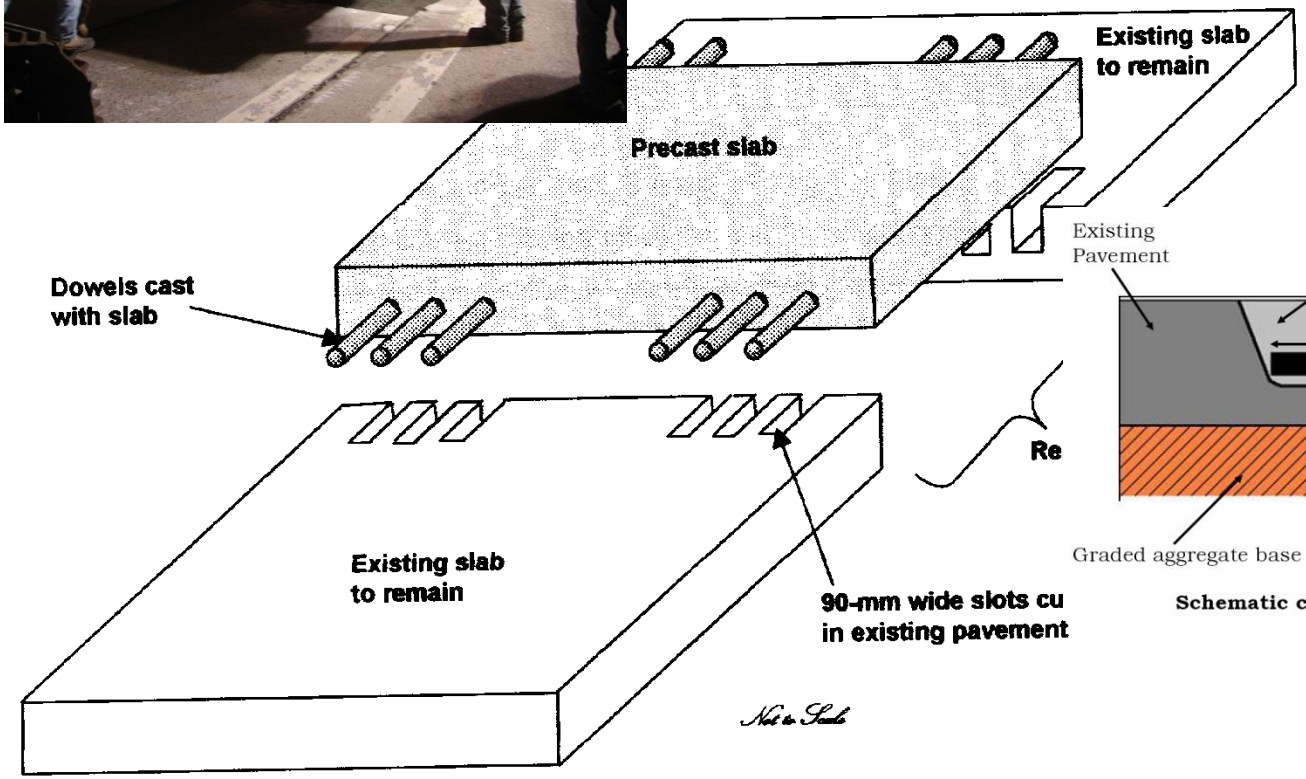


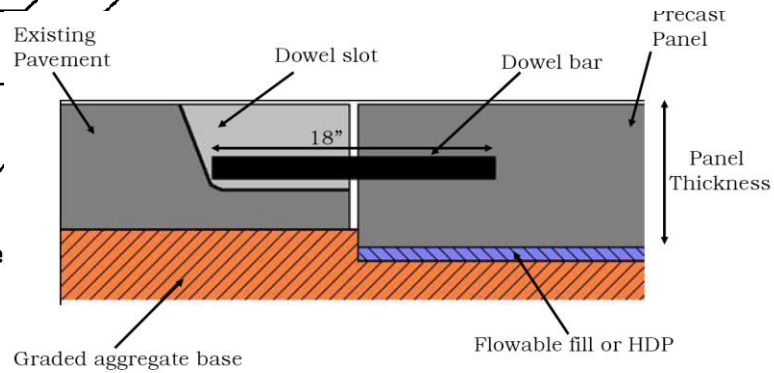
Repair Panels



Conventional Jointed PCP System

Intermittent (Repair) Applications





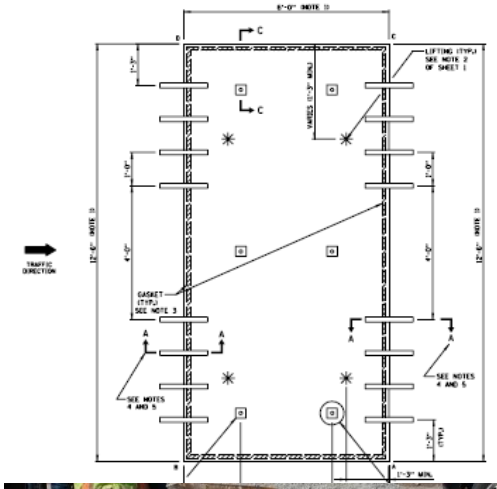
Schematic cross-section of the dowel assembly

State of Practice (Jointed Systems)

