

2020 Specifier Webinar Series – *Jointed Precast Concrete Pavement: Design, Specification, and Installation*

May 19, 2020 Live Webinar Q&A

NPCA page on precast pavement: precast.org/precast-product/paving-slabs/

Acronyms referenced in this document:

- PCP: precast concrete pavement
- CTB: cement-treated base
- LCB: lean concrete base

Applications and Use:

Q: Can PCP be used in new construction?

A: Yes, PCP can be used in new construction as well as repair and rehabilitation work of existing roadway.

Q: Have these panels been used on bridges?

A: Yes, similar types of precast concrete panels have been used on bridges.

Q: Can PCP be used for bridge approach slab replacement? If yes, please share your experience.

A: Yes, this is a common application. Here are two such case studies:

- Florida Case Study – Florida I-10 Precast Concrete Bridge Approach Slab Demonstration Project fhwa.dot.gov/pavement/concrete/pubs/hif18057.pdf. This case study report provides details of the 2018 project that used PCP panels for rehabilitation of the east-side bridge approach slab along westbound I-10 near Quincy, Florida.
- Brooklyn Bridge Case Study – precast.org/bridge-never-sleeps. This case study provides details of a 2011 Brooklyn Bridge project where precast approaches saved time and mitigated traffic concerns.

Q: Can PCP be used to replace the middle lanes only?

A: Yes, PCP can be used to replace any lane, including just the middle lane. PCP panels can be tied into existing pavement.

Q: Can we use concrete pavement around rotary intersections, roundabouts and bus pads in urban areas where we often see damage to flexible pavement due to vehicles turning and braking frequently?

A: Yes, PCP is used for rotary intersections, roundabouts and bus pads. The rigid nature of concrete pavement helps it stand up to this type of use without exhibiting the signs of damage shown by flexible pavements in this application.



Q: Is there an option that would allow panels to be removed and replaced multiple times? I am looking for an option for a roadway (major bus route) where we will likely need to come back in at multiple points in time to add/replace various utility lines.

A: Yes, panels can be removed and replaced multiple times. This is currently being done in New York City using bottom-slot panels and removable dowel bars.

Q: Are these applications all on-grade only, or are there cases where PCPs can be used on simple or multi-span elevated uses?

A: The applications discussed during this webinar were primarily for roadway use, at grade; however, PCP panels can be used for other applications including bridges.

Q: Can PCP methodology be applied to asphalt pavements?

A: No, PCP methodology cannot be applied to asphalt pavements. Asphalt pavements can be easily resurfaced, but their service life, design, ability to manufacture panels in a controlled plant environment, their flexible nature, etc. is not comparable or translatable to PCP.

Q: Are you aware of any projects using PCP technology on an interstate freeway that involved lowering the profile by 2 feet, or similar, in nighttime-only lane closures?

A: This type of work requires extended lane closures anyway, so although the panels could be installed overnight and the lane closure due to the panel installation would be short, you would still need extended lane closures due to the nature of the work and the jobsite preparation. However, using PCP in this application would still offer the benefit of plant-cured products, quick installation, and being able to reopen the lane quickly because the concrete does not need to cure.

Q: Are the use of panels an economic way to repair a concrete parking lot?

A: You would have to compare costs and service lives of your paving options to make an informed financial decision.

Panel Design and Production:

Q: How do the precast plants remove the panel formwork without having to rebuild the forms every time?

A: The formwork comes apart easily so the precast panel can be stripped from the form, and the formwork is reassembled easily to pour another panel. The forms are typically steel so they remain rigid and within dimensional tolerances.

Q: Can slots be cast into the PCP panels for tie bars?

A: Yes, if tie bars are needed, slots can be cast into the PCP panels.

Q: What is meant by "top slot" panel and "bottom slot" panel?

A: Panels are designed with openings to accommodate the dowels. The openings or slots can be positioned on the bottom of the panels or the top of the panels, hence "top slot" and "bottom slot" panels.

Q: How do you match PCP to an existing flexible pavement like hot mixed asphalt?

A: PCP transition panels are used to match existing flexible pavement to the precast concrete pavement.



Q: What are the design criteria used for deciding quantity of reinforcement? Is reinforcement decided based on the actual field loading condition and traffic?

A: The reinforcement in the panels is primarily for lifting and handling. The lifting and handling loads must be determined, and the reinforcement designed in accordance with the specific needs of the panel.

Q: What is the lead time for fabrication and delivery of PCP?

