Fast Track Concrete Pavement Repair & Replacement Using Precast Concrete Panels

The Fort Miller Co., Inc.

TN Concrete Pavement Conference

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The Fort Miller Co., Inc.
NPCA, PCI & Caltrans Precast Pavement Committees
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How Fast-Track Do We Need To Be (in terms of ADT)?

145,000 ADT
I-287, Tarrytown, NY

200,000 ADT
I-15, Ontario, CA

180,000 ADT
I-66, Fairfax, VA
What Does High ADT’s Mean For Pavement Repair & Maintenance?

- Heavily-deteriorated pavement
  - Historically, too much traffic to repair properly
    - Often repaired with non-durable materials
- Very short work windows
  - 8 – 5 hour night work windows
  - 55 hour weekend closures
- Need for durable repairs

**Summary** - Premium pavement required - overnight!
What's Under that Interstate Traffic Right Now

- Shattered Slabs
  Pasadena, CA
- Failed Rapid Set Patches
  Hollywood, CA
- Heavily Faulted Slabs
  Pasadena, CA

210 Freeway, Pasadena, CA
Urban Arterial & Intersection Pavement in Poor Condition

50 Year Old Pavement

Many Utilities

Poor Surface Drainage

Shoved Black Top Overlays
Why Precast Concrete Pavement?

- Precast slabs are more durable
  - Cast in controlled conditions
  - Testing (of installed pavement) show promise of 40+ years of service
- Precast slabs can be installed in very short work windows
  - Enables concrete pavement replacement in 5 hour night work windows
- **Precast pavement + Premium pavement overnight!**
Does Precast Compete With Cast-in-Place Concrete Pavement?

- Precast pavement will never compete on a cost basis
  - Precast more expensive because it has to be cast, stored and shipped before installation
- Precast is that “special tool” for heavily traveled (impossible to stage) locations
  - Particularly suited for spots that are impossible to stage or detour
- Precast pavement is really an “agent” to keep pavement white!
  - Finally a material and a method for rapidly and durably repairing concrete pavement!
Precast Pavement Emulates Cast in Place

- Full Bedding Support
- Load transfer Dowels
- Grade Control
- Slab Surface Geometry
Overview of Current Precast Systems

- Precast Prestressed Concrete Pavement (PPCP)
  - Pre & post tensioned (250’+ assembly)
  - Developed by FHWA (non-proprietary)
- Top-Slot Jointed Systems (Michigan Method)
  - Jointed – slab lengths 16’ ± long
  - Developed by FHWA (non-proprietary)
  - Flowable fill or urethane foam support
- Bottom-Slot Jointed System (Super-Slab®)
  - Jointed – slabs 6’ to 16’
  - Grade supported
- Other systems are “appearing”
Precast Prestressed Concrete Pavement (PPCP) System – (Post Tensioned From Top)

250’ ±

PT & Top-Slot Dowels Load Transfer
Grout Slab Support

(8 projects, 5.9 lane miles completed in 6 states)
Prestressed Post Tensioned Concrete Pavement System (PPCP)

Source: Shiraz Tayabji, Fugro Consultants, Inc.
Roman Road System
Urethane-Supported, Top Slot System

Installation Steps

• Prepare hole
• Place slab
• Jack to grade (with urethane grout)
• Saw and prepare slots
• Place and grout dowels

Compacting Over-Excavated Hole
Grading Stone Dust To 1" Below

LIE Project, September, 2011
Roman Road System
Jacking & Providing Slab Support

Injecting Urethane

Slab Placed in Over-Excavated Hole

Urethane Provides Grade Control and Slab Support
Top-Slot – Dowel Bar Installation

Gang Saw For Cutting Slots (Step 1)

Sand Blast Cleaning – Vital (Step 3)

Chipping Our Slots (Step 2)

Install and Grout Dowels (Step 4)
Load Transfer Mechanism - Top Slot Systems

- Grout must cure 2-3 hours before opening to traffic

Sand Blast Cleaning - Vital

Failed Top Slot (Utah)

Failed Slots

Load Transfer Through Bond Only
Illinois State Toll Highway Authority
Grade-Supported Top-Slot System

Placing Slabs On Precise Grade

Installing Dowels Through Hand-Holes
(Correctly?)

