Precast Pavement Construction Using The Super-Slab System ®

October 31, 2013
The Fort Miller Co., Inc.
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The Fort Miller Co., Inc.

- Located in **upstate** New York
- Transportation products
  - Highway barrier
  - Precast retaining walls
  - Bridges
  - Precast pavement slabs
- Specializing in accelerated bridge construction
- **Developer and promulgator of the Super-Slab® Precast Pavement System**
Precast Concrete Pavement Slabs = Overnight Repairs

145,000 ADT
I-287, Tarrytown, NY

180,000 ADT
Cross Bronx Exp.

162,000 ADT
Brooklyn-Queens Exp.
Overnight repairs for Failed Interstate Pavement!

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

Poor Surface Drainage

Many Utilities

Shoved Black Top
Precast Pavement BASICS

Precast Slabs
+ Uniform Support
+ Match Road Surface
+ Effective Load Transfer Between Slabs

Successful Long-term Repair
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”
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
- 15,000 + slabs = 1,575,000 SF INSTALLED

(78 projects, 27 lane-miles completed in 13 States + ONT & QUE)
Controlled Fabrication Conditions

- Accurate Forms
- Roller Screed - Accurate Top Surface
- Accurate Piece Drawings
- Ideal Finishing (and curing) Conditions
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

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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

Dove-tail-shaped slot
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

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
At the Site

- Lay out slab locations and limits
- Cut and remove existing slabs
  - May be a single or a multiple of single slabs
- Install load transfer dowels and tie bars
- Place, grade and compact bedding material
  - Mainline or ramps
- Place slabs
  - At specified locations
- Install dowel and bedding grout
- Grind (if necessary) to achieve smoothness requirements

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Saw Cutting and Removal

Cuts - Full Depth - Accurate

Slab crab bucket

Trucks - right size - right number
Drilling for Dowels

Mark Out (accurately) to Match Dovetail Slots

16 holes – 12 minutes
Precision Grading is the Key!

Super-Grading = Grading to 1/8\textsuperscript{th} inch ±, fully compacted

- Thin layer (1/2’’) fine bedding material
- Grade – Compact - Grade
- Provides “near complete” subgrade support without grout
- Slabs can be opened to traffic before grouting
Small Scale Grading
Rail Supported and Hand Operated

Auger H.O.G.

Hand Operated Grader (H.O.G.)

Mini-H.O.G.

Shutter Screed
Grading Patches With Hand-Operated Grader (H.O.G.)

Three Steps

(12 minutes)

First Pass (high)

Compaction

Last Pass (done)
Continuous Grading With Hand Operated Grader H.O.G.

Three Steps

First Pass (1/4” high)

Compaction

Last Pass (done)
(over 500 LF per night possible)
Drilling for Dowels

Mark Out (accurately) to Match Dovetail Slots

16 holes – 12 minutes
Shipping and Placing

- Size slabs for shipping
  - 12’ Max. width
  - Special permits

- Ship in order – by mark number

- Provide unloading lane / shoulder
Placing Slabs – Continuous

Crane Occupies New Slabs

Set Slab to String

12’ Lane & 10’ Shoulder (min.)
Placing Slabs – Intermittent

Center Slab in Hole
(Single Slab Holes)

Crane Occupies New Slab
**Grouting**

- Truck (grout material & water)
- Trailer (grout mixer/pump)
- Short hose & nozzle
- Pails (for water measuring)
- Barrels (for waste)

Requires Grout Rig

(Typically completed subsequent nights)
Installing Dowel Grout

Fill Dowel Slots and Joints First

Contractor-Designed Joint Dam
Installing Bedding Grout

Pre-bagged Bedding Grout (Recommended)

Flow Rate
15 - 20 Seconds Max.

Keep Ports Full by “topping off”
NJDOT & NYSDOT Specifications

NJDOT Sec 453 – Full Depth Concrete Pavement Repair, Precast

NYSDOT 704-15 Precast Concrete Pavement Slab Systems
- Fabrication Standard Drawings, Install Instructions, Trial Installation
- Approved List

NYSDOT EI 05-043 Precast Concrete Pavement Slab Systems – Design Guidance

NYSDOT 502.15PF—18, Precast Concrete Pavement Slabs
Intermittent Repairs (CPR)

I-90
Albany, NY

I-676 Vine St Expressway
Philadelphia, PA

I-15 Salt Lake City, Utah

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

3,000 SF / 8 Hour Shift
(Within ± 1/8")
2001 - 2002

Open for Rush Hour
(135,000 ADT)
Continuous - Mainline Placement

Mainline I-15, Ontario, CA
(200,000 VPD)
Ramps

Chicago, IL

Plan View Tarrytown

Brooklyn, NY

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

New & Old

Complex Geometry

Undercuts

Replaced in 17 Nights!
NY 7 Crosstown Connection
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
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
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Bus Pad, Hollywood & Santa Monica Blvd.
North Hollywood, CA