A: The fabrication lead time depends on the project and the number of panels to be installed during each work shift. Typically a precaster would begin casting panels a month before the first placement. Additionally, the panel production rate and the installation rate need to be compared. If the panel installation rate is faster than the production rate, an appropriate number of panels should be cast before installation begins.

Q: How do you ensure the panel thickness meets the design traffic wheel load and service life of the road pavement?

A: Ensure the panel thickness and design meets the necessary requirements by performing a design analysis using the agency's pavement design process.

Q: Can panels be designed and cast to be the width of a traffic lane but much longer in length to reduce the number of dowels and joints that are required?

A: Yes. Panel lengths typically range from 12 feet to 16 feet, but they can be longer or shorter depending on the need. The panel dimensions and lengths are only limited by the transportation method and the crane being used in the panel installation.

Q: Since the precast concrete is superior strength-wise, I would have thought the replacement panel would be thinner than the replaced one.

A: The reason the PCP panels are of equivalent or greater thickness than the existing, removed pavement is because the new PCP panels are being designed to carry greater traffic volumes and greater traffic loads, particularly truck traffic.

Q: On a city road, how do you get around watermain valves, manholes, gas valves, catch basins, etc.?

A: The panels can be produced with "blockouts" or openings in the panels to accommodate obstructions. Panels can also be designed to be removed and replaced periodically for underground utility maintenance.

Q: How is a two-lane panel crowned to have proper drainage?

A: The panels can be cast with a crown at the precast manufacturing plant. Since the crown is usually at the centerline joint, the slope is provided in the base, and uniformly thick panels can be used. Otherwise, panels with trapezoidal cross sections can be used to achieve the crown.

Panel Sizes and Geometry & Addressing Grades and Slopes:

Q: How do the panels handle grade change?

A: Slopes and grade changes are accommodated by preparing the bedding and base according to the grade change requirements. Additionally, panels do not need to be perfect rectangular prisms. The panels can be cast with trapezoidal cross sections, angles, slopes, skews, warped shapes, blockouts or holes, etc. to accommodate on-site needs.



Q: How are super-elevations handled?

A: Similar to how grade changes are addressed, PCP panels can be produced with a super-elevation, skew, trapezoidal cross sections, etc. to accommodate the site conditions and roadway needs.

Q: Are there any guidelines for designing PCP panels to repair intersections? Is it a challenge when there are different slopes converging?

A: The panels may need to be customized to fit the site geometry, but that is already done routinely so it is not necessarily a challenge. Panels are not always perfect rectangular prisms. To avoid designing custom panel cross sections to accommodate the intersections grades, the intersection grades could be redesigned.

Q: What are the largest panels you have replaced on a project? We are an airport and have 25-foot-by-25-foot-by-16-inch panels in our runway and runway intersection. Would this be an appropriate application for PCP?

A: The maximum panel size depends on the crane available for installation as well as the ability to transport the panels from the precast plant to the job site. At La Guardia Airport's apron area, 12.5-foot-by-25-foot-by-16-inch panels were previously placed.

Q: If you were replacing an existing 16-inch concrete slab constructed on a 6-to 8-inch cement-treated base, would you replace this existing pavement with a thicker precast panel? Can you leave the existing CTB in place?

A: If the CTB is not damaged while removing the old pavement, the CTB could be reused, and the PCP panel thickness can remain the same as the previous pavement. If the cement-treated base is damaged, however, it is best to add a new layer of lean concrete base and adjust the panel thickness accordingly.

Joints:

Q: What is the average width of joints in PCP panels?

A: The specified joint width for transverse joints is 1/4-inch, not to exceed 1/2-inch.

Q: Do the PCP panel joints have to match the location of the joints of the existing adjacent concrete pavement to avoid sympathetic cracking?

A: If the longitudinal joint is tied into the adjacent pavement, the joint locations must match. If the longitudinal joint is not tied into the adjacent pavement, the joint locations do not need to match.

Q: Why aren't dovetail joints or a male/female joints used?

A: These types of joints would be very challenging to install without causing spalling.

Q: Is there a way to provide space between PCP panels for thermal expansion?

A: Transverse joints between panels are required to have a width from 1/4-inch up to 1/2-inch and provide space for expansion.



Dowels:

Q: How do you ensure dowel alignment between panels?

A: The QA/QC processes at the precast plant ensure the paving slab panels, the dowels and the dowel slots are in accordance with design and are within the strict tolerances. These strict processes prevent alignment issues or inconsistencies during installation.