Narrow - Wide Top Slot
Caltrans Gracie-Lift System
Grout-Supported Top Slot System

Slabs Placed on Lowered CTB or LCBRS

Leveling Screw Grade Control

Install Rapid-Setting Bedding and (Dowel) Grouts Before Traffic
Grade-Supported, Bottom-Slot Super-Slab® System

- Simple slab-on-grade system
- Standard dowels and tie bars (JRCP)
- Built-in bedding grout distribution
- Precision grading equipment
- Warped and planar surfaces
- 17,500 + slabs = 2,100,000 SF INSTALLED

(85 projects, 32 lane-miles completed in 14 States + ONT & QUE)
Grade Control & Slab Support – A Two-Step Process

Primary Bedding

Grade control rails placed to survey marks

Precisely-Graded (to ± 1/8") and Compacted Fine Aggregate Material

Secondary Bedding

Grout Distribution Channel Foam Gaskets

Bedding Grout Fills Any Voids

Proof
Super-Slab®
Load Transfer Dowel System

- Dowels engage slots in adjacent slab
- Pump dowel group into ports
  - Grout reaches 2500 psi in about 2 hours
- Fill slots and joint between slabs
- Dove-tail slot resists bar pop out
Load Transfer Mechanisms
– Bottom-Slot Super-Slab®

- “CLEAN” TOP OF SLAB
- STRONG CONNECTION
- FAST – SLOTS CAST IN

(proprietary detail)
Indicators for Long Life

Full scale load testing in California

Falling Weight Deflectometer
(Should be used to test every proposed system)

Test results show no cracks or distress

Heavy vehicle simulator

143 Million ESALs (100 KN Load)
4.3 Million Cycles
Slab Surface Geometry

**Single Plane**
- Slopes of opposite sides are equal

**Warped Plane**
- Slopes of opposite sides are un-equal
Candidate Projects (Locations) for Precast Concrete Pavement

(Completed Projects)
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Intermittent Repairs (CPR)

I-90
Albany, NY
(2004)

I-676 Vine St Expressway
Philadelphia, PA
(2009)

I-15 Salt Lake City, Utah
(2012)

I-95, New Rochelle, NY
(2007)
Continuous - Tappan Zee Bridge Toll Plaza

Off Peak Hours = 20 Hour Work Windows

This
(3,000 SF Per Eight Hour Shift)
(Within ± 3 mm)
In 2001 and 2002

While Maintaining
This
(135,000 Vehicles per Day)
Continuous - Mainline Placement

Mainline I-15, Ontario, CA
(200,000 VPD)
Continuous - Ramps and Ramp-Termini

Plan View Tarrytown

Eight Hour Work Windows!

Chicago, IL

Brooklyn, NY

Tarrytown, NY

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Intersections – Replacing Composite Pavement, – Rotterdam, NY - 2006

New & Old

Complex Geometry

Undercuts

Replaced in 17 Nights!
Intersection Approaches – Replacing Full Depth Asphalt, Rockaway Blvd., Queens, NY – 2010

Farmers Blvd

Guy R. Brewer Blvd.

Intersection Approaches Only
Bridge Approach Slabs
(Existing Bridges)

Cross Section at Abutment

Binghamton, NY (2009)

NY State DOT
New Bridge and Approach Slab Total Replacement

US 46 Over Broad St., Clifton, NJ

- Bridge replaced over two weekends - April 2011
- Two-span (40.2’, 40.2’) continuous, 28.76° skew
- Precast Approach Slabs - tied to prefabricated bridge units
Industrial Driveways
City of Mamaroneck, NY

Continuous Access During Construction
Pavement Under Low-Clearance Interstate Bridges, Kalamazoo, MI

