Highways for LIFE
Accelerating the Implementation of Innovation

Presented by: Byron Lord
Program Coordinator Highways for LIFE
More cars and trucks
Old highways and bridges
Too many crashes and injuries
We can build highways:

• Faster
• With less congestion
• With better safety and quality
• At lower cost
Highways for LIFE

- Demo Projects/Showcases
- Technology Partnerships
- Technology Transfer
- Information Dissemination
- Stakeholder Participation
- Monitoring and Evaluation
Demonstration Projects

• Performance goals for safety, quality, construction congestion and user satisfaction

• Innovations to achieve goals

• Showcases/Workshops
Technology Transfer

- Workshops/showcases/open-houses
- Vanguard Technologies
- Training Course "Leap not Creep"
- Webinars
- Toolkit DVD's (PBES, RSA, PCPS, HfL)
Vanguard Technologies

• Prefabricated bridge elements and system (PBES)
• Road safety audits (RSA)
• Making work zones work better
• Precast concrete pavement system (PCPS)
Information Dissemination
Highways for LIFE Activities

Key:
- Demonstration Project Recipient
- Demonstration Project 2008 Selectee
- Seeking the Best Solutions Workshop
- "Leap not Creep" NHI Course

- Performance Contracting for Construction Workshop
- Road Safety Audits Activities
- Making Work Zones Work Better Activities
- Accelerated Bridge Construction Activities
- Precast Concrete Pavement Systems Activities
- Technology Partnership Sponsor
Minnesota 2006

Innovations:
- Full road closure
- Innovative contracting
- Intelligent Compaction
- Lightweight Deflectometer
- Real-time ITS

Benefits:
- Reduce construction time by 80% (5 months vs. 2 years)
Innovations:

• Design / build
• Performance contracting
• Prefab bridge elements
• Real-time ITS

Benefits:

• Reduce construction time by 40%
Oregon 2007

Innovations:

• Work zone safety technologies
• Sliding and Jacking Method
• Prefab bridge elements
• High performance concrete
• Innovative contracting
• Context sensitive solutions

Benefits:

• Minimize disruption to traveling public
Utah 2007

Innovations:

- Total prefab bridge
- Self propelled modular transporter (SPMT)
- Construction manager contractor
- Work zone traffic technologies
- Silica fume concrete deck

Benefits: Traffic was interrupted for 48 hours only
California 2007

Innovations:
• Precast concrete pavement systems
• CA4PRS Software
• Dynameq Software

Benefits:
• Longer lasting pavement
• Optimize construction sequence, reduce impact to users
Virginia 2007

Innovations:

• Precast concrete pavement systems (both pre-stressed and jointed systems)
• Innovative contracting
• Elaborate MOT technologies (ITS)
• I-66 & US 50 Ramp

Benefits:

75% reduction in construction impacts to traffic
For additional Information

Highways for LIFE website

http://www.fhwa.dot.gov/hfl/
Precast Concrete Pavement Systems for Rapid Repair, Rehabilitation, and Construction-Delaware Showcase

Presented by: Gary L. Hoffman
Principal Engineer
HfL Project Manager

U.S. Department of Transportation
Federal Highway Administration
PCPS Projects in 2008 & 2009

- **NYSTA I-95** (CT-State line/Mamaroneck River to Cross Bronx Expressway)
- **NYSDOT** – Nassau-Queens Expressway, Staten Island-West shore Expressway, Approach to Alexander Hamilton Bridge
- **NY City DOT** - Approach to Brooklyn Bridge
- **NJDOT I-280 & Rt.21** (Newark)
- **Toronto, Canada** (Downtown, Hwy 427)
- **Iowa DOT** (precast bridge approaches)
- **DELDOT, intersection Rt.896 & Rt. 40** (Bear, DE)
- **PENNDOT I-676 & I-78**
- **Highways for Life Projects**
  - Virginia DOT I-66 Mainline & Interchange Ramp
  - Florida DOT (Daytona) - Intersections
  - CALTRANS I-15 – Mainline
  - UDOT I-215
Benefits of PCPS

- Cast under ideal conditions
- Long life expectancy with low maintenance
- Placement in a short time frame – congestion & safety
- Less Risk to owner/contractor
- Growing documentation of performance history
- Established industry, method and technology
- Staged construction is possible
- Installation not affected by adverse weather conditions
- Supported by FHWA, AASHTO, ACPA, NPCA, PCI, SHRP 2
- Reduced Work Zone timeframe
- Choice of surface Textures
- Pre-approval of PCPS System is possible
- Pre-existing specifications are available (TIG)
- Generic specifications are available (TIG)
- Economically competitive with alternative PCC pavement treatments
Paving and Pavement Rehabilitation Applications for PCPS

- Continuous Paving
- Intermittent Full Depth Repairs of PCC Pavements
- Applications: airport runways & taxiways, heavily trafficked highways, ramps, toll plazas, intersections, crosswalks, ports-docks, bus pads, smart-sensor embedment's, bridge approach slabs, pavement under bridges – vertical clearance
PCPS Basics

- Fabricated off-site
- Transported to the project site
- Installed on a prepared foundation
- No field curing or time to achieve strength
- Two main categories
  - Jointed Systems
  - Prestressed/Post-tensioned Systems
PCPS General Terminology

- Load transfer mechanism with new or existing pavement
- Pretension in transverse direction option (PPCP)
- Structural capacity for handling
- PCC thickness, material properties
- Existing structure
- Friction reducing interlayer or filler material (N.T.S.)
- Slab length
- Grouting materials
- Post-tensioning option (PPCP)
- Load transfer mechanism with new or existing pavement
- Pretension in transverse direction option (PPCP)
Jointed System - Key Features

- High performance concrete
- Embedded dowels and tie bars
- Matching inverted dovetail slots
- Thickness as required
- Length and width as required
- 2D & 3D Application
**Bedding Grout Distribution System**