Q: What is the typical diameter for dowel bars?

A: Most often, dowel bars are 1¼ inch to 1½ inch in diameter.

Q: Are the slots for the load transfer bars/dowel bars preferred on top or bottom of the precast panel?

A: The dowel slot position depends on the panel design. Dowel slots can be located on the bottom of the panel or the top of the panel. Either method works well.

Q: Can fiberglass dowel bars be used for load transfer at joints?

A: Yes, fiberglass dowel bars can be used; however, when using fiberglass bars, larger diameter bars and closer spacing is required.

Bedding, Grout and Leveling:

Q: How do you ensure full grout coverage in the dowel slots or openings?

A: First, the amount of grout needed for a particular scenario (panel dimensions, bedding conditions, dowel scenario, etc.) is predetermined. Additionally, the panels contain grout ports which provide an opening to validate the grout has achieved full coverage. As the panel is grouted, the grout coverage can be determined by monitoring the level of the grout visible in the grout port.

Q: Does using a cemented bedding layer impact drainage if water gets trapped between the panel and the bedding?

A: Cemented bedding layers are used with free-draining granular bases to prevent water from being trapped between or under panels.

Q: If you use a lean concrete base under the panels, do you still have to use a grout under the panels?

A: Yes, the grout is still required. It is unrealistic for a base to be graded smooth enough to match the smoothness of the bottom of the panel, so the grout is needed to achieve the appropriate levelness and smoothness.

Q: From which holes is bedding grout being applied/injected?

A: There are small holes in the top surface of the PCP panels specifically for applying bedding grout. These holes are called grout ports.

Q: Have there been sections examined to evaluate how well the grout distribution was below the slab? I am curious if it provided support under the entire slab.

A: Yes, this has been examined and found grout distribution is even and complete. Grout distribution has not been found to be an issue.

Q: Is low-shrinkage grout used?

A: Yes, low-shrinkage grout is used. The grout must conform with the requirements set forth in the project specifications.



Q: Is there any bonding between the lean concrete base and PCP?

A: Yes, the lean concrete base and PCP panels are bonded by the grout layer between them.

Q: Are the leveling bolt bases strong enough to hold the panel weight?

A: Yes, the base plates of leveling bolts are designed to carry the panel weight.

Q: When grouting is done on the second night, does that keep the lane closed after the first night?

A: No. If panels are installed one night and will be grouted the following night, the panels can still be opened to traffic even before the grouting has taken place. This is not common because it would result in the panels sitting directly on the base layer (rather than having the grouted layer between the base and the bottom of the panel), but it can be done.

Q: What is the definition of “lean concrete” with respect to the term “lean concrete base”?

A: Lean concrete refers to concrete with a relatively low amount of cement per cubic yard - typically around 200 lbs to 300 lbs of cement per cubic yard of concrete. It has lower strength as a result of the low cement content, but lean concrete in these terms is used for the base, so the lower strength is acceptable.

Q: How do you fill the void area under the dowel rods after the panel is set?

A: Grout is injected into the grout ports and fills the area under the panels and fills the area surrounding the dowel rods.

Q: Can the existing pavement base be reused for a PCP project?

A: Yes, during both intermittent repair and continuous paving projects, the existing base can often be reused. The base is repaired, regraded and compacted. However, some agencies may require the base be removed and replaced rather than allowing the existing base to be reused.

Q: What usually happens if the bedding voids are greater than 1 inch?

A: If the bedding voids are larger, more grout will be required to fill the voids and create a level surface.

Panel Lifting and Installation:

Q: What lifting arrangement is used on PCP panels?

A: Typically four-point lifting is used for PCP panels.

Q: Can you elaborate on why shorter lane closures have led to shorter service life?

A: This is specifically in reference to use of rapid-set concrete. Rapid-set concrete may seem like an ideal option in some cases because it requires a short lane closure; however, historically its performance has been inconsistent or unreliable. Therefore, historically, some have correlated the short-period lane closure in rapid-set concrete applications to shorter service lives. With PCP, you can achieve short lane closures without sacrificing service life.

Q: On a roadway carrying 300,000 vehicles per day, what would you consider to be the maximum length of roadway that can be removed and replaced in a 7-hour, night-time work period?

A: Likely about 400 feet to 500 feet of panels, but it depends on the number of lanes, the contractor's experience level, etc.



