

PRECAST CONCRETE PAVEMENT TECHNOLOGY MARKETING PLAN FOR IMPLEMENTATION OF PRODUCTS FROM SHRP2 PROJECT R05



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16. Abstract <p>This project is a national effort to support the implementation of products developed under the recently completed Strategic Highway Research Program 2 (SHRP2) Project R05 on Precast Concrete Pavement Technology. Managed by the Federal Highway Administration (FHWA) through partnership with the American Association of Highway and Transportation Officials (AASHTO), the goals of this project are to accelerate the implementation of PCP technology for rapid repair and rehabilitation of the nation's highway system, thereby reducing construction related congestion, improve safety, lower life cycle costs, improve performance of repair and rehabilitation treatments, and foster innovation.</p> <p>The PCP technology products were identified and detailed in the final report for SHRP2 Project R05, published during early 2013. The Project R05 products for jointed and prestressed (post-tensioned) PCP systems include best practices guidelines for:</p> <ul style="list-style-type: none"> ● PCP design. ● PCP fabrication. ● PCP installation. ● PCP project selection. ● PCP system acceptance. <p>These guidelines (products) and other recently developed related products are implementation-ready. This marketing plan provides an overall framework for carrying out activities that will support delivery and implementation of these promising PCP technology products.</p> <p>A technical report summarizing the discussions from a FHWA PCP Expert Task Group meeting held in Washington, DC, March 5-6, 2014 is attached as Appendix B. The marketing plan implementation activities will incorporate the discussions from the ETG meeting.</p>			
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PREFACE

This project is an integrated, national effort to encourage the wider adoption of the precast concrete pavement technology by highway agencies and industry. PCP technology provides for accelerated repair and rehabilitation of pavements and results in durable and longer-lasting pavements. Use of PCP technology can significantly minimize the impact of construction on the driving public, as lane closures and traffic congestion within the work zone are kept to a minimum. Additionally, the use of PCP can lower life cycle costs by improving the performance of repair and rehabilitation treatments. Safety is also improved by reducing road users' and workers' exposure to construction traffic.

During 2008, SHRP2 Project R05 was authorized and funded to develop the necessary information and guidelines that would help encourage the rapid and successful adoption of the new PCP technologies. Under Project R05, the project team reviewed the state of PCP practice, identified gaps in technology, evaluated the performance of constructed PCP projects, interacted with stakeholders, and developed best practices guidelines for project selection and PCP system approval, and for design, fabrication, and installation of PCP systems. In addition, the project team identified refinements and new applications to advance the implementation of PCP technologies. The Project R05 study demonstrated that the PCP technology is ready for wider implementation and that PCP systems available in the US can meet the needs of highway agencies for rapid renewal of their highway systems.

The FHWA, as part of its congressionally mandated role to improve mobility on our nation's highways through national leadership, innovation, and program delivery, has been actively involved in supporting the implementation of PCP technology. Recently, FHWA awarded a contract to ARA to support implementation of SHRP2 Project R05 PCP technology products. The PCP technology product implementation marketing plan, presented in this document, has been developed to provide an overall framework for the many activities that are expected to be performed under the FHWA contract.

TABLE OF CONTENTS

CHAPTER 1 – INTRODUCTION	1
INTRODUCTION	1
PCP OVERVIEW	3
CONSIDERATIONS FOR PRECAST CONCRETE PAVEMENT USE	4
PCP TECHNOLOGY IMPLEMENTATION GOALS	5
CHAPTER 2 – PCP TECHNOLOGY BACKGROUND.....	7
PCP CURRENT PRACTICES	7
PCP APPLICATION TYPES.....	7
PCP PRODUCT CATEGORIES.....	10
CHAPTER 3 – PCP PRODUCTS MARKETING STRATEGIES	11
INTRODUCTION	11
TARGET RECIPIENTS OF PCP PRODUCTS.....	12
PROPOSED MARKETING STRATEGIES	12
PARTNERING WITH INDUSTRY ASSOCIATIONS.....	14
OVERALL CHRONOLOGY OF THE MARKETING PLAN.....	14
SUMMARY	15
CHAPTER 4 – PCP MARKETING PLAN.....	17
INTRODUCTION	17
PCP PRODUCT MATRIX.....	20
TIMELINE FOR PCP PRODUCTS FOR DEPLOYMENT	20
CHAPTER 5 – RECOMMENDATIONS AND SUMMARY	21
REFERENCES	23
APPENDIX A – PCP PRODUCT IMPLEMENTATION MATRIX BY CATEGORY AND AVAILABILITY	25
APPENDIX B – REPORT OF THE MARCH 2014 MEETING OF THE FHWA EXPERT TASK GROUP ON IMPLEMENTATION OF PRECAST CONCRETE PAVEMENT TECHNOLOGY	33
EXECUTIVE SUMMARY	33
INTRODUCTION	33
SHRP2 PROJECT R05 PRODUCTS	34
FHWA EXPERT TASK GROUP ON PROJECT R05 PRODUCTS IMPLEMENTATION..	34
MARCH 2014 EXPERT TASK GROUP MEETING.....	36
SHRP2 PROJECT R05 IMPLEMENTATION PROGRAM OVERVIEW	38

FHWA IMPLEMENTATION SUPPORT CONTRACT	40
PCP IMPLEMENTATION MARKETING PLAN	42
FIRST ETG OPEN DISCUSSION (DAY 1).....	43
TASK FORCE ON PLANNING AND DESIGN.....	45
TASK FORCE ON FABRICATION AND INSTALLATION	46
TASK FORCE ON SYSTEM ACCEPTANCE AND NEW DEVELOPMENTS	47
IMPLEMENTING AT THE HIGHWAY AGENCY.....	48
THE INDUSTRY ROLE IN PROMOTING IMPLEMENTATION	49
INDUSTRY PERSPECTIVE: WHERE DO CONTRACTORS FIT IN?	50
SECOND ETG OPEN DISCUSSION (DAY 2)	51
FHWA CONTRACTOR PLANS FOR 2014	53
ADJOURNMENT.....	54

LIST OF FIGURES

Figure 1. Schematic. Intermittent repair.	8
Figure 2. Photo. Installation of intermittent repair.	8
Figure 3. Photo. Example of JPrCP application.	9
Figure 4. Schematic. Illustration of three PPCP systems.	9

LIST OF TABLES

Table 1. Implementation package for category 1 – warrants for PCP considerations.	26
Table 2. Implementation package for category 2 – design procedures and design details.	26
Table 3. Implementation package for category 2 – design procedures and design details (additional products).	27
Table 4. Implementation package for category 3 – panel fabrication.	28
Table 5. Implementation package for category 3 – panel fabrication (additional products).	29
Table 6. Implementation package for category 4 – panel installation and workforce training.	29
Table 7. Implementation package for category 4 – panel installation and workforce training (additional products).	30
Table 8. Implementation package for category 5 – PCP systems acceptance.	31
Table 9. Implementation package for category 6 – construction plans and specifications.	32
Table 10. Implementation package for category 6 – construction plans and specifications (additional products).	32

ABBREVIATIONS AND ACRONYMS

AASHTO	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute
ACPA	American Concrete Pavement Association
AIPT	Accelerated Implementation and Deployment of Pavement Technologies
ARA	Applied Research Associates, Inc.
CPCP	Concrete Pavement Technology Program
DOT	department of transportation
ETG	expert task group
FHWA	Federal Highway Administration
FWD	Falling weight deflectometer
HVS	Heavy vehicle simulator
IAP	Implementation Assistance Program
ICPCP	incrementally connected precast concrete panel
JPrCP	jointed precast concrete pavement
MAP-21	Moving Ahead for Progress in the 21st Century Act
MEPDG	Mechanistic-Empirical Pavement Design Guide
MSE	mechanically stabilized earth
NPCA	National Precast Products Association
PCC	portland cement concrete
PCI	Prestress/Precast Concrete Institute
PCP	precast concrete pavement
PCPT	precast concrete pavement technology
PPCP	precast prestressed concrete pavement
PTI	Post-Tensioning Institute
SHRP2	Second Strategic Highway Research Program
TRB	Transportation Research Board

CHAPTER 1 – INTRODUCTION

INTRODUCTION

Pavement rehabilitation and reconstruction, major activities for all US highway agencies, have a significant impact on agency resources and traffic disruptions because of extensive and extended lane closures. The traffic volumes on the primary highway system, especially in urban areas, have seen tremendous increases over the last 20 years, leading in many instances to an earlier-than-expected need to rehabilitate and reconstruct highway pavements. Pavement rehabilitation in urban areas is resulting in serious challenges for highway agencies because of construction-related traffic congestion and safety issues. Agencies continue to investigate alternative strategies for pavement rehabilitation and reconstruction that allow for faster and durable rehabilitation and reconstruction of pavements. A promising alternative strategy is the effective use of precast concrete pavement (PCP) technology that provides for accelerated repair and rehabilitation of pavements and results in durable, longer-lasting pavements. Accelerated construction techniques can significantly minimize the impact on the driving public, as lane closures and traffic congestion are kept to a minimum. Safety is also improved by reducing road users' and workers' exposure to construction traffic.

PCP technologies had been considered in the US over 50+ years ago. At that time, the technology was considered as a matter of technical curiosity, that is, to investigate if the PCP technology was technically feasible. No serious attempts were made then to fully develop the technology as a cost-effective pavement rehabilitation strategy and to implement the technology on a production basis. Today, as more roadways are reaching maturity and the need for timely repair and rehabilitation becomes acute and urgent, highway agencies are looking at new technologies that will result in shorter lane closures and long-life pavements that are economical over the life cycle and do not require major interventions for repair or rehabilitation during their service life. Over the last 10+ years there have been significant developments in PCP technologies, and the use of these technologies is becoming technically feasible and economically justifiable. The installed PCP price has dropped more than 50% over the last 10 years.

The Renewal focus area under the recently completed Second Strategic Highway Research Program (SHRP2) emphasized the need to complete highway pavement projects quickly, with minimal disruption to the users and local communities, and to produce pavements that are long-lasting. The goals of this focus area included applying new methods and materials for preserving, rehabilitating, and reconstructing roadways. The effective use of PCP technologies for rapid repair, rehabilitation, and reconstruction of pavements addresses this goal. Since interest in PCP technology has been renewed (which began in earnest since about 2000), several highway agencies in the US have begun to implement the technology, and a few others have constructed demonstration projects. The implemented PCP systems include both proprietary and non-proprietary systems.

Because the PCP technology is relatively new and the information on PCP practices and performance was not well documented, as of 2007 many highway agencies and industry partners

had not fully embraced the technology. SHRP2 Project R05 was authorized and funded in 2008 to develop the necessary information and guidelines that would help encourage the rapid and successful adoption of the new PCP technologies. Under Project R05, the project team reviewed the state of PCP practice, identified gaps in technology, evaluated the performance of constructed PCP projects, interacted with stakeholders, and developed best practices guidelines for project selection, design, fabrication, installation, and rehabilitation of PCP systems. In addition, the project team identified refinements and new applications to advance the implementation of PCP technologies. The Project R05 study demonstrated that the PCP technology is ready for wider implementation and that many of the PCP systems available in the US can meet the needs of highway agencies for rapid renewal of their highway systems. The review of projects constructed in the US and the SHRP2 field testing indicated that sufficient advances have been made to reliably design and construct PCP systems to achieve five key attributes of successful pavements, as follows:

- Constructability – Techniques and equipment are available to ensure acceptable production rates for the installation of PCP systems.
- Concrete durability – Plant fabrication of precast panels results in excellent concrete strength and durability.
- Load transfer at joints – Reliable and economical techniques are available to provide effective load transfer at transverse joints in jointed PCP systems and post-tensioned PCP systems.
- Panel support – Techniques to provide adequate and uniform base support conditions continue to be improved.
- Efficiency – Panels are thinner than standard cast-in-place concrete and last longer because of prestressing and/or reinforcing elements in the PCP system.

The following products, incorporated in the final report, were developed under SHRP2 Project R05:

- Overall findings related to viability of the PCP technology.
- Findings based on SHRP2 field testing.
- Guidelines for PCP project selection.
- Guidelines for PCP system acceptance.
- Guidelines for design of PCP systems.
- Guidelines for PCP fabrication.
- Guidelines for PCP installation.
- Implementation plan for PCP technology.
- Long-term monitoring plan for PCP projects.
- Model specifications.