Positive Distribution to Entire Under-Surface

- **Pumping Bedding Grout**
  - Used only to fill voids
  - Flow rate: 17 – 20 seconds
  - 600 psi in 12 hours
Jointed-Two Types of Slabs
Selection depends on pavement surface

Single Plane

Warped Plane
Small Scale Grader
Rail Supported and Hand Operated
Typical PPCP Panel Layout
Project Scope

- Pavement service life and objectives
- Current & projected traffic density
- Slab replacement criteria
- Estimated project duration
- Work window options
Pavement Treatment Alternatives

General rules of thumb, based on lane occupancy times

- Cast in place
- VHES
- PCPS
- HES

Hours
Project Specific Considerations

- Need for accelerated construction
  - M&PT considerations, seasonal restrictions, stakeholder impact
- Funding guidelines
- Design and engineering data requirements
- Construction risk
- Specifications

Maintenance and protection of traffic
Construction Considerations

- Qualified precaster presence in area
- Contractor’s familiarity with PCPS construction process
- Planning and scheduling
- Quality assurance
- Contract plans
Cost Considerations

- Should expand beyond initial costs
- LCCA - Reduced maintenance costs and user-delay cost
- MTO reports only 10% higher cost than high early strength
- Economies of scale and industry familiarity
PCPS Lessons Learned

- Before construction – Decision logic to select candidate projects
- During construction - Good planning, and mobilization critical for success
- Post construction
  - PCPS perform very well
  - M&R schedules and treatments different
PCPS Summary

- Successful installations nationwide
- Proven long term performance
- Ideal for accelerated construction for projects with lane closure restrictions
- Specification and guidelines available for your use
- PCPS can be added to your PCC treatment toolbox
Highways for LIFE
Accelerating innovation for the American driving experience

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Timothy J. LaCoss
Timothy.LaCoss@fhwa.dot.gov
THANK YOU
Precast Concrete Pavement Systems Workshop


RTE 896 NB @ RTE 40 – Project Overview

Precast Prestressed Concrete Pavement (PPCP) System

May 21, 2009
Newark, DE
Project Overview

1. Project Team
2. Project Location
3. Project Development
4. Advertise, Bid & Award Process
5. Construction
6. Lessons Learned
1. Project Team

• **Sponsor:** FHWA Office of Pavement Technology

Samuel S. Tyson, PE – Concrete Pavement Engineer
202-366-1326
sam.tyson@dot.gov
1. Project Team

- **Sponsor:** FHWA Office of Pavement Technology
- **Owner:** Delaware Department of Transportation
1. Project Team

- **Sponsor:** FHWA Office of Pavement Technology
- **Owner:** Delaware Department of Transportation
- **Design Support:** The Transtec Group

David K. Merritt, PE - Project Manager
512-451-6233 Ext. 230
dmerritt@thetranstecgroup.com
1. Project Team

- **Sponsor:** FHWA Office of Pavement Technology
- **Owner:** Delaware Department of Transportation
- **Design Support:** The Transtec Group
- **Construction Inspection:** AECOM

AECOM

William Marshall – Pave & Rehab Supervisor
302-369-8665
william.marshall@aecom.com
1. Project Team

- **Sponsor:** FHWA Office of Pavement Technology
- **Owner:** Delaware Department of Transportation
- **Design Support:** The Transtec Group
- **Construction Inspection:** AECOM
- **Prime Contractor:** A-Del Construction Co.

A-Del Construction Co., Inc.
Kenneth A. Monroe, PE – Project Engineer
302-453-8286
kmonroe@a-del.com
2. Project Location

• Reasons for using PPCP technology
  ➢ Technology is non-proprietary
  ➢ Technology qualified for Federal Aid
  ➢ Design support provided by FHWA (thru Transtec)
  ➢ Progressive Department open to new technology
  ➢ Innovative Project Team
2. Project Location

- Reasons for using PPCP technology
- Identify potential locations
  - “Kick-off” Meeting held on April 15, 2008
  - Field Review of three potential locations
Potential PPCP Location 1 - RTE 273 WB @ Harmony Road
Potentially PPCP Location 1 - RTE 273 WB @ Harmony Road

Fact Sheet:
- Scope of work: Replace jointed plain concrete pavement with PPCP within the intersection
- Functional Class – Principal Arterial
- AADT – 42,226
- % Trucks – 6.9%
- Pavement Section – 10” PCC over soil cement (assumed)
- Proposed Replacement – 2,250 SY
Fact Sheet:

- Scope of work: Replace existing bituminous pavement with PPCP (travel lanes only)
- Functional Class – Principal Arterial
- AADT – 30,917
- % Trucks – 6.9%
- Pavement Section – 10” bituminous pavement over graded stone base
- Proposed Replacement Area – 1,540 SY
Potential PPCP Location 3 – RTE 896 NB @ RTE 40
Potential PPCP Location 3 – RTE 896 NB @ RTE 40

Fact Sheet:

- **Scope of work**: Replace jointed plain concrete pavement within the RT & LT turn lanes with PPCP
- **Functional Class** – Principal Arterial
- **AADT** – 37,679
- **% Trucks** – 9%
- **Pavement Section** – 12” PCC over soil cement (assumed)
- **Proposed Replacement Area** – 3,115 SY
2. Project Location

- Reasons for using PPCP technology
- Identify potential locations
- Location selection criteria
  - Minimal cross-slope changes
  - Minimal profile changes
  - No underground utilities within PPCP limits
  - Construction access – on-site staging area
2. Project Location

- Reasons for using PPCP technology
- Identify potential locations
- Location selection criteria
- **Project justification**
  - Location already a candidate for rehabilitation
  - Poor pavement condition - ASR
  - High AADT – High truck percentage
  - Large quantity for PPCP replacement
2. Project Location