Roman Stone System

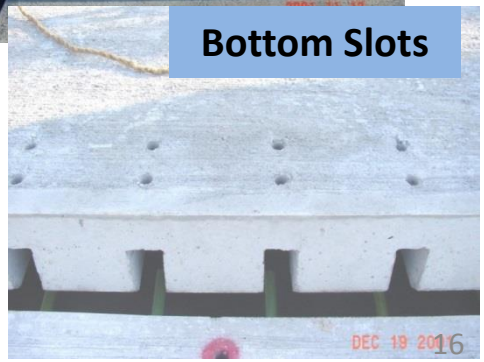
Polyurathane Foam Bedding

Illinois Tollway Generic System



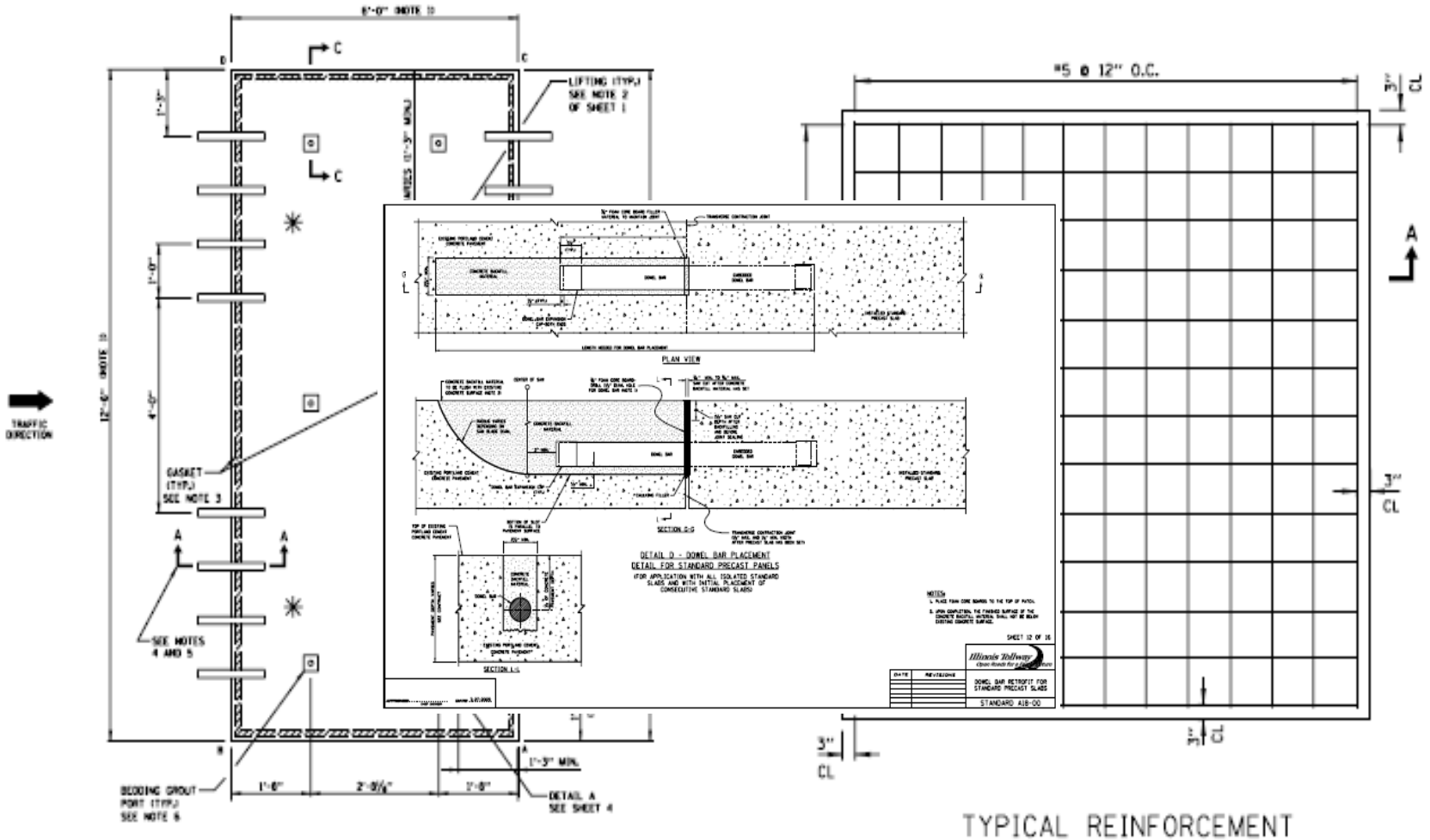
<<Narrow Mouth Surface Slots

Fort Miller System



Bottom Slots

