

## Overview of Precast Concrete for Pavement Applications

### Federal Highway Administration

The Federal Highway Administration (FHWA) has developed extensive guidance for the use of precast concrete pavement (PCP) technology. PCP has gained wide acceptance in the U.S. for **rapid and long-lasting** repair and rehabilitation of concrete pavements; for the reconstruction of access/exit ramps; for replacement of heavily-trafficked asphalt ramps, intersections, and bus pads; and for numerous other applications where **short work-windows and long-life pavement performance** are desired.

In April 2019 FHWA completed a five-year project titled **Implementation of Precast Concrete Pavement Technology**. Highway agencies, contractors and precast-concrete suppliers have worked together in 28 states in the U.S. to successfully construct one or more, up to ten or more, projects utilizing precast concrete panels. Project sizes have ranged from 200 panels for the replacement of intersections and ramps up to 7,000 panels for the reconstruction of continuous sections of pavement. Eleven of these agencies received funding from the SHRP2 implementation assistance program to offset a portion of the cost of PCP construction.

PCP panels can be reinforced top and bottom in both the longitudinal and transverse directions; pretensioned in the longitudinal direction and reinforced top and bottom in the transverse direction; or, pretensioned in both the longitudinal and transverse directions. Satisfactory base support has been achieved using either grade placement or placement on leveling lifts. Doweled load transfer has been provided using either bottom slots (a patented detail) or a variety of top-slot details.

Applications of PCP typically are scheduled for short lane-closures during periods of minimum traffic. An overnight closure from 9:00 p.m. to 5:00 a.m. the following morning allows for effective use of PCP and full opening of the pavement to traffic. Similarly, a weekend closure from 9:00 p.m. Saturday to 5:00 a.m. Monday allows for greatly improved productivity followed by full opening to traffic.

Maintenance of traffic (MOT) and long-life pavement performance are the principal needs that lead to the use of precast concrete for pavement applications. Precast concrete in full-depth repairs is expected to last for 20 or more years, depending on the condition of the adjoining pavement. Precast concrete intersections, ramps and other continuous applications are expected to provide 40 or more years of maintenance-free service, except for periodic grinding to restore desired surface characteristics. Asphalt and rapid-hardening concrete can provide short-term service, but will need to be replaced several times during the expected life of precast concrete panels.

Every highway agency has numerous sites, including intersections, ramps, underpasses, bus pads, full-depth repairs, and continuous sections of pavement, where precast concrete can be used both to improve MOT and to provide long-life pavement performance. FHWA has developed a Guide Specification that highway agencies can use as they develop plans and specifications for specific projects. Additionally, FHWA has developed checklists for fabrication and installation of precast concrete panels and other technical resources. Guidance documents from FHWA and other sources are available online for free download.

In the following pages, brief descriptions of FHWA publications concerning PCP are provided along with web links for downloading each publication. Included is a link for downloading the manual on jointed precast concrete pavement published by the National Precast Concrete Association.

## **Guidance Documents for Precast Concrete Pavement Applications**

***Guide Specification for Jointed Precast Concrete Pavement***, FHWA-HIF-19-017, January 2019

<https://www.fhwa.dot.gov/pavement/concrete/pubs/hif19017.pdf>

This guide specification presents considerations for the use of jointed precast concrete pavement (JPrCP) based on the best practices observed from experiences of numerous highway agencies. This guide specification does not create any Federal requirements other than those stipulated in statute or regulation.

***Jointed Precast Concrete Pavement Panel Fabrication and Installation Checklists***, FHWA-HIF-19-016, January 019

<https://www.fhwa.dot.gov/pavement/pubs/hif19016.pdf>

This guide set of checklists for the construction of PCP is intended for highway agency construction personnel. However, the checklists should be of use for the contractor personnel too. The checklists presented here follow the flow of typical PCP project construction activities. The checklists are not intended to replace the agency's QA and the contractor's QC activities, but rather to supplement and reinforce these activities to ensure a quality product is constructed. Agency and contractor personnel using the checklists should be knowledgeable in PCP construction and PCP technology. Depending on the type of PCP being used for a specific project and the project plans and specifications, not all the items in the checklists may be applicable. The user will need to determine which items are pertinent to their specific project.

***Precast Concrete Pavement Bedding Support Systems***, FHWA-HIF-16-009, November 2015

<https://www.fhwa.dot.gov/pavement/concrete/pubs/hif16009.pdf>

The proper seating of precast concrete panels on the base is a critical design and construction element. The support under the panels needs to be strong and uniform. The requirements for bedding support systems for precast panels should be no less than similar requirements for cast-in-place concrete pavement.

***Load Transfer Systems for Jointed Precast Concrete Pavement***, FHWA-HIF-16-008, October 2015

<https://www.fhwa.dot.gov/pavement/concrete/pubs/hif16008.pdf>

The incorporation of a well-designed load transfer system at active transverse joints is critical to long-term performance of jointed PCP systems. The process involves the use of a dowel-bar slot on either one or both sides of the joint. Slots may be located at either the bottom or top surface of the panel. Bottom slots are open along their full length whereas top slots typically incorporate a narrow width and may be either fully open at the surface or open only along a partial length of the slot.