The Federal Highway Administration (FHWA), as part of its congressionally-mandated role to improve mobility on our nation's highways through national leadership, innovation, and program delivery, has been actively involved in supporting the implementation of PCP technology. FHWA currently conducts its Pavement Technology Program as authorized under the Moving Ahead for Progress in the 21st Century Act (MAP-21). Within that program, FHWA's Accelerated Implementation and Deployment of Pavement Technologies (AIPT) Program

accounts for a significant portion of MAP-21 funds; and, the deployment, delivery, and implementation of advanced concrete pavement technology products, including PCP technology products are key elements of FHWA's AIPT program efforts to improve the long-term performance of portland cement concrete (PCC) pavements. It is expected that the PCP technology products will help us move forward in our quest to provide safer, smoother, sustainable, environmentally sensitive, and longer lasting concrete pavements. Recently, FHWA awarded a contract to Applied Research Associates, Inc. (ARA) to support implementation of SHRP2 Project R05 PCP technology products. The PCP technology product implementation marketing plan, presented in this report, has been developed to provide an overall framework for the many activities that are expected to be performed under the FHWA project.

The PCP technology product implementation marketing plan is targeted to support the wider adoption of the PCP technologies by highway agencies, which will in turn, encourage greater participation in PCP work by precasters, system suppliers, and contractors that will facilitate innovations in the technology and lead to higher installation productivity and efficiency in the field, durable PCP systems and a more competitive bidding environment.

PCP OVERVIEW

PCPs use prefabricated concrete panels for rapid repair of concrete pavements and for rehabilitation of concrete and asphalt pavements. PCPs may also be used for reconstruction or as an overlay. A generic definition of a PCP system is as follows:

Precast concrete pavement systems are fabricated or assembled off-site, transported to the project site and installed on a prepared foundation (existing pavement or regraded foundation). The system components require minimal field curing to achieve strength before opening to traffic.

The application of PCP technology offers the following benefits:

- Rapid installation for reduced congestion and traffic maintenance costs.
- Safer work zones through reduced exposure for workers and drivers.
- Traffic-ready upon installation, requiring no curing time for the concrete panels and very little curing time for grout materials.
- Panels are cast in precast plants under ideal conditions for optimum concrete and construction quality.
- Typically installed at night and can be installed under marginal weather conditions, thus optimizing lane closures and extending the construction season.
- Can significantly extend service life of distressed pavements.
- Concrete durability is typically better than fast-setting cast-in-place treatments.

PCP systems are used in highway corridors with high traffic volume and where lane closures are a challenge. The PCP work is performed during the night and with short lane closures, typically between 8 p.m. and 6 a.m. The current production rate per lane closure is about 15 to 20 repair locations and about 300 to 600 ft lengthwise for continuous rehabilitation. Once installed, precast concrete pavements can be expected to behave, under traffic and environmental loadings,

similarly to cast-in-place concrete pavements. The primary difference between the two technologies is how each pavement type is constructed. The main advantage of PCP is that it is a truly rapid rehabilitation technology that is also durable. In addition, prestressing and higher concrete strength allow the precast concrete panels to achieve higher load-carrying capacity within a constrained pavement cross section when reconstructing existing pavements.

CONSIDERATIONS FOR PRECAST CONCRETE PAVEMENT USE

For highway agencies investigating the implementation of PCP technology, the following technology issues are of interest:

- Warrant for use of the PCP technology – This is based on the availability/non-availability of successful alternative technologies for rapid pavement repair and rehabilitation.
- Suitability of a pavement as a candidate for PCP application – Site access, maintenance of traffic, and availability of nearby precasting plants are key decision criteria. It should be noted that not every repair/rehabilitation project may be a good candidate for application of PCP technology.
- Precast pavement system approval, selection, and design – Once a decision is made to use PCP, the most cost-effective PCP system needs to be selected. Typically, the PCP systems to be used by an agency are preapproved based on submittal of shop drawings and construction of trial installations. These systems include both proprietary and non-proprietary systems. In addition, the selected system needs to be designed to accommodate project-specific requirements.
- Precast pavement fabrication – The fabrication process for PCP systems is based on decades of well-established practices for precast concrete systems and is regulated by industry standards that result in durable concrete and durable structural components. The fabrication process is typically a routine process and may incorporate specific details related to the following:
 - Provisions for load transfer along panel sides that form the transverse joints and for tie bars along panel sides that form the longitudinal sides.
 - Provisions for pre-tensioning of the panels.
 - Provisions to allow for later post-tensioning a series of connected panels.
 - Provisions to allow for undersealing of the panels.
 - Provisions for surface texture as required by the specifying agency.
 - Provisions for panel acceptance.
- Precast pavement installation – The installation of precast pavement includes the removal of the existing pavement, re-establishing the base support, providing for bedding material over the base as necessary, and installing the panels. Depending on the PCP system used, additional considerations include provisions for load transfer at transverse joints, connectivity along longitudinal joints, establishing expansion joints, use of a panel/base interface medium, and accommodating post-tensioning operations.
- Precast pavement acceptance testing – As the PCP technology is of recent origin, acceptance procedures are not well established. Acceptance testing typically includes standard testing for concrete quality at the precast plants and smoothness testing of the completed work. Testing is not typically performed to validate the installed load transfer system at transverse joints, to evaluate the readiness of the base/bedding support, or to

measure the effectiveness of prestressing in precast prestressed concrete pavement (PPCP) systems. The SHRP2 Project R05 final report incorporates recommendations for process control and acceptance testing.

This marketing plan is aimed at helping highway agencies resolve these technology related issues and provide guidance with the implementation of the PCP technology more effectively.

PCP TECHNOLOGY IMPLEMENTATION GOALS

It is expected that the effort under the SHRP2 Implementation Assistance Program, will result in the following, as a minimum, over the next five years (2014 to 2018):

- Adoption of PCP technology.
 - Five to seven additional agencies will be routinely using PCP. Currently, the following agencies are routinely specifying use of PCP technology:
 - Caltrans.
 - Illinois Tollway.
 - Michigan Department of Transportation (DOT).
 - New Jersey DOT.
 - New Jersey Turnpike Agency.
 - New York State DOT.
 - New York State Thruway Authority.
 - Utah DOT.
 - Four to five additional agencies will initiate practice by constructing at least one PCP project. Currently, the following agencies have constructed a PCP project:
 - Colorado DOT.
 - Delaware DOT.
 - Florida DOT.
 - Georgia DOT.
 - Minnesota DOT.
 - Missouri DOT.
 - Nevada DOT.
 - Pennsylvania DOT.
 - Texas DOT.
 - Virginia DOT.
 - Wisconsin DOT.
 - Twenty agencies will accept PCP for use and develop generic plans and adopt specifications.
- AASHTO standards.
 - AASHTO will adopt and publish uniform and consistent standards, guidance, and model specifications for selecting PCP projects, as well as for designing, fabricating, and installing PCP systems.
- Training material.
 - PCP guidelines and recommendations resulting from Project R05 and continuing developments will have been incorporated into standard training courses available through the National Highway Institute and academia.

The SHRP2 Implementation Assistance Program consists of the following two components:

- FHWA and ARA, under FHWA Contract No. DTFH61-13-R-00035 and as detailed in this PCP Product Implementation Marketing Plan, will provide technical assistance in the form of guidance, workshops, and peer-to-peer assistance to key DOT personnel for project selection, design, and construction.
- SHRP2 implementation assistance funding under Round 3 will be provided during 2014 in an amount up to \$300,000 per highway agency to be applied to the cost of construction of a PCP project. The funding support will be provided to up to five highway agencies.

CHAPTER 2 – PCP TECHNOLOGY BACKGROUND

PCP CURRENT PRACTICES

PCP technology can be used for localized repair of existing jointed concrete pavements and continuously reinforced concrete pavements and for rehabilitation/reconstruction of distressed concrete or asphalt pavements. The rehabilitation applications may extend several miles in length and may include one or more lanes. Specifically, PCP applications almost always are limited to night-time work windows on high-volume traffic highway facilities to reduce traffic congestion, improve safety, and achieve long-life performance.

Because of their versatility, PCP systems are also used in the rehabilitation of special pavement facilities, such as toll plazas, urban highway intersections, freeway ramps, bridge underpasses, and bridge approach slabs. In addition, prestressed concrete panels can be used to increase the load capacity of an existing pavement while maintaining existing pavement cross-sections. PCP technology has been applied to tunnel, container port, and airfield pavements in other countries, and many US agencies are considering such applications.

PCP APPLICATION TYPES

The broader application of PCP technology was classified under the SHRP2 Project R05 as follows:

- Intermittent repairs of concrete pavements.
- Continuous applications.

Intermittent Repairs of Concrete Pavements

Under this approach, isolated pavement repairs are made using precast concrete slab panels. Two types of repairs are possible: full-depth repairs to repair deteriorated joints or cracking and full-panel replacement to replace severely cracked or shattered slab panels. The repairs are always full-lane width. The full-depth and full-panel processes are similar except for the length of the repair area.

The intermittent repair is shown schematically in figure 1 and photographically in figure 2. Various schemes for intermittent repairs have been used, as reported in the SHRP 2 Project R05 final report.

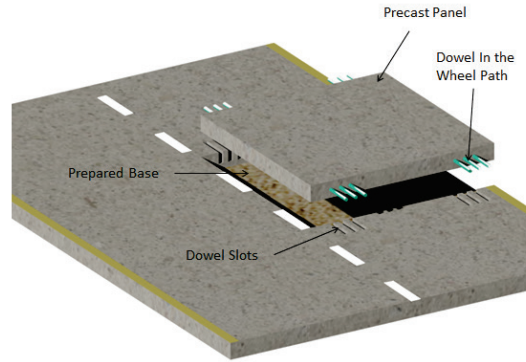


Figure 1. Schematic. Intermittent repair.



Figure 2. Photo. Installation of intermittent repair.

Continuous Application

Under this approach, full-scale project-level rehabilitation (reconstruction or overlay application) of asphalt and concrete pavements is performed using precast concrete panels. Two types of systems have been used in the United States:

- Jointed precast concrete pavement (JPrCP) systems: reinforced concrete panels and prestressed (pre-tensioned) concrete panels.
- Precast prestressed concrete pavement (PPCP) systems.

As part of the SHRP2 Project R05 study, a third category of continuous systems was established. This category is referred to as incrementally connected precast concrete panel (ICPCP) systems and includes systems that simulate hinged jointed reinforced concrete pavement behavior. The panels for ICPCP systems may be reinforced or prestressed.

Jointed Precast Concrete Pavements

JPrCPs are very similar to cast-in-place jointed concrete pavements and behave similarly once installed. The precast panels incorporate steel reinforcement. Therefore, any in-service cracking that may develop over time due to traffic loading can be maintained tight. Also, the panel transverse joint faces are smooth (fabricated), so aggregate interlock cannot be counted on for load transfer at these joints. As such, all JPrCP systems used in the US incorporate load transfer

at transverse joints. Figure 3 shows an example of JPrCP application. As reported in the SHRP2 Project R05 final report, various schemes have been used.



Figure 3. Photo. Example of JPrCP application.

Precast Prestressed Concrete Pavements

PPCP systems simulate cast-in-place prestressed concrete pavement. These systems incorporate longer lengths of post-tensioned sections and expansion joints between these sections. The post-tensioned sections are formed by post-tensioning together a series of panels. The section length may vary from about 150 to 250 ft. The individual panel width may be single-lane or multiple-lane, and panel length can vary from 8 to 10 ft for multilane panels to 10 to 30 ft or more for single-lane panels. A project in California (I-680 freeway near Oakland, May 2011) used panels up to 36 ft long.

Three types of PPCP systems have been developed, as shown in figure 4. In the original version, used at the first PPCP project in Texas, base, central stressing, and expansion joint panels were used. In a second version, used at the Delaware, Missouri, and the Virginia projects, only base and expansion joint panels were used. In the third version, used at the California I-680 project, base, end joint, and expansion joint gap panels were used. It appears this third version will be more widely used, especially for Caltrans projects. It is a more efficient system to fabricate and install.