Installation

Two Lanes Completed

New Panels (before Grinding)
Installation Rates, Cost and Other Considerations
Installation Rates (Intermittent Repair)

- 8 hour work window
  - 12 – 15 slabs (12’ x 10’) per night
- 5 hour work windows
  - 7 – 9 slabs (12’ x 10’) per night
- Dependent on work window length and spacing of repairs
Installation Rates (Continuous Installations)

- 8 hour night work windows
  - 10 – 30
  - Ontario, CA 30 slabs per night = 500 lane feet (.5 lane miles per week)
- Weekend closures
  - 8 – 10 (12’ x 14’) slabs per hour
  - Chicago - 90 slabs per weekend (2013)
- Rates should improve
  - Contractors more familiar
  - Improved specialized equipment
Smoothness

• Small differences are expected
  ▪ Fabrication tolerance
  ▪ Grading tolerance

• Super-Slab® finished surfaces ± 1/8”
  ▪ May be acceptable for slow speed traffic

• Grind for best International Roughness Index
  ▪ Diamond Grinding is an accepted and cost-effective practice
Installed Costs (Bid Prices)

- Intermittent Repairs
  - About $244 to $485 per SY
  - Similar to rapid-set concrete costs (in some states)

- Continuous Installations
  - About $244 to $401 per SY
  - Up to 20% less than intermittent repair slabs

- Varies greatly with
  - Length of work window
  - Size of project
  - Local labor rates
## Compare with Conventional Fast-Track Concrete Actual Bid Prices, NY State (2013)

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<th>Item No.</th>
<th>Description</th>
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<tr>
<td>502.3101</td>
<td>Lift Out Removal</td>
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<tr>
<td>502.3301</td>
<td>Tie Bars</td>
<td>$ 31.00</td>
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<td>502.3201</td>
<td>D &amp; A Dowels</td>
<td>$ 36.00</td>
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<td>502.3603</td>
<td>PCC Placement</td>
<td>$ 175 - $ 726</td>
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<td><strong>Total</strong></td>
<td></td>
<td><strong>$ 309 - $ 860</strong></td>
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Pavement (Asset) Management Strategies With Precast Available

- Use quality material (precast) every time
  - You won’t have to replace it (for 40 years)
- Use maintenance dollars for good repairs, not temporary ones
- Consider life cycle rather than first costs
- Rather than patching, consider “intermittent total replacement”
  - Keep adding on to good precast repair slabs
- Consider “re-usuable” precast pavement in utility-intensive areas
New Developments in Precast (Super-Slab) Pavement
Other Places for Fast-Track Precast Pavement

- Instrumented pavement
  - Toll booth treadles
- Weigh and Motion Stations
- Precast pavement “add-ons”
- Removable - re-usable pavement panels over utilities (intersections)

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Instrumented High Speed EZ Pass Slabs
Spring Valley, NY
Weigh-in-Motion Panels
I-95, Manhattan, NY

Embedded Equipment

Completed
Super-Dowel

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Enables

• Precast Pavement Add-ons
• Removable & Re-usable Precast Pavement

3/4" HEAVY DUTY HEX NUT WELDED TO INSIDE OF PIPE, TYP. EACH END OF TUBE

REMOVABLE STAINLESS STEEL DOWEL (RSSD)
NOMINAL 1/2" STAINLESS STEEL PIPE

Patent Pending
Precast Pavement Add-ons
(Using Super-Dowels)

Makes The Most of Our Existing Concrete Pavement Asset
Extracting Half Dowels Left Behind

Extracting Half Dowel

Cross Section
Benefits of Precast Pavement

Reduce construction-related traffic congestion

Longer lasting pavement repairs – Asset Preservation
- 40+ years
- Reduced (long-term) repair costs
- “Get in, get out and stay out”
- “Incremental Total Replacement” – now possible

Reduces field inspection time and cost
- Precast slabs – plant inspected

Pre-engineered, pre-inspected slabs result in a superior finished pavement
Keys to Success
(Still More to Learn)

Good engineering
Open minds
Real partnering
Thank You

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