***Precast Concrete Pavement Technology Resources***, FHWA-HIF-19-012, April 2019

<https://www.fhwa.dot.gov/pavement/concrete/pubs/hif19012.pdf>

Among the resources cited is the ***Manual for Jointed Precast Concrete Pavement***, 3<sup>rd</sup> Edition, published online by the **National Precast Concrete Association (NPCA)**. The link to the NPCA manual is, as follows: <https://precast.org/jprcp-manual/>. The NPCA manual has a extensive index for ease of use. Printed copies of the NPCA manual are being distributed to FHWA's Division Offices, Federal Lands Offices, Resource Center, and to each State highway agency. Similarly, a list of online addresses for downloading electronic copies of all FHWA publications resulting from this project to implement PCP technology is being sent to each of those recipients.

***Precast Concrete Pavement Technology Implementation***, Final Report, FHWA-HIF-19-013, April 2019

<https://www.fhwa.dot.gov/pavement/concrete/pubs/hif19013.pdf>

This final report provides an overview of precast concrete pavement (PCP) technology and explains FHWA's goal of providing technical support for PCP implementation not only for highway agencies receiving grants through the second Strategic Highway Research Program (SHRP2) but also for all highway agencies wishing to utilize PCP technology. PCP demonstration projects were constructed in 28 states, and highway agencies in 13 of those states are "production users" of PCP, meaning that they have adopted PCP as an alternate pavement for certain types of projects. California DOT has constructed more than 20 PCP projects, and other production users have constructed 5 to 10 PCP projects. The final report provides convenient links to Case-Study Reports for SHRP2 projects, links to technical briefs, and links to a guide specification, check-lists for fabrication and construction activities, and other resources.

***Precast Concrete Pavement Implementation by U.S. Highway Agencies***, FHWA-HIF-19-011, Jan. 2019

<https://www.fhwa.dot.gov/pavement/concrete/pubs/hif19011.pdf>

The use of both jointed and posttensioned PCP systems has advanced during the last decade due to a combination of work sponsored by the Federal Highway Administration (FHWA), projects constructed by highway agencies, and innovations by the construction industry. PCP has been adopted for routine use by several highway agencies, as detailed in this Tech Brief.

## Case-Study Reports for Precast Concrete Pavement

- **Alabama Department of Transportation** – Replacement of rutted two-lane asphalt exit ramp from I-165 in Mobile.  
<https://www.fhwa.dot.gov/pavement/concrete/pubs/hif18003.pdf>
- **Connecticut Department of Transportation** – Replacement of rutted asphalt bus pads on the rapid transit busway in New Britain.  
<https://www.fhwa.dot.gov/pavement/concrete/pubs/hif17015.pdf>
- **Florida Department of Transportation** – Replacement of concrete bridge approach on the east side of westbound I-10 near Quincy.  
<https://www.fhwa.dot.gov/pavement/concrete/pubs/hif18057.pdf>
- **Hawaii Department of Transportation** – Rehabilitation of concrete pavement along a section of H-1 near Honolulu.  
<https://www.fhwa.dot.gov/pavement/concrete/pubs/hif17001.pdf>
- **Kansas Department of Transportation** – Replacement of two distressed concrete intersections and a bridge approach on U.S. 73 in Leavenworth.  
<https://www.fhwa.dot.gov/pavement/concrete/pubs/hif17005.pdf>
- **Louisiana Department of Transportation and Development** – Reconstruction of distressed concrete access ramp onto eastbound I-20 at LA 169 near Greenwood.  
<https://www.fhwa.dot.gov/pavement/concrete/pubs/hif18053.pdf>
- **Texas Department of Transportation** – Replacement of rutted asphalt at the intersection of Routes 97 and 72, approximately 100 miles south of San Antonio.  
<https://www.fhwa.dot.gov/pavement/concrete/pubs/hif17017.pdf>
- **Washington State I-90 Pavement Rehabilitation Using Precast Concrete** – Replacement of deteriorated sections of eastbound I-90 near Issaquah.  
<https://www.fhwa.dot.gov/pavement/concrete/pubs/hif19026.pdf>
- **Wisconsin Department of Transportation** – Full-depth repair of distressed transverse joints on the Beltline Highway (U.S. 12) around Madison.  
<https://www.fhwa.dot.gov/pavement/concrete/pubs/hif17003.pdf>

## Cost of Precast Concrete Pavement

Highway agencies can expect to pay a small premium in terms of first-cost for PCP versus cast-in-place (CIP) concrete; however, the expected service life of PCP typically is much longer than CIP. Information concerning the cost of PCP compared to other paving and repair costs can be found on pages 13-14 of chapter 5 in the *Manual for Jointed Precast Concrete Pavement* published online by the National Precast Concrete Association. <https://precast.org/jprcp-manual/>

## Additional Information

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