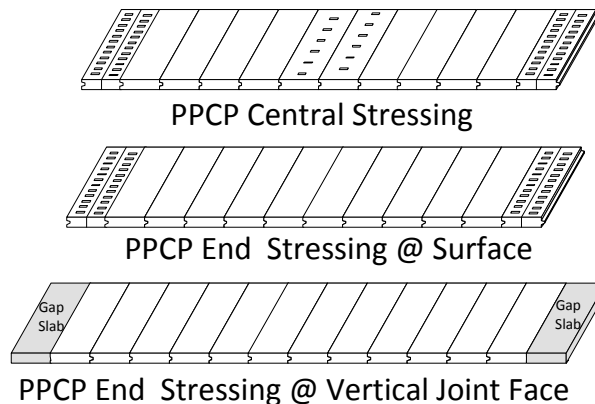


Figure 4. Schematic. Illustration of three PPCP systems.

Incrementally Connected Precast Concrete Pavements

ICPCP systems simulate a jointed reinforced concrete pavement with hinged joints and incorporate panels of varying lengths, typically 15 to 30 ft, which are connected together to achieve a continuous section length of 60 to 100 ft. The panels are connected using deformed dowel bars that lock up the connected joint and provide the required load transfer across joints. A small-width expansion joint is provided between connected panels. The advantages of ICPCP are the reduction in the number of active joints and the use of smaller-width expansion joints. Both nominally reinforced and prestressed panels can be considered for use. The ICPCP system is illustrated in figure 5. The prestressed panels allow for the use of thinner panels but require good support under the panel, similar to the support needed for PPCPs.

PCP PRODUCT CATEGORIES

For the PCP products implementation marketing plan, the PCP products can be categorized as follows:

- Category 1 – Warrants for PCP Considerations.
- Category 2 – Design Procedures and Design Details.
- Category 3 – Panel Fabrication.
- Category 4 – Panel Installation.
- Category 5 – New PCP Systems and Components Acceptance.
- Category 6 – Construction Plans and Specifications.

The above categorization of the PCP products will facilitate effective marketing of the PCP products as products can be targeted for use by appropriate user groups.

This report presents a Marketing Plan to support the technology transfer and deployment/delivery of the SHRP2 Project R05 and other recently developed related PCP technology (PCPT) products as per the categories listed above. Most of the identified PCPT products have not been exposed widely to US stakeholders or perhaps have only been exposed to a limited segment of the stakeholders as part of local/regional demonstrations or implementation. As indicated in the SHRP2 Project R05 final report and as detailed in this Marketing Plan, the identified PCPT products and Best Practices can help improve how precast concrete pavements are designed and constructed in the US so as to provide for safer and shorter work zones as well as a longer lasting pavement treatments that are cost-effective over the treatment's life cycle.

Finally, it is well known that the highway construction industry (both owner agencies and contractors) are typically very cautious about implementing new technologies that may affect the day-to-day operation of the highway facilities. Many decision-makers require evidence of successful implementation elsewhere before initiating implementation activities at their organizations. The proposed marketing plan has been developed to overcome this limitation.

CHAPTER 3 – PCP PRODUCTS MARKETING STRATEGIES

INTRODUCTION

The success of any new innovation lies in successful implementation of the innovation. In the commercial arena, implementation in the market place of new innovation is driven by the profit motive. That is typically not the case in the public arena where many innovations are funded by public money and there is no direct monetary incentive to consider implementation of innovative products. In fact, the risk of failure is often a bigger discriminator of innovative products. As a result, implementation of new products or technologies by public agencies can take many years. In recent years, FHWA has tried to overcome this limitation by showcasing promising advanced technologies, supporting the concept of lead-states groups and supporting funding for construction that incorporate innovative products. An example of a successful campaign for implementing new products is FHWA's Concrete Pavement Technology Program (CPTP) that has resulted in numerous advanced concrete pavement technology products, including the early PCP products. Many of these products have been implemented by highway agencies and the construction industry as standard or best practices. The successful product marketing strategies from the CPTP and other related program have been reviewed to develop the marketing plan for the PCP technology products presented in this report.

As discussed previously, the SHRP2 Project R05 and other related PCP technology products have been categorized by subject area. The advantage of this categorization is that the products can be marketed more effectively by targeting specific stakeholder groups that would benefit from implementing products within each category. The categories of PCP technology products derived from SHRP2 Project R05 are listed below:

- Category 1 – Warrants for PCP Considerations.
- Category 2 – Design Procedures and Design Details.
- Category 3 – Panel Fabrication.
- Category 4 – Panel Installation.
- Category 5 – New PCP Systems and Components Acceptance.
- Category 6 – Construction Plans and Specifications.

FHWA, SHRP2, and the American Association of State Highway and Transportation Officials (AASHTO) are cooperatively focused on implementing these Project R05 products. As part of the deliberations on product implementation, the following six strategies were developed:

- Provide technical support to a limited number of new users of PCP to mitigate perceived implementation risks.
- Heighten awareness of PCP technologies and dispel misunderstandings.
- Develop PCP training modules targeting the needs of highway agencies for key personnel in design, materials, and construction, as well as administrators and chief engineers.
- Improve PCP technology on a continuing basis through research and testing.
- Educate the contractor community, including concrete precasters and concrete paving companies, to address their role in PCP applications.

- Foster technology transfer in the academic community to advance knowledge and understanding of potential uses of PCP among current and future engineers.

These strategies seek to ensure routine use of PCP by a majority of highway agencies with support from FHWA, AASHTO, industry associations, and highway agencies, who are the ultimate product champions

TARGET RECIPIENTS OF PCP PRODUCTS

New product implementation typically requires interactions with the decision makers and the implementation groups. The decision makers are the key parties as the leadership for championing innovative products is derived from them. The decision makers are also responsible for allocating funding and setting priorities and schedules. Therefore, the marketing strategies for each promising PCPT product will address securing early buy-in by the decision makers.

The target recipients of information related to PCPT products include the following:

- Agency and industry senior management and supervisory staff.
- Highway agency engineering staff.
- Contractor field crews.
- Precasters.
- Academia.
 - Students (as future users of technology).
 - Professors (as mentors to the students).

Successful implementation of the PCP products will require a partnership between FHWA, highway agencies, academia, and industry groups (contractors, suppliers and trade associations). The creation of “Lead Highway Agencies” to champion specific product deployment and to monitor progress and performance will greatly facilitate deployment of PCP products. Building a network of “Product Champions” is very important to any new product implementation program.

PROPOSED MARKETING STRATEGIES

There are a number of methods that can be considered for effective implementation of the PCPT products. These include the following:

- Technical documentation.
 - Develop a PCP technology product matrix – identify in a clear and concise manner the available PCPT products and the deployment/delivery mechanisms for each product.
 - Develop model specifications and test protocols.
 - Prepare TechBriefs - Short (2- to 6 pages) descriptions of the products, the background on product development, guidelines on product use, and anticipated costs and benefits.
 - Prepare Best Practices guides on various topics based on PCP products and findings.

- Develop photographic and video library for representative PCP projects and processes.
- Develop a database of constructed PCP projects, incorporating agency, contractor, precaster contact information.
- Interactions with stakeholders.
 - Meet with decision makers in the DOTs and industry to seek champions among states and industry to implement the PCPT products.
 - Participate in technical presentations at national and regional workshops and conferences and at technical organization meetings, as appropriate.
 - Conduct Best Practices workshops on PCP technology, customized to meet an agency's specific needs.
 - Conduct topic-specific webinars.
 - Write articles for key highway construction related magazines, such as *Public Roads*.
 - Develop pamphlets, brochures, and fact sheet on PCP technology.
 - Work with the academia to promote PCP technology among students and encourage graduate students to conduct research to advance PCP technology.
 - Organize national conference on PCP technology and best practices.
- Field support.
 - Support open houses in the field during PCP implementations.
 - Support field demonstration of new PCP construction related testing equipment.
 - Support field demonstration of new PCP related construction equipment and processes.
 - Support equipment Loan Program for new PCP related testing equipment.
 - Conduct project-specific on-site training for DOT and contractor personnel.
 - Prepare design and construction reports for representative projects.
- Website support.
 - Provide updates and documents, as appropriate, for FHWA and industry websites. This effort would include the most recent PCP technology related information, including the PCP product status report, the PCP Product Implementation Marketing Plan, individual PCPT project information and updates, product implementation reports, PCPT projects calendar of events, technical reports, and other pertinent information.
- Standard development.
 - Work with AASHTO, the American Concrete Institute (ACI), and ASTM committees to develop, as appropriate, standards, guides and specifications.

In the current economic environment, most State DOTs have administered severe travel restrictions and have cut back on training/technology transfer activities. Therefore, this marketing plan incorporates various mechanisms for personalized technology transfer activities. We will explore the use of approaches such as distance learning or web-based courses (webinars). The benefits of distance learning include: convenience, flexibility, effectiveness, and affordability. However, the implementation of distance learning requires careful planning.

PARTNERING WITH INDUSTRY ASSOCIATIONS

As discussed, the PCP technology, as currently being implemented, is of recent origin. The genesis of the current technology lies in the initiative of FHWA as well as the industry, principally the precasting industry. Without the active support of the precasting industry and the innovative spirit of the precasters, the PCP technology would not have progressed to the level of readiness that it has today. On all PCP projects, the projects are typically constructed by local contractors with precasters supplying the specified precast panels. The contractors prepare the project sites, install the panels, and carry out the finishing operations. Over the last 10+ years, a large number of contractors have constructed PCP projects in various jurisdictions. In almost all cases, the contractors have assimilated the new PCP technology reasonably easily and after a brief slow installation period, most contractors have managed to maintain a high productivity with respect to number of panels installed per lane closure.

In order to continue to engage the industry, it is important that the roles played by precasters and contractors in implementing the PCP technology be recognized, highlighted, and nurtured. It is also important that the PCP product implementation program actively engage the appropriate industry groups that represent the precasting, the prestressing, and the contractor groups. We propose to actively involve the following four industry groups to facilitate wider implementation of PCP products:

- The Prestress/Precast Concrete Institute (PCI).
- The National Precast Products Association (NPCA).
- The Post-Tensioning Institute (PTI).
- The American Concrete Pavement Association (ACPA).

The PCI and NPCA have organized pavements committees to support technology transfer related activities for their membership. The PTI has an active interest in technologies related to posttensioning applications, although most of its activities to date have focused on cast-in-place concrete slab-on-grade type posttensioning applications. The ACPA membership includes a large number of contractors who are actively engaged in construction of PCP projects.

OVERALL CHRONOLOGY OF THE MARKETING PLAN

The marketing of the Project R05 PCP products will be carried out, over a period of 5 years (2 base years and 3 option years), within the framework of the scope of work defined for FHWA's Contract No. DTFH61-13-R-00035, as detailed below:

- Develop PCP marketing plan (this document).
- Establish PCP technology implementation expert task group (ETG) (in progress as of November 2013).
- Assist with population of PCP web-based databases, as maintained by PCI and NPCA.
- Conduct PCP Webinars (open to highway agencies, contractors, and academia).
 - On planning, design, and precasting.
 - On construction (panel installation and related activities).

- Organize PCP technical sessions at the January 2015 Annual Meeting of the Transportation Research Board (TRB).
- Prepare PCP executive briefing document and companion PowerPoint presentation for State highway and turnpike/tollway agencies.
- Conduct PCP technology workshops incorporating reports, technical briefs, guidance documents, plans and specifications, and slides.
 - For staff in State highway and turnpike/tollway agencies with the subject matter covering the full range of products resulting from SHRP2 Project R05.
 - For precaster and contractor groups.
- Provide peer-to-peer guidance to highway agencies for PCP project development activities including site selection, PCP design, and development of plans and specifications.
- Monitor key planning, design, and construction phases PCP demonstration projects.
- Organize PCP open houses in cooperation with highway and turnpike/tollway agencies that complete a PCP project.
- Identify safety improvements at PCP construction projects.

SUMMARY

It is planned to use multiple strategies for implementing various PCP products. A number of different marketing efforts are available for this effort, ranging from the development of technical documents, specifications, and standards to the presentation of workshops, conduct of webinars, and peer-to-peer technical support. It is expected that throughout the implementation process, key stakeholders will play a critical role in providing input to help guide the implementation effort.

CHAPTER 4 – PCP MARKETING PLAN

INTRODUCTION

The following is a summary of the PCPT products, based on the SHRP2 Project R05 Final Report, for deployment over the next five years. It is expected that the availability of the products listed below will result in a knowledge base that will remove uncertainties associated with the planning, design, and construction of PCP projects and allow agencies to embrace the PCP technology without fear of potential risks of early failures. At the same time, these products will encourage contractors and precasters to champion the adoption of PCP technology by highway agencies and actively participate in advancing innovations and breakthroughs in the technology.