RTE 896 NB @ RTE 40
(RT & LT turn lanes)
Project Location – RTE 896 NB @ RTE 40

EXISTING PCC

CAST-IN-PLACE

PPCP REPLACEMENT AREA

RTE 896 NB

DOUBLE LT TURN LANES

RT TRAVEL & TURN LANES

RIGHT TRAVEL LANE
3. Project Development

• Preliminary engineering
  ✓ Coring existing pavement
  ✓ FWD testing
  ✓ Survey – cross-slope and profile data
  ✓ Traffic Control Plans / Traffic Management Plans
3. Project Development

• Preliminary engineering

• Verify industry interest in the project
  ➢ Precast supplier meeting held May 28, 2008
  ➢ Positive feed-back from local contractors
3. Project Development

• Preliminary engineering
• Verify industry interest in the project

• Preparation of plans
  ➢ Keep it simple – 11” x 17” plan sheet format
  ➢ Bid on PPCP technology only – no design alternates
  ➢ Install slabs under “live traffic conditions”
  ➢ Complete fabrication & installation within 100 CDs
3. Project Development

• Preliminary engineering
• Verify industry interest in the project
• Preparation of plans
• Development of new specifications
  ➢ 501533 – Precast Prestressed Roadway Pavement
  ➢ 501532 – Pervious Portland Cement
4. Advertise, Bid & Award Process

- Advertisement timeline
  - Final Plans submitted August 20, 2008
  - Project Advertised on September 1, 2008
  - Mandatory Pre-Bid Meeting on September 18, 2008
  - Bids Received on October 16, 2008
4. Advertise, Bid & Award Process

- Advertisement timeline
- Bid results
  - Four Bidders: $2,379,388.97 to $3,059,506.72
  - Engineers Estimate: $1,827,070.72
  - Low Bid: 30.32% above EE
4. Advertise, Bid & Award Process

- Advertisement timeline
- Bid results
- **Award process**
  - Recommend to award to A-Del on 11/14/2008
  - Pre-construction Meeting held 12/10/2008
  - Time charges began 05/01/2009
    (First Production Day for Panel Fabrication)
5. Construction

• Fabrication

  ➢ Coordination with Post-Tensioning Supplier
    ✓ Meet & Greet at CPS held on 01/27/2009
    ✓ Adjust bar and strand spacing to accommodate ducts
    ✓ Don’t forget the instrumentation!
5. Construction

• Fabrication
  ➢ Coordination with Post-Tensioning Supplier
  ➢ Shop Drawing Submittal
    ✓ Electronic submittal/review process
5. Construction

• Fabrication
  ➢ Coordination with Post-Tensioning Supplier
  ➢ Shop Drawing Submittal Process
  ➢ Panel Sizes
    ✓ Recommended panel sizes - 8’ L x 12’ or 24’ W
    ✓ Plan sizes changed by supplier – 10’ L x 12’ or 24’ W
5. Construction

• Fabrication
  ➢ Coordination with Post-Tensioning Supplier
  ➢ Shop Drawing Submittal Process
  ➢ Panel Sizes
  ➢ Fit-test Requirement
    ✔ 3-panel demonstration
5. Construction

• Fabrication
  ➢ Coordination with Post-Tensioning Supplier
  ➢ Shop Drawing Submittal Process
  ➢ Panel Sizes
  ➢ Fit-test Requirement
    ✔ 3-panel demonstration
PPCP Fabrication – Fit Test – 04/29/2009
5. Construction

• Fabrication

• Installation

  ➢ Work Hour Restrictions
    ✓ 7:30 PM to 5:30 AM
    ✓ Work Monday evening through Saturday morning only
    ✓ No work will be permitted on Saturday or Sunday nights
    ✓ Restore traffic to unrestricted use at the end of each shift
5. Construction

• Fabrication

• Installation
  - Work Hour Restrictions
  - No Impact Removal
    - Full-depth perimeter saw cut
    - Remove existing PCC by lift-out technique
5. Construction

• Fabrication

• Installation
  ➢ Work Hour Restrictions
  ➢ No Impact Removal
  ➢ Pavement Section Detail
    ✓ Existing pavement section 12” PCC
    ✓ Replace with 8” PPCP over 4” pervious concrete
    ✓ Under-slab grouting after installation of all slabs
Pervious Concrete – Placement Demonstration – 05/13/2009
Pervious Concrete – Placement Demonstration – 05/13/2009
5. Construction

• Fabrication

• Installation
  - Work Hour Restrictions
  - No Impact Removal
  - Pavement Section Detail
  - Profilograph Testing / Diamond Grinding
    ✓ Blanket grind for smoothness
6. Lessons Learned

- It’s hard to fit six gallons of SH** in a five gallon bucket
- Be wary of the warp
- Unfamiliar materials = unexpected results
- Just like concrete it takes a while to set-up...and it needs to be permanent
- A year from now, if this was a success, it was the good materials...if not, research!!!
Highways for Life
Precast Concrete Pavement Systems Showcase
SR896 Project

Contractors Perspective

A-Del Construction Co., Inc.
SR896 @ US40, Glasgow, DE
The Bid Package/Scope

- Overall Size/Scope
- Panel Length Flexibility
- Contract Time & Work Hours
- Contract Players
- Staging Area
- Risk – same thought process as any other job
Staging
Contract #28-061-11
F.A.P. #ENHS-N387(14)

- Precast Pavement = 3115 S.Y.
- Panel Width = 24’ (90%) & 12’ (10%)
- Design Panel Length = 8’
  - Final Panel Length = 9’-10 1/8”
- Bid Amount = $2,379,388.97 (out of 4-Bids)
  - Precast Pavement Costs = $1,876,012.25
- Contract Time = 100 Calendar Days
Post-Award Details

