

Technical and Construction Considerations for Jointed Precast Concrete Pavement Applications

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Abstract

Continued efforts are being made to expedite the rehabilitation and reconstruction of concrete pavements using long life concrete repair alternatives. A promising strategy is the use of precast concrete pavement technologies that allow for accelerated repair and rehabilitation of pavements and also result 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. Road user and worker safety is also improved by reducing users' and workers' exposure to construction traffic. The precast technology can be used for intermittent repairs or full-scale, continuous rehabilitation. In *intermittent repair* of PCC pavement, isolated full-depth repairs at joints and cracks or full-panel replacements are conducted using precast concrete panels. The repairs are typically full-lane width. The process is similar to full-depth repairs and full-panel replacement. In *continuous applications*, full-scale, project-level rehabilitation (resurfacing) or reconstruction of asphalt and PCC pavements are performed using precast concrete panels. This paper highlights technical and construction considerations for implementing the jointed precast concrete pavement technology.

Introduction

Pavement rehabilitation and reconstruction are major activities for all U.S. highway agencies. These activities have significant impact on agency resources and are a source of traffic disruptions caused by extensive and extended lane closures. Traffic volumes on the primary highway system, especially in urban areas, have increased significantly 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. Many agencies also continue to wrestle with the age-old dilemma: longer delays now and longer service life versus shorter delays now but shorter service life.

In recent years, many agencies have started investigating strategies for pavement rehabilitation and reconstruction that are faster but can produce durable pavements. Expedient rehabilitation that results in a shorter pavement lifespan is no longer considered acceptable by most highway agencies. A promising rehabilitation strategy is the effective use of modular pavement technologies, principally precast concrete pavement (PCP) systems, which provide for rapid repair and rehabilitation of pavements and also result in durable, longer-lasting pavements. Rapid construction techniques can significantly minimize the impact on the driving public, as lane closures and traffic congestion are kept to a minimum. Road user and worker safety is also improved by reducing road users' and workers' exposure to construction traffic.

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PCP technologies have been investigated sporadically over the last 40 plus years. In the early years, the technology was looked into either as a matter of technical curiosity, that is, to learn whether PCP technology was technically feasible, or as an emergency repair technique with minimal concerns regarding long-life performance. No serious attempts had been made until more recently to fully develop the technology as a cost-effective strategy or to implement the technology on a production basis. Today, the maturing highway system in high-traffic-volume urban corridors makes the need for timely pavement repair and rehabilitation urgent, and highway agencies are looking at innovative technologies, including PCP technologies that require shorter lane closures and result in economical, long-life pavements that will not require major interventions for repair or rehabilitation during their service life. Over the last 10 years, new PCP technologies have been developed whose use is becoming technically feasible and economically justifiable on a project-by-project basis.

The “Renewal” focus area under the Strategic Highway Research Program 2 (SHRP 2) emphasizes the need to complete highway pavement projects rapidly, with minimal disruption to highway users and local communities, and to produce pavements that are long-lasting. A goal of this focus area includes applying new methods and materials to preserve, rehabilitate, and reconstruct roadways. The effective use of PCP technologies for rapid repair, rehabilitation, and reconstruction of pavements addresses this goal. One of the projects funded under SHRP 2 is Project R05, Modular Pavement Technology (Tayabji, Ye, and Buch, 2011). The objective of Project R05 project was to develop better guidance for use by highway agencies to design, construct, install, maintain, and evaluate modular pavement systems.

Jointed Precast Concrete Pavement Concepts

The application of precast concrete pavement technology can be classified as follows:

1. Intermittent repairs of concrete pavements.
2. Continuous applications.

For the *intermittent* installation, isolated pavement repairs are conducted using precast concrete slab panels. Two types of repairs are possible under this application:

1. Full-depth repairs (FDRs) - to repair deteriorated joints or cracking and punchouts and deteriorated cracks in CRCP.
2. Full-panel replacement - to replace severely cracked or shattered slab panels.

The repairs are always full-lane width. The process is similar to conventional FDRs and full-panel replacement, except for the length of the repair area. A schematic of the repair is shown in Figure 1.

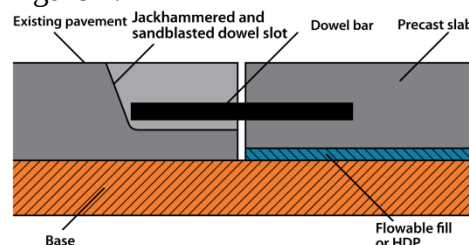


Fig. 1. Schematic of the Intermittent Repair Application.
(Hall and Tayabji, 2008)

Under the scheme shown in Figure 1, dowel bars are embedded in the precast panel, and slots for dowel bars are cut in the existing concrete pavement, similar to

the dowel bar retrofit (DBR) method, as illustrated in Figure 2. The dowel slots are then filled with fast-setting patching material. In a variation of this scheme, no dowel bars are embedded in the precast panel and dowel bars are installed after panel installation using the DBR technique, as shown in Figure 3.