PCPT Product Category 1 – Warrants for PCP Considerations

- Warrants for PCP considerations.
 - An executive summary for senior highway agency and industry personnel highlighting the PCP technology features and benefits.
 - A systematic decision making process for considering the technical applicability of PCP technology to a specific agency repair/rehabilitation project.
- Cost/benefit considerations for PCP applications – A decision process involving life cycle cost analysis, constructability analysis, construction traffic management analysis policy directives, and expert knowledge to evaluate the most optimal strategy for a given rapid repair/rehabilitation project.

PCPT Product Category 2 – Design Procedures and Design Details

- Design details for intermittent (full-depth/full-panel) repairs – A set of design details for a range of design applications. The design details would include details on:
 - Precast panel design (panel plan dimensions and thickness).
 - Concrete requirements.
 - Reinforcement.
 - Prestressing (pretensioning), as applicable.
 - Transverse joint load transfer system.
 - Slab panel support system.
- Structural design of jointed PCP – A structural design framework, incorporating mechanistic-empirical design considerations, for long-life jointed PCP using prestressed as well as reinforced panels.
- Structural design of PPCP – A structural design framework for long-life PPCP, based on design procedures developed for cast-in-place prestressed concrete pavements.
- Design of the prestressing system for PPCP – Set of design features for PPCP prestressing systems, including details on:
 - Prestressing tendons.
 - Prestressing accessories.
 - Posttensioning methods.

- Prestress losses for posttensioned system.
 - Pre-tensioning considerations.
- Design of expansion joint for PPCP systems – Set of design details for PPCP expansion joints, including details on:
 - Joint width considerations.
 - Joint width at time of panel installation.
 - Joint assembly type and joint hardware, if any.
 - Joint sealing.
 - Load transfer at the joint.
 - Geometric (smoothness) requirements.
- Load transfer considerations for repair and continuous PCP systems – Technical guidance on proper design and installation of load transfer at PCP joints. A critical item for successful performance of PCP systems.
- Support considerations for PCP systems – Technical guidance on proper design and provision of adequate support under PCP panels. Another critical item for successful performance of PCP systems.
- Reinforcement and prestress design for PCP panels – Technical guidance on reinforcement and prestressing of individual panels for jointed as well as PPCP systems.

PCPT Product Category 3 – Panel Fabrication

- Concrete requirements for PCP panels – Guidelines for concrete for PCP applications, incorporating durability, strength and constructability considerations. Early age concrete strength is critical for efficient turnover of panel formwork.
- Guidelines for precaster qualifications and certification – Highlights of NPCA and PCI and select highway agency plant certification programs to ensure that high standards are maintained for precast plant facilities, production operations, and internal quality control procedures.
- Guidelines for pretensioning of precast panels – Set of details for pretensioning of panels meeting the needs for handling and shipping and also for providing additional structural capacity for the panels.
- Guidelines for precast panel fabrication, process control and acceptance testing, Jointed PCP – Technical summary of key processes of the precasting operation, including a detailed checklist for process control and acceptance testing, as applicable to panels for jointed systems. The summary to include guidelines for curing, handling, and storage of PCP panels
- Guidelines for precast panel fabrication, process control and acceptance testing. PPCP – Technical summary of key processes of the precasting operation, including a detailed checklist for process control and acceptance testing, as applicable to panels for PPCP systems. The summary to include guidelines for curing, handling, and storage of PCP panels.

PCPT Product Category 4 – Panel Installation and Workforce Training

- Guidelines for existing pavement removal and base/bedding preparation – Best practices guidelines for efficiently removing existing pavement and preparing the base for panel installation. Guidance to be provided on bedding use.
- Precast panel installation processes for intermittent repairs – Guidance on installing panels for repair applications, including setting panels in the repair area, load transfer provisions, and various finishing activities.
- Precast panel installation processes for continuous jointed PCP – Guidance on installing panels for jointed continuous applications, including setting panels, load transfer provisions for inter-connected panels, and various finishing activities.
- Precast panel installation processes for PPCP – Guidance on installing panels for PPCP applications, including use of panel/base interface medium, setting panels, temporary and final posttensioning, expansion joint installation with or without a gap slab, and various finishing activities.
- Process control and acceptance testing of installed PCP – Guidance on contractor process control and agency acceptance testing to ensure a quality PCP project. Guidance to include recommendations for remediation treatments if specified project requirements are not met.
- Design and construction reports for representative PCP projects.

PCPT Product Category 5 – New PCP Systems Acceptance

- Requirements for new PCP systems and components – Guidance on the key features that need to be evaluated for new PCP systems and components. The evaluation to include panel structural design (concrete properties, reinforcement and prestressing), joint load transfer provision, any unique bedding requirements, ease of constructability, and installation productivity.
- New PCP system approval process.
 - Guidance on acceptance process for new PCP systems to be implemented by an agency. The guidance would include the following:
 - Standard design features that need to be specified by the agency for non-project-specific PCP system approval.
 - PCP system standard drawings and supplemental information.
 - PCP system installation details.
 - Post-installation activities.
 - Trial installation requirements.
 - Guidance on acceptance of a PCP system by comity if the PCP system has been evaluated and accepted for production use by another highway agency.
- Trial installation and testing of new PCP systems and components –Detailed guidance on conduct of trial installation and testing of new PCP systems. The guidance to include details on:
 - Test site – single panel for repair and multiple panels for continuous applications.
 - Base/bedding.
 - Posttensioning, for PPCP systems.
 - Tendon grouting.

- Undersealing.
- Acceptance testing, including deflection testing at joints.

PCPT Product Category 6 – Construction Plans and Specifications

- Model specification for intermittent repairs using precast panels – A model specification that details the requirements for materials and processes for fabrication and installation of precast concrete panels for intermittent repairs of concrete pavements.
- Model specification for use of continuous jointed PCP – A model specification that details the requirements for materials and processes for fabrication and installation of precast panels for continuous rehabilitation of existing concrete and asphalt pavements.
- Model specification for use of PPCP – A model specification that details the requirements for materials and processes for fabrication and installation processes for PPCP systems to be used for continuous rehabilitation of existing asphalt and concrete pavements.
- Generic shop drawings for intermittent repair panels – A set of standard shop drawings for repair applications
- Generic shop drawings for continuous jointed PCP – A set of standard drawings for jointed PCP applications, including lane replacements, ramp rehabilitation, and bridge approach slab rehabilitation.
- Generic shop drawing for PPCP – A set of standard drawings for PPCP applications, including details on prestressing hardware and expansion joint for each conceptually different PPCP system.

Note: These products will include PCP technology information presented in the SHRP2 Project R05 Final Report as well as additional recent information on PCP technology.

PCP PRODUCT MATRIX

The PCP technology product marketing implementation plan for each product has been developed as a product matrix for each PCP technology category and is included in appendix A. it is expected as FHWA authorizes the implementation activity of each PCP technology product, a detailed product implementation plan will be developed for the product in conjunction with the marketing and implementation of the overall PCP technology products.

TIMELINE FOR PCP PRODUCTS FOR DEPLOYMENT

The timeline for delivery of the above promising PCP technology products can be categorized as follows:

- The guidelines, webinars, workshops and peer-to-peer assistance for PCP technology are implementation-ready and can be delivered as needed to highway agencies and related stakeholders.
- The products are available but require further refinement for delivery after incorporating some new developments since the completion of Project R05.

CHAPTER 5 – RECOMMENDATIONS AND SUMMARY

The following SHRP2 Project R05 products are available now for implementation. In some cases implementation will follow after the incorporation of refinements and new developments since the completion of Project R05. It is recommended that, as presented in appendix A, these products be delivered in an expeditious manner to support the wider implementation of PCP technology by stakeholders.

PCPT Product Category 1 – Warrants for PCP Considerations

- Warrants for PCP considerations.
- Cost/benefit considerations for PCP applications.

PCPT Product Category 2 – Design Procedures and Design Details

- Design details for intermittent (full-depth/full-panel) repairs.
- Structural design of jointed PCP.
- Design of expansion joint for PPCP systems.
- Load transfer considerations for repair and continuous PCP systems.
- Support considerations for PCP systems.
- Reinforcement and prestress design for PCP panels.

PCPT Product Category 3 – Panel Fabrication

- Concrete requirements for PCP panels.
- Guidelines for precaster qualifications and certification.
- Guidelines for pretensioning of precast panels.
- Guidelines for precast panel fabrication, process control and acceptance testing – jointed PCP.
- Guidelines for precast panel fabrication, process control and acceptance testing – PPCP.

PCPT Product Category 4 – Panel Installation

- Guidelines for existing pavement removal and base/bedding preparation.
- Precast panel installation processes for intermittent repairs.
- Precast panel installation processes for continuous jointed PCP.
- Precast panel installation processes for PPCP.
- Process control and acceptance testing of installed PCP.
- Design and construction reports for representative PCP projects.

PCPT Product Category 5 – New PCP Systems and Components Acceptance

- Requirements for new PCP systems and components.
- New PCP system approval process.

- Trial installation and testing of new PCP systems and components.

PCPT Product Category 6 – Construction Plans and Specifications

- Model specification for intermittent repairs using precast panels.
- Model specification for use of continuous jointed PCP.
- Model specification for use of PPCP.
- Generic shop drawings for intermittent repair panels.
- Generic shop drawings for continuous jointed PCP.
- Generic shop drawing for PPCP.

REFERENCES

Tayabji, S., Buch, N. and Ye, D., (2013). Precast Concrete Pavement Technology Program, Final Report, Report No. S2-R05-RR-1, Strategic Highway Research Program 2 (SHRP2), Washington, DC. http://onlinepubs.trb.org/onlinepubs/shrp2/SHRP2_S2-R05-RR-1.pdf.

APPENDIX A – PCP PRODUCT IMPLEMENTATION MATRIX BY CATEGORY AND AVAILABILITY

Tables 1 through 10 provide details for the proposed implementation packages for the selected PCP product categories.

Table 1. Implementation package for category 1 – warrants for PCP considerations.

Proposed Products	Warrants for PCP Considerations	Cost/Benefit Considerations for PCP Applications
Tech Summaries and Tech Briefs	Executive summary Decision making process	Technical summary
Presentations (30-60 minutes) and/or webinars	Technical presentations and webinar	Technical presentations and webinar
Implementation Timeline	Immediate	Immediate

Table 2. Implementation package for category 2 – design procedures and design details.

Proposed Products	Design Details for Intermittent (Full-Depth/Full-Panel) Repairs	Structural Design of Jointed PCP	Structural Design of PPCP
Guidelines, Tech Summaries and Tech Briefs	Guidelines for jointed and continuously reinforced concrete pavements	Tech Summary and Tech Brief	Tech Summary and Tech Brief
Software		Supplemental software for use with AASHTO's DARWIN ME	Stand-alone software for PPCP structural design, prestressing system design, and expansion joint design
Workshops (1day)	Workshop on design of PCP systems – 4 to 6 hour duration		
Presentations (30-60 minutes) and webinars	45 to 60 minute webinar on each topic and a 120 minute webinar on all three topics		
Implementation Timeline	Immediate	Immediate	Immediate

Table 3. Implementation package for category 2 – design procedures and design details (additional products).

Proposed Products	Load Transfer Considerations for Repair and Continuous PCP Systems	Support Considerations for PCP Systems	Reinforcement and Prestress Design for PCP Panels
Guidelines and Tech Briefs	Guidelines and TechBrief	Guidelines and TechBrief	Guidelines and TechBrief
Test Protocols and Draft Specs	Protocol for deflection testing at joint and interior locations of PCP systems	Test protocol for use of lightweight deflectometer to assess PCP support condition	Draft spec for reinforcement and prestress use in PCP panels
Workshops (1-2 days), including video-conferencing	Material to be integrated with the design workshop		
Presentations (30-60 minutes) and/or webinars	30 to 45minute presentation for each topic and a 45 to 60 minute presentation for all three topics. Webinar on “Technical Considerations for PCP”		
Field Demonstrations/ Equipment Loan Program	Field demo of new load transfer systems	Loan of light-weight deflectometer to assess support condition	
Implementation Timeline	Immediate	Immediate	Immediate

Table 4. Implementation package for category 3 – panel fabrication.