- Submittals
- QA/QC
- Schedule
- As Built Survey
- Obstructions
- Procurement
- Misc.
- Communication
Master Schedule
Master Schedule (cont’d)

| Activity Description | Order
<table>
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**Important Notes:***
- RESUME CONTRACT TIME CHARGES
- BEGIN PRECAST PANEL PHASE
- ADVANCE SAWCUTTING FOR PRECAST PANELS
- LT. TURN SLOT, INSTALL PANELS & TENSION
- LT. TURN SLOT, TY-A PATCH CLOSURE POURS
- AT LANE, INSTALL PANELS & TENSION
- AT LANE, TY-A PATCH CLOSURE POURS
- DIAMOND GRIND-RECYC
- JOINT SEALING: PROJECT LIMITS
- LOOP DETECTORS
- PERM. STRIPING: PROJECT LIMITS
- COMPLETE PRECAST PANEL PHASE
- SUBSTANTIAL COMPLETION: SUSPEND CONTRACT
- PROJECT COMPLETION

**Dates:**
- **3/18/2023**
- **2/18/2023**
- **1/18/2023**

**Copies:**
- **3 of 3**

**Other Notes:**
- **Next Activity:**
- **Engineering:**
- **Construction:**

**Pages:**
- **Page 1 of 4**
### Hourly Schedule

**Pre-Start Activities - Activities Done Days or Hours Prior to the Road/Lanes Actually Being Closed**

**Activity**
- Safety: Have all PPE (Hard-hat, Night-Time Vest, Steel-Toe Boots, Glasses, etc.) that you will need on hand and ready for use.
- Plans/Planning: Have in your possession a copy of the approved panel shop drawings & approved Post-Tensioning Shop Drawings AND know the contents of each.
- Longitudinal Sawcutting = 100% complete. Transverse Sawcutting = Partial @ closure pour - saving the closure pour slab; @ nightly stop points - this will change each night and thought needs to be provided.
- Panels: Trucks should be pre-loaded with the proper panel sequence each day - prior to the nightly work operation. **KEEP TRACK OF ALL LIFTING HARDWARE**
- Pervious Concrete: Have a “will call” in each night for this mix (quantity will change each night - an approximation is 30 CY each night => Check and confirm the sub-grade for depth as 4-5" of thickness may be required)
- Pervious Concrete: Laser Screed checked out and ready to work. Understanding of cross-slopes required and profile slope needed for each work area segment.
- Donut Gaskets: Have them on hand. Know which one goes where and how they are to be installed.
- Epoxy Adhesive: Have accurate mixing buckets, drill, paddle bit, generator, application tools, etc. for getting this mix on the ends of each slab as they are being set (limited working window for this material).
- Crane: Confirm both cranes are good to go (fuel, oil, greased, etc.)
- Bar Tendons + Hardware: Know what you need, where it’s needed and how it’s installed. Have the equipment needed to make the temporary P/T pull on hand.
- Strand Tendons + Hardware: Know what you need, where it’s needed and how it’s installed. Have the equipment needed to make the permanent P/T pull on hand - will do the entire left lane pulls on one dedicated night.
- Panels: **KNOW** which panel goes where, **KNOW** which panels is your anchor panel, **KNOW** when to install the dowels in the anchor panel

### Detailed Sequencing Schedule for Each Production “Panel Setting” Night

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<td>Open Lanes - MOT</td>
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</table>

### Other Misc. Work Items (everyone needing more to do)

- Load Panels for next nights operation (load backwards, follow max. stack height, damage requirements, AND **KEEP TRACK OF THE LIFTING HARDWARE**
- Set up an “Epoxy Adhesive Work Area” with all tools, materials, etc. to perform this operation (will move each night)
- Help close the lane. Help open the lane.
- Prep & Ready P/T equipment. Know where this equipment is at all times

---

**Contract #88-081-11**
**Pave & Rehab., North X/FY2008**
**$0090(NB) @ $840**
As-Builts

<table>
<thead>
<tr>
<th>Contract #: 28-061-11</th>
<th>Pave/Rehab: N-XI/FY08 (SR956 @ US40)</th>
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<td>Mirrored Plane Pick Length Data</td>
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<table>
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<tr>
<th>&quot;As-Built&quot; STA.</th>
<th>= Shop Drawing STA.</th>
<th>ELEV. @ LEFT EDGE OF TURN-SLOT</th>
<th>LENGTH ADDED TO &quot;ZERO-PICK&quot; LENGTH</th>
<th>PANEL MARK or NUMBER</th>
<th>LENGTH ADDED TO RIGHT EDGE OF TURN-SLOT (MATCH AGAINST EXISTING ROADWAY)</th>
<th>ELEV @ RIGHT EDGE OF TURN-SLOT</th>
<th>Post-Tension Unit #</th>
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</table>

St 896 N.B.
Ex. Left Turn Lane
Scale 1"=50'

(Hand-drawn diagram and table content from the page)

(Hand-drawn diagram and table content from the page)
Panel Installation

- Task Assignments
- Panel to Panel Length
- Full Unit Length
- Full Run Length
Task Assignments

- Implement TCP
- Saw Cut Planning
- Sub-Grade Visual Check
- Pervious Concrete
- Panel Setting
- Structural Epoxy
- P/T Material & Equipment Cover/Treat Block-Outs
- Open to Traffic
Setting an A-Panel
Intervals

► Panel to Panel Length
  ▪ Temp. Post-Tension (Bar)

► Full Unit Length
  ▪ Permanent Post-Tension (Strand)

► Full Run Length
  ▪ Duct Grouting
  ▪ Sounding & Potential Under-Slab Grouting
  ▪ Diamond Grinding
  ▪ Joint Seals
  ▪ Striping
Success

- Owner Satisfaction
- Production
- Safety
- Pride/Ownership of Work
- Public Perception/Wants
  - Get In, Get Done, Get Out & “Don’t come back”
Future

► Cost
  ▪ Should go down with time and experience.
  ▪ Current market may increase willingness to take risks.