Illinois Tollway Generic System



STANDARD 12'-6" WIDE PANEL FOR ISOLATED PLACEMENT

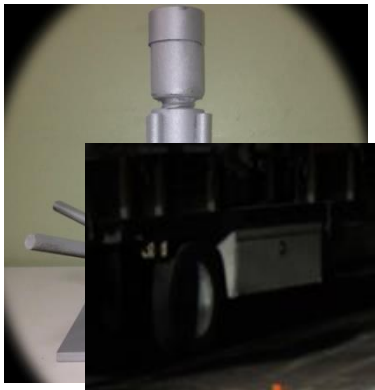
TYPICAL REINFORCEMENT

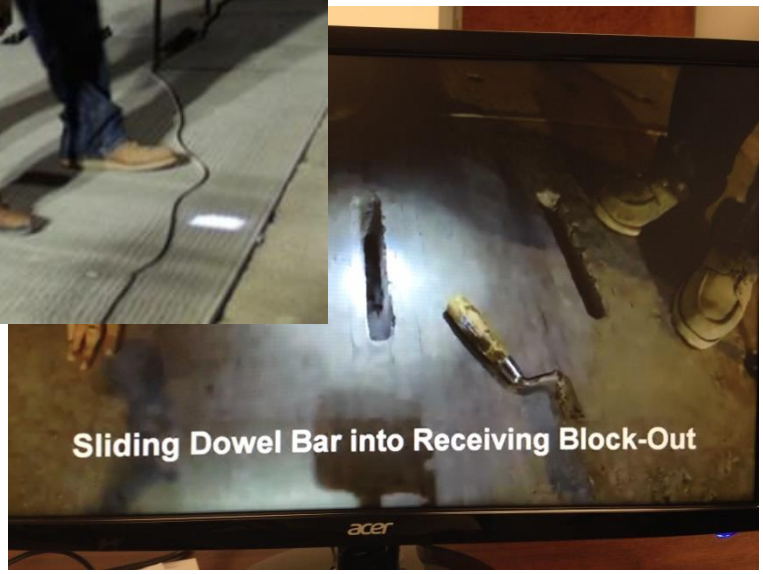
Illinois Tollway Trial Installation