Proposed Products	Concrete Requirements for PCP Panels	Guidelines for Precaster Qualifications and Certification	Guidelines for Pretensioning of Precast Panels
Guidelines, Technical Summaries, and Tech Briefs	TechBrief on concrete properties to be specified for PCP applications, including quality control/quality assurance testing	Technical Summary of industry (PCI & NAPA) and agency requirements for precast plant certification.	Technical Summary of industry (PCI & NAPA) guidelines for pretensioning of precast panels
Test Protocols and Draft Specs	Model spec for PCP concrete requirements, together with a commentary document		Protocol for pretensioning of precast panels
Workshops (1-2 days), including video-conferencing	To be integrated with the PCP Panel Fabrication workshop		
Presentations (30-60 minutes) and/or webinars	45 to 60 minute webinar on each topic and a 120 minute webinar on all three topics		
Implementation Timeline	Immediate	Immediate	Immediate

Table 5. Implementation package for category 3 – panel fabrication (additional products).

Proposed Products	Guidelines for Precast Panel Fabrication, Process Control and Acceptance Testing – Jointed PCP	Guidelines for Precast Panel Fabrication, Process Control and Acceptance Testing – PPCP
Guidelines and Tech Briefs	Guidelines & TechBrief	Guidelines & TechBrief
Test Protocols and Draft Specs	Quality control/quality assurance checklist	Quality control/quality assurance checklist
Workshops (1-2 days), including video-conferencing	PCP Panel Fabrication workshop with case studies	
Presentations (30-60 minutes) and/or webinars	60 minute presentation on each topic and a 90 to 120 minute combined presentation 120 minute webinar with case studies	
Implementation Timeline	Immediate	Immediate

Table 6. Implementation package for category 4 – panel installation and workforce training.

Proposed Products	Guidelines for Existing Pavement Removal and Base/Bedding Preparation	Precast Panel Installation Processes for Intermittent Repairs	Precast Panel Installation Processes for Continuous Jointed PCP
Guidelines, Tech Summaries and Tech Briefs	Guidelines & TechBrief	Guidelines & TechBrief	Guidelines & TechBrief
Workshops (1-2 days), including video-conferencing	PCP installation workshop with case studies		
Presentations (30-60 minutes) and/or webinars	60 minute presentation on each topic and a 90 to 120 minute combined presentation 120 minute webinar with case studies		
Field Demonstrations	Field demo projects to showcase unique features of selected PCP projects		
Implementation Timeline	After refinement	After refinement	After refinement

Table 7. Implementation package for category 4 – panel installation and workforce training (additional products).

Proposed Products	Precast Panel Installation Processes for PPCP	Process Control and Acceptance Testing of Installed PCP	Design and Construction Reports for Representative PCP Projects
Guidelines, Tech Summaries and Tech Briefs	Guidelines & TechBrief	Guidelines & TechBrief	Technical summaries and TechBriefs
Test Protocols and Draft Specs		Quality control/quality assurance test protocols	
Workshops (1-2 days), including video-conferencing	PCP installation workshop with case studies		
Presentations (30-60 minutes) and/or webinars	60 minute presentation on each topic (see previous page) and a 90 to 120 minute combined presentation 120 minute webinar with case studies		Presentation on PCP Case Studies
Field Demonstrations/ Equipment Loan Program	Field demo projects (including open houses) to showcase unique features of selected PCP projects		
Implementation Timeline	After refinement	After refinement	After refinement

Table 8. Implementation package for category 5 – PCP systems acceptance.

Proposed Products	Requirements for new PCP systems and components	New PCP system approval process	Trial installation and testing of new PCP systems and components
Guidelines and Tech Briefs	Guidelines & TechBrief	Guidelines & TechBrief	Guidelines & TechBrief
Test Protocols and Draft Specs		Protocol for approval of new PCP systems and components	Protocol for trial installation and testing of new PCP systems
Presentations (30-60 minutes) and/or webinars	30 to 60 minute presentation on new PCP system acceptance 90 minute webinar on new PCP system acceptance, with case studies		
Field Demonstrations	Field demonstration support for evaluation of new PCP systems		
Implementation Timeline	After refinement	After refinement	After refinement

Table 9. Implementation package for category 6 – construction plans and specifications.

Proposed Products	Model Specification for Intermittent Repairs Using Precast Panels	Model Specification for Use of Continuous Jointed	Model Specification for Use of PPCP
Model Specs	Model spec	Model spec	Model spec
Workshops (1-2 days), including video-conferencing	Included in Panel Installation workshop		
Presentations (30-60 minutes) and/or webinars	45 to 60 minute presentation on PCP model specifications 60 minute webinar on PCP model specifications		
Implementation Timeline	Immediate	Immediate	Immediate

Table 10. Implementation package for category 6 – construction plans and specifications (additional products).

Proposed Products	Generic Shop Drawings for Intermittent Repair Panels	Generic Shop Drawings for Continuous Jointed PCP	Generic Shop Drawing for PPCP
Guidelines, Tech Summaries and Tech Briefs	Generic shop drawings	Generic shop drawings for specific application type	Generic shop drawings for specific application type
Workshops (1-2 days), including video-conferencing	Included in Panel Installation workshop		
Presentations (30-60 minutes) and/or webinars	45 to 60 minute presentation on PCP model specifications 60 minute webinar on PCP model specifications		
Implementation Timeline	Immediate	Immediate	Immediate

APPENDIX B – REPORT OF THE MARCH 2014 MEETING OF THE FHWA EXPERT TASK GROUP ON IMPLEMENTATION OF PRECAST CONCRETE PAVEMENT TECHNOLOGY

EXECUTIVE SUMMARY

FHWA Contract No. DTFH61-13-R-00035 was awarded during late September 2013 to ARA, to provide FHWA with technical support for the implementation of products from SHRP2 Project R05 – PCP Technology. Two of the activities underway under this contract are:

- Preparation of a Marketing Plan for the implementation of products from SHRP2 Project R05 (Task 1).
- Formation and management of an ETG (Task 2) with participants from highway agencies, industry, and academia.

The Marketing Plan was submitted to FHWA during December 2013 and was distributed to the ETG during January 2014. A meeting of the ETG was held at the FHWA facilities in Washington, DC, on March 5 and 6, 2014. This report presents the highlights of the discussions at the March 5 and 6, 2014 meeting of the ETG.

INTRODUCTION

Since late 1990s, there have been significant developments in PCP technologies, and the use of these technologies is becoming technically feasible and economically justifiable. Since 2001, several highway agencies in the US have begun to implement the technology, and a few others have constructed demonstration projects. The implemented PCP systems include both proprietary and non-proprietary systems.

Because the PCP technology is relatively new and the information on PCP practices and performance was not well documented, SHRP2 Project R05 was authorized and funded in 2008 to develop the necessary information and guidelines that would help encourage the rapid and successful adoption of the new PCP technologies. The Project R05 study demonstrated that the PCP technology is ready for wider implementation and that many of the PCP systems available in the US can meet the needs of highway agencies for rapid renewal of their highway systems. The review of projects constructed in the US and the SHRP2 field testing indicated that sufficient advances have been made to reliably design and construct PCP systems to achieve five key attributes of successful pavements, as follows:

- Constructability – Techniques and equipment are available to ensure acceptable production rates for the installation of PCP systems.
- Concrete durability – Plant fabrication of precast panels results in excellent concrete strength and durability.
- Load transfer at joints – Reliable and economical techniques are available to provide effective load transfer at transverse joints in jointed PCP systems and post-tensioned PCP systems.

- Panel support – Techniques to provide adequate and uniform base support conditions continue to be improved.
- Efficiency – Panels are thinner than standard cast-in-place concrete and last longer because of prestressing and/or reinforcing elements in the PCP system.

SHRP2 PROJECT R05 PRODUCTS

The following products, incorporated in the final report, were developed under SHRP2 Project R05:

- Overall findings related to viability of the PCP technology.
- Findings based on SHRP2 field testing.
- Guidelines for PCP project selection.
- Guidelines for PCP system acceptance.
- Guidelines for design of PCP systems.
- Guidelines for PCP fabrication.
- Guidelines for PCP installation.
- Implementation plan for PCP technology.
- Long-term monitoring plan for PCP projects.
- Model specifications.

FHWA EXPERT TASK GROUP ON PROJECT R05 PRODUCTS IMPLEMENTATION

The ETG on Project R05 Product Implementation was established during December 2013 to review work progress in the referenced contract, discuss technical issues related to PCP technology and specifically related to Project R05 products, and to make comments and recommendations on the progress and direction of the on-going work under the contract.

The ETG membership is as follows:

PCP User Agencies

- Steve Gillen, Illinois Tollway.
- Scott Nussbaum, Utah DOT.
- Mehdi Parvini, Caltrans.

PCP Demonstration Project Agencies

- Jim Pappas, Delaware DOT.
- Maria Matsen, Minnesota DOT.
- Shabbir Hossain, Virginia DOT.

PCP Non-user/Non-demo Agencies

- Tommy Nantung, Indiana.

- Nilesh Surti, North Carolina.
- Jeff Uhlmeyer, Washington.

Academia

- Jeff Roessler, University of Illinois.
- Other (with expertise in concrete/precast concrete).

National Associations

- Evan Gurley, NPCA.
- Leif Wathne, ACPA.
- William N. Nickas, PCI.
- Ted Neff, PTI.

Precasters

- Peter J. Smith, Fort Miller Corporation (New York State).
- Thomas Montalbino, Roman Stone Company (New York City Precaster).
- Tom Heraty, Utility Concrete (Chicago Precaster).
- Mike Hein, Confab (California Precaster).
- Stephanie Loud, Mountain West Precast (Utah Precaster).

Contractors

- Jeff Dunteman, R.W. Dunteman Co.
- Tim Phillips, GP's Enterprises, Inc, Auburn, Georgia.
- Baltazar Siqueiros, Balthazar Construction, California.

Suppliers

- John Collins, Renu Materials Company, LLC, Aliso Viejo, California.
- Bing Tian, Old Castle.
- Nicholas Rotondo, Dayton Superior.

FHWA

- Sam Tyson, Concrete Pavement Engineer, Office of Asset Management, Pavements, and Construction, Washington, DC.
- Steve Cooper, SHRP2 Pavement Renewal Engineer, FHWA Resource Center, Baltimore.

ARA R05 Implementation Team

- Shiraz Tayabji, ARA.
- Shree Rao, ARA.

Within the framework of the ETG, three task forces have been established to help focus the work of the ETG within specific subject matters related to PCP technology. The task forces are as follows:

- Task Force on Planning and Design.
- Task Force on Fabrication and Installation.
- Task Force on PCP System Acceptance and New Developments.

MARCH 2014 EXPERT TASK GROUP MEETING

The first meeting of the ETG was held on March 5 and 6 at FHWA's headquarter in Washington, DC. The meeting agenda is summarized below:

March 5 (Wednesday)

- Welcome & Introductions.
- SHRP2 R05 Implementation Program Genesis.
- SHRP2 R05 Implementation Support Project.
 - Project details.
 - SHRP2 R05 product marketing plan.
- ETG Discussion.
 - Technical review of R05 products.
 - Task Force on Planning & Design.
 - Task Force on Fabrication & Installation.
 - Task Force on PCP System Acceptance & New Developments.
- Implementing at the Highway Agency.
- The Industry Role in Promoting Implementation.
- Where do the Contractors Fit In?

March 6 (Thursday – 8:00 am to noon)

- Review of Day 1 Discussions.
- PCP Technology Review.
- ETG Discussion.
- FHWA Contractor Plans for 2014.
- Meeting Action Items.

The meeting attendees included the following:

- PCP User Agencies: Steve Gillen, Illinois Tollway; Scott Nussbaum, Utah DOT; Mehdi Parvini, Caltrans.
- PCP Demonstration Project Agencies: Jim Pappas, Delaware DOT; Shabbir Hossain, Virginia DOT.
- PCP Non-user/Non-demo Agencies: None (due to agency travel restrictions or conflicts).
- Academia: Jeff Roessler, University of Illinois.

