Highways for LIFE
Accelerating the Implementation of Innovation

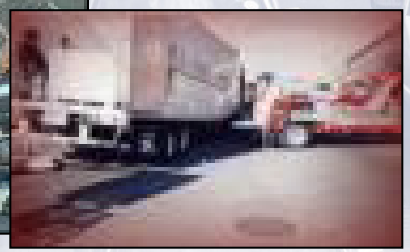
Presented by: Byron Lord
Program Coordinator Highways for LIFE

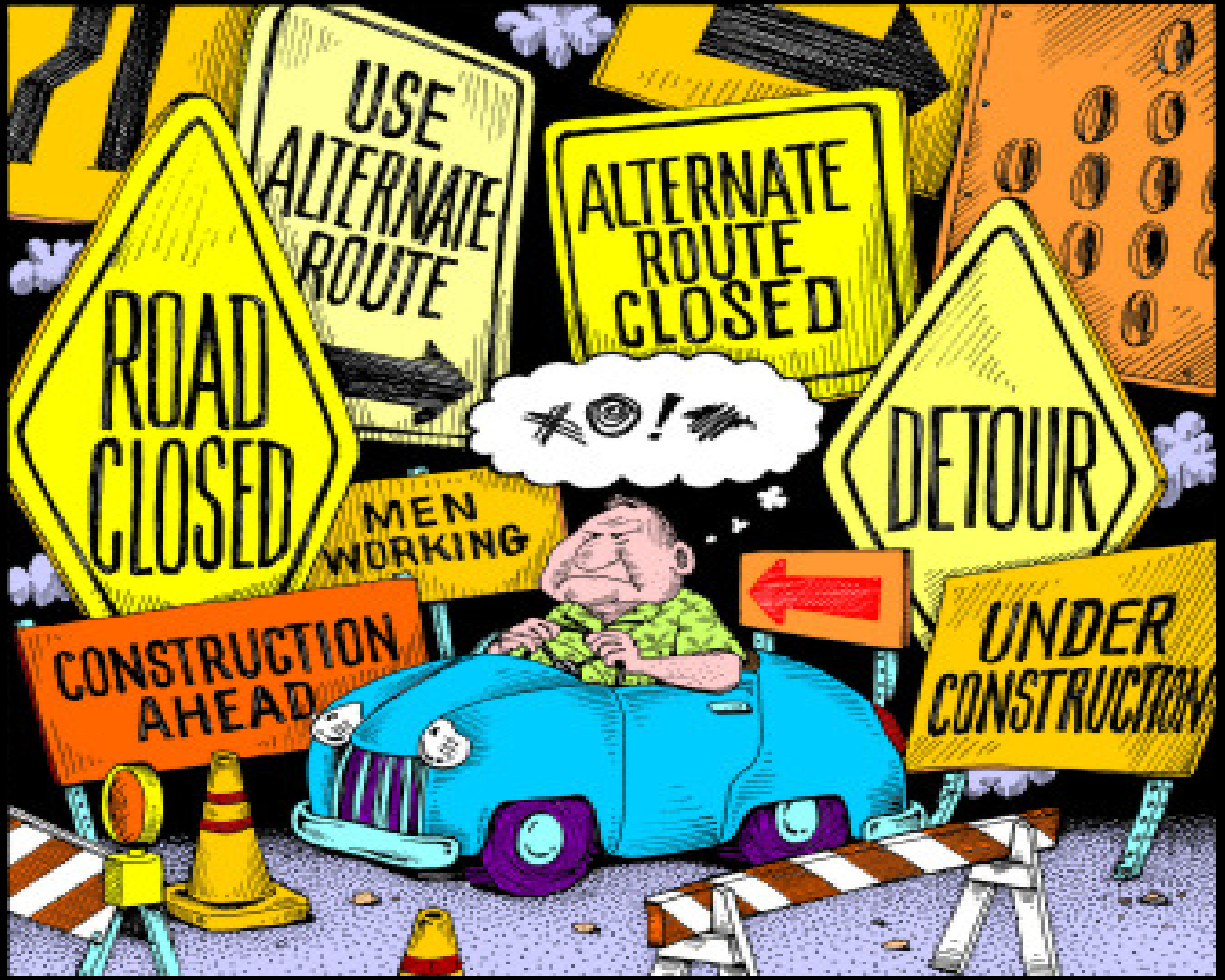
U.S. Department of Transportation
Federal Highway Administration

More cars and trucks

Old highways and bridges

Too many crashes and injuries




USE ALTERNATE ROUTE
ALTERNATE ROUTE CLOSED
ROAD CLOSED
DETOUR
MEN WORKING
CONSTRUCTION AHEAD
UNDER CONSTRUCTION

We can build highways:

Highways for LIFE

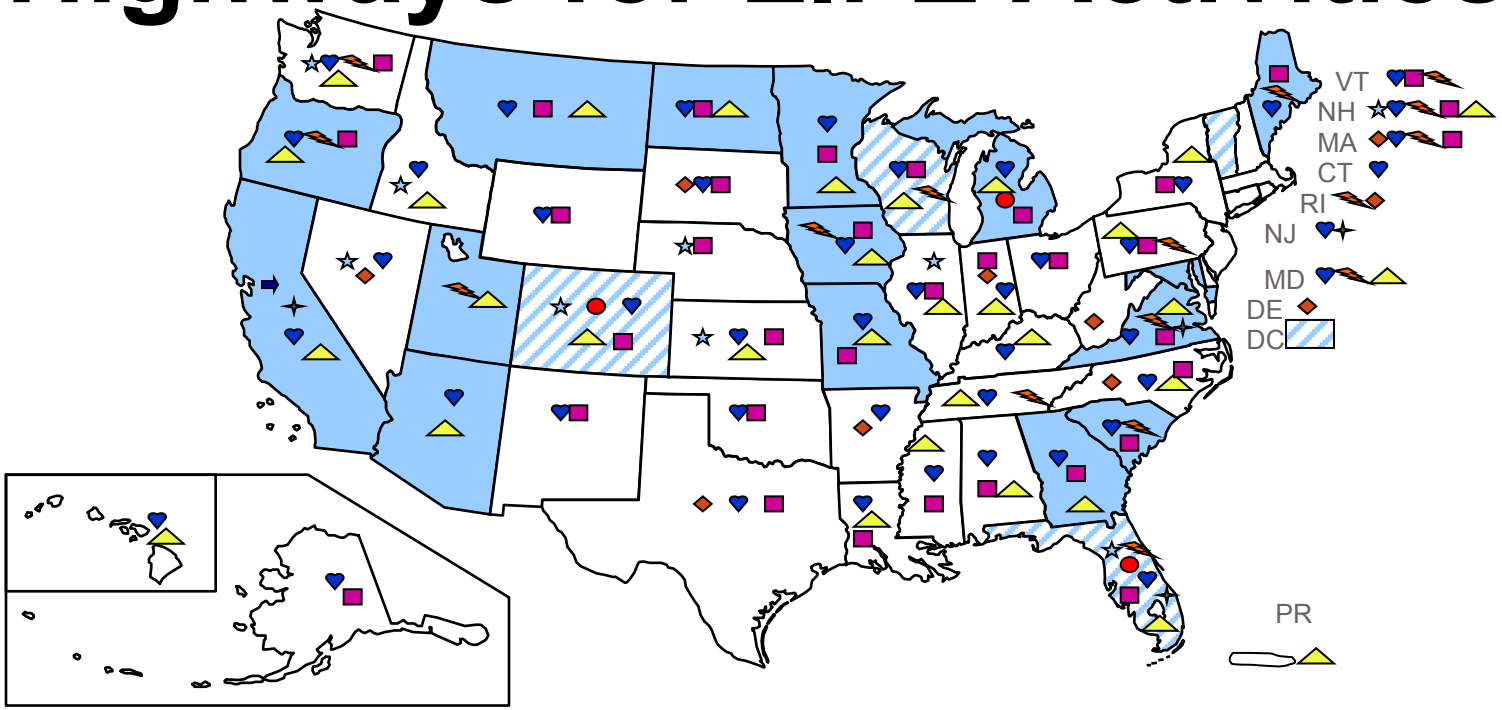
Demonstration Projects

Technology Transfer

Vanguard Technologies

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 year)**

Georgia 2007

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**


Existing condition

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
Applied Res. Assocs.
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

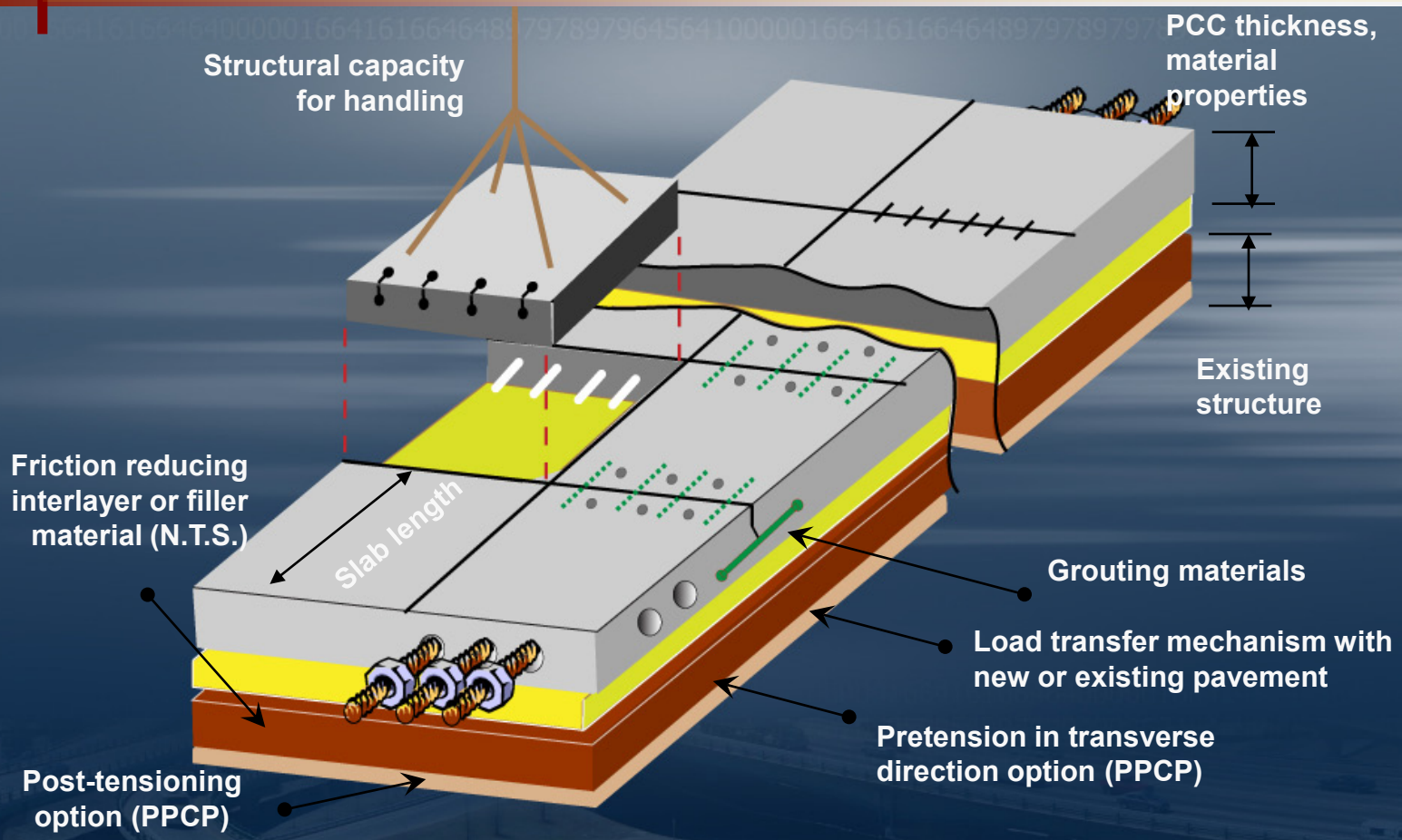
Paving and Pavement Rehabilitation Applications for PCPS

- 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



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

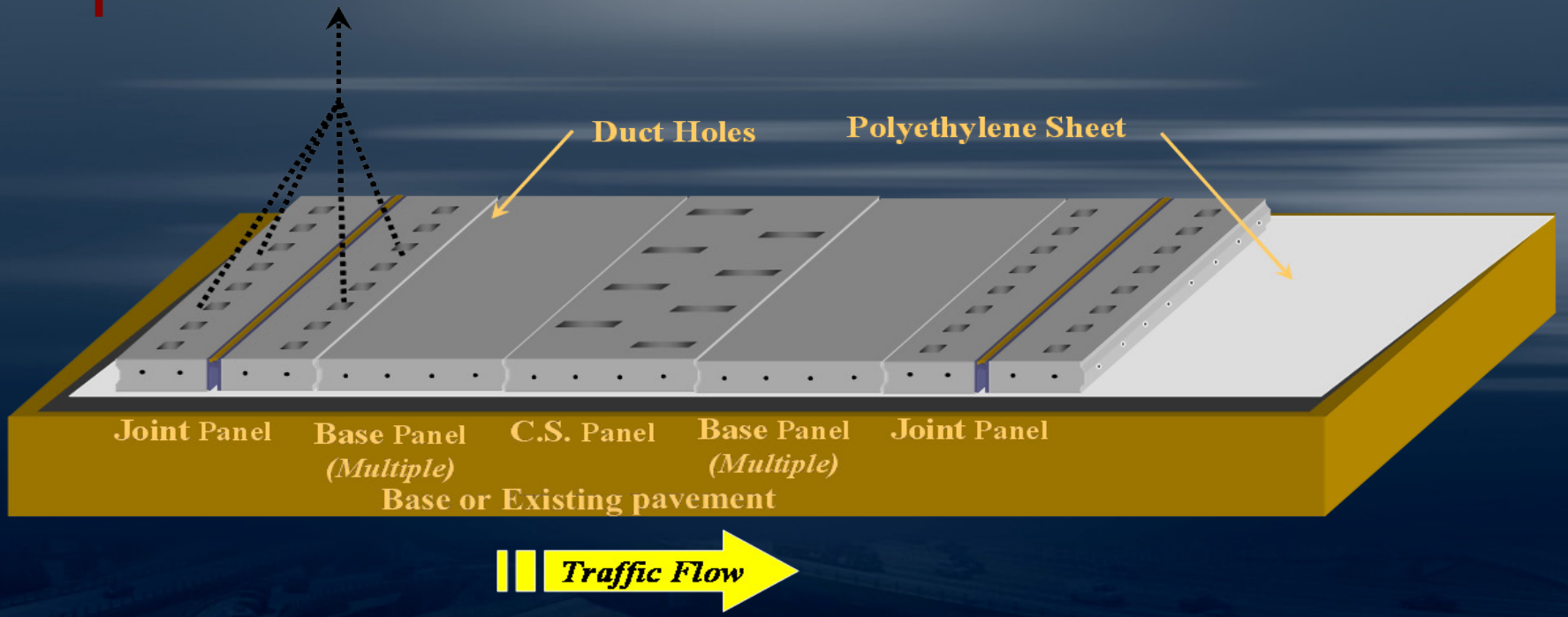
Selection depends on pavement surface

Single Plane

Small Scale Grader

Rail Supported and Hand Operated

Typical PPCP Panel Layout

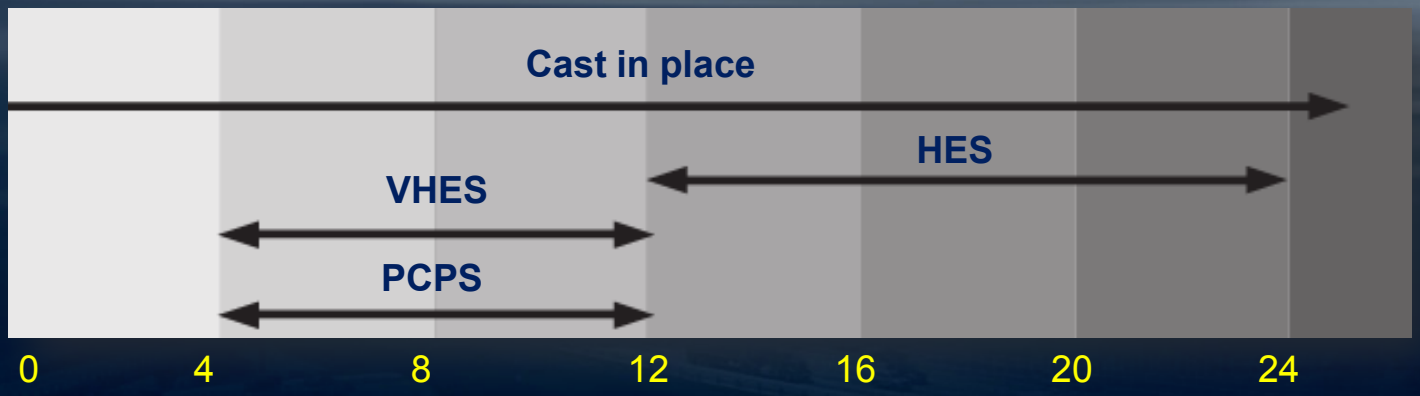


Project Scope

- 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



Project Specific Considerations

Maintenance and protection of traffic

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

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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U.S. Department of Transportation
Federal Highway Administration

THANK YOU

HIGHWAYS FOR LIFE

Accelerating Innovation for the American Driving Experience.

