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***PRECAST CONCRETE PAVEMENT PRACTICES -
GENERIC SYSTEM USE IN MICHIGAN, TEXAS &
CALIFORNIA***

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Presentation Focus

- Michigan PCP system – not used as developed; refined systems now in use
 - Development funded by FHWA & Michigan DOT
 - System developed by Michigan State researchers
- Texas PCP system – developed in-house by TxDOT
 - Implemented at a heavily loaded energy roads intersection
- Caltrans PCP system – developed by Caltrans engineers
 - Minor variations from project to project

Michigan PCP System

(FHWA/MIDOT funded Non-Proprietary System)

- For intermittent repair of jointed concrete pavements
- As conceived, applicable to repairs at joints (full lane width and about 6 ft long repair areas) and performed by DOT maintenance staff
- Panels to be fabricated at DOT maintenance yards, stored at the yards and used as needed
- Repair work to be performed by DOT maintenance staff between the rush hours during daytime
- Assumed installation rate – 8 to 10 panels/day

Michigan PCP System

- Panel geometry: Standardized as full width by 6 ft long. When repair areas are longer, two panels may be used side by side.
- Panel thickness: The precast panels to be 0.25 in. to 0.5 in. thinner than the existing concrete pavement to account for variable thickness of the existing pavement.
- Load transfer at transverse joints:
 - Dowels embedded in the precast panel and slots provided in the existing pavement.
- Bedding material:
 - A fast-setting cementitious flowable material placed before installation of the precast panel.
 - A fast-setting polymer-based material injected under the panel after installation of the panel.

Michigan PCP System

Panel Fabrication

Michigan PCP System

Michigan PCP System

Michigan PCP System

Michigan PCP System Performance

April 2010

Texas Energy Sector Intersection Application of PCP

Texas Oil and Gas Regions

Texas oil and gas fields

Texas has more than one-fifth of the world's drilling rigs operating and five major areas of oil and gas production. The Barnett Shale in North Texas was the first field where horizontal drilling and hydraulic fracturing were used to produce oil and gas from dense shale rock. Since then, drilling and production has ramped up in the Eagle Ford in South Texas, the Haynesville/Bossier Shale in East Texas and the Panhandle's Granite Wash, a tight sandstone. The Permian Basin, a historically prolific area for oil and gas production, has re-emerged as a complex field with drilling in multiple geologic horizons.

The Challenge - Heavily Loaded Traffic

Texas Energy Sector Intersection Application

*The Challenge:
Excessive rutting
in AC pavements
due to heavy truck
traffic*

The Intersection Demo Site

(Partially funded by FHWA/SHRP2 R05 IAP)

Texas Intersection PCP Demo (May 2016)

(Rehab of intersections damaged by energy trucks)

Bid/Cost Data

\$425/SY for Intersection
Construction = \$1,550,000

Estimated cost of precast
panel: \$200/SY

Preliminary panel cost: \$180 to
\$225 SY

TABLE OF PANEL QUANTITIES

PANEL	SIZE	NO.
P-1	8 x 18	78
P-2	8 x 12	39
P-3	8 x 18	118
TOTAL NO. OF PANELS		235
TOTAL AREA =		31,968.00 SQ.FT.
TOTAL NO. OF 1/2" x 14" LONG DOWEL BAR =		4,532

- Base layer: compacted subgrade and 4" HMA layer
- Panels placed directly over HMA layer
- "Generic" Panel Design
- 12" Thick Panels
- Panels pre-tensioned in the long direction.
- Doweled on all interior sides.
- Grout holes for filling voids beneath panels.
- Exterior panels anchored thru base layers.

Texas April 2016 Installation

Placed directly over a well-graded AC base

Caltrans PCP Use Evolution

Location	System	Phase
I-10 El Monte, Los Angeles	PPCP	Completed 2004
Research Center - APT	Super Slab	2005
I-15 Ontario, San Bernardino	Super Slab	Completed 2010
I-5/14 Sylmar, Los Angeles	PPCP	Completed 2010
I-680 San Ramon	PPCP & ISR	Completed 2012
I-710 Los Angeles	PPCP	Construction
I-80 Dixon, Solano	PPCP	Completed 2014
I-580 Alameda	PPCP & IPSR	Completed 2014
I-5 Los Angeles	PPCP & IPSR	Completed 2014
I-405 Los Angeles	PPCP	Construction
I-210 Los Angeles	PJCP, IPSR	Construction
101 (Section 1) Los Angeles	PJCP, IPSR	Completed
101 (Section 2) Los Angeles	PJCP, IPSR	Construction
I-605 Los Angeles	PJCP, IPSR	Construction
I-15 Cajon Pass, San Bernardino	PPCP or IPSR	Design
I-710 (Phase II) Los Angeles	PPCP	Design
210, 134, 101, 15 Los Angeles, San Bernardino	IPSR	Maintenance Projects
101 Santa Barbara	IPSR	Construction
I-15/215 San Bernardino	IPSR	Construction
57 Los Angeles	IPSR	Design