- National Associations: Evan Gurley, NPCA; Leif Wathne, ACPA; William N. Nickas, PCI; Ted Neff, PTI.
- Precasters: Peter J. Smith, Fort Miller Corporation (New York State); Thomas Montalbino, Roman Stone Company (NY City Precaster); Tom Heraty, Utility Concrete (Chicago Precaster); Mike Hein, Confab (California Precaster); Stephanie Loud, Mountain West Precast (Utah Precaster).
- Contractors: Jeff Dunteman, R.W. Dunteman Co.; Tim Phillips, GP’s Enterprises, Inc, Auburn, GA; Baltazar Siqueiros, Balthazar Construction, California.
- Suppliers: John Collins, Renu Materials Company, LLC, Aliso Viejo, CA; Bing Tian, Old Castle; Nicholas Rotondo, Dayton Superior.
- FHWA: Sam Tyson, Office of Asset Management, Pavements, and Construction, Washington, DC; Steve Cooper, Resource Center, Baltimore.
- FHWA R05 Implementation Team: Shiraz Tayabji and Shree Rao, Applied Research Associates, Inc.
- Visitors/Invited Presenters:
 - FHWA:
 - Walter “Butch” Waidelich, Associate Administrator, Office of Infrastructure.
 - Butch Wlaschin, Director, Office of Asset Management, Pavements, and Construction.
 - Joe Conway, Acting Team Director, Communications and Outreach Team, Office of Corporate Research, Technology, and Innovation Management.
 - Suneel Vanikar, Team Leader, Pavement Design and Analysis Team, Office of Asset Management, Pavements, and Construction.
 - AASHTO: Jameelah Hayes.
 - Precaster: Eveelyn Garcia, Essential Precast Elements, California; Ted Jones, Fort Miller Corporation.
 - ARA R05 Implementation Team: Maher Tadros, Don Kline.

Sam Tyson moderated the first part of the ETG meeting and asked for self-introductions from the State highway agencies, contractors, academia, industry/trade associations, the ARA team, and the FHWA team.

Butch Wlaschin provided introductory comments. He stressed that it is a goal of FHWA to make SHRP2 product implementation a success and provide win-win alternatives to the stakeholders that are the right solutions for the right applications. Butch Wlaschin introduced Butch Waidelich.

Butch Waidelich welcomed the ETG members and visitors and provided a brief history of FHWA’s initiatives and efforts to improve the nation’s highway system. He indicated that public expectations in the last 30 years or so have changed and we need to keep pace with this change. He stated that accountability to the public and to meet public expectations does not always mean low cost. It also means – faster construction and less inconvenience to the users while being economical. Success means that innovative products are implemented in the right place at the right time. He closed by reminding the ETG that we were here at this ETG meeting to discuss how to promote and get wider buy-in from States and Industry for the use of PCP technology and

to facilitate implementation of the products from the SHRP2 Project R05 on precast concrete pavement technology.

Sam went over the agenda and some general house-keeping announcements. Sam then reviewed the role of the ETG. He noted that the role of the ETG is to provide technical input to the ARA project team. The function of the ETG is to review work progress, discuss technical issues, and make comments and recommendations, which shall be reviewed by ARA and by FHWA. The ETG will not direct any of the work to be performed under this contract. The goal of the ETG will be to provide a broader perspective both on how R05 and related products can support agency, industry, and academia needs related to precast concrete pavement technology and on the implementation activities that need to be carried out to achieve that goal. The initial term of the ETG members will be January 2014 to September 2015. He indicated that he expected the ETG members would serve as champions for the promising R05 and related products that will support adoption of Best Practices for PCP by the stakeholders and encourage non-user highway agencies and non-involved precasters/contractors to seriously consider PCP as a viable and ready-to-use technology.

SHRP2 PROJECT R05 IMPLEMENTATION PROGRAM OVERVIEW

During the morning session on Day 1, FHWA staff provided an overview of the R05 products and the overall SHRP2 products implementation program as follows:

Introduction to R05 products by Sam Tyson

Sam reviewed the history of the R05 project. He noted the following:

- The R05 project was conducted between 2008 and 2012 and resulted in several products, ranging from best practices guidelines to model specifications.
- The SHRP2 implementation planning workshop for R05 products held in April 2012, when an initial plan for implementing the PCP technology was discussed.
- The R05 final report and model specifications for PCP were posted on the SHRP2 website during 2013.
- FHWA was designated the lead organization for implementation of R05 products.
- The implementation of SHRP2 R05 is a cooperative effort between FHWA and AASHTO.
- A 5-year window has been established for implementation of the R05 PCP technology.
- ARA was awarded a contract during late September 2013 to support FHWA's implementation efforts.
- ARA delivered the PCP Implementation Marketing Plan to FHWA during January 2014.

Sam also discussed FHWA's emphasis on Long Life Concrete Pavement and how PCP technology supports this need. He said that the principal benefits of PCP that we need to keep in mind are maintenance of traffic and opening to traffic the next morning, life cycle costs, and sustainability considerations.

AASHTO's Commitment to Support SHRP2 Product Implementation by Jameelah Hayes (discussed during Day 2)

Jameelah reiterated that AASHTO fully supports the overall SHRP2 products implementation program that is intended to improve the performance of the nation's highway infrastructure. With respect to the R05 products, she stated that these products will significantly reduce work zone durations and improve user safety in construction zones. Jameelah noted that presentations at the AASHTO Subcommittee and Task Force meetings coming up in summer 2014 are a key way to spread the message on PCP. Her office can provide help in developing presentations.

FHWA Initiatives Related to PCP Technology by Suneel Vanikar

Suneel reviewed FHWA's involvement in furthering the PCP technology from the early days during the mid-1990s to the current implementation efforts. He indicated that it required patience on the part of FHWA and it was rewarding to see that the PCP technology had made a lot of progress in the last decade. He also cited the critical role of the AASHTO Technology Implementation Group on PCP and the FHWA's Highways for Life (HfL) program for providing a public forum for the PCP technology awareness. Suneel also acknowledged the role of the private sector side in developing various PCP systems and the role of the industry associations (PCI and NPCA) in promoting use of PCP.

SHRP2 Implementation Assistance Program (IAP) Highlights by Steve Cooper

Steve Cooper serves as the SHRP2 Renewal Pavement Engineer at FHWA. He provided an overview of the SHRP2 IAP and noted that there were opportunities for three types of assistance from FHWA, as follows:

- Support for proof of concept pilots.
- Lead adopter incentives.
- User incentives.

Steve reviewed the IAP funding under Rounds 1 and 2, with 45 Renewal projects awarded in 28 States. Steve also reviewed the upcoming (March 2014) Round 3 funding that includes funding for R05 related projects. A total of five Lead Adopter Incentive awards are planned for R05 related projects. Steve also reviewed the anticipated (mid-2014) Round 4 implementation assistance program. Sam noted that even though only five awards will be made for R05 related projects under Round 3, he expects that FHWA will support non-awardees with technical, peer-to-peer, and other non-monetary type assistance through the R05 Implementation program (and through FHWA's contract with ARA).

Marketing the SHRP2 Products by Joe Conway

Joe discussed the marketing and communications resources available to help promote the SHRP2 PCP products. Joe stated that SHRP2 has a small group of communications experts from FHWA, AASHTO, and TRB that make up a Marketing and Communications Work Group (known as MarCom). This group has developed and is implementing a communications and outreach plan

for SHRP2 at the “corporate” or program level. This group is also available to support individual product marketing in a number of specific ways. He stressed that because of the multi-faceted nature of SHRP2 outreach, it is important that there is careful coordination to ensure that product and program outreach efforts are unified and complementary to continually enhance the SHRP2 brand. SHRP2 users are being exposed to programmatic-level and product-level marketing, as well as marketing for product bundles or groups. These different communications must work together seamlessly to tell the SHRP2 story. He indicated that it is MarCom’s role is to ensure that all SHRP2 communications are aligned and complementary to strengthen the brand and further product adoption. Joe then discussed various ways that MarCom is providing SHRP2 product implementation support and provided a live demonstration of the SHRP2 websites, including the GoSHRP2 site. In closing, Joe stressed to the ETG that “as you get into your product, think about evaluation, how to make the product work, and how to make sure that people hear about what works and if something does not, why not.”

FHWA IMPLEMENTATION SUPPORT CONTRACT

Shiraz Tayabji provided an overview of the PCP technology to ensure that all attendees were up to date with respect to the PCP technology developments over the last 10+ years. He noted that the overall SHRP2 Project findings included the following:

- The performance of projects constructed in the US indicate that sufficient advances have been made to reliably achieve the following four key attributes of PCPs:
 - Constructability.
 - Concrete durability.
 - Load transfer at joints.
 - Panel support condition.
 - PCP systems are more efficient – thinner pavements /panels can be used and installed rapidly overnight.
- However, several jointed PCP projects have exhibited early-age cracking. Design details and construction practices need to be improved for processes used in these projects.

Shiraz briefly reviewed the products from the R05 study, as summarized below:

- Overall findings.
- Findings based on field testing.
- Guidelines for PCP design.
- Guidelines for PCP fabrication.
- Guidelines for PCP installation.
- Guidelines for PCP project selection.
- Guidelines for PCP system acceptance.
- Model specifications.

Shiraz stressed that we need to make sure that we do not have early failures. If early failures develop, we must determine reasons for early failures and provide solutions so that it does not happen again. This process must be transparent so that the early failures do not distract from the

overall product implementation effort. Shiraz then reviewed the scope and the work plan for the FHWA contract awarded to ARA. Details are as follows:

- Title: FHWA SHRP2 Project R05 Products Implementation Support Project.
- FHWA Contract No.: DTFH61-13-C-00028.
- Scope: Deployment, delivery, and implementation of products developed under the SHRP2 Project R05 – PCP Technology.
- FHWA Contact (COR): Sam Tyson, Washington, DC.
- Contractor: ARA.
- ARA Project Manager: Shiraz Tayabji.
- Duration: 2 years plus 3 option years.

Shiraz indicated that a goal of the ARA’s contract with FHWA is to significantly expand the number of agencies who are actively using the PCP technology for production work. ARA will address the PCP product implementation within the framework of the following six product categories:

- Category 1 – Warrants for PCP Considerations.
- Category 2 – Design Procedures & Design Details.
- Category 3 – Panel Fabrication.
- Category 4 – Panel Installation.
- Category 5 – New PCP Systems & Component Acceptance.
- Category 6 – Construction Plans & Specifications.

Shiraz informed the ETG that the future work of the ETG will be conducted within the framework of the following three task forces and categories of products:

- Task Force on Planning & Design.
 - Category 1 – Warrants for PCP Considerations.
 - Category 2 – Design Procedures and Design Details.
- Task Force on Fabrication & Installation.
 - Category 3 – Panel Fabrication.
 - Category 4 – Panel Installation.
- Task Force on PCP System Acceptance & New Developments.
 - Category 5 – PCP System Acceptance.
 - Category 6 – Construction Plans & Specifications.

The discussion during Shiraz’s presentation included the following:

- Sam Tyson – There were 16 applicants for assistance under the Round 3 IAP funding. In addition, 2 additional agencies have expressed interest in assistance through the FHWA/AASHTO R05 implementation program.
- Comment – Is there a report published on the AASHTO/FHWA international PCP desk scan?

- Shiraz – The scan trip was cancelled and the desk scan report was not published. Shiraz will provide a copy of the report to the ETG members.
- Comment – Quality of precast concrete should not be taken for granted. Competition should improve quality over time. Would like to add surface condition (texture, friction, etc.) for PCP to the acceptance testing requirements. Would also like to move the monitoring and evaluation task to an earlier year. Feels that field performance data will help agencies look favorably at PCP technology. Recommended moving the monitoring task so that it could be conducted during the first two years.
- Comment – agreement. If we want to tell a story, then that will be important. There may be other avenues for telling a story of these past projects.
- Shiraz also agreed and stated that field performance information is important to have confidence in the technology.
- Comment – Noted that R05 field evaluation was performed almost 4 years ago with projects only 2 to 10 years old. Now the younger projects have been in place a few more years so there is more to learn about their performance.
- Comment – Inquired about the Japanese patented load transfer system with an air blast dowel bar sliding system mentioned in Shiraz’s slide.
- Shiraz showed a presentation with details on PCP systems used in France, the Netherlands, Russia, Japan, and Indonesia.

PCP IMPLEMENTATION MARKETING PLAN

Shiraz provided an overview of the marketing plan that was developed as part of the first task under the FHWA contract. As a preamble to the discussion, he posed the following:

- PCP technology has been in use for many years by many agencies. We need to promote their institutional decision making processes and the reasons for wider use of the PCP technology by these agencies.
- Other agencies have installed demonstration projects, but no additional projects have been developed. We need to understand why.
- Other agencies are waiting on the sidelines to see where the technology goes before considering PCP use. We need to support these agencies with appropriate technology transfer material and other assistance to help them advance the use of PCP technologies within their agencies.
- The PCP Marketing Plan needs to address all three categories of highway agencies & consider outreach activities to encourage more industry partners (precasters, contractors, and materials providers) to participate in expanding the market for PCP use.