► Product
  ▪ Provides 1:1 Replacement with the Quickest Turn-Around
  ▪ Same Life Expectancy as Original PCC Pavement
THANK YOU

Contact Information:

Kenneth A. Monroe, P.E.
A-Del Construction Company Inc.

kmonroe@a-del.com

May 22, 2009
DYWIDAG Post-Tensioning

- Company Evolution
- DYWIDAG Post-Tensioning System, DelDOT 896
- Installation Procedure
- Completed/Current/Future PPCP Projects
- Force Monitoring
What business are we in?

Development, manufacturing and supply of:

Construction Systems:
- Post-Tensioning and Geotechnics
- Concrete Accessories

Underground Systems:
- Mining Strata Control
- Tunneling Support

Plus Complementary Services:
- Rental of Equipment
- Engineering, Installation etc.
DYWIDAG
POST-TENSIONING:
DeIDOT RT896
DYWIDAG Threadbar®

- ASTM A722 Post-Tensioning Steel (Grade 150)
  - 1”, 1-1/4”, 1-3/8” (hot rolled)

- 1-3/4”, 2-1/2” (turned, polished & cold threaded)

- Bare
- Epoxy Coated
- Galvanized
7-Wire P/S Strand

- ASTM A416 7-Wire Strand (Grade 270) 0.6” Diameter
- Bare
- Epoxy Coated
DYWIDAG Threadbar® System: DelDOT RT896

- **Epoxy Coated Anchor Nut**
- **4”x6.5”x1.25”, GR36 Steel Anchor Plate**
- **21MM Grout Tube**
- **Grout Valve**
- **Grout Tube Saddle**
- **2” ID Galvanized Metal Duct**
- **1” Dia, Grade 150, Epoxy Coated Threadbar**
DYWIDAG Threadbar® System: DelDOT RT896
Threadbar® Stressing Rams

- Internal Ratchet Mechanism

60 Ton Capacity

1" & 1-1/4"

110 Ton Capacity

1-1/4" & 1-3/8"
Threadbar® Stressing Rams

Plan View

Anchor Nut Epoxy Coated
B26E20155

Jack

Anchor Plate "A" Uncoated
B32E21210

Panel

Elevation View

Blockout
Full Depth x 9" x 36"
(Engineer Please
Note: Dimensions Modified To
Accommodate Jack)

Jack

Anchor Nut Epoxy Coated
B26E20155

5 x 8 x 1.5"
Anchor Plate "A" Uncoated
B32E21210

75mm Spiro Duct
UC7541010

1"
GR, 150 Bar Epoxy Coated
B26E Coat

75mm Spiro Duct
UC7541010

Panel
DYWIDAG Bonded Mono-Strand: DelDOT RT896

- 0.6” Encapsulated Mono-Strand Anchor
- 21MM Grout Tube
- Grout Valve
- Duct Adapter w/ Vent
- 1.5” ID Galvanized Metal Duct
- 0.6” Dia, Grade 270, Epoxy Coated Strand
DYWIDAG Bonded Mono-Strand: DelDOT RT896

3-Part Wedge

Pre Stressing
(prior to wedge seating)

Post Stressing
(after seating and cutting)

Grease Cap w/ O-Ring Seal
Mono-strand Stressing Equipment

- PE 55 Hydraulic Pump
- 0.6” Stressing Jack with Power Seater
Mono-strand Stressing Equipment

PLAN VIEW

ELEVATION VIEW
INSTALLATION PROCEDURES
DELDOT RT896
DelDOT 896 Post-Tensioning Installation

Panel Unit
(Length Varies Approx 108ft – 128ft)

Type A3
Type B or C
Type A2

PT Stressing Pocket (Typ)

Concrete Panels

Roadway Sub-base

BU PT
DelDOT 896 Post-Tensioning Installation
DelDOT 896 Post-Tensioning Installation

Type A3
Type B
DelDOT 896 Post-Tensioning Installation
DelDOT 896 Post-Tensioning Installation

Repeat process...
COMPLETED / CURRENT / FUTURE PPCP PROJECTS
DYWIDAG-SYSTEMS INTERNATIONAL

NTP Summer 2009
0.6” Dia. GR270, 7-Wire Strand
1,680 LB

Year 2006
0.6” Dia. GR270, 7-Wire Strand
3,965 LB

Current
DIA. GR270, 7-Wire Strand
7,500 lb

1” Dia. GR150 Threadbar®
7,365 lb

Year 2002
0.6” Dia. GR270, 7-Wire Strand
28,610 LB
Looking to the Future...
MONITORING POST-TENSIONING FORCES
Dynaforce Force Monitoring

Diagram showing the components of a Dynaforce force monitoring system, including secondary coil, primary coil, and strand or bar. The diagram also includes dimensions labeled as L, D, and d.
Dynaforce Force Monitoring

- Magnetics
- Robust
- Requires no maintenance
- No moving parts
- Similar service life as structure installed into
- Real time force measurements
Thank You

DYWIDAG Systems International – USA, Inc.
North East Division
525 Wanaque Avenue, Suite LL1
Pompton Lakes, NJ 07442
ROUTE 896 PRECAST PAVEMENT