- Trial conducted April 1, 2009, full scale installation 2010 on

California Slab Repair System

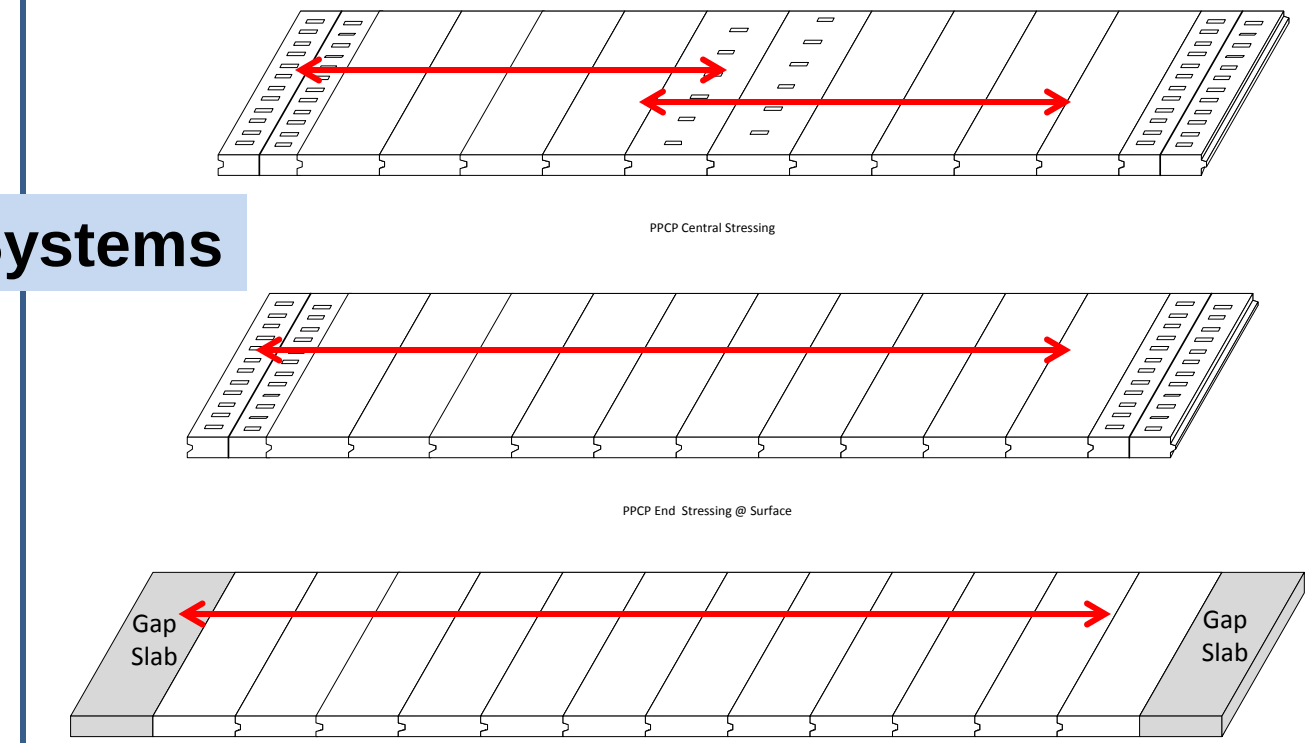
Barra Glide Load Transfer System & Gracie Lift Device
Developed in 2013; used by Caltrans