Shiraz identified the target recipients of R05 PCP products as:

- Agency and industry senior management and supervisory staff.
- Highway agency engineering staff.
- Contractors (field crews).
- Precasters.
- Academia.

- Students (as future users of technology).
- Professors (as mentors to the students).

Shiraz presented a summary of the various marketing strategies documented in the Marketing Plan. These strategies were presented by PCP product categories.

The discussion during Shiraz's presentation included the following:

- Comment – We should not give the impression that more research work needs to be done. There was over \$1,000,000 spent on R05 and the R05 products are ready for marketing/implementation based on the work already done and information developed.
- Comment – Asked if a SHRP2 Implementation Plan for R05 had been developed.
- Steve Cooper stated that the R05 implementation plan was developed following the IPW. This was followed by a tactical plan developed by FHWA which was used for procurement of technical assistance (the ARA contract).
- Sam stated that the overall strategic SHRP2 marketing issues are being handled by Volpe. We are addressing technical issues in this contract and in this ETG.
- Comment – We need to look at the marketing effort from the perspective of an agency, the precasters, contracting community, etc. What is in it for each stakeholder? Volpe's marketing effort should be dovetailed and be synergistic with the technical push that is being discussed here.

FIRST ETG OPEN DISCUSSION (DAY 1)

A part of Day 1 was devoted to open discussion by the ETG members. This session was moderated by Sam. Items discussed included the following:

- We should focus on marketing for use of PCP in metropolitan areas where maintenance of traffic is a major issue. We should encourage peer-to-peer marketing.
- Sam noted that the PCP on I-66 in Virginia could be used as an example that included life cycle cost analysis. Sam asked if a white paper or tech brief should be prepared on life cycle cost analysis and consideration of congestion related costs.
- Comment – Comparison of PCP use should be to similar or equivalent strategies. Should not compare precast to cast-in-place. PCP will be chosen only when there are traffic constraints. So an equivalent comparison should be with other quick repair strategies. LCC is always about comparisons but the comparisons should be made with equivalent strategies. If we do not compare correctly, the comparison results would not be useful.
- Comment – One thing that is missing in performing a reliable life cycle cost analysis is objective consideration of user costs. We need good tools to get a good handle on the user costs.
- Comment – We should also market the environmental aspects of PCP because its use results in less stop and go traffic.
- Comment – As further deployment takes place, the dissemination of products that came out of R05 – specifications, tolerances, sequence of construction, etc. should be done so that there is no fear or less fear from the contractor community. We do not want contractors to increase prices due to a perception of unreasonable expectations from

owners. Some states had to go through a learning curve the first few nights. Lots of lessons were learned during the first few nights. Testimony from contractors needs to be part of the marketing.

- Comment – As training and peer-to-peer exchanges take place, all of the development work should not be redone by agencies as this could affect costs. There has been a lot that has already been learned and it is not necessary to reinvent the known information. For example, PCI documents already have a lot of best practices information.
- Comment – Model specification development for agencies is not just as easy as changing passive voice vs. active voice vs. formatting vs. language. Model specifications cannot be stand-alone but need to be properly integrated with agency specifications. Adopting model specification is not just about changing titles, numbering system, etc.
- Comment – As an example, if we wanted to hold a contractor to a specification for smoothness, it needs to match the agency's current smoothness specifications. Also, there are different standards for slab replacement vs. lane replacement with respect to smoothness requirements. Not requiring grinding of precast panels could make PCP more cost-competitive. It is considered not a good practice to give a contractor smoothness-related incentives for a bad job that is corrected by grinding, especially for continuous applications.
- Comment – If grinding is not included as separate bid item, will contractor bid it into their bid price?
- Comment – Competition will take care of it. Good contractors should know how to do their job.
- Comment – Precast slabs are made to specific tolerances. If each slab is specified to +/- 0.25 inch tolerance, then it is not hard to see that there will be unevenness that needs to be ground.
- Comment – If everything is performance based, the DOT does not care how the contractor achieves the end result. Some states will be going with performance based specifications soon, whether it is precast, cast-in-place concrete pavement, or hot mix asphalt.
- Comment – Unfair to hold PCP end product to a higher standard.
- Comment – We are dealing with individually cast slabs that have a tolerance built into the specifications.
- Comment – For example, "Tolerance Manual for Precast and Prefab ..." Section 9 of Caltrans Manual for Precast Pavements. Panel thickness tolerance is 1/16 inch. Section 40: Tolerance for cast-in-place is 1.8/16 inch (1/100 of a foot) before a contractor gets a deduction. If we are holding cast-in-place to a certain tolerance, we should hold precast to the same tolerances.
- Comment – That is a pay item issue. Comparing thickness of cast-in-place based on structural capacity to smoothness issues for precast is not an equivalent comparison. Also, it is probably more cost effective to highway agencies to grind and achieve the end result for the public anyway.
- Comment – Another factor is speed of production. We are using PCP primarily for speed of production and less disruption to traffic. There is a cost to achieve the speed of construction. You can open it up to traffic following construction and grind the next day to meet the smoothness specification.

- Comment – This is where innovations (such as the leveling bolt system) come in to get the surface elevation even and reduce roughness due to differences in elevation at joints.
- Comment – On a number of intermittent projects in the northwestern US, the projects were ground and the bid prices have been less than \$200/sq. yd.
- Comment – There is something to be said about not over specifying. That can kill innovation and also increase costs.
- Comment – Let the agency decide whether specifications should be prescriptive or end result. Keep in mind what the deliverable from this ETG needs to be.
- Comment – We have model specifications ready for delivery from the R05 work. Are there some changes that need to be made to these model specs?
- Comment – There is nothing missing in the model specifications. The model specifications provide a starting point but states still need to adjust it to meet their needs/requirements.
- Comment – Specifications need to incorporate language/references to the industry guidelines.
- Comment – We are going to go and promote intermittent repair precast panels with 15-20 year lives, but that bothers me a little bit. There is a big project in New York where the intent is to keep adding precast panels in the future so longer life for the older panels is important.
- Comment – We are looking at salvaging and stockpiling the precast panels so that the panels need to have useful longer life. In future, we plan to replace the pavement but salvage the precast panels.
- Comment – There should be a process that allows a state agency to work with various patented systems. Often times, we cannot put all details in specs/plans because a system is patented. In addition, general contractors complain when we keep the plans too generic without sufficient details. Such projects are hard to bid because contractors do not know what is involved in the actual construction due to the patents.
- Comment – The most important part from an agency perspective is to know what is patented so we can deal with it the right way and protect the intellectual property. Fear of lawsuits and violation of intellectual property may potentially affect the effective implementation of PCP technology.

TASK FORCE ON PLANNING AND DESIGN

A discussion on issues related to planning and design for PCP systems was moderated by Shree Rao. The topics for discussion included the following:

- Project selection/candidate projects.
- Demo States – What is limiting the production use of PCP?
- Structural design considerations/gaps.
 - Mechanistic-Empirical Pavement Design Guide (MEPDG) module development.
- Performance expectations.
 - We need to be careful not to over-sell PCP technology.
 - We are hoping for a permanent increasing market share for PCP, jointed systems as well as PPCP.

Items discussed included the following:

- Comment – User cost is the key component missing in trying to evaluate whether a project is suitable for PCP. However, since user delay costs do not come directly out of state budget, many states do not give it full consideration in evaluation of costs.
- Comment – Need to develop case studies on user costs and considerations of user costs in life cycle cost analysis for PCP projects.
- Comment – Should value engineering be allowed to turn a PCP project to a rapid setting cast-in-place project?
- Comments – Discussion on inclusion of PCP design into the new AASHTO Pavement ME Design procedure and software. There was discussion about presenting this need to the AASHTO Joint Task Force on Pavement Design.
- Comment – Need to develop a white paper on maintenance of traffic cost impacts for users.
- Comment – Consider lane rental costs.
- Comment – Consider PCP use for intersections. Allows use of same grade and minimal base/subgrade disturbance. Currently, there is a need for re-doing a lot of key intersections using cast-in-place concrete.
- Comment – Price perception affects consideration of PCP repair/rehabilitation projects. Many agencies are not aware that PCP costs have dropped significantly over the last few years.
- Comment – Need to develop information on unit costs of typical PCP projects and show how costs have decreased over a period of 10 years or so, using the experience at Caltrans, Illinois Tollway, New Jersey DOT, and New York State DOT.
- Comment – Project engineers are not familiar with benefits of PCP. So, effort must be made to educate the project engineers at various DOTs.
- Comment – PCP is good for intersections. Can build in blockouts manholes. etc.

TASK FORCE ON FABRICATION AND INSTALLATION

A discussion on issues related to fabrication and installation of precast panels was moderated by Maher Tadros. The topics for discussion included the following:

- Proprietary and generic systems & components.
- Fabrication considerations.
- Installation considerations.
- Process control and acceptance testing considerations.

Items discussed included the following:

- Comment – One of the issues with proprietary vs. generics is how to specify? Should systems be pre-accepted?
- Comment – Specifications can be open and allow for systems equivalent to a generic system.

- Comment – Specifications can be in line with the AASHTO Technology Implementation Group proposed specifications. Evaluation process and acceptance for PCP systems is included in the R05 report.
- Comment – It is planned to try to have the R05 model specifications to be accepted as provisional AASHTO specifications.
- Comment – Can you define a public interest finding for use of proprietary products?
- Comment – For Federal Aid projects, as long as there is a competing product and a single product available to all bidders, it is not much of an issue.
- Comment – Hard to get the proper performance measures early. For example, Falling Weight Deflectometer (FWD) deflection testing does not really indicate how the system is going to perform in the long term. FWD testing is good to assess initial condition of load transfer at joints, but does not indicate if the base is going to deteriorate quickly.
- Comment – How do we start using new systems and components? Agencies typically say show me where this has been used before. So, it is a Catch-22 type situation. At some point agencies need to take the risk and implement new technologies.
- Comment – Problems with putting panels together due to dimensional tolerance issues. Also, pavement wander issues result in longitudinal joint width increasing over distance.
- Comment – If we over specify precast panels, this may create more problems than it may solve.
- Comments – Discussion on match casting and how it is achieved. General agreement that match-casting typically is not relevant for PCP applications. The technology is there but it has its own issues (time, space, etc.) for fabrication and would be very expensive. It may not make economical or practical sense for routine PCP applications.
- Comment – Issues with spalls along panel edges and at corners. Contractor education is important. Starting to see installation consultants. Low-bid scenario means non-knowledgeable contractors can win PCP projects.
- Comment – Looking into contractor certification. Precasters do a relatively good job in terms of fabricating the panels, but installers who may be general contractors, may not have proper experience to do a good job. .
- Comment – Not only contractors need to be trained, but inspectors need to be trained. Some success training contractors. Some states requesting that state inspectors to be certified as well.
- Comment – Sometimes inspectors are not from the DOT, but work for consultants. They need to be trained as well.
- Comments – PCI and NPCA have certification programs for precasters. Most agencies have requirement for certification from one of these outside agencies. Some states manage their own certification programs.

TASK FORCE ON SYSTEM ACCEPTANCE AND NEW DEVELOPMENTS

A discussion on issues related to fabrication and installation of precast panels was moderated by Joe Kline. The topics for discussion included the following:

- Generic and proprietary systems/components.
- New system/component evaluation and acceptance.

- Lead agency approach to acceptance testing (lessons from other product acceptance).