Precast Concrete Pavement Systems Workshop

28-061-11 – Pavement & Rehabilitation, North XI, 2008

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

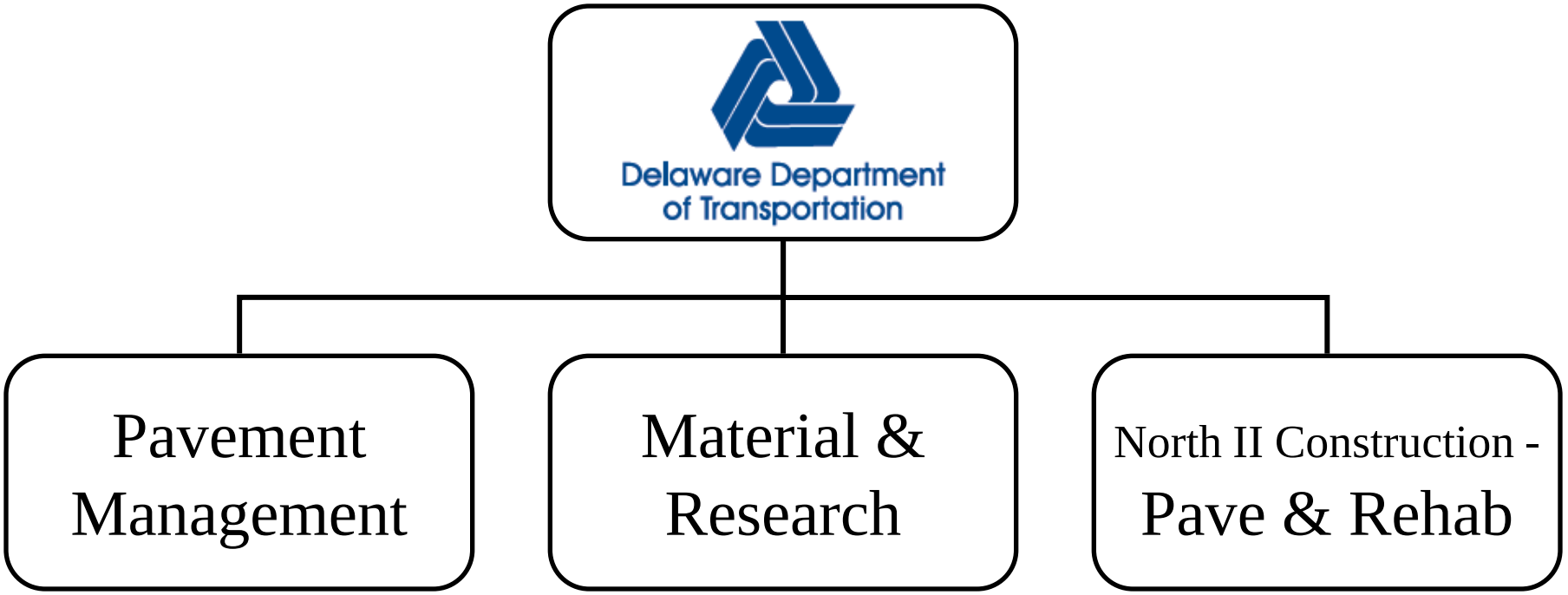
1. Project Team

- **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

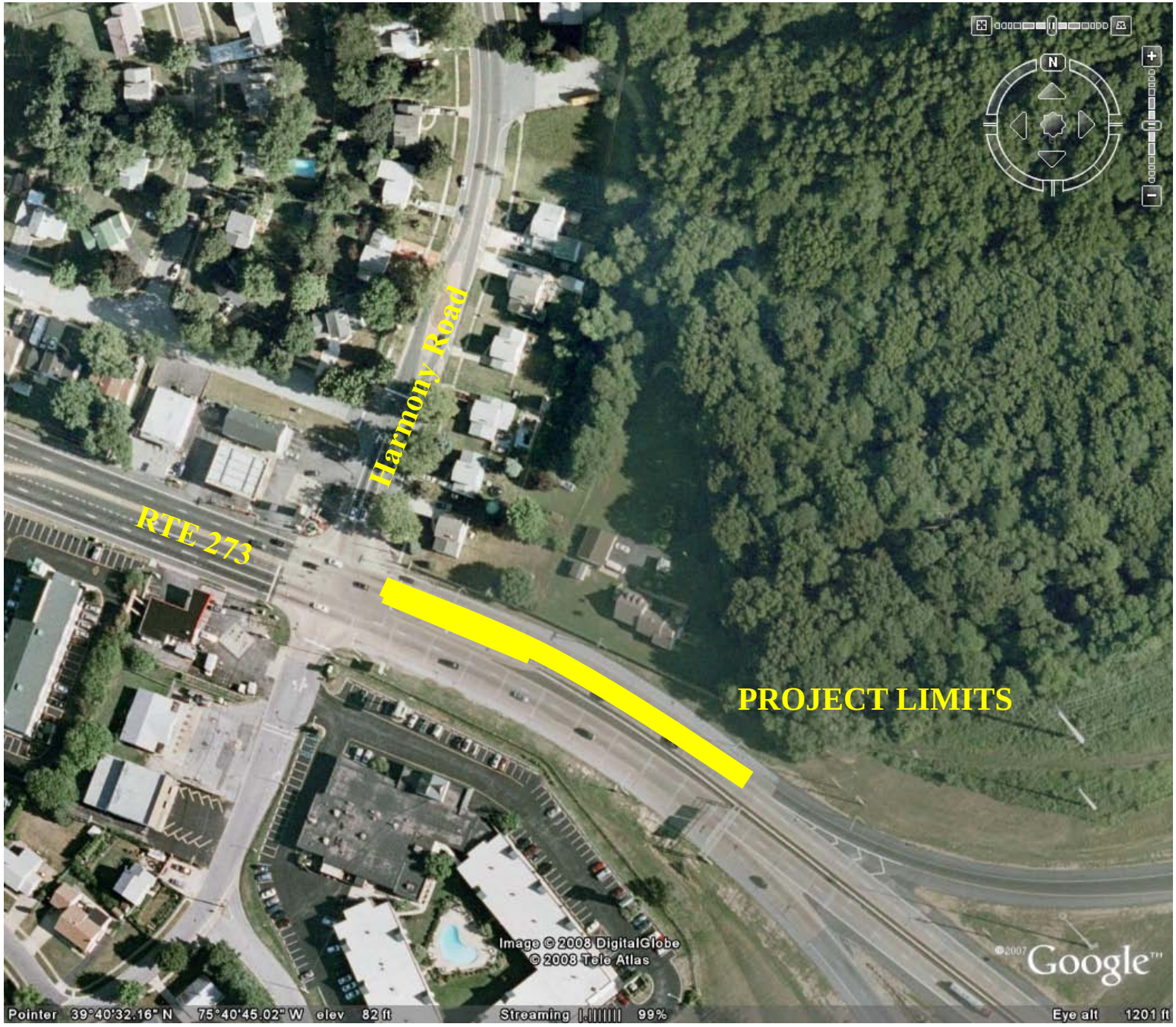
2. Project Location

- **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

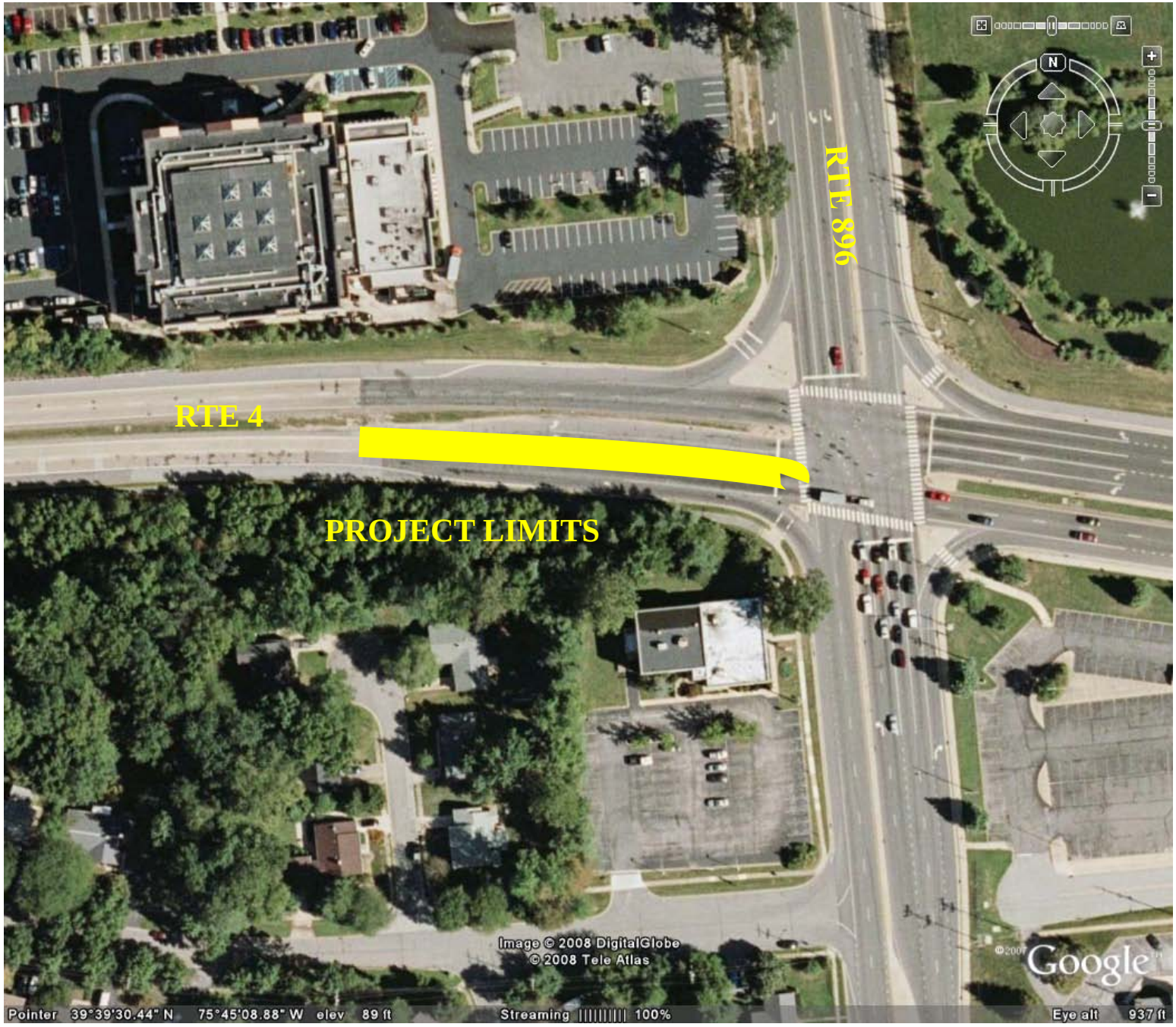


Potential PPCP Location 1 - RTE 273 WB @ Harmony Road

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

Potential PPCP Location 2 - RTE 4 EB @ RTE 896

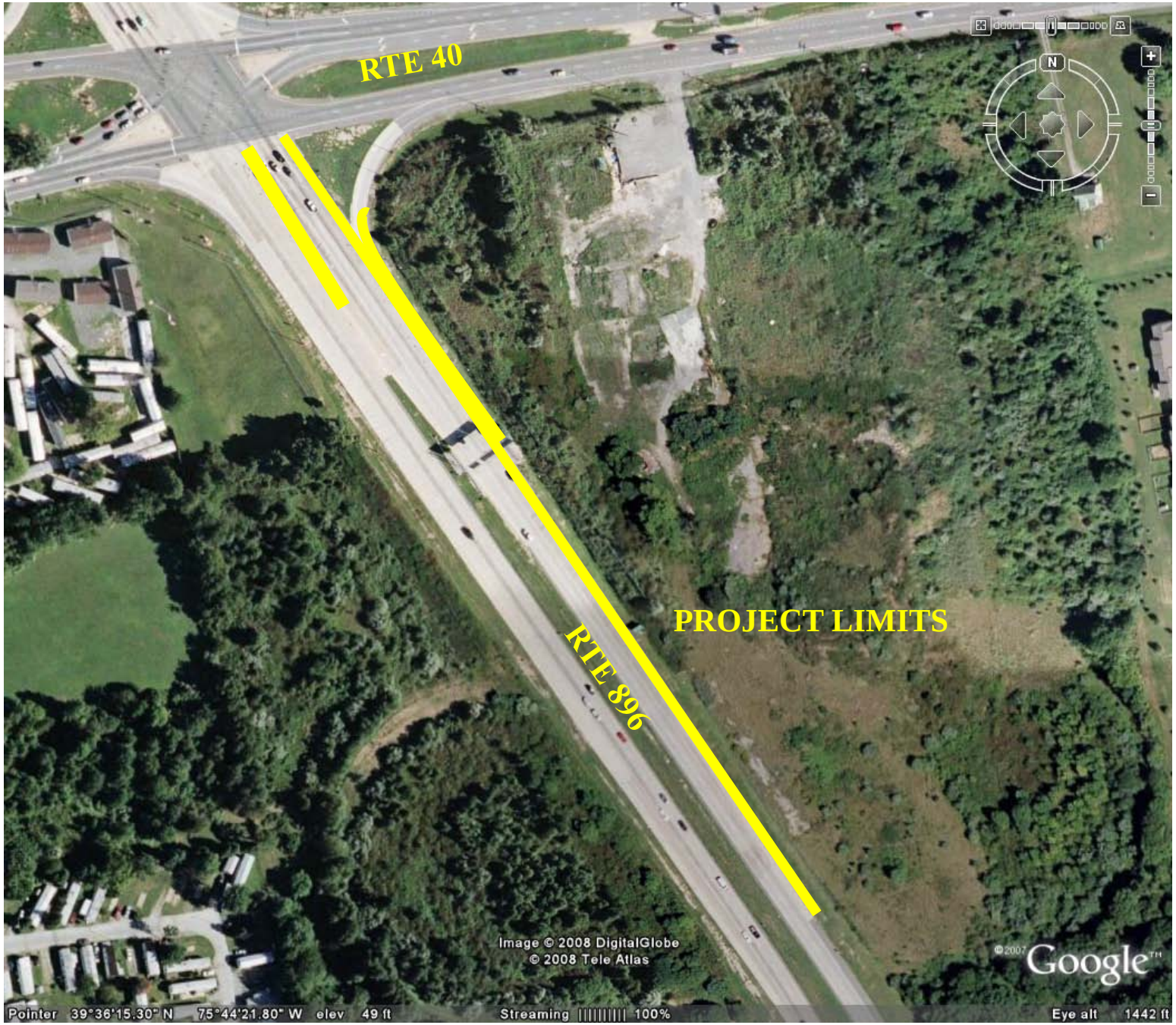


Potential PPCP Location 2 - RTE 4 EB @ RTE 896

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

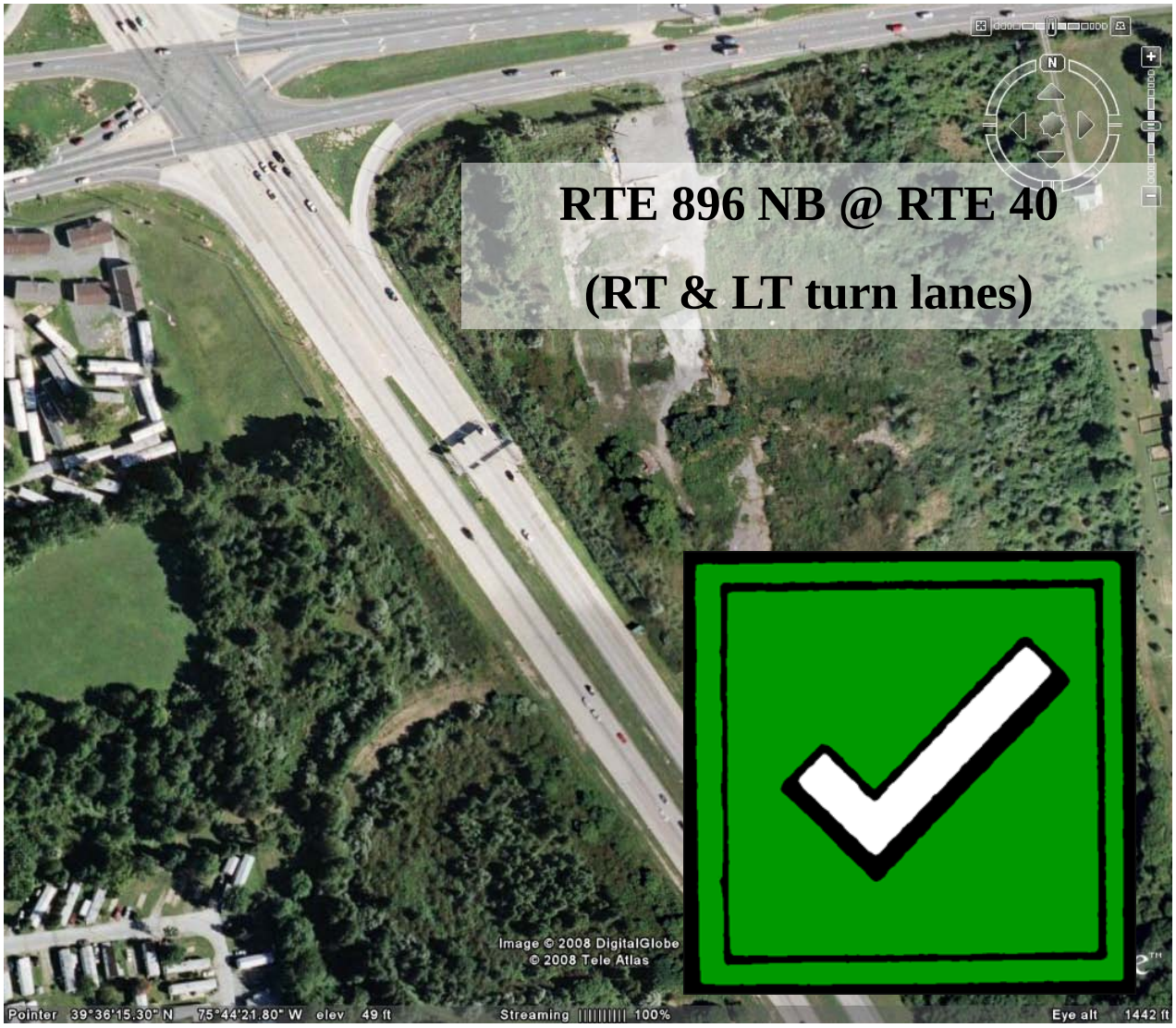
2. Project Location

- 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



Project Location – RTE 896 NB @ RTE 40

EXISTING PCC

CAST-IN-PLACE

PPCP REPLACEMENT AREA

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

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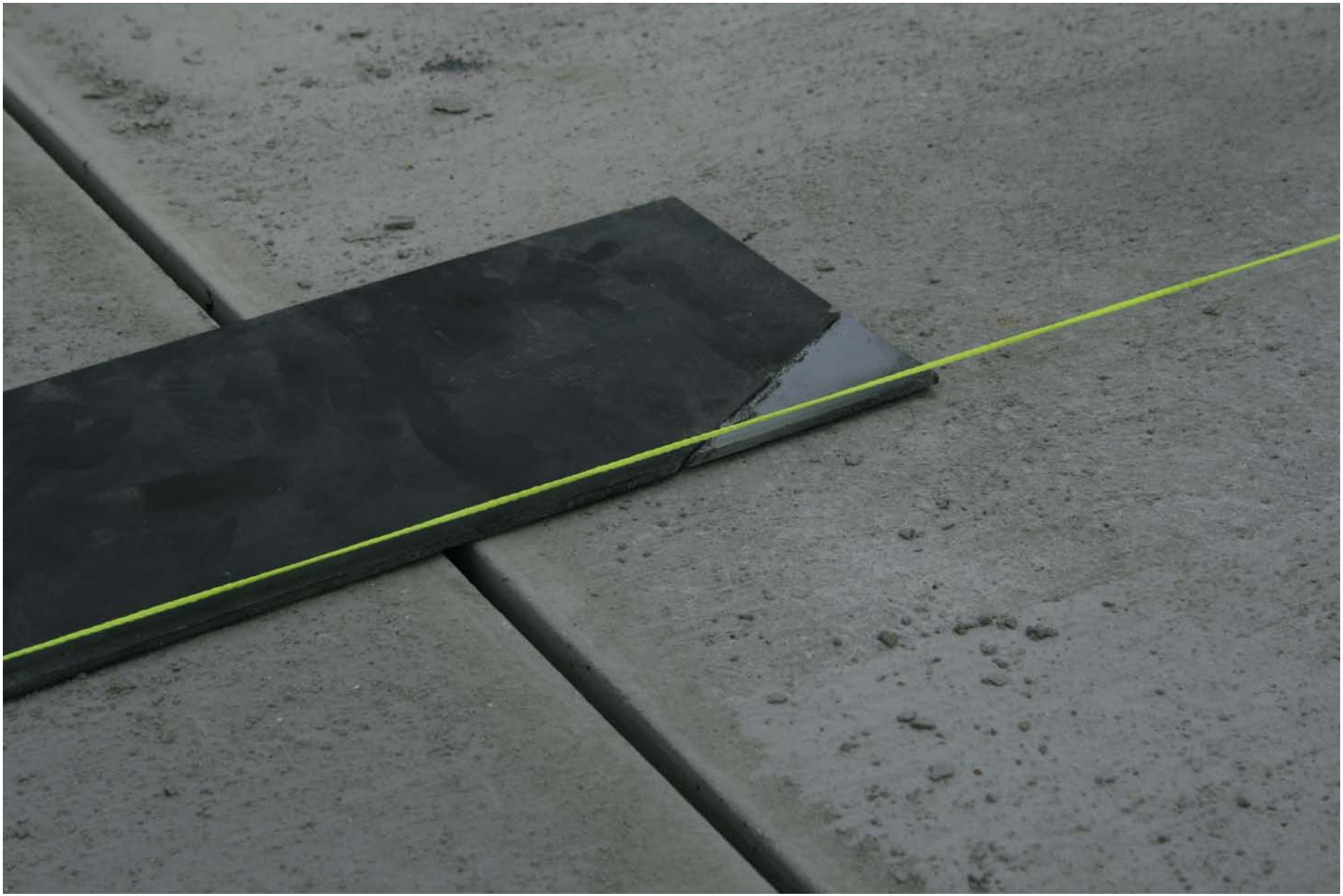
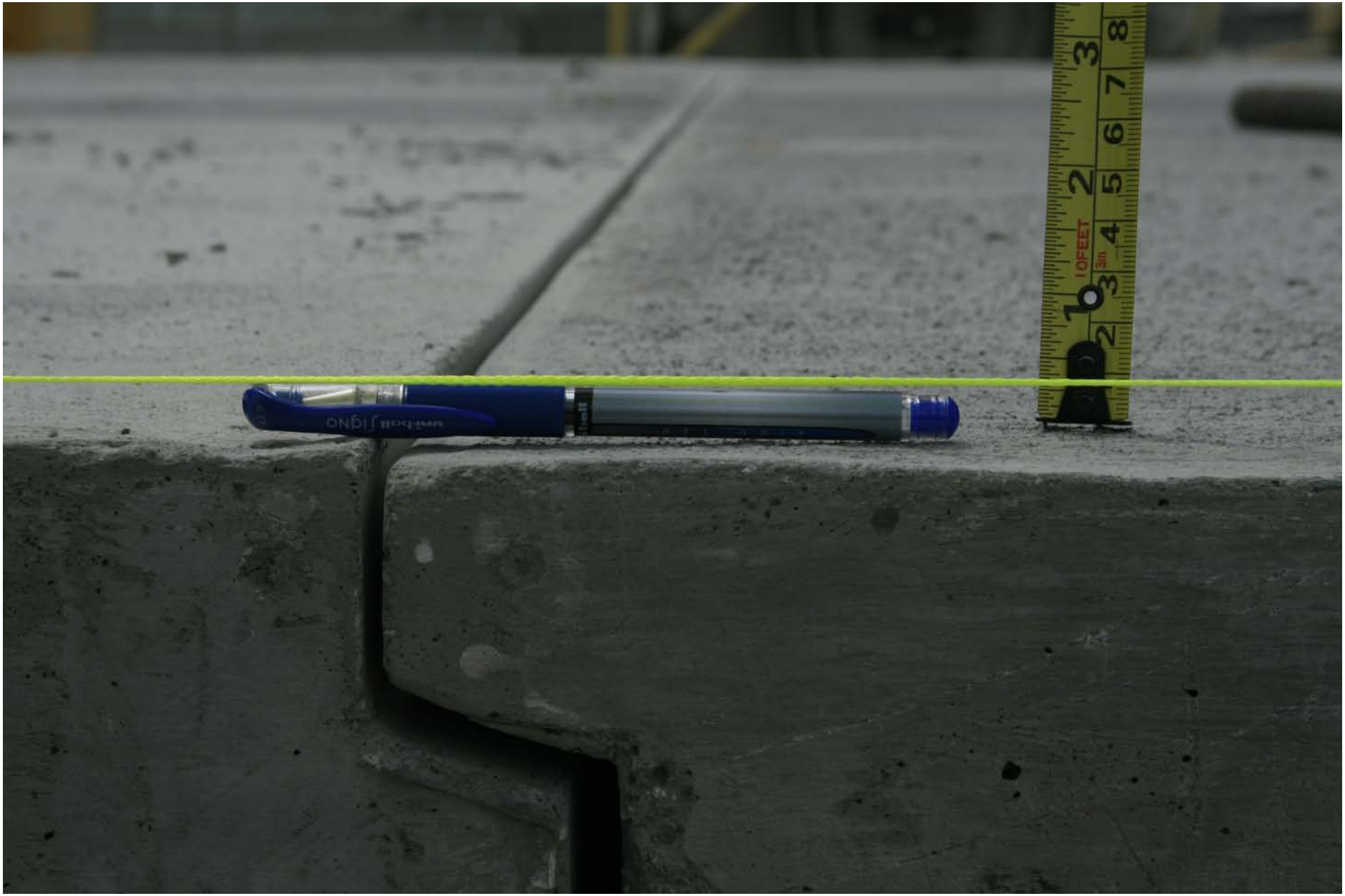
PPCP Fabrication – Fit Test – 04/29/2009



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

Pervious Concrete – Placement Demonstration – 05/13/2009

PPCP Panel Delivery – 05/14/2009

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

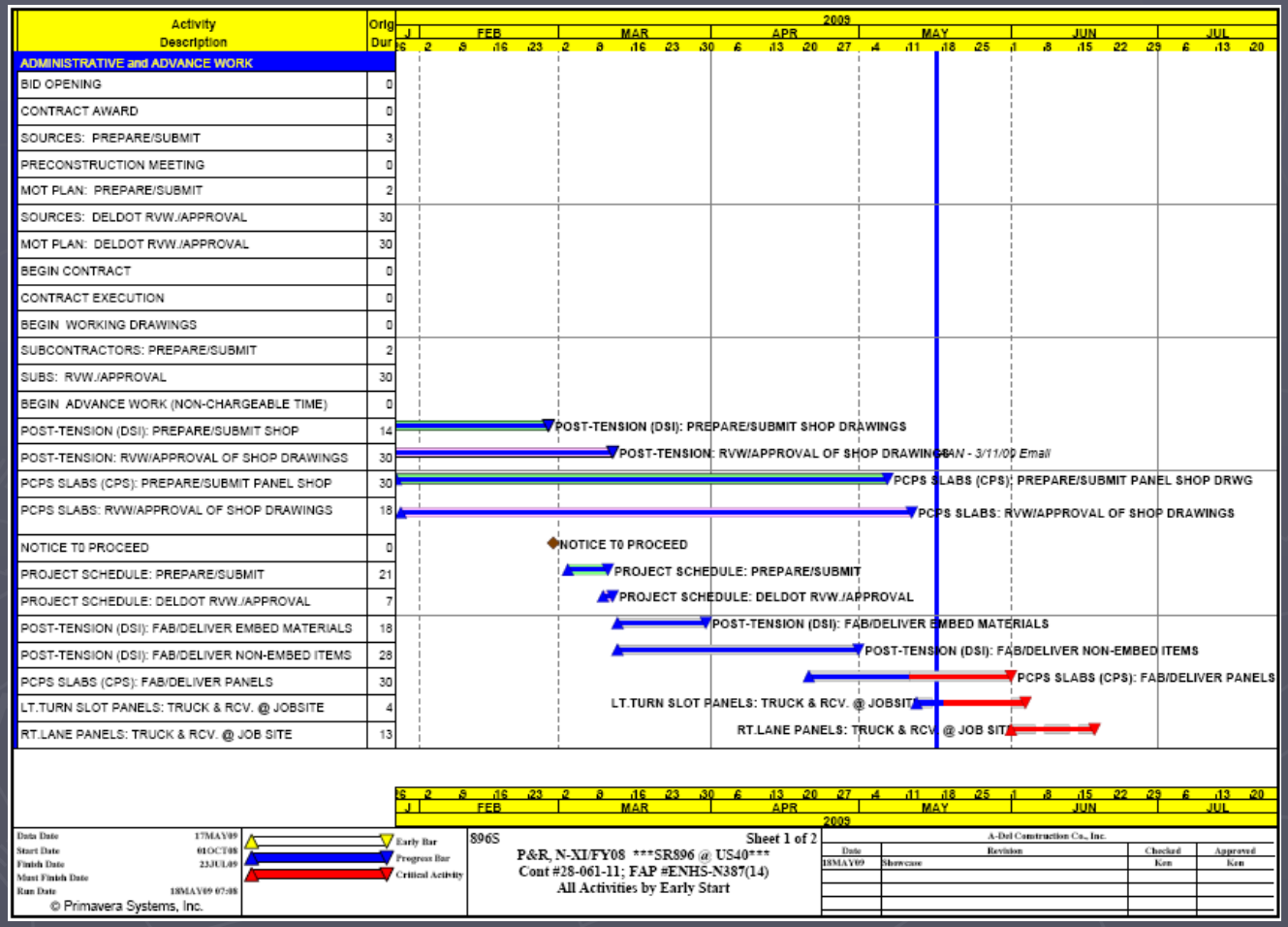
Contract #28-061-11
F.A.P. #ENHS-N387(14)

- 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

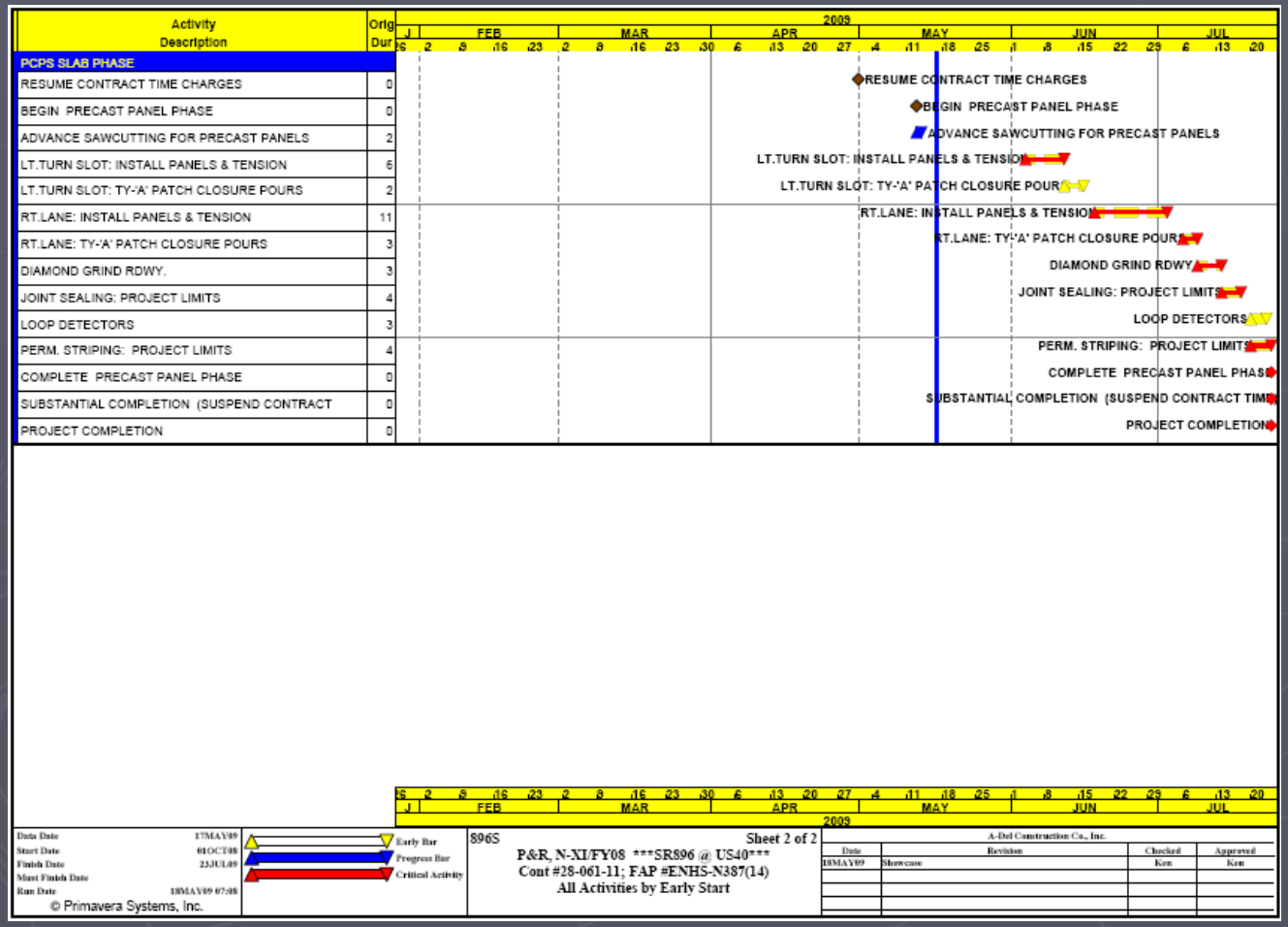
Post-Award Details

- Submittals
- QA/QC
- Schedule
- As Built Survey
- Obstructions
- Procurement
- Misc.
- Communication

Master Schedule



Master Schedule (cont'd)



Hourly Schedule

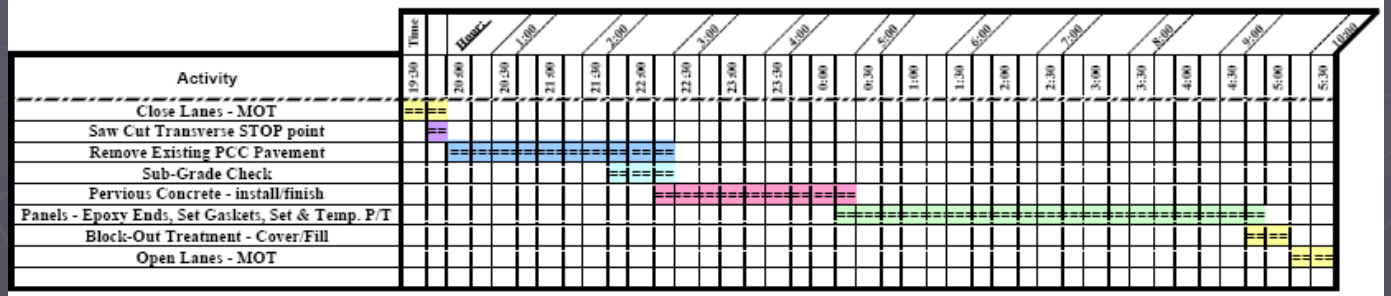
Contract #28-061-11
Pave & Rehab., North XI/FY2008
SR896(NB) @ US40

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 4-5.5" of thickness may be required)
> Pervious Concrete: Laser Screed checked out and ready to work. Understanding of cross-slope 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