PRECAST, PRESTRESSED, POST-TENSIONED CONCRETE PRODUCTION

PRODUCED BY COASTAL PRECAST SYSTEMS
COASTAL PRECAST SYSTEMS

• 35 ACRE PRECAST PLANT IN CHESAPEAKE, VA
• 80,000 SF INDOOR MANUFACTURING FACILITY
• ABILITY TO SHIP PRODUCT BY TRUCK OR BARGE
• ON SITE BATCH PLANT ASSURES CONSISTENT CONCRETE WITH NO DELAYS BETWEEN BATCHES
• PRODUCER OF HEAVY STRUCTURAL PRECAST COMPONENTS FOR MARINE AND HIGHWAY STRUCTURES
• PCI CERTIFIED SINCE 1996
CONCRETE MIX DESIGN

• TYPE III CEMENT (LOW ALKALI) COMBINED WITH CLASS “F” FLY ASH

• WATER CEMENT RATIO OF .33

• REQUIRED TO MEET ASR LIMITS OF $\leq 0.1$ PER MODIFIED AASHTO TEST T 303

• $F'_c = 5,000 \text{ PSI @ 28 DAYS, 4,000 PSI RELEASE}$
FORMING SYSTEM
FORMING SYSTEM

• 240 LF X 10’-0” WIDE CASTING BED
• ABLE TO CAST SIX PANELS PER CYCLE
• STEEL KEYWAYS ENSURE PROPER FIT UP OF MALE/FEMALE KEYS
• STEEL INTERMEDIATE BULKHEADS ENSURE PANEL EDGES ARE TRUE AND SQUARE
• TOP PORTION OF MALE KEYWAY BOLTED ON FOR RELEASE @ STRIPPING
PANEL DIMENSIONS

• PANEL WIDTH REVISED FROM 8’-0” TO 9’-11 ½”
• SUBSTANTIALLY REDUCES NUMBER OF CRANE PICKS
• RESULTS IN A PANEL WEIGHT OF APP. 24,000 POUNDS
• REVISED WEIGHT AND DIMENSIONS (UNDER 10’-0”)
  MINIMIZES WIDTH RESTRICTIONS AND STILL ALLOWS
  2 PANELS PER TRUCK W/ LIGHTWEIGHT TRAILERS
JOINT DETAILS
JOINT DETAILS
JOINT DETAILS
PRODUCTION SEQUENCE

• CONSTRUCTION SEQUENCE REQUIRES LEFT LANE PANELS (24’ WIDE) TO BE PRODUCED FIRST

• MUST HAVE AN “A” PANEL (ANCHORAGES) TO BE ABLE TO TEMPORARILY PT EACH NIGHT

• “A” PANELS HAVE DIFFERENT STRAND PATTERN THAN “B” AND “C” PANELS – MUST BE CAST SEPARATELY

• PANELS CASTING COMPLETE IN 22 POURS
“A” PANEL SPECIAL CONSIDERATIONS

- KEYWAY DEVIATIONS
- POCKETS FOR PT STRESSING JACK
- BURSTING STEEL AND ANCHORAGE PLATES
- EXPANSION JOINT/STRONGBACKS
- ATYPICAL STRAND PATTERN
- BLOCKOUT FOR EXPANSION JOINT
- TWO TYPES
  - ADJACENT TO EXISTING PAVEMENT
  - WITHIN A UNIT
“A” PANEL SPECIAL

CONSIDERATIONS

“A” PANEL BETWEEN UNITS
"A" PANEL SPECIAL
CONSIDERATIONS

"A" PANEL ADJACENT TO EXISTING PAVEMENT

EXISTING PAVEMENT SIDE WITH REBAR COUPLERS

PRECAST PAVEMENT
FIT UP TEST

- FIT UP OF FIRST THREE PANELS CAST
  - NO FURTHER CASTING UNTIL FIT WAS VERIFIED
- SET UP FLAT, LEVEL LAYDOWN AREA
- “SNUG UP” PANELS W/ THREADED BAR
- CHECK MALE TO FEMALE INTERFACE
- CHECK BEARING ON BOTH TOP AND BOTTOM JOINT EDGE
- VERIFY W/ SHIM BOARDS APPROPRIATE “GAP” BETWEEN PANELS
HANDLING / TRANSPORTATION

- RL-24 LIFTING HARDWARE 4 – TON CAPACITY
- FOUR POINT PICK
- 24,000 POUND LOAD
- OVERHEAD CRANE USED FOR STRIPPING
- WEIGHT ALLOWS TWO PANELS PER TRUCKLOAD
Update on AASHTO TIG for the Advancement of PCPS Technologies

Gary L. Hoffman
Principal Engineer
HfL Project Manager
AASHTO Technology Implementation Group (TIG)

• Champions the more rapid Deployment of Proven Advancements in Highway Transportation
  – Selects (3 per year) valuable products software, test methods, construction technologies adopted by one state
• Supports efforts to implement them as a standard nationwide
AASHTO Technology Implementation Group (TIG)

- Shares information between AASHTO member agencies, local agencies, and industry partners
- Example technologies with TIGs
  - Prefabricated Bridge Element Systems
  - Road Safety Audits
  - Accelerated Construction Technologies
  - PCPS
PCPS TIG Mission

To promote the use of Precast Concrete Pavement Systems for the Repair, Rehabilitation and Reconstruction of PCC Pavements to transportation agencies and owners nationwide.
Agency Partnerships

Federal Highway Administration
Highways for Life
Accelerating Innovation for the American Driving Experience

DRIVING INNOVATION FOR TRANSPORTATION

TIG
AASHTO TECHNOLOGY IMPLEMENTATION GROUP

http://aashtotig.org
TIG Lead States Team

TIG’s Role in the Technology Lifecycle

Research

Lead States
Pursue
Practical
Applications

TIG

Tech Transfer

State

State

State

State

State

State

State

State

State

State

State

State

State

State

State

Industry Practice

From AASHTO TIG WEBSITE
AASHTO TIG Lead States Team
AASHTO TIG Lead States Team

- Ernie Barenberg, Emeritus Professor, UIUC
- Mike Brinkman, New York
- Mark Dunn, Iowa
- John Donahue, Missouri
- Thomas Kazmierowski, Ontario
- Tommy Nantung, Indiana
- Dr. Celik Ozyildirim, Virginia
- Tom Pyle, California
- Benjamin Timerson, Minnesota
- Others.....
PCPS Systems Identified by TIG