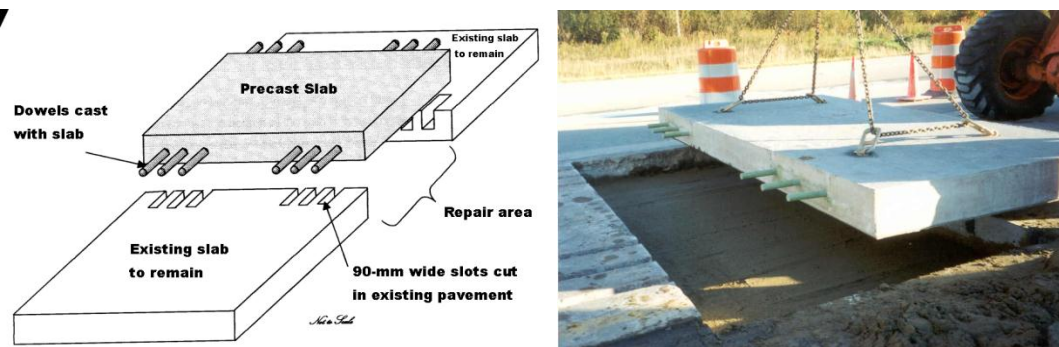


Fig. 2. Alternative Scheme for Installing Intermittent Panels



Fig. 3. A variation for Installing Dowel Bars Using the DBR Method (Tayabji, Ye, Buch, 2011)

In another scheme for intermittent repairs, the dowel bars are positioned in the existing concrete pavement by drilling and epoxy-grouting, similar to CIP FDRs or full slab repairs, and the slots for the dowel bars are fabricated in the repair panels along the bottom of the transverse sides, as illustrated and shown in Figure 4. The slots and the joint perimeter gap are then filled with fast-setting grout.

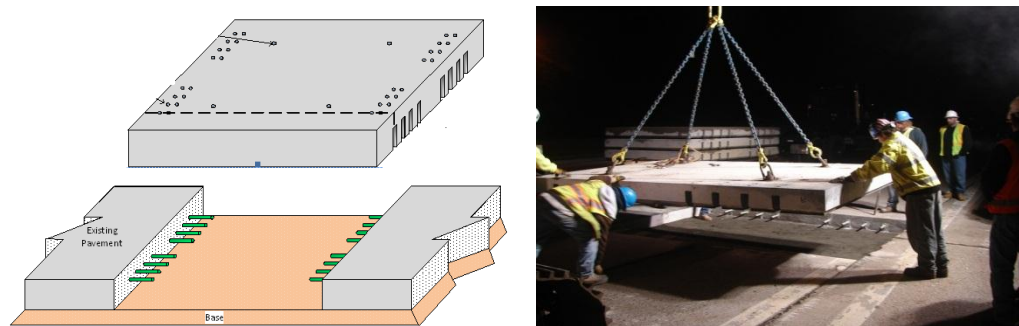


Fig. 4. Another Scheme for Intermittent Repairs (Courtesy: FMC)

Each of the above methods of panel installation, with respect to the load transfer provisions, has certain advantages and disadvantages. In addition, the actual

panel installation and the base support under the panel can be achieved using techniques as follows:

1. Panel placed directly over the prepared base.
2. Panel placed and raised to proper elevation using expandable polyurethane foam.
3. Panel held in place using strong back beams and bedding material injected under the panel.
4. Panel positioned at the proper elevation using setting bolts and bedding material injected under the panel.

Key features of the intermittent repair applications are:

1. The need to establish good support condition under the panels.
2. The need to provide adequate load transfer at transverse joints.
3. The need to install the panel so that the elevation differences between the panel and the existing pavement are minimized.
4. Acceptable long-term performance of the repair area.

The jointed precast and the precast prestressed concrete pavement systems are viable rapid renewal alternatives for full-scale project level rehabilitation (such as reconstruction or overlay application).

For the purposes of this paper only the jointed precast concrete pavement system will be discussed. Jointed precast concrete pavements (JPrCP) are very similar to CIP JCPs. Once installed, the JPrCPs behave similarly to CIP JCPs. Some specific differences that influence the performance of the JPrCP are as follows:

1. The panels are installed with flat with no geometric deformation. As a result the panels do not exhibit construction-related, built-in curl/warp behavior.
2. The panels incorporate steel reinforcement. Therefore, any in-service cracking that may develop over time due to traffic loading can be maintained tight.
3. The panel transverse joint faces are smooth (fabricated); therefore, aggregate interlock cannot be counted on for load transfer at these joints.