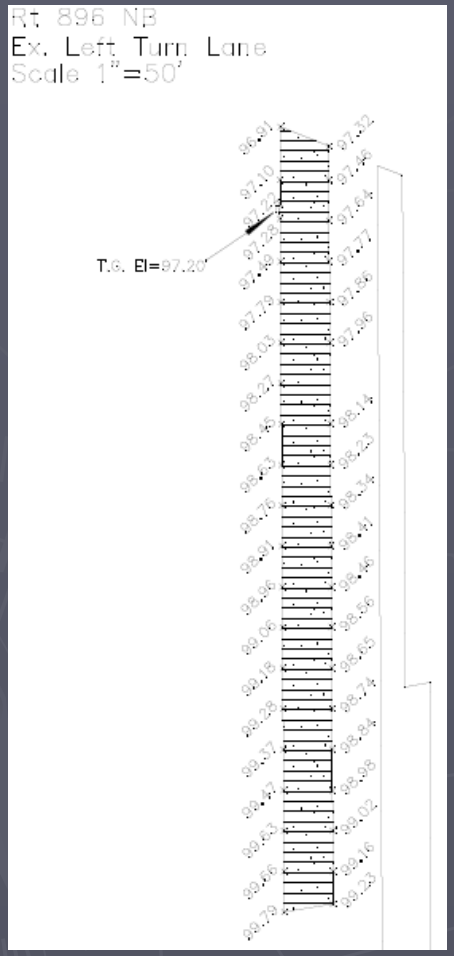
Detailed Sequencing Schedule for Each Production "Panel Setting" Night



Other Misc. Work Items (anyone needing more to do)

> Load Panels for next nights operation (load backwards, follow max. stack height, dunnage 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

As-Builts



Contract #: 28-061-11
Pave/Rehab; N-XI/FY08 (SR896 @ US40)

Mirrored Plane Pick Length Data

"As-Built" STA. =	= Shop Drawing STA.	ELEV. @ LEFT EDGE OF TURN-SLOT	LENGTH ADDED TO "ZERO-PICK" LENGTH	PANEL MARK or NUMBER	LENGTH ADDED TO "ZERO-PICK" LENGTH	ELEV. @ RIGHT EDGE OF TURN-SLOT (MATCH AGAINST EXISTING ROADWAY)	Post-Tension Unit #
		98.02		Tongue		98.05	
			+ 0 - 1/2"		+ 0 - 3/8"		
				B1-24			
			+ 0 - 1/8"		0"		
2+69.96	= 2+46.09	98.09		Groove		98.10	
		98.09		Tongue		98.10	
			+ 0 - 3/8"		+ 0 - 3/8"		
				A2-24			
			0"		0"		
2+60.04	= 2+36.17	98.15		Groove		98.14	
		98.15		Tongue		98.14	
			+ 0 - 3/8"		+ 0 - 1/2"		
				B1-24			
			0"		+ 0 - 1/8"		
2+50.20	= 2+26.33	98.21		Groove		98.18	
		98.21		Tongue		98.18	
			+ 0 - 3/8"		+ 0 - 5/8"		
				B3-24			
			0"		+ 0 - 3/8"		
2+40.35	= 2+16.49	98.28		Groove		98.23	
		98.28		Tongue		98.23	
			+ 0 - 1/2"		+ 0 - 7/8"		
				B1-24			
			0"		+ 0 - 1/2"		
2+30.51	= 2+06.64	98.35		Groove		98.28	
		98.35		Tongue		98.28	
			+ 0 - 1/2"		+ 1 - 0"		
				B4-24			
			0"		+ 0 - 5/8"		
2+20.67	= 1+96.80	98.43		Groove		98.34	
		98.43		Tongue		98.34	
			+ 0 - 3/8"		+ 1 - 0"		
				B1-24			
			0"		+ 0 - 3/4"		
2+10.82	= 1+86.95	98.48		Groove		98.37	

UNIT # 9

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

DelDOT
Prefabricated Concrete Pavement Systems

Rt.896/US40

local presence – global competence

Highways for LIFE

May 21-22, 2009

BU PT

DYWIDAG Post-Tensioning

- Company Evolution
- DYWIDAG Post-Tensioning System, DelDOT 896
- Installation Procedure
- Completed/Current/Future PPCP Projects
- Force Monitoring

Company Evolution

Dyckerhoff & Widmann Aktiengesellschaft

DYWIDAG Systems International

DSI

BU PT

What business are we in?