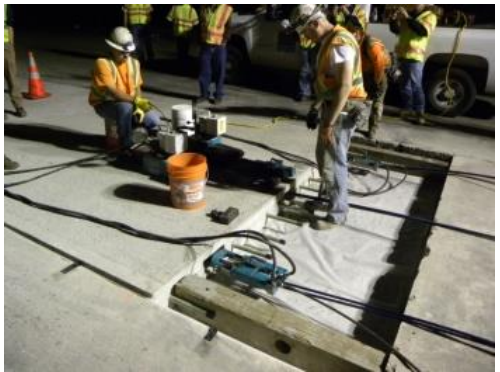




PCP Systems

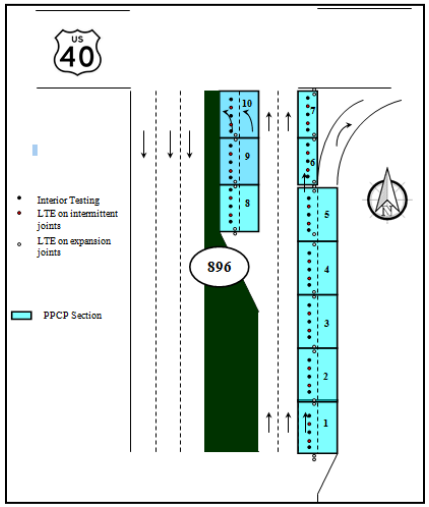
PPCP Systems

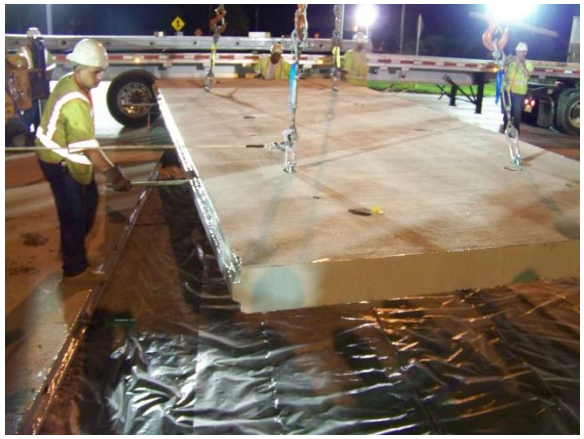




Delaware Route 896 PPCP Project

(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

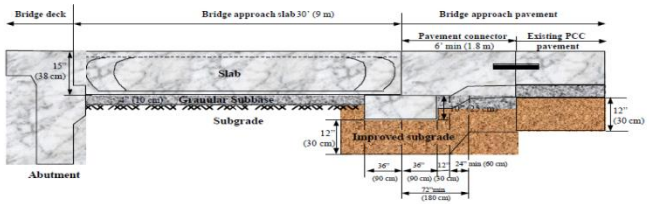
	Precast Jointed	Precast Prestressed
Thickness	Conventional – 10 to 14 in.	Thinner - 8 to 10 in.
Active Joint Spacing	15 ft, typical	150 to 250 ft
Joint Width, typical	0.25 to 0.35 in.	0.5 to 2.0 in.
Joint Load Transfer	Dowel Bars	Dowel Bars
Support Needs	Good support	Very Good Support
Base/Panel Interface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

Production Rates/Closure

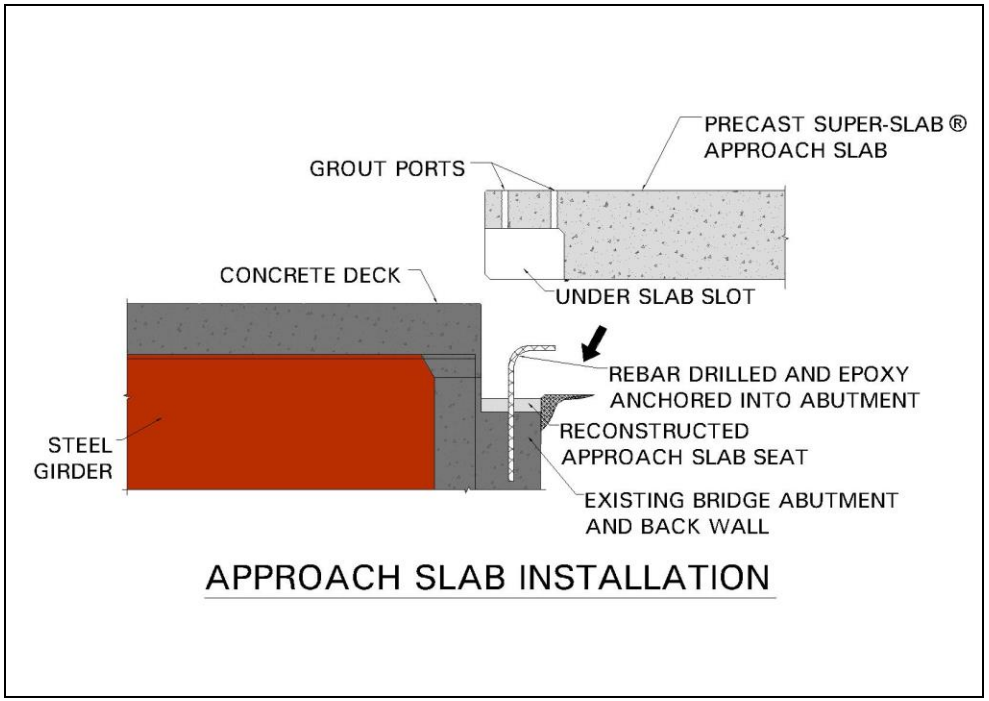
- Typical (current) production rates/nighttime closure
  - Repairs: 15 to 20
  - Continuous:
    - 30 to 40 panels for jointed application (up to 600 ft)
    - Up to 600 ft for posttensioned (prestressed) system
  - **Higher rates possible with larger crews/better planning**

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.