All JPrCP systems used in the United States incorporate load transfer at transverse joints. All currently used JPrCP systems use round dowel bars, typically steel bars, for load transfer. One scheme that is used to incorporate the load transfer is shown in Figure 5, similar in concept to the system shown in Figure 4 for intermittent repairs. Under this scheme, one side of the panel has slots along the slab bottom to accommodate the dowel bars and the other side has embedded dowel bars at locations that match the dowel slot locations. After installation, the slots and the joint perimeter gap are filled with fast-setting grout.



Fig. 5. Scheme for Providing Load Transfer in JPrCP (Courtesy: FMC).

A simpler scheme using the DBR technique can also be used for JPrCP applications. Such a scheme requires patching of the dowel slots during the same lane closure as the panel installation because of use of wide-mouth dowel slots. The primary reason for not using this scheme is not related to performance but to avoid leaving open, wide-mouth slots exposed to highway traffic for a day or two. The retrofitted dowel bar scheme was used at an airfield demonstration application. Under this scheme, the dowel bars were embedded along one transverse side of the panel and dowel bar slots were placed at the top side of the panel along the other transverse side. The panels were then interconnected by positioning one panel with the embedded dowels adjacent to another panel with the dowel slots as shown in Figure 6.



Fig. 6. Alternate Scheme for Providing Load Transfer in JPrCP (Tayabji, Ye, Buch, 2011).

Construction Considerations

There are several construction features that need attention when installing JPrCP (intermittent or continuous). If these features are properly harmonized then this rapid renewal strategy has the potential for long life.

Concrete Requirements. Precast concrete requirements need to be similar to those specified by the highway agency for CIP concrete pavements. However, because the precast pavements are to be used for highways with high traffic volumes where lanes closures are at a premium, *concrete durability is of great importance. Concrete must not fail because of materials-related distress or poor-quality construction (during fabrication).* The fabricator may optimize the aggregate size and gradation to achieve an economical and sustainable concrete mixture that is workable for fabrication of the panels. The maximum size aggregate should not be less than 0.75 in. (19 mm) as there is a need to ensure that load transfer by aggregate interlock is available at panel cracking locations if any panels develop cracking under long-term traffic loading. Use of larger-size aggregate is encouraged as it results in sustainable concrete mixtures requiring less cementitious materials. Also, concrete volume changes related to early-age drying shrinkage are not of significant concern since these effects take place over a smaller panel length and typically before panel installation. Typically concrete mixtures should yield a flexural strength (at 28-days) of 650 psi and a compressive strength (at 28-days) of 4000 psi. Examples of strength requirements by some highway agencies for concrete used for precast panels are listed in Table 1.

Table 1. Examples of Concrete Strength Requirements.

Agency	28-day Compressive Strength
Michigan DOT	4,300 lbf/in ²
Minnesota DOT	3,900 lbf/in ²
Illinois Tollway Authority	4,500 lbf/in ²
Ministry of Transportation Ontario	4,500 lbf/in ²
New England Tollway	5,000 lbf/in ²
New York State DOT	4,500 lbf/in ²
AASHTO PCPS TIG	4,000 lbf/in ²
Virginia DOT	5,000 lbf/in ²

NOTE: 1 lbf/in² = 6.89 kPa.

Concrete used for fabrication may be slump concrete or self-consolidating concrete (SCC). Precasters may use higher-slump concrete as long as the allowable water-cementitious materials ratio is not compromised. Precasters typically use concrete with a slump of about 6 to 8 in. (150 to 200 mm) to facilitate manual placement and finishing of the concrete. When SCC is used, the concrete flow characteristics are based on the plant's experience. Irrespective of the concrete type used, the concrete used must enable rapid placement and finishing at the plant.

The concrete strength required to strip the forms is about 2000 psi (16-24 hours after casting concrete). Additional concrete properties to be considered include the coefficient of thermal expansion, elastic modulus and ultimate shrinkage strain (important for the Precast Prestressed Concrete Pavement system). These additional properties have a significant bearing on the structural and joint design of the precast panels.