Development, manufacturing and supply of:

Construction Systems:

- Post-Tensioning and Geotechnics
- Concrete Accessories

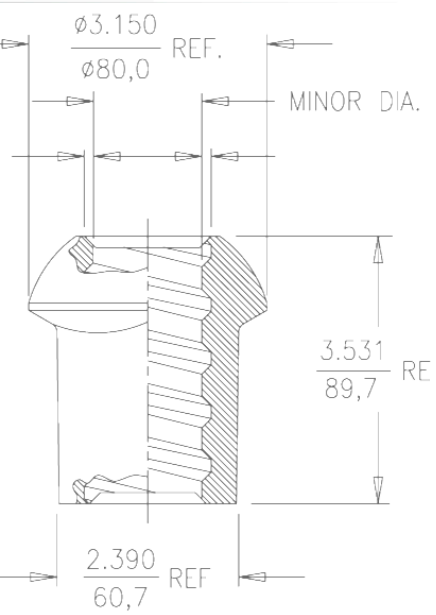
Underground Systems:

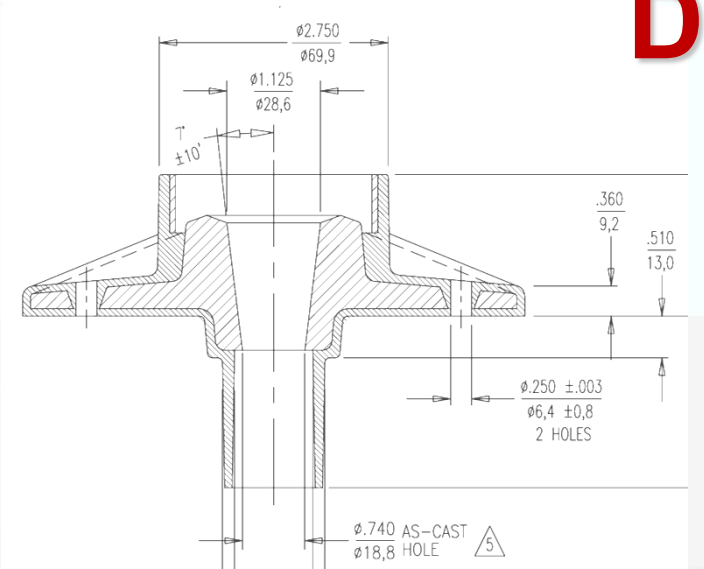
- Mining Strata Control
- Tunneling Support

Plus Complementary Services:

- Rental of Equipment
- Engineering, Installation etc.

BU PT





DYWIDAG POST-TENSIONING:

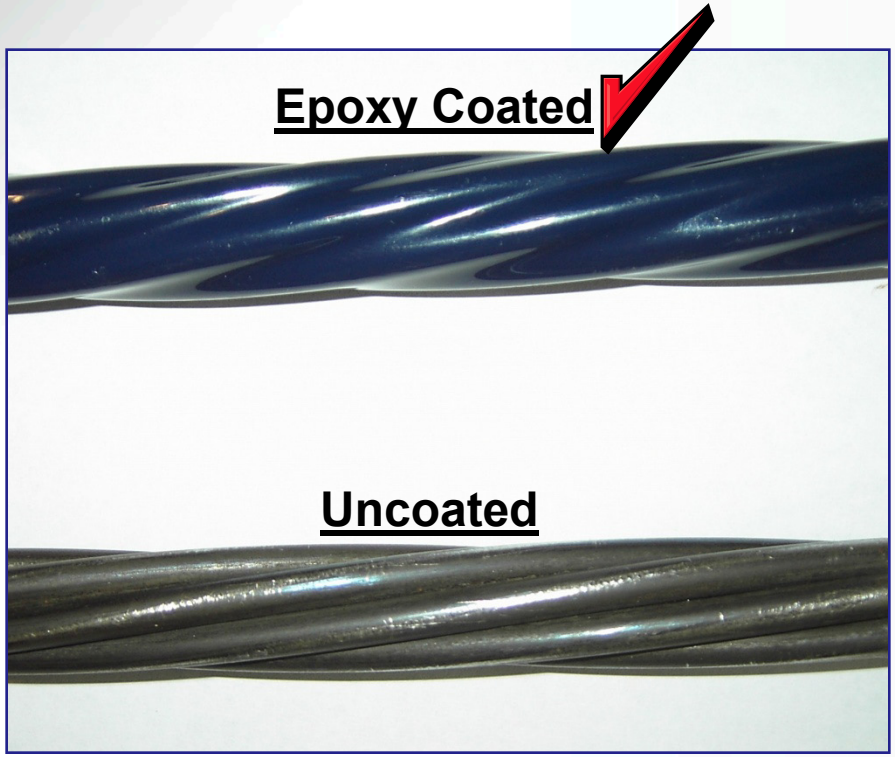
DelDOT RT896

DYWIDAG Threadbar®

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

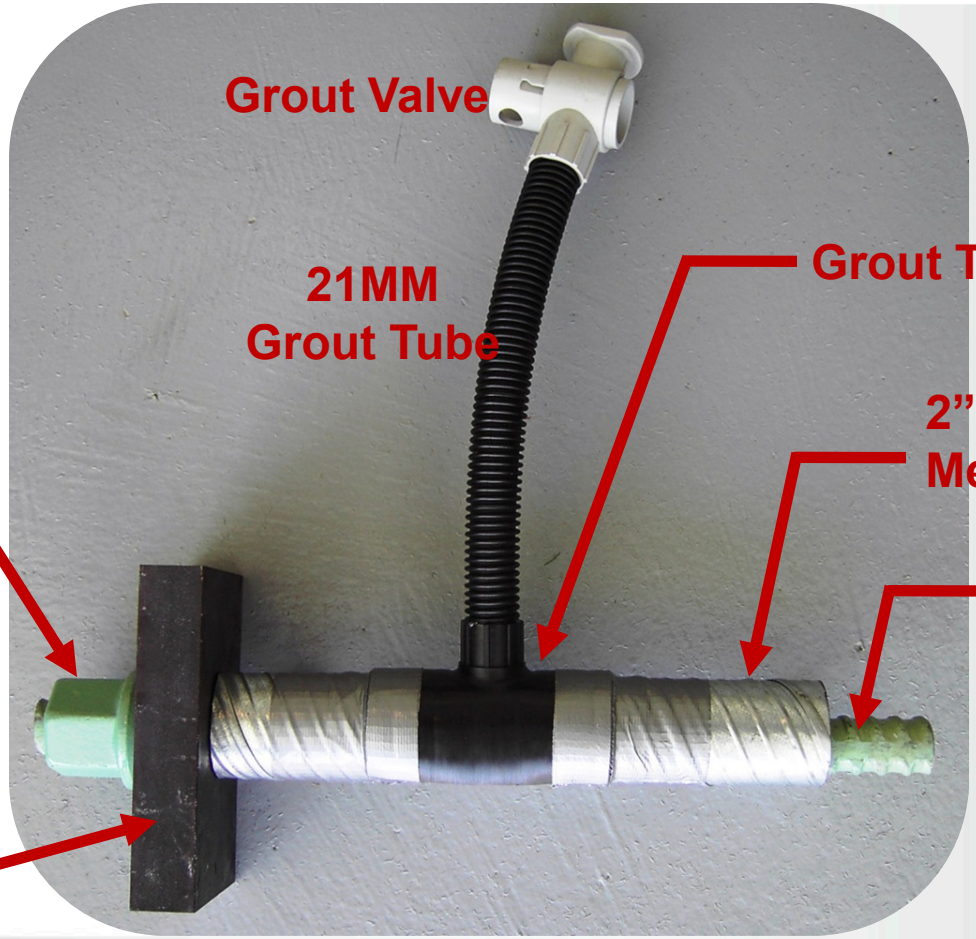
  1-3/4”, 2-1/2” (turned, polished & cold threaded)
- Bare
- Epoxy Coated
- Galvanized