Q: Have you used embedded drainage elements on the underside of the precast panel to minimize the effect of wet subgrade conditions?

A: No, but it could be considered if needed.

Q: When installing the precast concrete pavement panel bus pads, did any of the asphalt edges require repairs, i.e. raveling or loss of base material?

A: No. Sawing and removing the existing roadway was done carefully so as not to damage the surrounding asphalt. The joint between the PCP bus pad and the adjacent asphalt lane was filled with grout.

Q: How are the panels tied into the existing adjacent lanes?

A: The new PCP panels are tied into the existing adjacent lanes using dowels. The existing lanes will have top slots sawed into them, dowels will protrude from the new PCP panel, and the dowels will enter the slots when the panel is positioned. The dowel slots are then grouted.

Service Considerations and Observations:

Q: Have any existing PCP roadways had heat applied under them in colder regions to aid deicing or snow melting?

A: Yes, this has already been conducted successfully in Japan.

Q: Do you have any cases of cracks on the construction joints due to traffic load impact? If so, how is the repair procedure?

A: If cracks would develop due to traffic load impact, they are most likely to occur at the corner or mid-panel. This is uncommon due to the strict bedding, design and installation requirements, but if cracks were to develop, conventional concrete pavement crack repair techniques could be used. The panel producer may have recommended repair guidelines and materials as well depending on the PCP application.

Q: Do vehicles feel a very smooth ride? Or are there some bumps?

A: The vehicle ride is very smooth. Additionally, surface grinding could be performed on the PCP panels to provide an even smoother ride.

Q: How do you maintain top riding surface as per standards? How do you detail match points with the existing pavement?

A: The dimensions and tolerances are very strict. Top riding surface standards as well as match point details are maintained through high quality panel production, strict quality control and careful installation.

Q: Have you seen dowel corrosion in panels?

A: No, corrosion of dowels in the panels has not been an issue. Certain steps can be taken to prevent corrosion of the dowel bars within the panels, including using a dense concrete mix, a low water-cement ratio, supplementary cementitious materials and air-entrainment. Epoxy-coated dowel bars can be used as well.

Q: Have you observed any cracking around penetrations, blockouts or holes in PCP slabs?

A: No, this has not been an issue. Additionally, some reinforcement can be positioned/embedded within the panel around penetrations to provide additional support (similar to an opening in a manhole top slab, for example).



Q: Do you see any early failures in the surface grout over the life of the PCP? This is a Foreign Object Debris (FOD) concern for installations at airports.

A: This has not been an issue in highway projects. Bottom-slot panels would be applicable for airport use and the bottom-slot design would keep the grout on the bottom of the panel and alleviate this potential concern.

Case Study-Specific Questions:

Q: Was the cause of the Hawaii H1 pavement settling ever investigated prior to replacing the roadway?

A: It was determined to be due to use of a high embankment.

Q: In the Connecticut bus pad example, how was the load transfer achieved between the PCP and the asphalt pavement?

A: No load transfer was designed in this case. The first and last panels were designed as transition panels. There is more information on this topic in the case study report referenced within the presentation.

Q: Can you please elaborate on the type of joints used for the intersection replacement in Texas?

A: The Texas intersection replacement project referenced in the webinar used doweled joints.

General:

Q: What are the most common reasons for specifiers to not be comfortable with PCP?

A: Typically, if a specifier is uncomfortable with PCP it's attributed to unfamiliarity with the technology.

Q: What concerns do contractors have when they are new to PCP technology?

A: Contractors haven't shown concern, rather contractors are guided through the process to answer questions and ensure a smooth installation. Contractors are provided detailed plans, installation procedures, and specifications, and they're also part of pre-construction meetings to address questions and ensure everyone is prepared. If a contractor has not previously worked with PCP, they may perform a trial installation adjacent to the job site prior to the project to become familiar with the installation process.

Q: Are there videos showing manufacturing and placing of panels?

A:

[youtube.com/watch?v=Va6EcSpE7HA](https://www.youtube.com/watch?v=Va6EcSpE7HA)

[youtube.com/watch?v=Li4wbKWulkg](https://www.youtube.com/watch?v=Li4wbKWulkg)

[youtube.com/watch?v=fzrRb7o1bOg](https://www.youtube.com/watch?v=fzrRb7o1bOg)

[youtube.com/watch?v=Wv11k4NLVIY](https://www.youtube.com/watch?v=Wv11k4NLVIY)