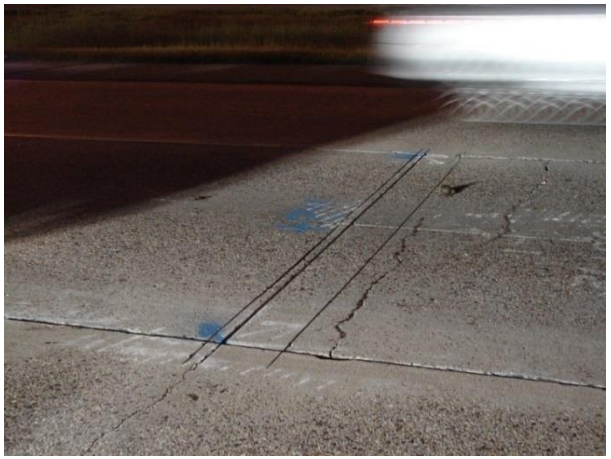
Case Study Projects

- 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

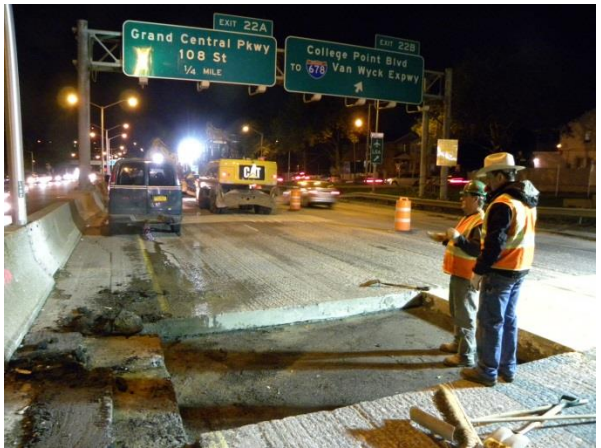
FIRTST NIGHT

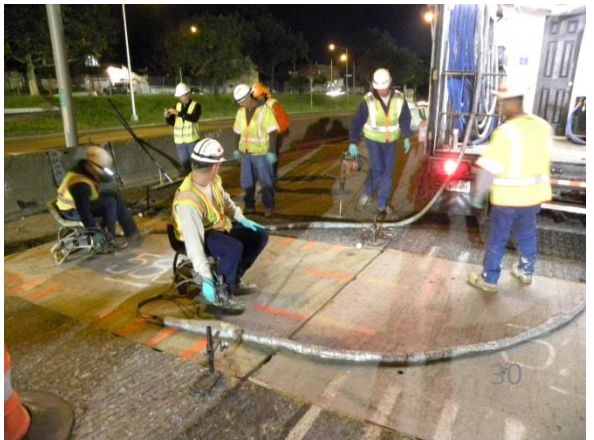
NEXT NIGHT ➔

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)

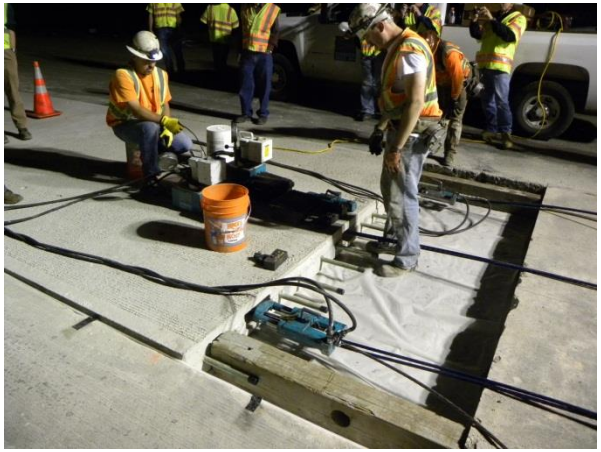
- Project details
  - Precast pavement system: Fort Miller's Super Slab system
  - Panel thickness: 10 in.
  - Panel dimensions: length –18 ft; Width – 10 ft (toll plaza drive lanes; 12 lanes)
  - Number of panels installed: 1,071
  - Base: existing granular base (top 2 in. removed) with 1.5 in. leveling stone dust
  - Joints: Doweled transverse joints; longitudinal joints tied
  - Total project area: over 40,000 y^2 (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!