7-Wire P/S Strand



- ASTM A416 7-Wire Strand (Grade 270) 0.6” Diameter
- Bare
- Epoxy Coated

DYWIDAG Threadbar® System: DelDOT RT896



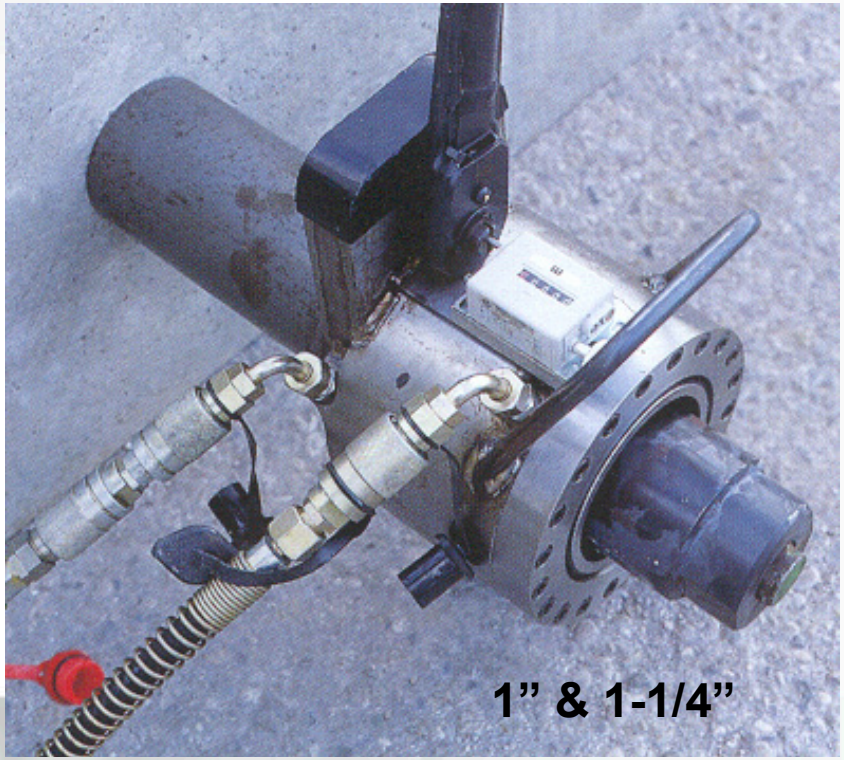
BU PT

DYWIDAG Threadbar® System: DelDOT RT896

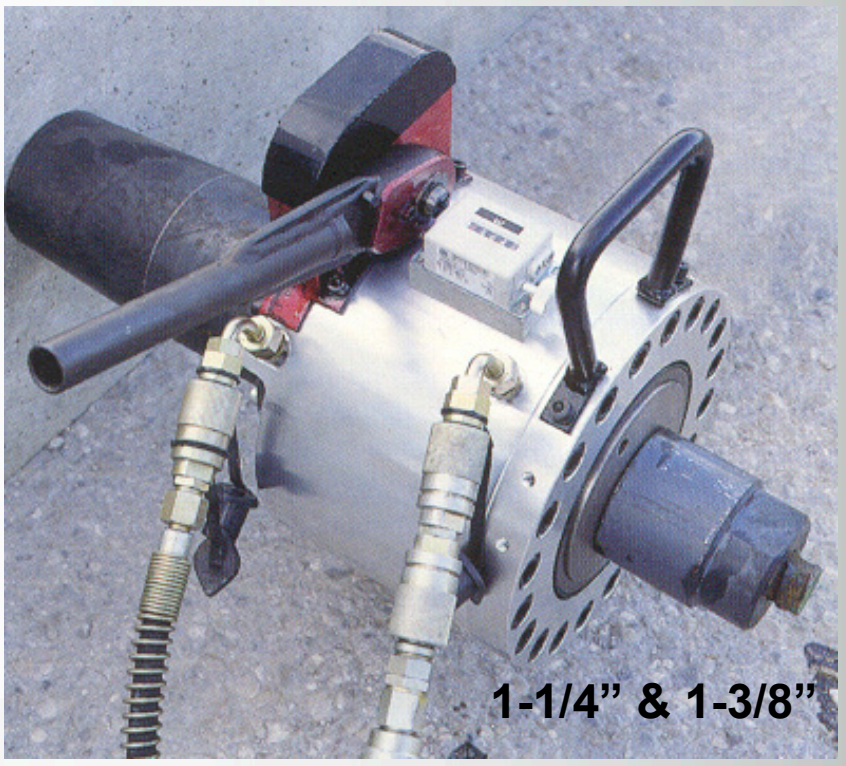
Threadbar® Stressing Rams

- Internal Ratchet Mechanism

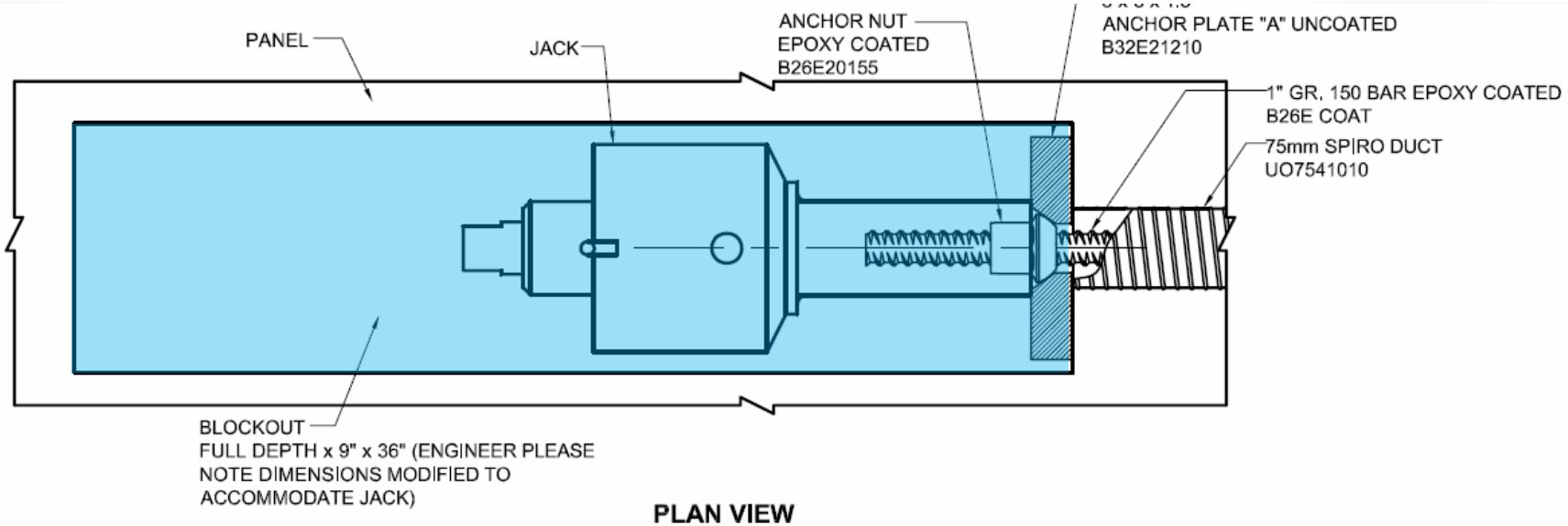
60 Ton Capacity



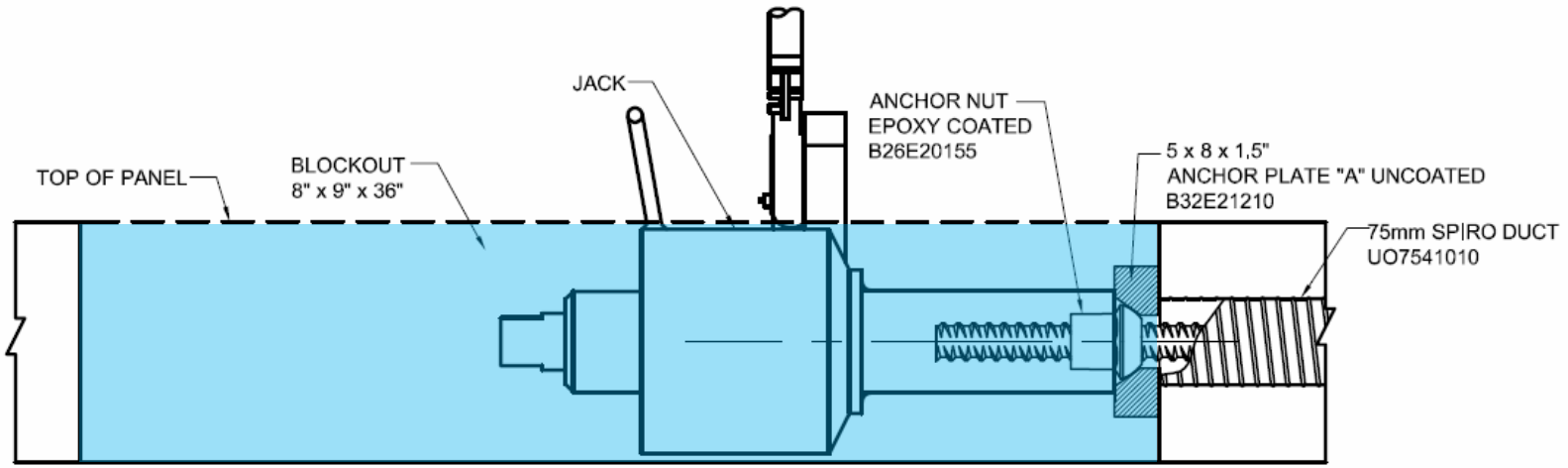
110 Ton Capacity



Threadbar® Stressing Rams

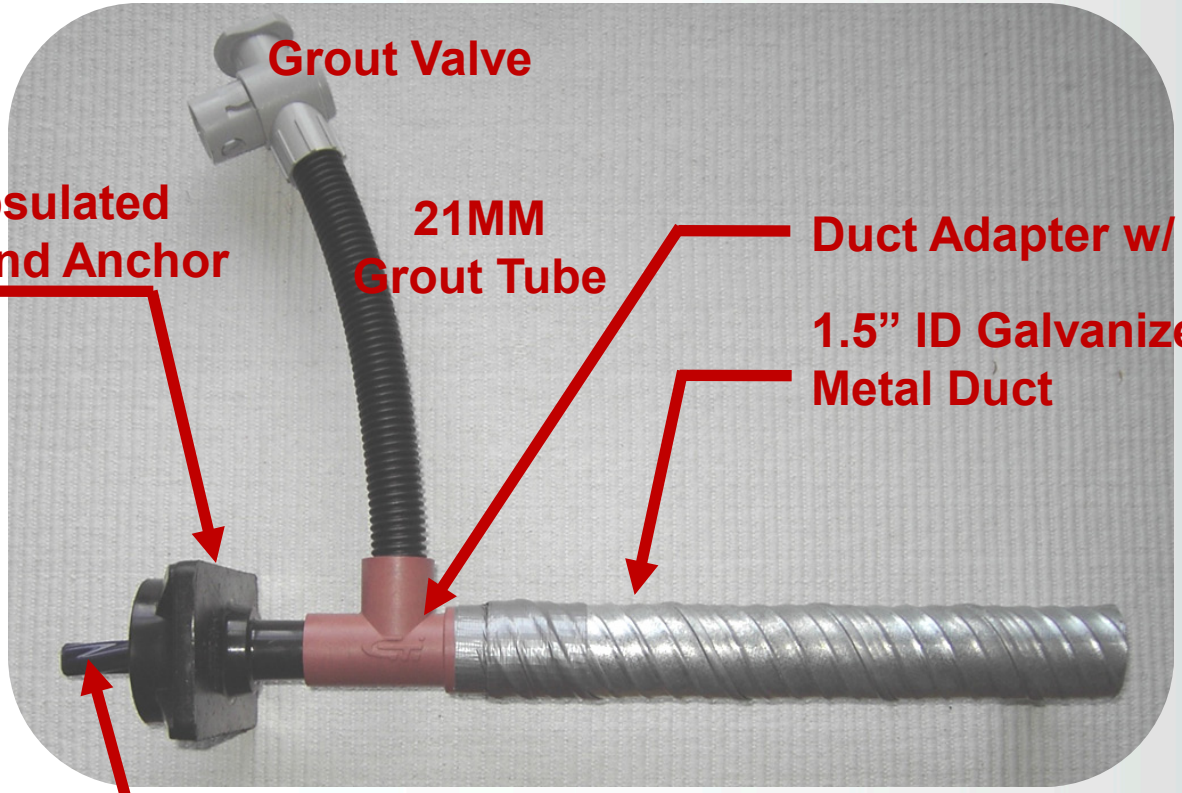


PLAN VIEW

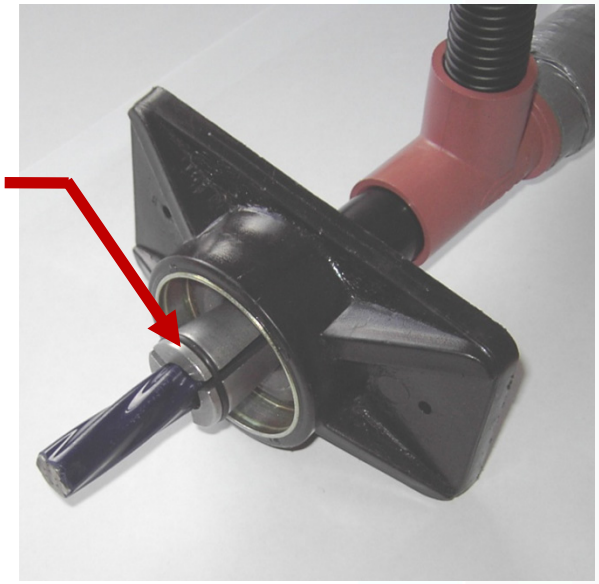


ELEVATION VIEW

DYWIDAG Bonded Mono-Strand: DelDOT RT896



DYWIDAG Bonded Mono-Strand: DelDOT RT896



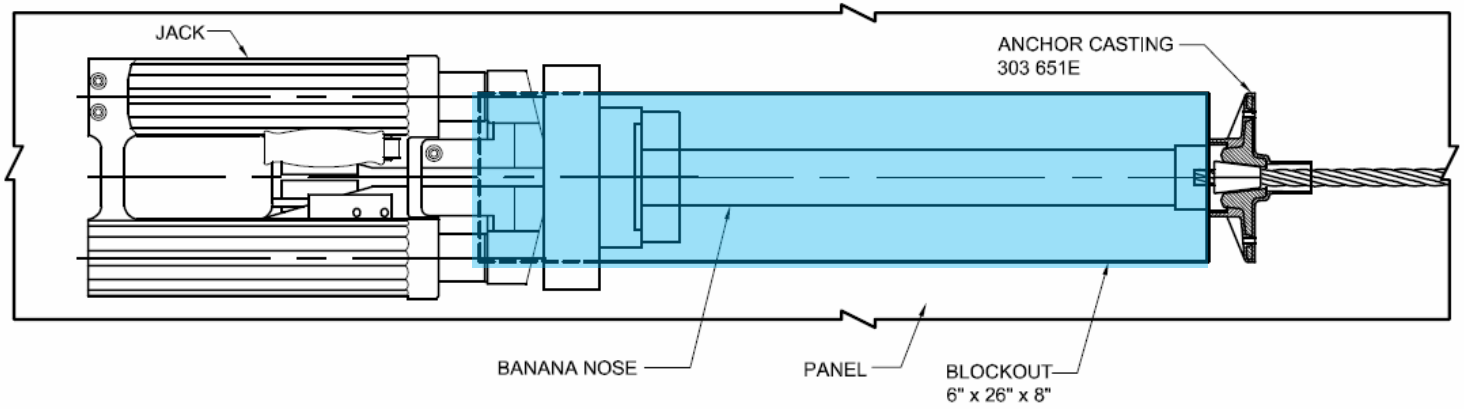
Pre Stressing
(prior to wedge seating)

Post Stressing
(after seating and cutting)