Ft. Miller - SuperSlab™

Prestressed Precast Concrete Pavement

Kwik Slab™

Uretek USA™

FDR/DBR
Kwik-Slab

- Developed in Hawaii
- Joint steel couplers
- Reinforced slabs and designed for monolithic action
- Does not allow movement at joints – needs enhancements
Uretek – Stitch in Time

- Generic precast slab
- Uses Stitch-In –Time® load transfer device
- Validated in lab tests
- Base leveled with Uretek foam injected after slab is set
- Questionable field performance (LTE)
Precast Full-Depth Replacement/Dowel Bar Retrofit Method

- Developed by Michigan DOT & MSU
- Undersealing with flowable fill
- Retrofit Dowel bars
- Slots are filled with hydraulic cementitious material.
AASHTO TIG Specifications & Guidelines for PCPS

• Guidance and Considerations for the **Design** of PCPS
• Generic Specification for **Fabricating and Constructing** PCPS
• Generic Specification for PCPS **Approval**
• PCPS for Rapid Pavement Repair and Replacement: **Basic Information and Commentary**

Available at [WWW.AASHTOTIG.ORG](http://WWW.AASHTOTIG.ORG) under the PCPS dropdown menu
What’s online?

- Detailed information about each of these 5 leading Precast Paving Systems or Components
- Design Guideline Specifications
- Construction Guideline Specifications
- Approval Guidelines for PCPS
- Research Reports and Case Histories
- Proven Agency Specifications
AASHTO TIG SUCCESSES

- Developed a nationally recognized forum for PCPS
- Identified various PCPS Systems, their attributes, their applications
- Developed generic specifications and guidelines for PCPS
- Developed relationships with ACI, PCI, NPCA, ACPA, SHRP and other national organizations.
- Developed and implemented a Marketing Plan for outreach efforts
- Partnered with FHWA’s Highways for Life Program to further the outreach efforts nationwide
- Applied for the FHWA/AASHTO 2010 International Scanning Tour on PCPS applications.
Highways for LIFE
Accelerating innovation for the American driving experience

Gary L. Hoffman
ghoffman@ara.com
Angel Correa
Angel.Correa@dot.gov
Precast/Prestressed Concrete Institute (PCI)

Highways for LIFE
Newark, Delaware
May 22, 2009

William Nickas, P.E.
Director, Transportation Systems
Precast/Prestressed Concrete Institute
Chicago, IL
Precast Concrete Pavements

Agenda

FHWA/AASHTO and Accelerated Construction Techniques and Technologies (ACTT)

PCI Plant Certification

Cooperative Agreement with FHWA and PCI
SCAN MISSION

To investigate and document the applications and experience with prefabricated bridges in Japan and selected European countries, with emphasis on:

- Routine bridges with 20 ft – 140 ft spans
- Innovative systems
- Replacement and new highway and railroad bridges
- Including seismic considerations and emergency work
TOPICS OF INTEREST

- Minimized traffic disruption (Congestion)
- Improved work zone safety
- Minimized environmental impacts
- Improved constructibility
- Improved product quality
- Lower life-cycle costs
SCAN COUNTRIES

Netherlands

Japan

France

Belgium

Germany
Integrated approach

Technology

Project Delivery

Successful Renewal
• PCI is an international trade association and Technical Institute
  – Promotes technical understanding and use of high-quality precast and prestressed concrete
  – Full staff of technical and marketing specialists
• Over 350 Producer Member plants
  – Architectural, structural, and specialty precast concrete products and structures
  – Every U.S. PCI Producer Member plant must be PCI Certified
  – PCI Membership is not required to be PCI Certified
  – Over 80 Technical Committees
• Approximately 200 Supplier Associate Members
• 100 Erector Associate Members
  – PCI Qualified/Certified Erector Program
• Over 1,300 Professional Members
  – Academics, design professionals, and other industry stakeholders
  – Provide much of the technical knowledge contained in PCI design guides and other technical publications
PCI Publications

• Design Manuals and Guidelines
• Quality Control Manual
• PCI Journal, Ascent, and Aspire Magazines
• Codes and Standards
  – PCI works very closely with code bodies, such as ACI, ICC, ASTM, AASHTO, etc.

• Industry Events
  – PCI works with FHWA in producing the National Bridge Conference
• Research & Development
  – DSDM Seismic Project
  – FHWA Precast Pavement Project
• PCI Regional Representation
  – 11 Regional Associations Affiliated with PCI
  – Mid-Atlantic Precast Association (MAPA)
PCI has 3 Different Certification Programs:

– Plant Certification Program – 1967
– Personnel Training & Certification – 1985
– Erector Qualification and Certification - 1999
Program History:

• Plant Certification Program established in 1967
• Began with 36 Plants
• Voluntary membership until 1991
• Mandatory for PCI Producer Members after 1991 – PCI Membership is not required
• Approximately 300 Plants Currently Certified
PCI Plant Certification

Purpose:

• Provide a means for project owners/specifiers to select producers who demonstrate compliance to nationally recognized standards of engineering, production and quality control

• To permit certified producers to distinguish themselves from non-compliant/non-participating producers
Product Groups and Categories:
A — Architectural Products (MNL-117)
B — Bridge Products (MNL-116)
C — Commercial (Structural) Products (MNL-116)
G — Glass Fiber Reinforced Concrete (GFRC) Products (MNL-130)
Product Groups and Categories:

- Supplemental, Non-Prestressed, Non-Architectural Products
- MNL-118 will be released and program launched in 2009
Program Recognition