Items discussed included the following:

- Comment – In the future what we would like to get from research groups and ETGs is how to specify generic performance criteria for PCP systems rather than specifically identifying some criteria uniquely for each system. For example, mechanically stabilized earth (MSE) walls - whatever system fits the specified performance criteria can be acceptable.
- Comment – Would new systems need preapproval?
- Comment – All systems have to be approved before bidding, but if a contractor does value engineering using a different system, the contractor would need to test and prove that the new proposed system will meet the specified performance criteria and present the data to the agency for acceptance.
- Comment – AASHTO Technology Implementation Group specifications have acceptance tests for new systems and the specification works well. It includes load transfer testing, coring to assure that dowels get encased with grout and a measure to make sure that slabs are fully supported.
- Comment – AASHTO Technology Implementation Group specifications do not fully address prestressed pavements (PPCP) because there are other considerations that are not covered. Jointed and PPCP designs and performance requirements are different.
- Comment – What about durability issues?
- Comment – Concrete durability requirements for precast concrete should be the same as required for long-life cast-in-place concrete pavements.
- Comment – Prequalification of systems is important because some contractors bid first and then change the playing field if they do not have experience with the system, which is unfair to the other potentially more qualified bidders.
- Comment – Although it is important to have a prequalification process, a barrier is availability of agency staff and resources to administer this program. There is value in keeping it simple to keep the costs down as we first enter into the implementation of PCP. There are lots of things we would like to consider, but let us keep it simpler.
- Comment – Need standards for non-concrete materials, such as panel levelling systems, bedding grout materials, etc.

IMPLEMENTING AT THE HIGHWAY AGENCY

A discussion on issues related to implementation at a highway agency was moderated by Steve Gillen. The topics for discussion included the following:

- Upper management buy-in.
- Institutional barriers.

Items discussed included the following:

- Comment – Need a good presentation on selling the concept to agency administration. Prove the benefits in dollar terms to administrators and overcome the barriers.

- Comment – The use of PCP helps reduce impact on traffic and loss of toll revenue without having to divert traffic or backup/split traffic. Also, PCP use provides safety to traveling public and contractors.
- Comment – One way to advance a new technology within an agency is to make the initial implementation a gift. System developers can pay for proof-of-concept testing.
- Comment – Agency staff needs to be able to travel to see how other agencies do it. Demonstration projects help greatly.
- Comment – Concerning barriers, extra upfront costs to agency have to be offset by something. Proof of durability/longevity is needed. Technical assistance and training are needed for both contractors and consultants.
- Comment – Competition is needed to help with pricing.
- Comment – Drivers of new technologies can be different. A higher tolerance of risk allows engineers to take reasonable risk with new innovations without risk of losing their jobs. An important driver is safety in the work zone, and PCP has a strong advantage here.
- Comment – Different agencies have different requirements/standards for travel so that affects how information gets disseminated. Need to promote PCP use at difference agency forums, such as the National Concrete Consortium meetings. Consider doing a mini-workshop at one of the National Concrete Consortium meetings.
- Comment – It is important to convince district project engineers of the benefits of using PCP and to support them rather than just force new technologies on them.

THE INDUSTRY ROLE IN PROMOTING IMPLEMENTATION

A discussion on issues related to the industry role in promoting PCP implementation was moderated by William Nickas and Evan Gurley. The topics for discussion included the following:

- Expanding participation by member companies.
- Expanding participation by non-member companies.

Items discussed included the following:

NPCA Activities (Evan)

- NPCA Pavement Committee formed to promote use of jointed PCP. Currently 19 members on committee.
- Developed website to become repository for PCP information.
- Website has been updated recently. There is lot of information, including installation videos (professional and raw footage).
- Publications and education: Three webinars were presented in 2013. Webinars 4 and 5 will be presented this year.
- “Manual of Practice for Jointed PCP” to be rolled out in August 2015.

PCI Activities (William)

- PCI perspective: Focus on basic PCP education. Project selection, manufacturing, and installation.
- Website repository of case study projects including Highways for LIFE projects, posttensioning details, durability concerns, and grouting reference from the bridge side, etc.
- Distributed 350 copies of “State-of-the-Art Report on Precast Concrete Pavements” to agencies and others in the pavement community. Reaching contractors and owners with education.

Other items discussed included the following:

- Comment – Partnering with ACPA, joint training and marketing effort. Convince ACPA/contractors that PCP helps keep pavements white (big picture). More and more ACPA contractors and regional ACPA chapters are seeing this as a positive rather than as competition.
- Comment – We are seeing that the superior product is concrete pavement and PCP offers another concrete solution. Concrete industry is coming around to seeing this and supporting PCP use.
- Comment – Need to see PCP as tool in a tool box rather than as competition to conventional PCC pavement.
- Comment – More than 35 lane miles of jointed PCP has been installed.
- Comment – Close to 20 lane miles of PPCP installed.
- Many contractors that have installed PCP are not APCA members.

INDUSTRY PERSPECTIVE: WHERE DO CONTRACTORS FIT IN?

A discussion on issues related to contractor participation in the PCP market was moderated by Leif Wathne. The topics for discussion included the following:

- The Risk factor: Are there risks in implementing new technologies and who pays for these risks?
- Need for reasonably standardized plans/specifications from agency to agency

Items discussed included the following:

- Risks are built into the price and passed on to the owner. If contractors are very unfamiliar with new product implementation, then risk is high and the price reflects that. Specifications are an important element of that. Having good specs gives contractor confidence in bidding.
- One of the risks that we often do not take into account is the risk of investing a significant amount of capital into a new product while the contractor is not confident that the product will take off and become routine practice. This is reflected in a higher price.
- It would benefit technology development if owners can signal that there is some commitment on their part to new products and processes so that contractors can

confidently invest in equipment, etc. Where there is a healthy market for a product and contractors have opportunities to compete, that results in a good environment for getting good value and good end results. So, agencies need to commit to a program.

Communicate the value of the products so that contractors can have confidence that the agency will continue support its use.

- Steep learning curve on PCP technology, but now many have more education and knowledge. This will help lower their risk and allow them to bid on future projects at competitive pricing.
- Certainly there is a higher risk on the front end but as risk goes down with experience and contractors invest in equipment and become more knowledgeable and understand that there is a market, the prices will go down.
- Comment – What sort of issues do precasters see with the general contractors and what sort of issues do contractors see with precasters?
- Comment – Experience with a good precaster and no issues at the Winder project in Georgia. There were some issues with field inspectors who were also new to PCP work. Also, within a highway agency, it is important that all key staff be on board with the new technology.
- Comment – Many agencies require system fabricator or developer to be present during the first few days of installation.
- Comment – This practice facilitates a good job of working with contractors, addressing needs, and having regular meetings to make sure everything is proceeding smoothly.
- Comment – Driver of the technology has to be the owners. Engineering challenges are probably relatively easily addressed. Owners need to recognize the value of the PCP solution and signal the value of this solution to the community so industry can jump on it. We must find ways to communicate the benefits of PCP to agencies.
- Comment – The perceived quality of the contractor by the precaster may affect the bid price from the precaster for panels because more hand holding may be needed for some contractors.

SECOND ETG OPEN DISCUSSION (DAY 2)

A part of Day 2 was devoted to open discussion by the ETG members. This session was moderated by Jim Pappas. Items discussed included the following:

- Suneel – Has the issue of accelerated testing been discussed? Some accelerated testing has been done, but this may need to be done for other systems as well.
- Suneel – We need to see if the need is there and if there is, we can look for funding for it through other sources if the ETG thinks it is important.
- Peter Smith – Fort Miller spent \$300,000 on accelerated testing in cooperation with Caltrans. The total cost of testing was over \$1,000,000 (Caltrans matched funds). Fort Miller spent a lot of money but Caltrans does not directly use the results in project selection. So, not sure if it was worth spending all that money.
- Comments – Discussion of whether there is a need or not for accelerated testing.
- Comment – There is not much of an appetite for more fundamental research.
- Comment – Monitoring and evaluating existing systems in place may be more useful. While Heavy Vehicle Simulator (HVS) results have been obtained, there have been some

failures in the field that were not captured by HVS testing. There is more to PCP than the panels. Field installation and contractor experience makes a big difference in field performance.

- Comment (Using photos from a poorly installed PCP project) – Bad PCP projects can happen. This issue needs to be addressed. We have been saying that PCP is a one-time solution and we would not need to get back to it once the repair is done. But if we have to go back to fix concrete or installation problems right away that reflects badly on the PCP technology regardless of who is at fault.
- Comment – If bad PCP is accepted and allowed to remain, then some of the blame is on the agency.
- Comment – With respect to PCP implementation, should we focus on the 20 or so states that are interested and give up on the 30 states that are not interested?
- Sam – You may be surprised by the list of agencies that applied for funding for PCP projects in Round 3 of the SHRP2 implementation assistance program. More than 50 percent of applications are from agencies that we might not have thought were not interested in PCP technology. A brochure describing the assistance and listing the applicants will be published soon.
- Comments – Discussion of whether to spend marketing efforts on states that are not interested and whether we should focus on states that have shown interest.
- Comment – Need for smaller jobs marketing (e.g., bus pads at National Parks; resort communities with limited access where road closure is not an option).
- Comment – We need to broadcast the successes.
- Comment – There is usually a time gap between leaders and followers. We should support and encourage the leaders and others will soon follow.
- Sam – FHWA’s perspective is to encourage agencies that have not used PCP and promote the technology to meet their rapid renewal needs.
- Comment – The first PCP project is always toughest to get going by an agency, but once the agency has developed its own specifications by making appropriate modifications to model specifications, then it is easier to continue.
- Comment – Getting the 15 applications for R05 IAP is already a success. Even if only 5 awards are made, it shows that there is a champion at the remaining agencies. Let us not forget these champions and market to them even if they do not get an award.
- Sam – Each applicant submitted a letter of support from their chief engineer or secretary of transportation confirming their intention to construct a PCP project.
- Comments – Discussion on inclusion of engineering consultants (larger architectural/engineering firms such as AECOM, CH2MHill, etc. and smaller firms) for training purposes.
- Comment – A website is needed for case studies and contact information within user agencies to allow other agencies to contact experienced peers directly.
- Comment – Is there a way to show what justification was used by agencies as to why they selected PCP as an option?
- Shiraz showed a video on the Gracie leveling lift and the Barra dowel bar glide system. Installation production using this system was about 45 slabs per nighttime closure.

- Comment – Need to develop strong partnership and buy-in between precasters and contractors. Small contractors may make the investment in PCP technology, possibly due to their lower overhead structure.
- Comment – Overriding agenda for contractors is to be profitable. If you give contractors a choice, then they might go with a cast-in-place alternative. PCP use needs to be specified if agencies want to implement PCP.
- Comment – Patents and proprietary products need to be recognized. We need to have some way of letting people know about what is and what is not proprietary.

Economic Analysis of PCP on VA I-66

A remote presentation was provided by Nathaniel Coley Jr., FHWA on the economic analysis performed for the Virginia I-66 PCP project, which included both jointed and PPCP systems.

FHWA CONTRACTOR PLANS FOR 2014

Shiraz presented the FHWA contractor plans for 2014. The contractor work will be performed as requested and as authorized by FHWA. The activities for 2014 may include the following:

- Workshops.
 - The workshop program is already in progress. A workshop was provided to Hawaii DOT during January 2014 and one is planned for Nevada DOT during April 2014.
 - Workshops will be provided to the recipients of the R05 IAP funds.
 - Additional workshops will be provided as requested.
- Technical presentations & webinars.
 - 2014 Delaware DOT Materials Conference, Dover, Feb. 2014 – PCP overview.
 - 2014 Northeast Pavement Preservation Partnership, Burlington, Vermont, April 2014 – PCP overview.
 - Discussion on webinar topics on-going with TRB; 90 minute duration, October 2014 timeframe.
 - Webinar 1 - Planning & design process/details.
 - Webinar 2 - Fabrication & installation.
 - Preparation for TRB technical sessions on PCP at the January Annual Meeting of the TRB.
- TechBriefs/TechNotes.
 - Planning several brief TechBriefs based on the SHRP2 R05 final report and recent developments.
 - Planning Case study TechNotes on several field projects.
- Briefing papers/Executive summaries.
- Database support to PCI and NPCA.
 - Help populate the PCI and NPCA pavement web pages.
 - Provide 50 items of relevant & non-duplicated information during 2014 and additional 25 items during 2015 & 2016, subject to review by FHWA.
- PCP technology innovations updates.

- Prepare updates on new developments and circulate to user groups – agency and industry.
 - To be prepared twice a year.
- Open houses.
 - As authorized, support PCP open house activities, in coordination with highway agencies/FHWA/industry.
 - Plan logistics – date, place.
 - Invite presenters.
 - Promote events.
 - Organize project specific workshop & site activities.

ADJOURNMENT

In closing, Sam indicated that the discussions that took place over the last two days will be utilized to make refinements in the PCP Implementation Marketing Plan. The revised marketing plan will be posted on FHWA's website as soon as possible.

The ETG meeting was adjourned at noon, March 6, 2014.