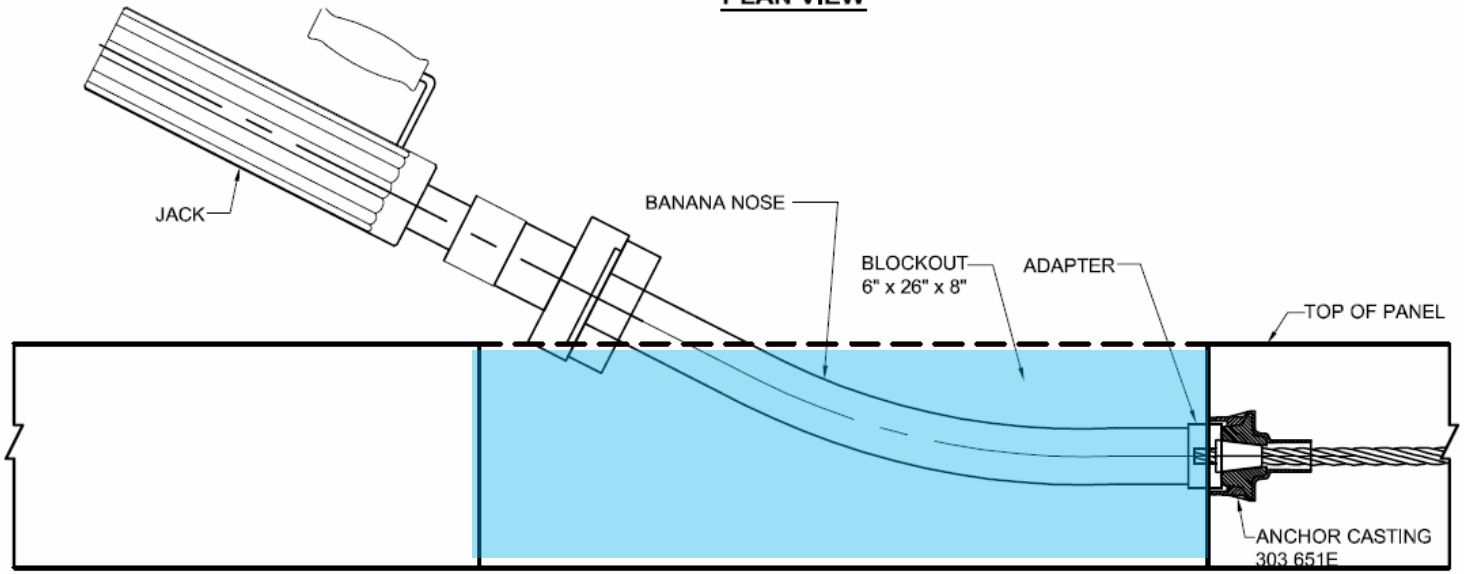
Mono-strand Stressing Equipment

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

Mono-strand Stressing Equipment

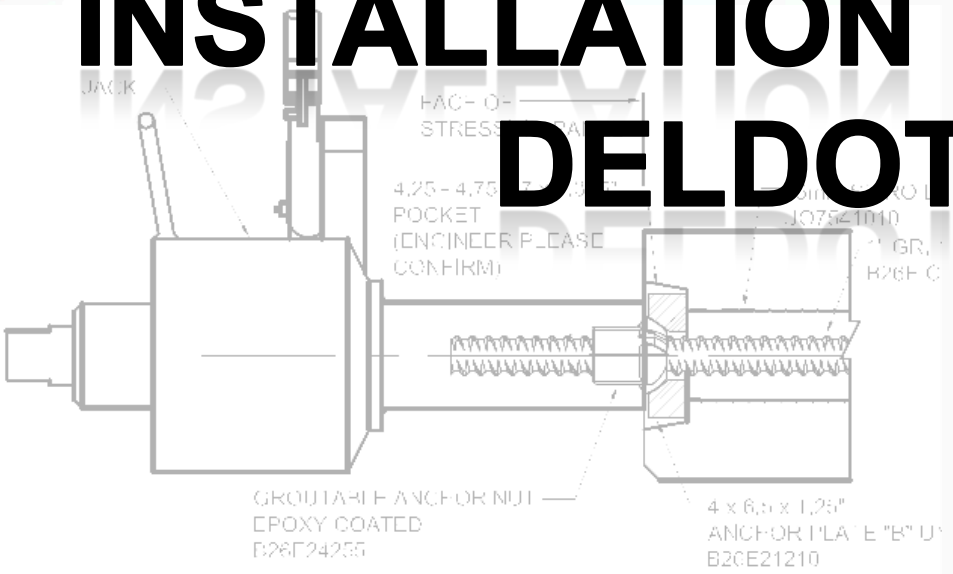


PLAN VIEW



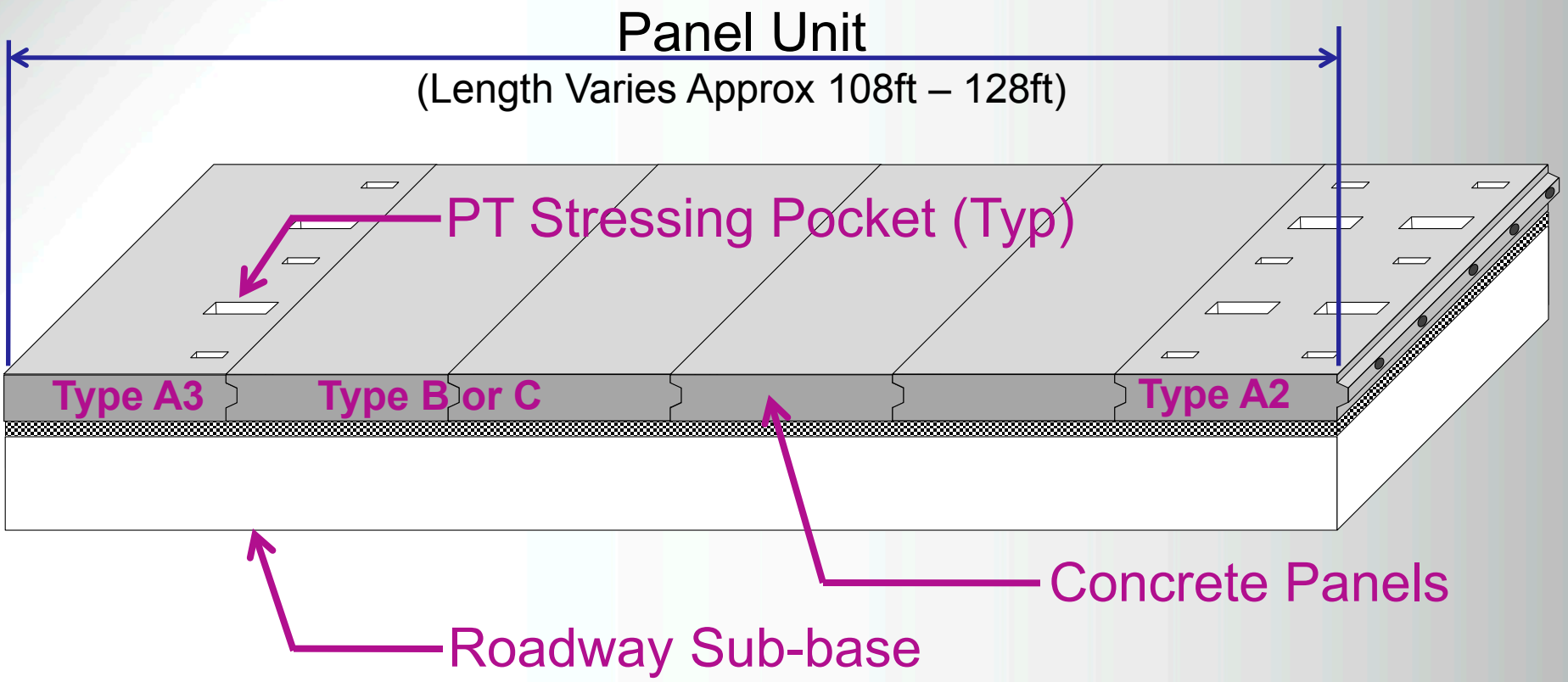
ELEVATION VIEW

INSTALLATION PROCEDURES
DELDOT RT896

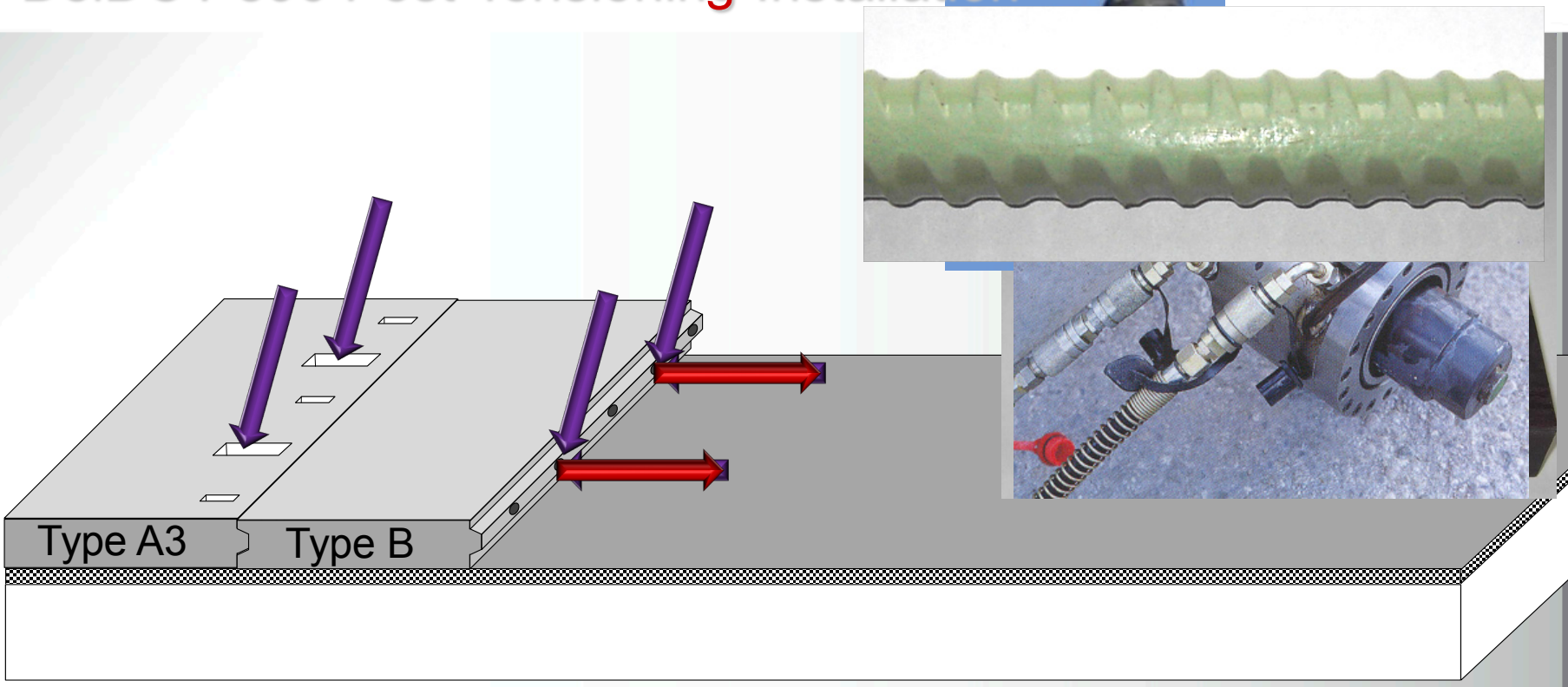


BU PT

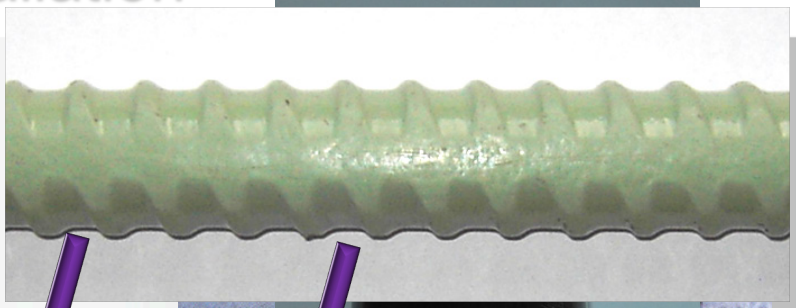
DelDOT 896 Post-Tensioning Installation

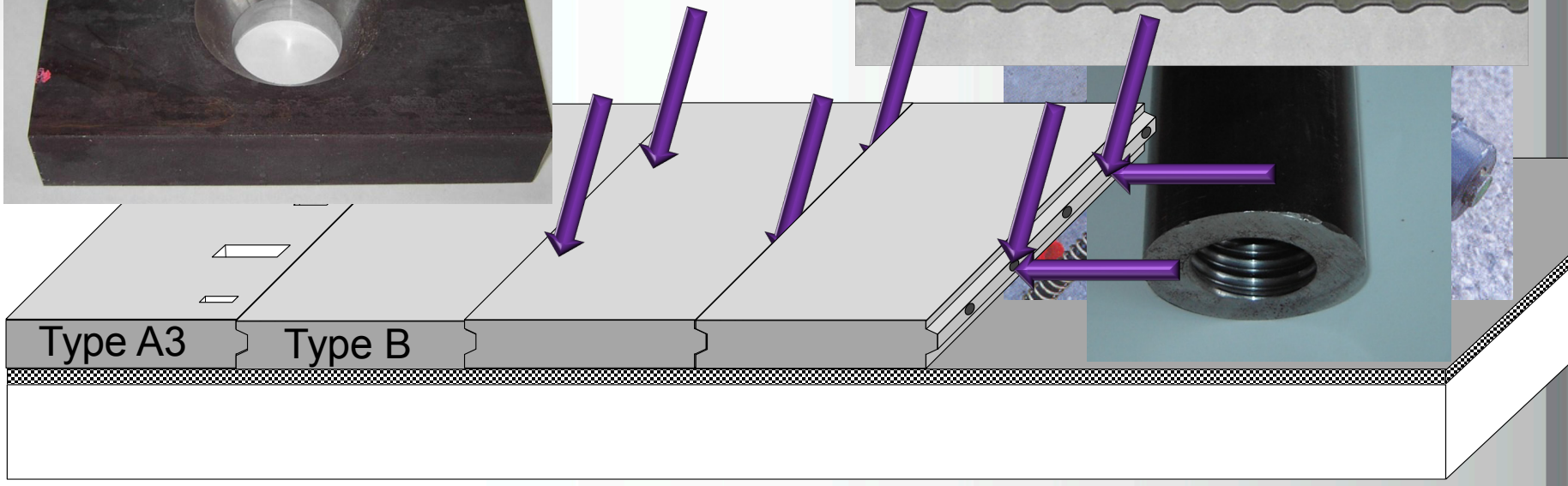


DelDOT 896 Post-Tensioning Installation

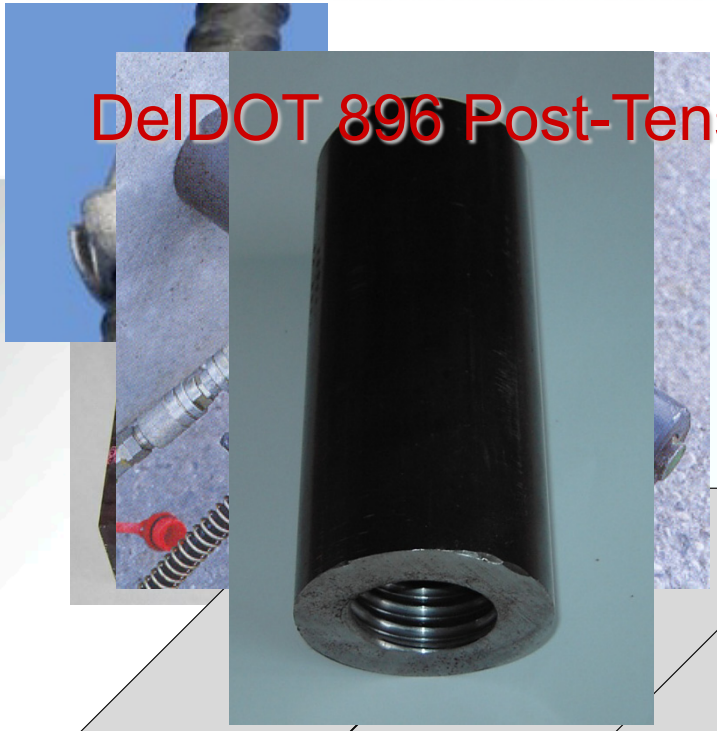


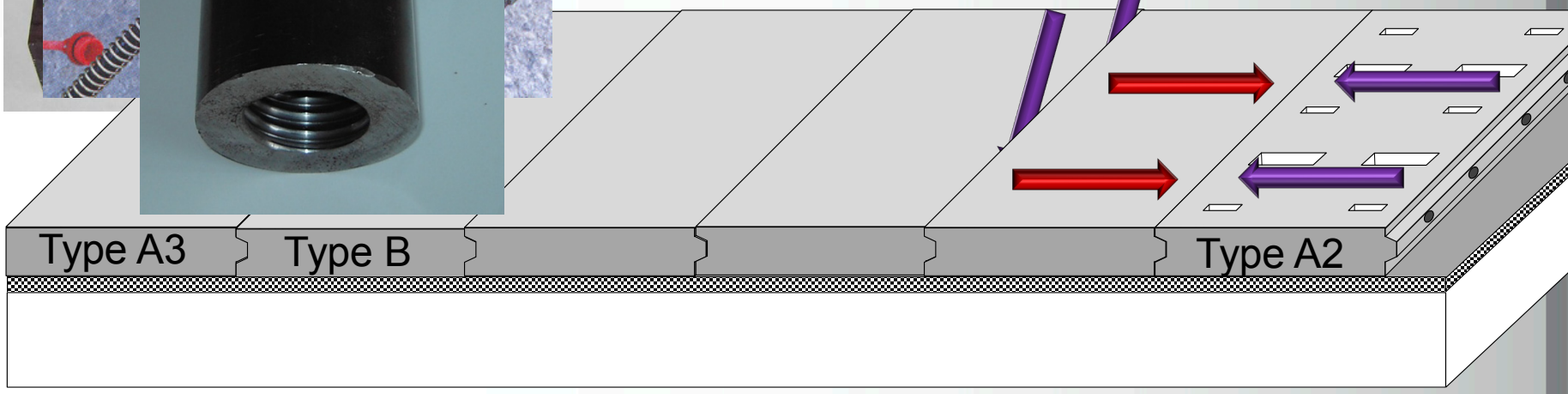
DelDOT 896 Post-Tensioning Installation





DelDOT 896 Post-Tensioning Installation





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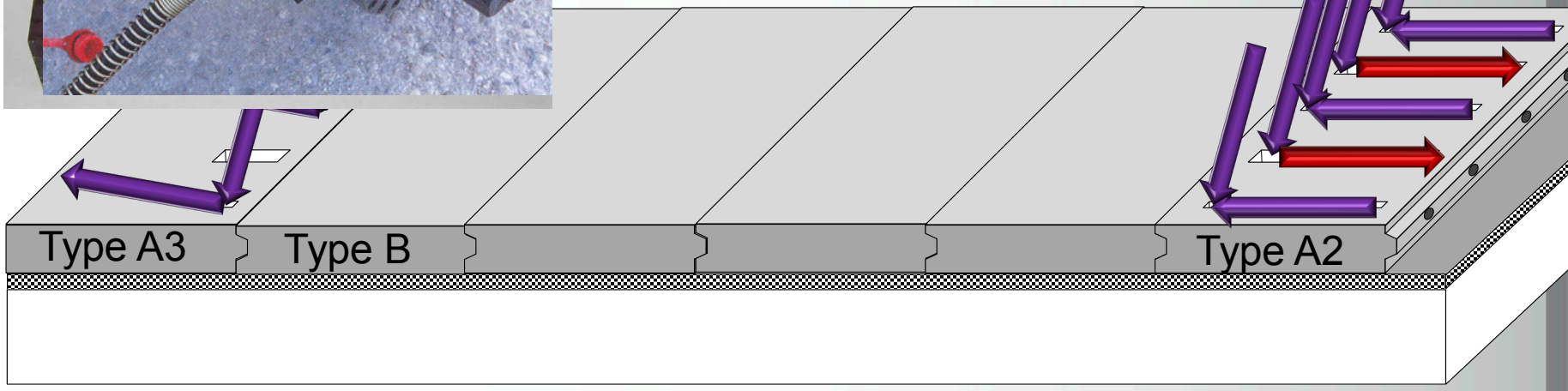

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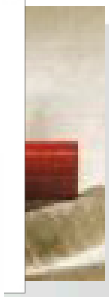
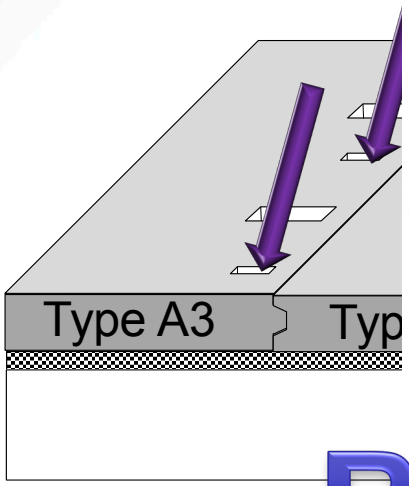
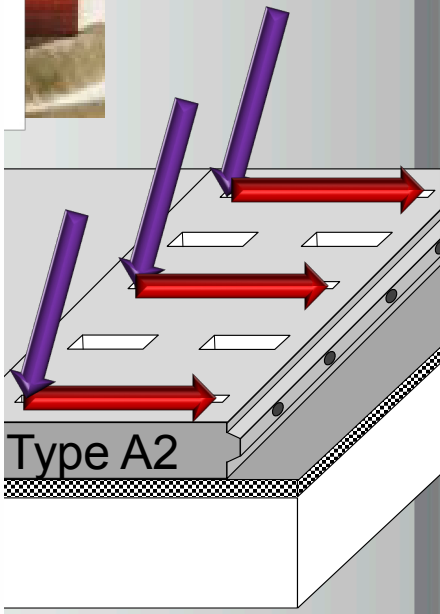






Repeat process…

COMPLETED / CURRENT / FUTURE PPCP PROJECTS

BU PT

DSI

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

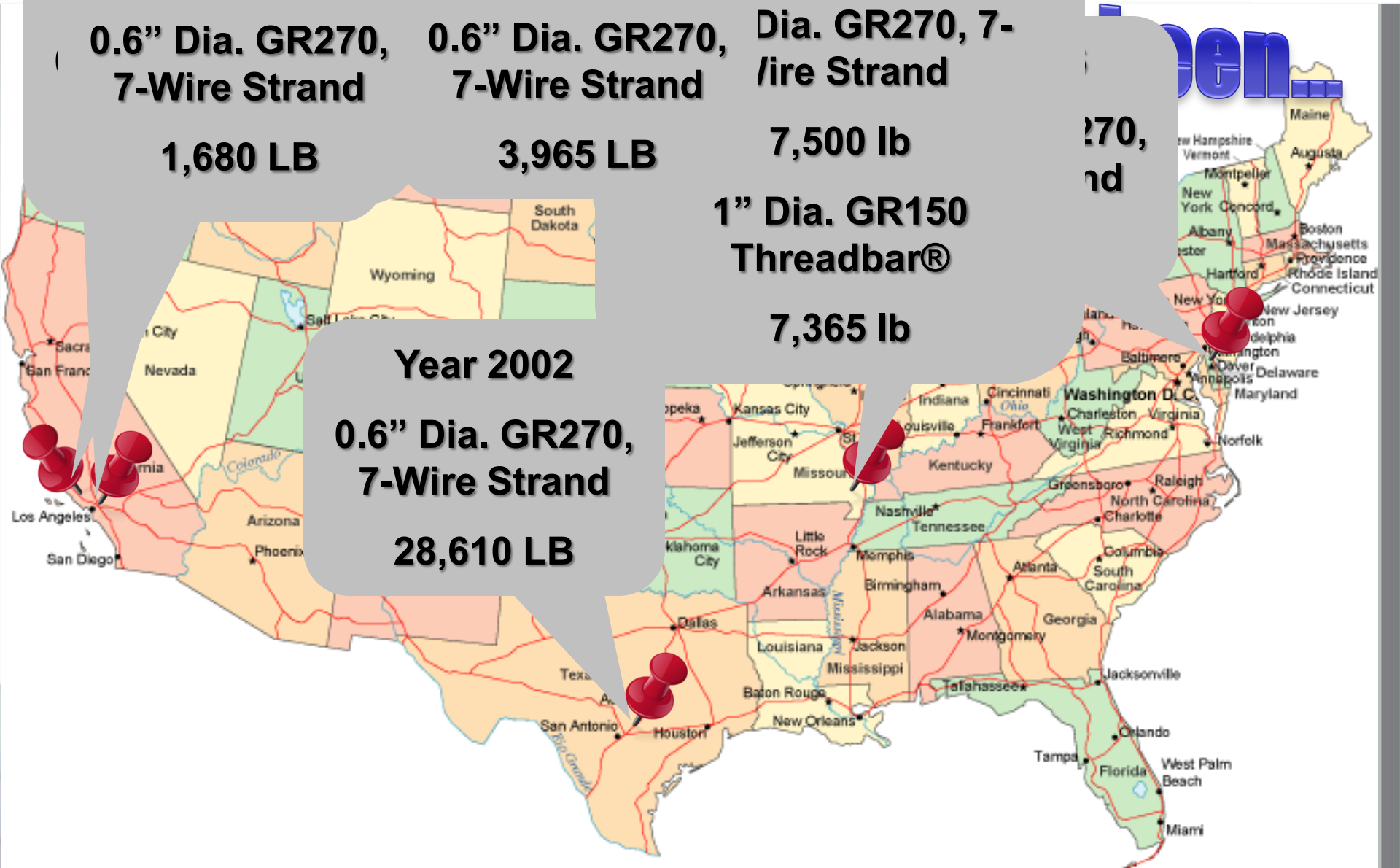
1” Dia. GR150 Threadbar®

7,365 lb

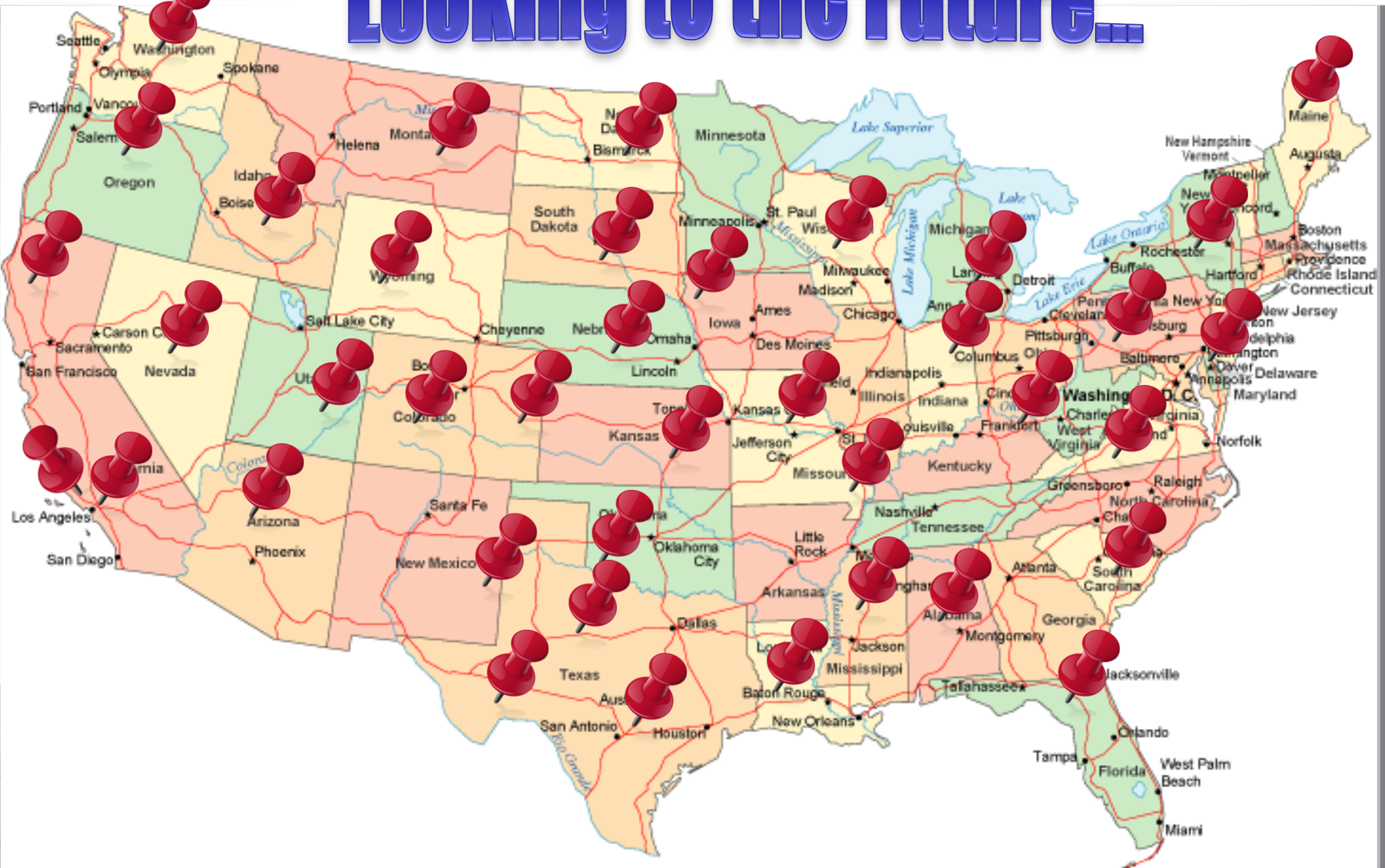
Year 2002

0.6” Dia. GR270, 7-Wire Strand

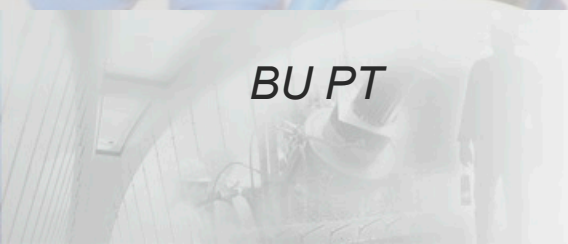
28,610 LB



Looking to the Future...