Caltrans PCP Use Evolution

- Prepared draft specifications
- Prepared draft Construction Details
- Developed a report on PCP design methodology
- Developed technical guidance
- Conducted workshops
- Pilot projects
- Production projects
- Requires a JITT – Just in Time Training before start of each new PCP project, by an approved instructor

SH 101 Case Study

U.S. Highway 101, is a north–south [U.S. highway](#) that runs through the states of California, Oregon, and Washington. It is also known as [El Camino Real](#) (*The Royal Road*).

The southern terminus of U.S. 101 is in [Los Angeles](#) at the [East Los Angeles Interchange](#), **the world's busiest freeway interchange.**

The Los Angeles portion of SH 101 consists of typically 4 lanes in each direction. The existing jointed concrete pavement was constructed in 1950s.

SH 101 Project Scope

Project Scope: Furnish & install continuous panels and repair panels along sections of SH101, typically along the two outside distressed truck lanes in each direction.

Work to include panel fabrication (including pretensioning), **existing pavement & base removal**, repair area preparation, installing panels and bedding system, and installing load transfer at transverse joints

Project owner: Caltrans, District 7

Contractor: OHL USA, Inc.

Precaster: ProCast products Inc., Highland, California

*The SH101 Project (Los Angeles Downtown)
July 2015 to On-Going*

The SH101 Project (Los Angeles Downtown)

Use of precast concrete panels to rehabilitate the outside two lanes in each direction along

Work Item

1. Remove base
2. Install precast concrete pavement – 10,000 cy (PJCP)
3. Install individual precast panel repairs – 1,350 cy (IPSR)
4. Grind concrete pavement – 306,000 sy

Overall Site Views

(typically 4 lanes in each direction; work in outside two lanes; heavy traffic; challenging work areas)

<< At Hollywood Blvd

Near Benton Way >>

Overall Site Views

(typically 4 lanes in each direction; work in outside two lanes; heavy traffic; challenging work areas)

At Northwestern Avenue >>

SH101 Project General Details

Panel installation started July 31, 2015

- Existing concrete pavement
 - 0.75 ft (9 in.) concrete slab
 - 0.45 ft (5.4 in.) LCB or CTB
- Work involves
 - Continuous panel installation (~90%)
 - **Standard panels: 12 ft wide, 16 ft (nominal) long**
 - Individual panel replacement
 - **Panel size: Variable width, 16 ft (nominal) long**
 - **Total no. of panels: ~2,300**
 - **Work duration: 200 (work) days – allowed to work Friday and Saturday nights only (from about 8 pm to about 5 am)**

SH101 Project General Details

- Panels
 - To be prestressed at plant
 - 28-day Concrete strength: 6,000 psi
 - Panels shipped to site after 14 days
 - Panel thickness & base type
 - Repair: 0.7 ft (8.40 in.)
 - Continuous: 0.8 ft (9.60 in.)
- Base type (New)
 - Repair: 0.05 ft (0.60 in.) Rapid Setting LCB
 - Continuous: 0.40 ft (4.80 in.) RSLCB

Panel Types (PJCP – A Series)

- A-PP: Approach panel (at beginning of a section)
- A: Center panel (most)
- A-DD: Departure panel (at end of a section)
- A-DBS: Departure panel (at end of a section) with bottom slots for dowel bars

Panel Types (PJCP – A Series)

- A-PP: Approach panel (at beginning of a section)
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Panel Types

(PJCP – A Series; Trapezoidal)

- AR2: 2,000 ft radius to the right
- AR4: 3,500 to 4,000 ft radius to the right
- AL2: 2,000 ft radius to the left
- AL4: 3,500 to 4,000 ft radius to the left

Typical Panel Details

(Load transfer details vary between panel types)

REBAR	NAME	QTY.
#4 @ TOP & BOT.	U-BARS	4
#4 @ TOP & BOT.	A-BARS	8
1/2" STRAND	STRAND	10

STRAND/POCKET LAYOUT SIDE VIEW "A1"
SCALE: 3/8"=1'-0"

PANEL "IA" (IPSR) "APPROACH"
SCALE: 3/8"=1'-0"

REBAR/STRAND LAYOUT SECTION "B"
SCALE: 3/8" = 1'-0"