• AIA MASTERSPEC

• Unified Facilities Guide Specifications (UFGS)
  – A joint effort of the U.S. Army Corps of Engineers (USACE), the Naval Facilities Engineering Command (NAVFAC), the Air Force Civil Engineer Support Agency (AFCESA) and the National Aeronautics and Space Administration (NASA)

• US Department of Agriculture – FSIS
Program Recognition

- US Department of Transportation - Federal Aviation Agency
- Federal Bureau of Prisons
- General Services Administration (GSA)
- Federal Highway Administration
- 31 state Departments of Transportation
- Houston, Las Vegas, Phoenix, Seattle, and Portland
State DOT-Specific Certification

- PCI Working with other DOTs in developing programs specifically tailored to their needs
- Auditors will provide a special report specifically addressing DOT-specified criteria
- IL DOT, TX DOT, Mass Highways
PCI Plant Certification

QC Criteria

- Detailed quality control and audit criteria
- Drawings and Calculations Reviewed
- Comprehensive Tolerance Manual
- Detailed Quality System Manual (QSM) must be approved by PCI
PCI Plant Certification

Program Oversight

• Overseen by a diverse and balanced Quality Assurance committee
  – design professionals, consultants, producers, and materials suppliers.

• Further oversight provided by PCI Technical Activities Committee
PCI Plant Certification

Audits and Auditor Qualification

2-day, twice per year audits

- All audits unannounced
- IAS Accredited
- Audit firm has over 40 years of experience
Conclusion

• PCI wrote the book

• PCI has 40+ year track record for precast and precast / prestressed quality control and quality assurance programs

• PCI will work to tailor the program to each state’s needs
Engaging Industry –
A Cooperative Approach
Precast/Prestressed Concrete Institute (PCI)

Federal Highway Administration (FHWA)
A manufacturing operation...

...not off-site construction!
“Advancement of Precast Prestressed Concrete Pavement System through Technology Transfer and Development of Industry Guidance for Design and Engineering”
This is a 4 year PROGRAM

**Part A: Strategy for technology transfer**

- agency/owner
- industry communities

**Part B: Development of industry guidance for design and engineering**
The Transtec Group

- David Merritt
  - TxDOT Demonstration Project
  - Was also involved with the CalTrans I-10 in El Monte, CA
• Non-Proprietary
• Manufactured in PCI-Certified Plants
• “Precast Prestressed Concrete Pavements” (PPCP)
What is PPCP?

• **Precast Prestressed Concrete Pavement**
  - “Standardized” full-depth precast panels
  - Keyed panel joints for vertical alignment during assembly (generally, not match-cast)
  - Constructed over a prepared base (HMA, LCB, Aggregate Base, etc.)
What is PPCP?

- 2-way prestressing
- Combination of pretensioning/post-tensioning
- Or 2-way post-tensioning
- Bonded/grouted P-T system
Typical PPCP Panel

- Ducts for Post-tensioning
- Continuous Shear Key
- Pretensioning Strands
Precast Concrete Pavements

Typical PPCP Panel Layout
Precast Concrete Pavements

Typical PPCP Panel Layout
WHY PRESTRESSED CONCRETE?

- Reduces/eliminates slab cracking (maintenance)
- Reduced number of joints (maintenance/smoothness)
- Reduced Slab Thickness (8” vs. 12”)
  - Material savings
  - Allows for replacement of pavement in-kind
- Ability to span voids/unsound support layers
- Proven Long-Term Performance
  - 6” CIP post-tensioned pavement constructed in 1985 (near West, Texas)
  - Virtually no maintenance in 23 years
Picture of Connection details
Precast Concrete Pavements

Getting ready to post tension the PC pavement
- **Program Activity 1**
  - Create contacts lists
  - ETG

- **Program Activity 2**
  - Create the “The National Center for Prestressed Concrete Highway Pavements”
  - Board of Advisors

- **Program Activity 3**
  - Informational Literature

- **Program Activity 4**
  - Showcases and workshops
- **Program Activity 5**
  - Guidance Documents, Sample Plans, Specifications

- **Program Activity 6**
  - PCI Pavement Committee
    - Develop “action items”
    - Develop a detailed timeline
  - Industry “guidance” documents for “design and engineering” of the PPCP System
Four “Guidance Documents”

1) Selecting Applications for Precast Concrete Pavements
2) Design, Layout and Maintenance of Precast Concrete Pavements
3) Precast Pavement Panel Fabrication Recommendations
4) Construction Recommendations for Precast Concrete Pavements
Selecting Applications for Precast Concrete Pavements (Volume 1 of 4)

- Considerations for Selection
- Types of Applications
- Site Selection
- Agency Considerations
- Resources
- Appendix - Projects
Design, Layout and Maintenance of Precast Concrete Pavements (Vol. 2 of 4)

- Key Features
- Design Considerations
- Pavement Management Considerations
- Performance Monitoring
- Appendix – Details and Specifications
Precast Pavement Panel Fabrication Recommendations (Vol. 3 of 4)

- Producer Qualifications
- Formwork
- Materials
- Prestressing
- Expansion Joints
- Concreting
- Lifting/Handling
- Acceptance Testing
Construction Recommendations for Precast Concrete Pavements (Vol. 4 of 4)

- Installation-Staging
- Base Preparation
- Materials
- Installation-Equipment & Methods
- Post-Tensioning
- Final Surface Finish
- Final Inspection
Precast Concrete Pavements

PCI-FHWA Cooperative Agreement

Cooperative Effort to Engage Industry and Agencies
Precast/Prestressed Concrete Institute (PCI)

Highways for LIFE
Newark, Delaware
May 22, 2009

William Nickas, P.E.
Director, Transportation Systems
Precast/Prestressed Concrete Institute
Chicago, IL