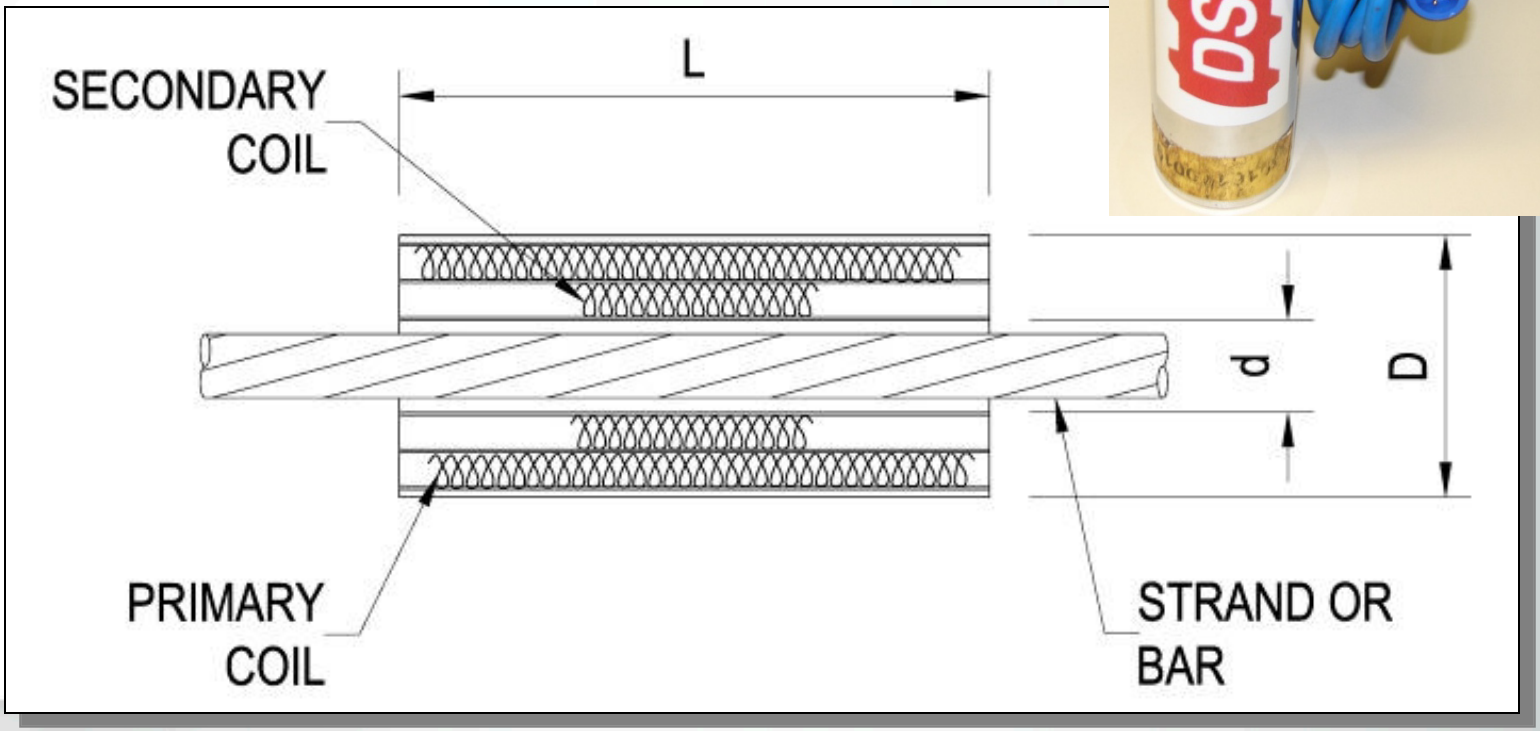


MONITORING POST-TENSIONING FORCES



BU PT

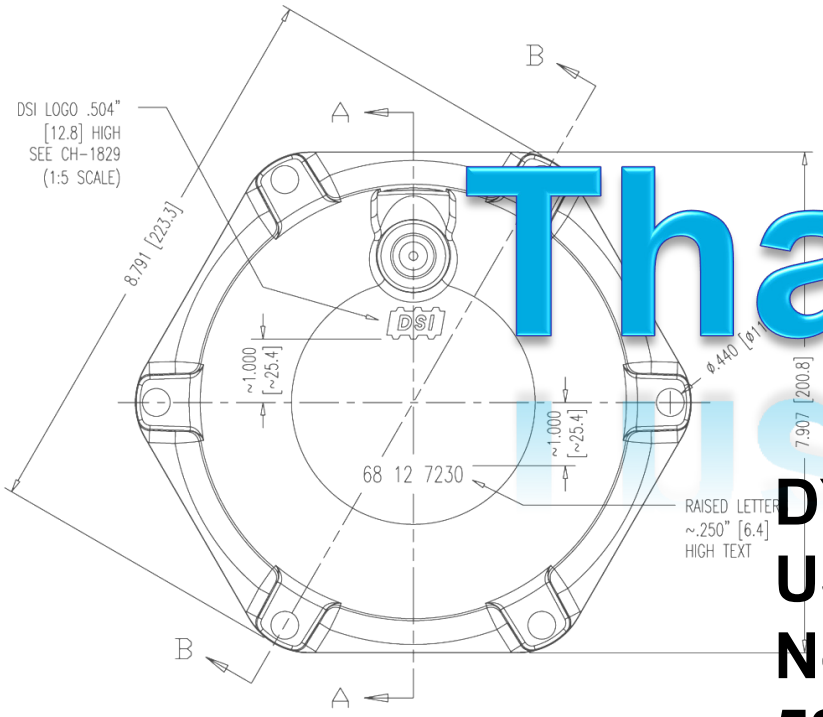
Dynaforce Force Monitoring



BU PT

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

BU PT

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 PSI @ 28 DAYS, 4,000 PSI RELEASE

FORMING SYSTEM

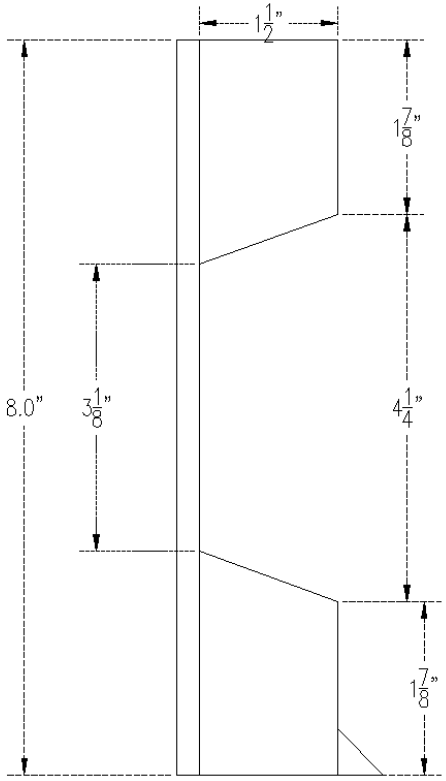
FORMING SYSTEM

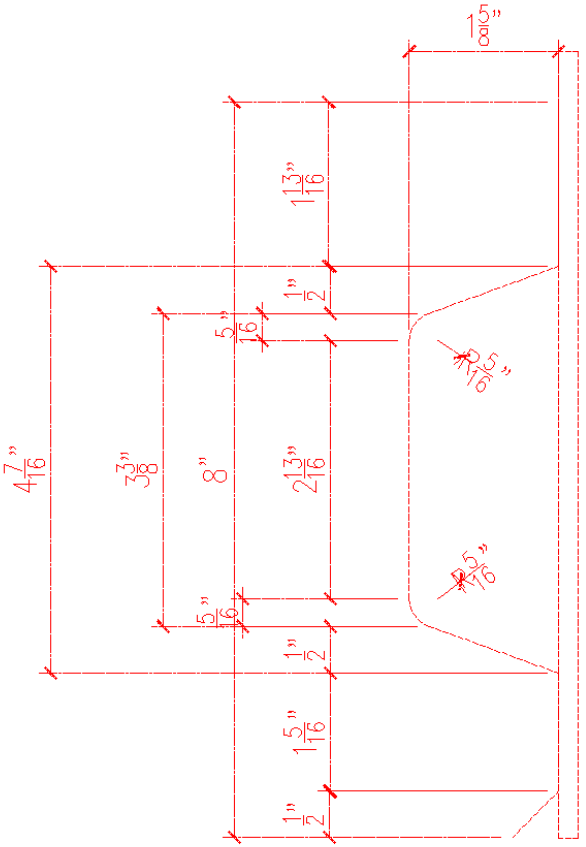
- 240 LF X 10’-0” WIDE CASTING BED
- ABLE TO CAST SIX PANELS PER CYCLE
- STEEL KEYWAYS ENSURE PROPER FIT UP OF MALE/FEMALE KEYS
- STEEL INTERMEDIATE BULKHEADS ENSURE PANEL EDGES ARE TRUE AND SQUARE
- TOP PORTION OF MALE KEYWAY BOLTED ON FOR RELEASE @ STRIPPING

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

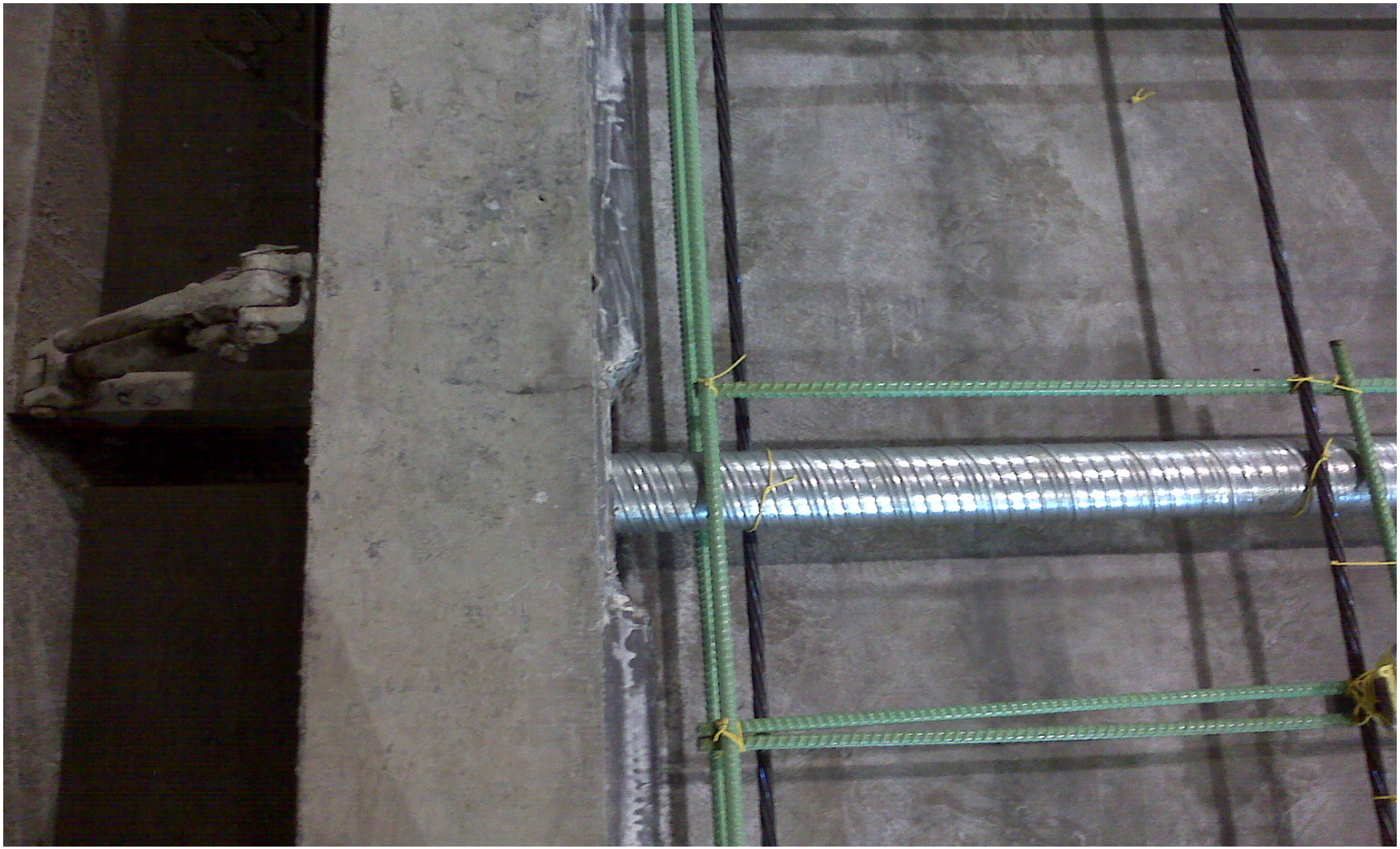
JOINT DETAILS





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

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
Applied Res. Assocs.
HfL Project Manager

U.S. Department of Transportation
Federal Highway Administration

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

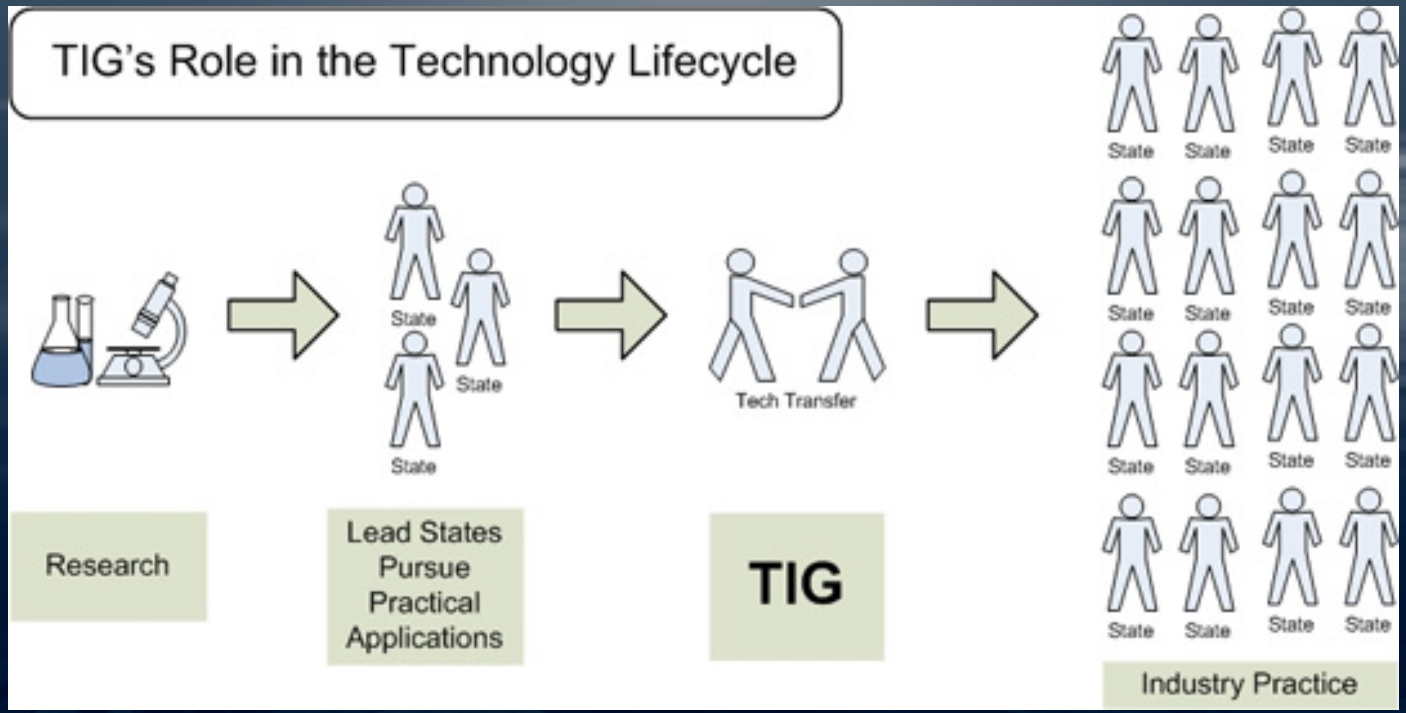
DRIVING INNOVATION FOR TRANSPORTATION

TIG

http://aashtotig.org

AASHTO TECHNOLOGY IMPLEMENTATION GROUP

TIG Lead States Team



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™

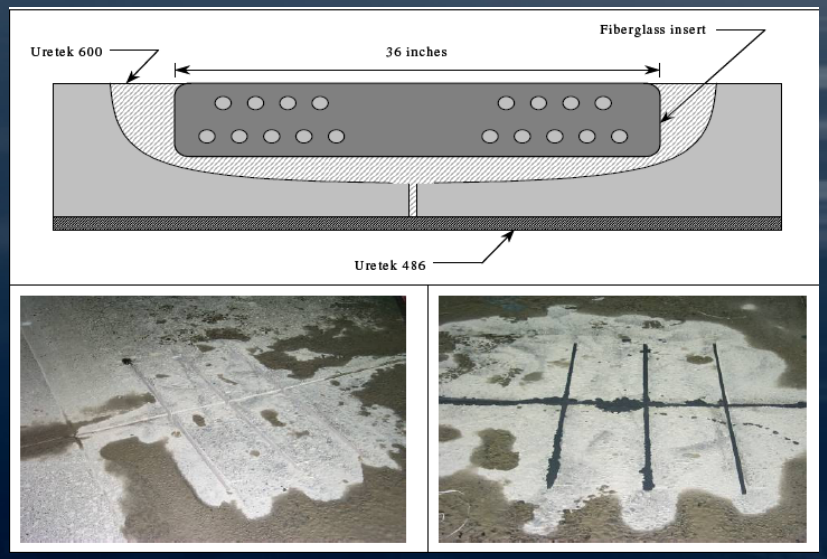
Uretek USA™

FDR/DBR

Kwik-Slab

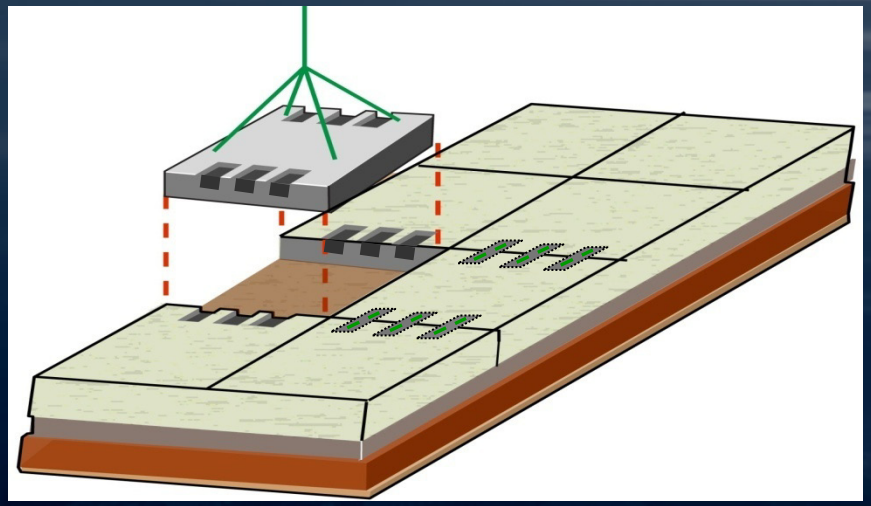
- Developed in Hawaii
- Joint steel couplers
- Reinforced slabs and designed for monolithic action
- Does not allow movement at joints – needs enhancements

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 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

U.S. Department of Transportation
Federal Highway Administration

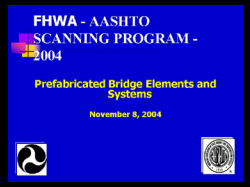
Precast/Prestressed Concrete Institute (PCI)

Highways for LIFE
Newark, Delaware
May 22, 2009

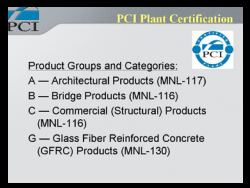
William Nickas, P.E.
Director, Transportation Systems
Precast/Prestressed Concrete Institute
Chicago, IL

Agenda

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



PCI Plant Certification



Cooperative Agreement with FHWA and PCI

FHWA - AASHTO SCANNING PROGRAM - 2004

Prefabricated Bridge Elements and Systems

SCAN MISSION

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

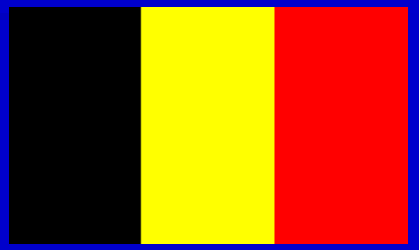
- Routine bridges with 20 ft – 140 ft spans
- Innovative systems
- Replacement and new highway and railroad bridges
- Including seismic considerations and emergency work