POCKETS/ GROUT PORTS/ LIFTING ANCHORS

STATE HIGHWAY
101
CT# 07-205504

OHL
1820 Main Street, Suite 310
Irvine, CA 92614
Tel: (949) 242-4432

DATAWRTD	R.MICH	7/17/2019
REVISED DT	R.MICH	08/16/2019
CHANGED DT	M.J.	6/1/2018
CHECKED DT	D.J.	06/1/2018
REMARKS DT	D.J.	07/03/2018
APPROVED		
PLT DATE		
REVISION		

PROJECT NO. 14-209

(IPSR) PRE-STRESSED
PANEL "IA"

IA

Typical Panel Details

Load Transfer Details (At Joints)

(1-1/2 in. diam. dowel bars)

Load Transfer Details (At Joints)

(1-1/2 in. diam., 18 in. long dowel bars)

Polyester Grout for Dowel Bar Slots

➤ As per Section 41-8.03I

Time to reach 1250 psi compressive strength (hours:minutes)	Minimum opening age ^a (hours:minutes)
0:10–1:29	2:15
1:30–1:49	2:30
1:50–2:09	2:45
2:10–2:29	3:00
2:30–2:49	3:15
2:50–3:09	3:30
3:10–3:29	3:45
3:30 or more	4:00

^aDuring placing, determine the initial set time for polyester concrete under California Test 551. Add 2 minutes to the minimum opening age for each 1 minute that the initial set time exceeds 30 minutes.

Panel Layout Example

SH 101 Project – Panel Fabrication

Panel Dimensional Tolerances

PJCP Panel Fabrication

Dimension	Tolerances
Length (longer dimension)	+/- 1/4 inch
Width (shorter dimension)	+/- 1/8 inch
Nominal thickness	+/- 1/16 inch
Edge alignment straightness measured from a horizontal plane	+/- 1/8 inch
Skew at the ends	+/- 1/8 inch
Batter	+/- 1/16 inch
Position of pre-tensioning strands	+/- 1/8 inch, vertical ^a
	+/- 1/8 inch, horizontal
Diagonal difference of the corner to corner measurement	+/- 1/8 inch
Position of lifting anchors	+/- 3 inches

^aMeasured from the bottom of the panel

Panel Dimensional Tolerances

Installing the Panels

- Pre-sawcut the repair areas (few nights before)
- Remove existing pavement
- Prepare base
- Attach foam boards (filler boards) along the transverse and longitudinal joint faces (except at keyway faces)
- Inject bedding grout under the panels
- Apply polyester grout into dowel bar slots
- Fill longitudinal joint gap with bedding grout
- Seal joints
- Grind roadway surface

Gracie Levelling Lift for Setting Panels

Underslab Grout

Proportion grout for under slab grouting under ASTM C938 or use prepackaged grout complying with ASTM C1107. Fine aggregate, if used, must meet grading 2 in ASTM C637. Proportion the ingredients of the grout to meet the following properties:

Quality Characteristic	Test method	Requirement
Strength at 1 hr:	ASTM C942	
@73°F		2500 PSI Min
@45°F		2000 PSI Min
Strength at 7 days	ASTM C942	
@73°F		7600 PSI Min
@45°F		6000 PSI Min
Expansion	ASTM C940	0 to 3%
Bleeding at 30 min	ASTM C940	0.1% Max
Eflux Time	ASTM C939	15 to 30 seconds
Grout Bond Strength, bond to dry PCC	CT 551	150 PSI Min in 24 hr
Note: For tests at 45°F condition materials to 45°F for 24 hr before fabrication and store specimens at 45°F until testing		

SH 101 Project – Installation – 2015/16

Rapid setting LCB →

Panel Setting Process

- Embedded dowel bars slid into the receiving slot in the previously placed pane

DEPARTURE SETTING PROCESS
SOLOTEC

FREE LAY FOR DOWEL DETAILS

Submitted for Record: 6/16/15

SH 101 Project – Installation – 2015/16

Panel Installation Tolerances

Need to maintain tighter joint width

SH 101 Summary

- Work completed during Spring 2016.
- Contractor maintained installation at the rate of up to 50 panels per night.

Caltrans Current Projects

- I-210 project in the LA area – thin shims being used with bedding grout; also, modified dowel slot (generic slot design)
- Panels are prestressed in one direction

Caltrans Current Projects

- Several projects starting out later this year (2016) will use the Fort Miller's bottom slot design with a levelling lift system and bedding grout

Summary

- PCP performance to-date indicate that well-designed and well-constructed PCP systems can be installed rapidly and can be expected to provide long-term service
- Precast concrete pavement technology is an implementable technology and continues to evolve.
- And, more highways agencies are finding PCP technology to be an important strategy for rehabilitating distressed highway pavements.