Grading

Placing

Last Slab

Finished, Next Day

Eight Hour Work Windows
Industrial Driveways
City of Mamaroneck, NY

Continuous Access During Construction
Brooklyn Bridge Approaches
2010 – 2013

Grading

Placing

Looking Towards Manhattan

Looking Towards Brooklyn
Alexander Hamilton Bridge
West Approach, 2011 – 2013

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Contractor Gets One Lane To Replace The Same Lane

Grading

Placing, June 2012
Other Places for Fast-Track Precast Pavement

- Under Bridges
- Instrumented pavement
  - Toll booth treadles
- Weigh and Motion Stations
- Round-Abouts
- Utility corridors
I-78 Interchange 14C Toll Plaza
NJ Turnpike Authority, Jersey City, NJ
Intermittent - Installation Rates

- 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
Continuous - Installation Rates

8 – 10 Slabs (1500 – 2000 SF) per Hour
- 12’ x 14’ slabs
- Average rate of over 6000 SF (500 Lane Ft.) per 8 hour shift – I-15, Ontario, CA
  - About one mile in two weeks

Rates should improve
- As Contractors become 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
• Intermittent Repairs
  ▪ About $ 238 to $ 450 per SY
  ▪ Similar to rapid-set concrete costs (in some states)

• Continuous Installations
  ▪ About $ 238 to $ 400 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)

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Description</th>
<th>(SY)</th>
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<tbody>
<tr>
<td>502.2001</td>
<td>Saw Cutting</td>
<td>$ 23.33</td>
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<tr>
<td>502.3101</td>
<td>Lift Out Removal</td>
<td>$ 13.33</td>
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<td>502.3301</td>
<td>Tie Bars</td>
<td>$ 30.00</td>
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<td>502.3201</td>
<td>D &amp; A Dowels</td>
<td>$ 30.00</td>
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<tr>
<td>502.3603</td>
<td>PCC Placement</td>
<td>$ 175 - $ 238</td>
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<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>$ 272 - $ 335</strong></td>
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Pavement - Asset Management Strategies With Precast Available

- Use quality precast material every time
  - 40-year service life
- 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-usable” precast pavement in utility-intensive areas
New Developments in Super-Slab Precast Pavement
Super-Dowel (Pat. Pending)

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Removable & Replaceable

Enables Removable (& Replacable)

Precast Pavement

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

REMOVABLE STAINLESS STEEL DOWEL (RSSD)

NOMINAL 1/4"Ø STAINLESS STEEL PIPE
Incremental Total Replacement Using Super-Dowels

Makes The Most of Our Existing Concrete Pavement Asset
Super-Paver – A Re-usable Urban Pavement (RUP) System (Made Possible With Super-Dowels)

- Light weight
- 6’ x 6’ weighs 2 T
- Vertically removable & replaceable
- Warped as required to fit any surface
- Standard warps are in stock
- Removable and reusable

(Designed specifically for utility-intensive urban highways and intersections)
Slab Removal & Replacement

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Remove Slab Vertically and Clean

DRILL OUT (CLEAN) PORT HOLES
REMOVE GROUT PLUG & DOWEL
REMOVE BEDDING GROUT

REMOVE DOWEL ONLY

EPOXY ANCHOR NEW DOWEL

APPLY BONDBREAKER

Utility Trench

Super-Dowel

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

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

Replacing Cleaned-up Slab Over New Dowels
Slab Layout Possibilities

• Remove slabs to work on utilities (Super-Dowels)
• Clean up and replace removed slabs
• Mix big and small Super-Pavers as needed

Super-Pavers Installed Over Utilities
Reasons for Using Precast Pavement

- Heavy traffic
  - Requires most durable repair
  - Urban arterials most likely candidates
- Long term detours and staging not options
  - Access ramps, intersections prime candidates
- Traffic volumes require short work windows
  - If you have only 8 hrs., you need to strongly consider precast pavement
  - If you have only 5 hrs., precast likely your best option
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
Benefits to Contractors

Eliminates design and submittal of fast-track concrete mix
- NYSDOT requires 45 Days for approval

Fewer risks in placement
- No finishing
- No curing time
- Immediately open to traffic
- Less weather sensitive – longer construction season

Material costs known at bid time
Super-Slab® Pavement BASICS

Precast Slabs – Precision Engineered, Durable 40+ yr, Cost Effective

+ Uniform Support – Super-Grading, Fully Compacted Subgrade
+ Match Road Surface – Plane & Warped
+ Effective Load Transfer Between Slabs - Dowels in Fully Grouted Dovetail Slots

Successful Long-term Overnight Repair
15,000 Slabs = 25+ lane-miles
Keys to Success
(Still More to Learn)

Good engineering
Open minds
Real partnering
Question #1: 

What are the two types of concrete roadway repair made with Super-Slab® System?

Answer:

1) Intermittent or patch repair installations
2) Continuous repair installations
Question #2:

How does Super-Slab® System accommodate complex pavement surface geometry?

Answer:

Using a combination of planar and non-planar slabs on a matching precision graded subbase
Question #3:

What is the shortest work-window to be used with Super-Slab® System?

Answer:

5 Hours – 1:00 AM to 6:00 AM

NYS Thruway Authority – I-95 New Rochelle, NY
Thank You

The Fort Miller Co., Inc.