TOPICS OF INTEREST

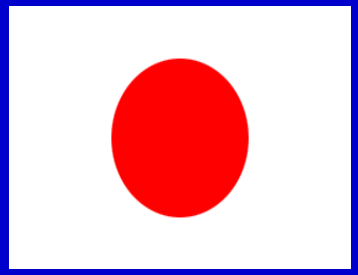
- Minimized traffic disruption (Congestion)
- Improved work zone safety
- Minimized environmental impacts
- Improved constructibility
- Improved product quality
- Lower life-cycle costs

SCAN COUNTRIES

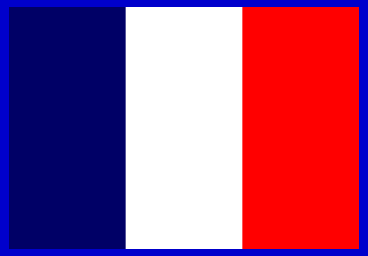
Netherlands



Belgium



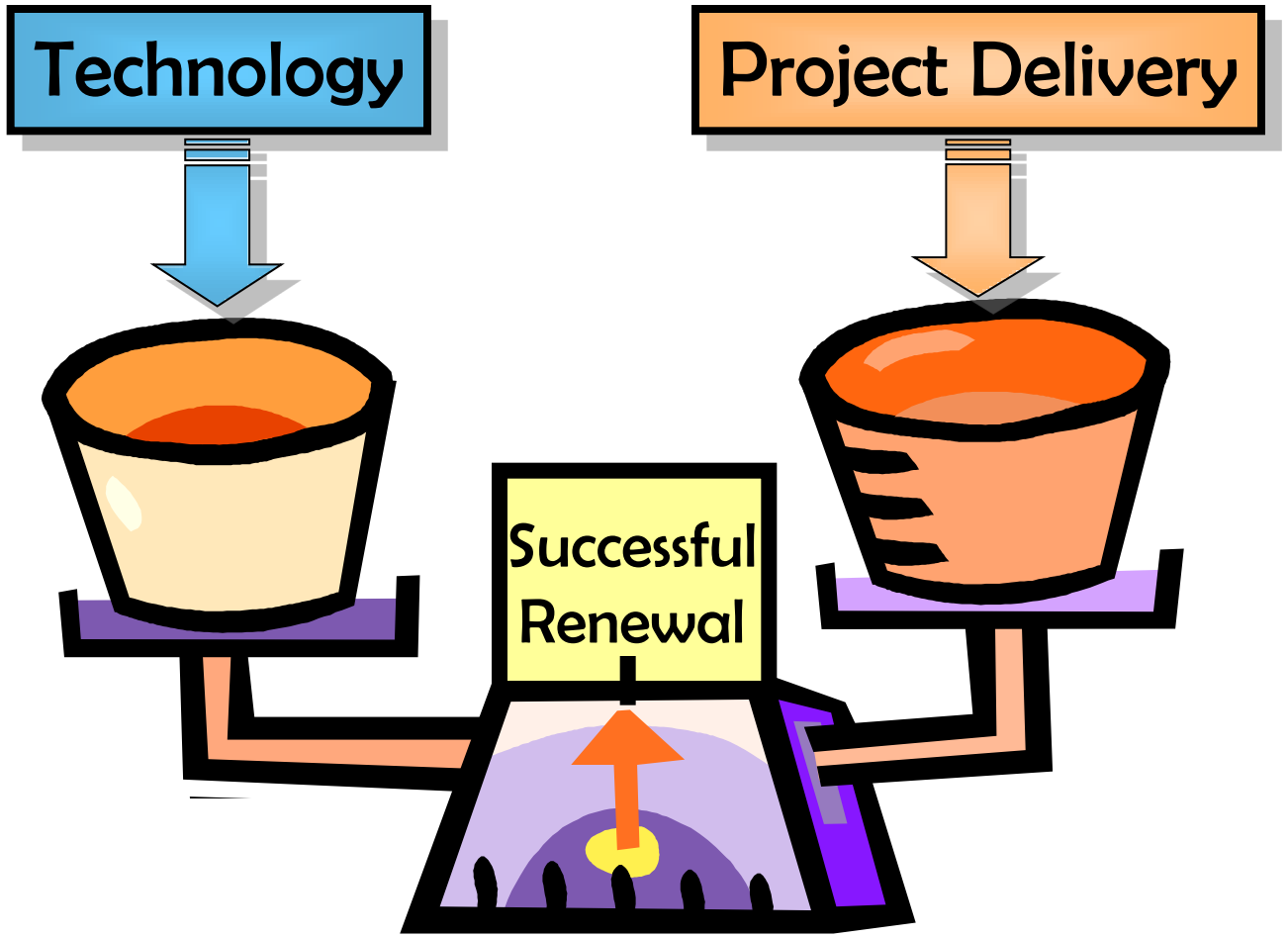
Japan



France

Germany

Integrated approach

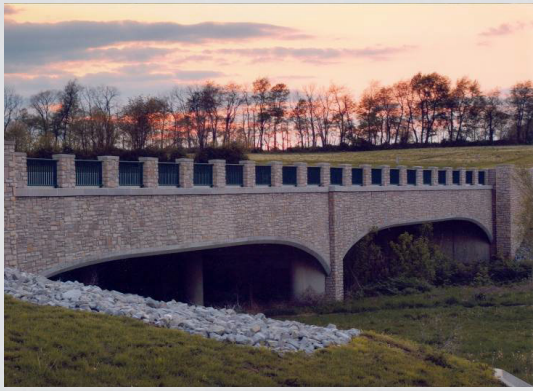


About PCI

- 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

About PCI

- 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



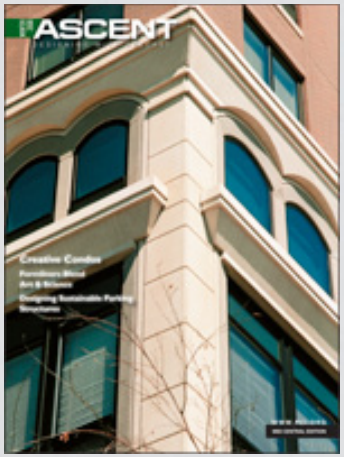
About PCI

- 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

About PCI

PCI Publications

- Design Manuals and Guidelines
- Quality Control Manual
- PCI Journal, Ascent, and Aspire Magazines



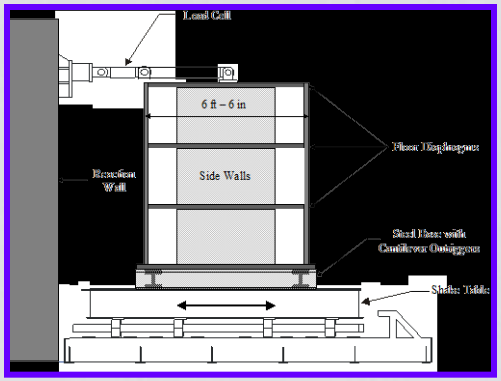
About PCI

- 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

U.S. Department of Transportation
Federal Highway Administration

About PCI

- Research & Development
  - DSDM Seismic Project
  - FHWA Precast Pavement Project



UCSD

About PCI

- PCI Regional Representation
  - 11 Regional Associations Affiliated with PCI
  - Mid-Atlantic Precast Association (MAPA)

PCI Certification Programs

PCI has 3 Different Certification Programs:

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

PCI Plant Certification

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

PCI Plant Certification

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)

PCI Plant Certification

Product Groups and Categories:

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

PCI Plant Certification

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

PCI Plant Certification

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

PCI Plant Certification

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

Illinois Department of Transportation
Milton R. Sees, Secretary

Texas Department of Transportation

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 states' needs

Engaging Industry – A Cooperative Approach

PCI

Precast/Prestressed Concrete Institute (PCI)

Federal Highway Administration (FHWA)

PRECASTING PLANTS

A manufacturing operation…

…not off-site construction!

PCI-FHWA Cooperative Agreement

"Advancement of Precast Prestressed Concrete Pavement System through Technology Transfer and Development of Industry Guidance for Design and Engineering"

PCI-FHWA Cooperative Agreement

This is a 4 year PROGRAM

Part A: Strategy for technology transfer

- agency/owner
- industry communities

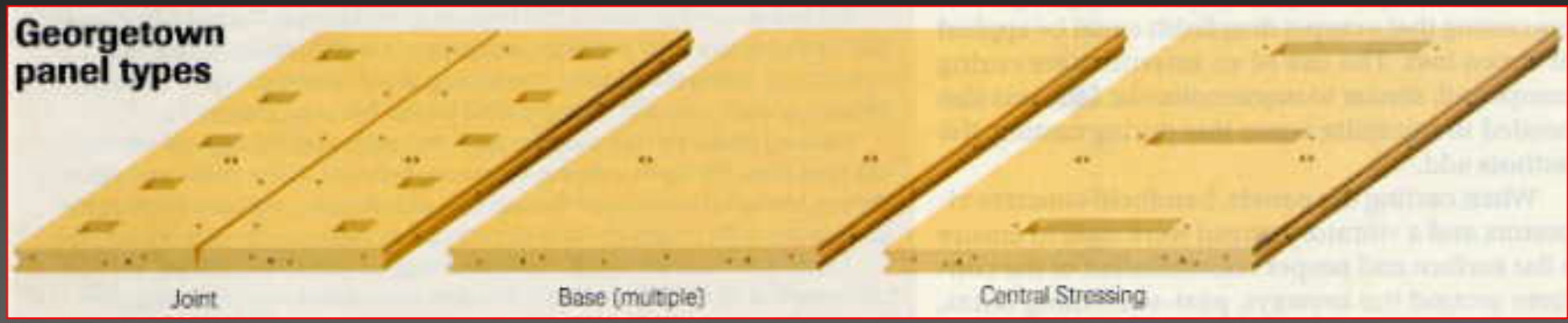
Part B: Development of industry guidance for design and engineering

PCI-FHWA Cooperative Agreement

- The Transtec Group
  - David Merritt
    - TxDOT Demonstration Project
    - Was also involved with the CalTrans I-10 in El Monte, CA

PCI-FHWA Cooperative Agreement

- Non-Proprietary
- Manufactured in PCI-Certified Plants
- "Precast Prestressed Concrete Pavements" (PPCP)



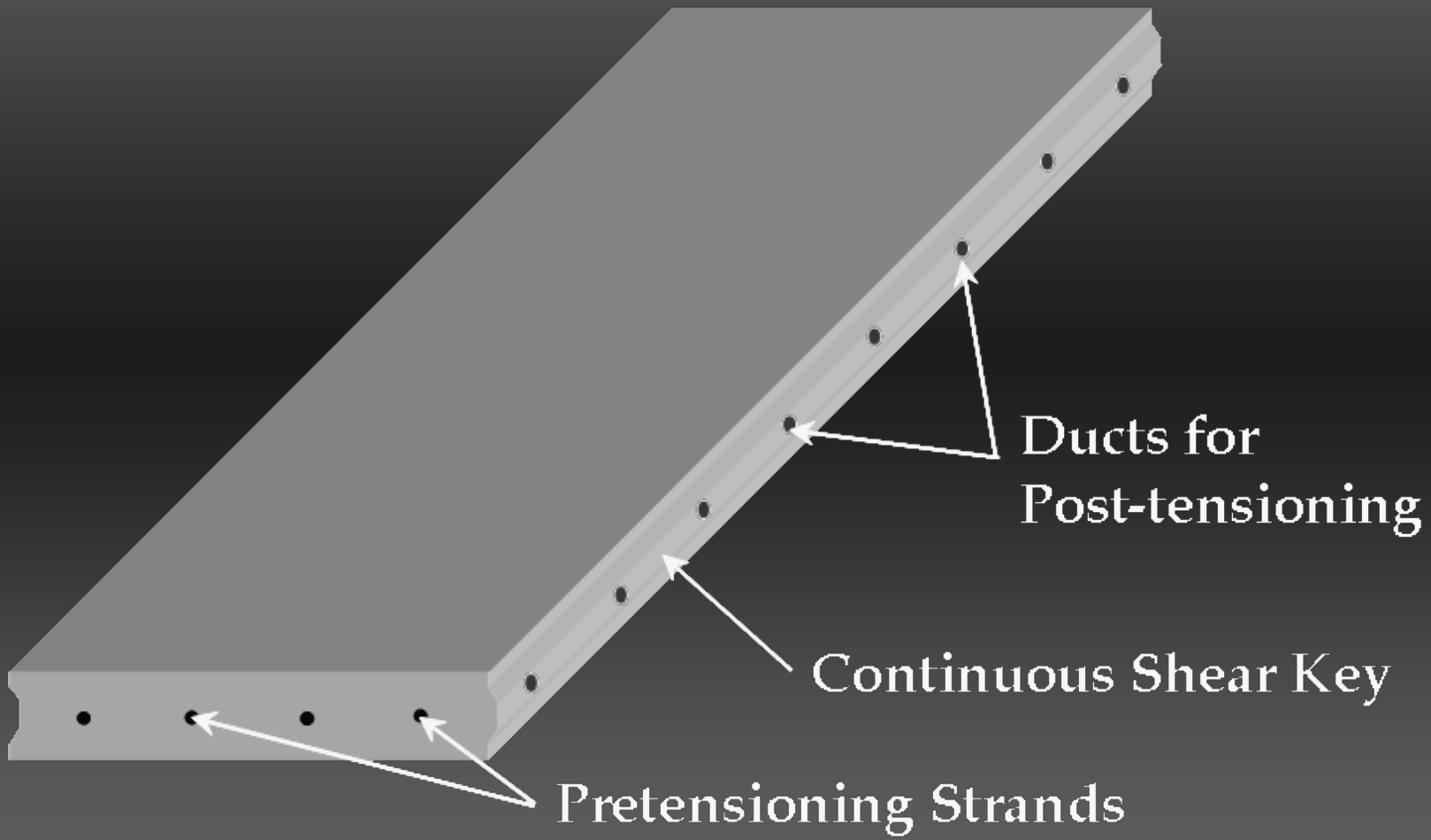
What is PPCP?

- *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.)

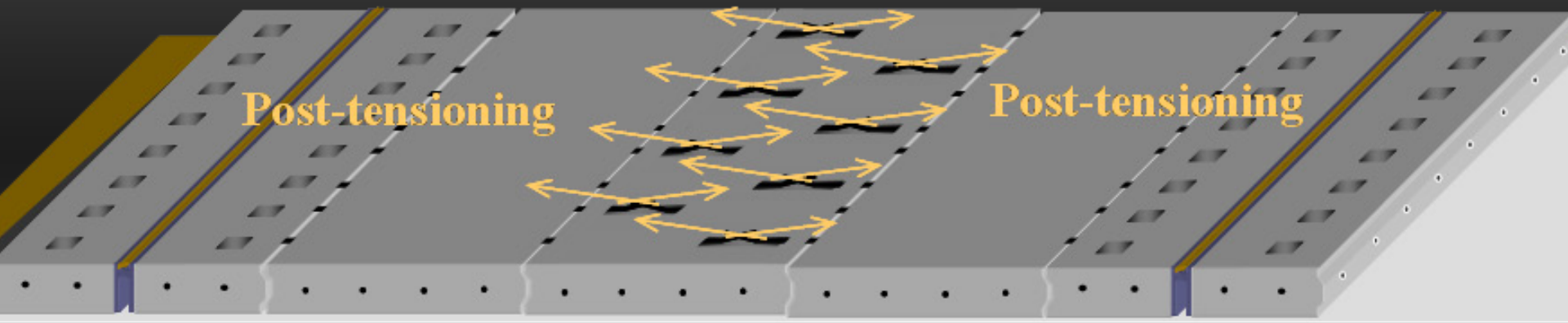
What is PPCP?

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

Typical PPCP Panel



Typical PPCP Panel Layout



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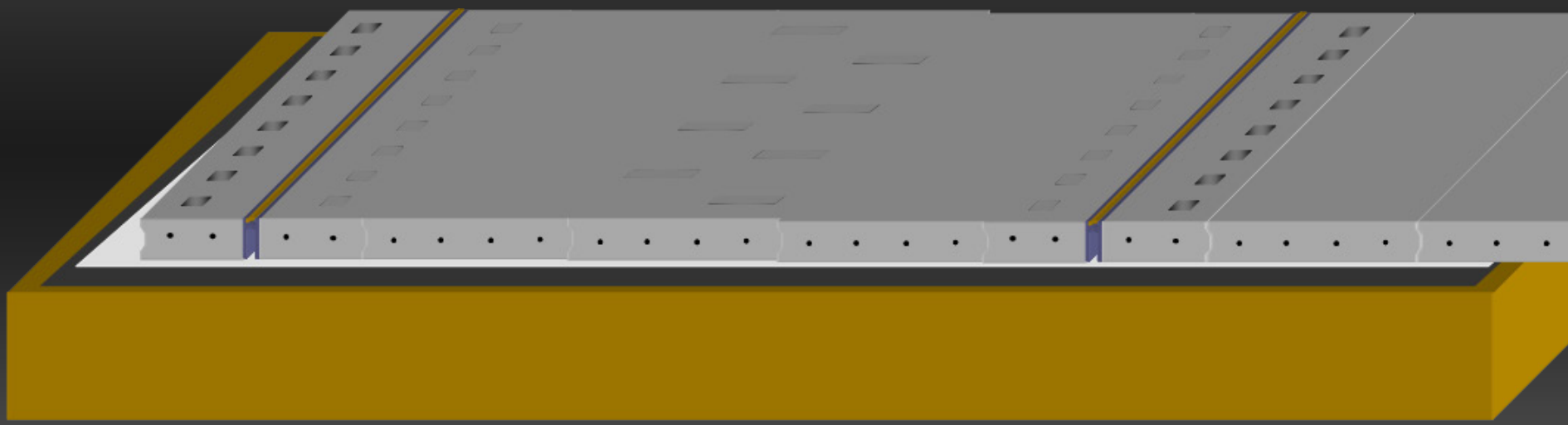

Benefits

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

Getting ready to post tension the PC pavement

PCI-FHWA Cooperative Agreement

- 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

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- 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

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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

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Selecting Applications for Precast Concrete Pavements (Volume1 of 4)

- Considerations for Selection
- Types of Applications
- Site Selection
- Agency Considerations
- Resources
- Appendix - Projects

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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

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Precast Pavement Panel Fabrication Recommendations (Vol. 3 of 4)

- Producer Qualifications
- Formwork
- Materials
- Prestressing
- Expansion Joints
- Concreting
- Lifting/Handling
- Acceptance Testing

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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

PCI-FHWA Cooperative Agreement

Cooperative Effort to Engage Industry and Agencies

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