Panel Reinforcement. The primary purpose for placing steel reinforcement in precast panels is to reduce the potential for cracking during lifting, handling, transportation and installation operations. Secondly, the panel reinforcement may assist in bridging cracks that may develop over time due to traffic loading. The crack width can be expected to remain tight without affecting pavement serviceability. Typically, the panel reinforcement is at least 0.20% of the panel cross-sectional area in both directions. It should be noted that the reinforcement is not necessary for enhanced pavement performance unless the panels are designed as reinforced concrete pavements. For the top panel reinforcing steel the cover should be at least 2.5 in. (64 mm) after allowing for up to 0.5 in. (13 mm) future grinding. The bottom panel reinforcing should have at least 2 in. (50 mm) clear cover. Transverse and longitudinal bars should have at least 2 in. (50 mm) cover at bar ends. Figure 7 illustrates a typical reinforcement arrangement for a precast panel.

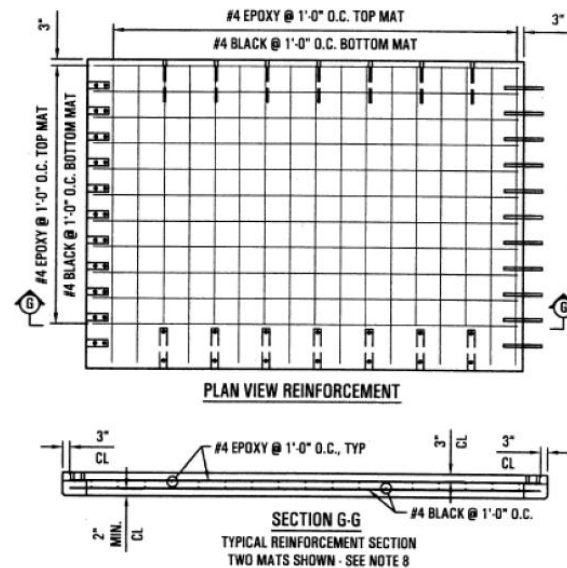


Fig. 7. Typical panel reinforcement layout. (Courtesy: FMC).

Panel Lifting and Shipping. The stresses induced in the precast panel due to lifting and handling forces need to be considered in the design of the precast panels. Typically, the panel dimensions dictate the capacity of the lifting design. The static four-point lift anchor static loads can range from 1,750-15,550 lbs depending on the panel dimensions and slab thickness. Typical stresses induced in the panel due to lifting range from 40 to 350 psi (as a function of the panel dimensions and slab thickness). It is important that the technical information related to the anchors, rigging, lifting, hauling, and storage should be included in the shop drawings. Also, any lifting hardware left in place must have 2.75 in. (70 mm) top cover and 2 in. (50 mm) bottom cover after installation. Such cover requirements are necessary for corrosion purposes as well as to provide sufficient space for profile grinding of the surface. Figure 8 illustrates a typical four-point lifting of a precast panel.

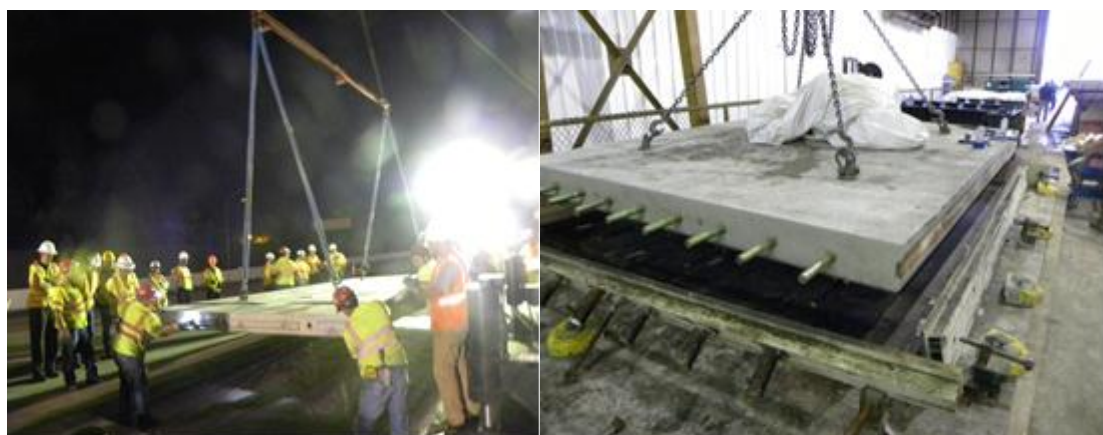


Fig. 8. Typical four-point lifting of a precast panel (Tayabji, Ye, Buch, 2011).

Surface Characteristics. For intermittent repair applications, the ability to install and seat individual panels impacts only local roughness. Typical specifications limit the elevation difference at a joint between the precast panel and the existing pavement to

not more than 0.25 in. (6 mm). On many projects, the elevation difference is controlled by grinding after the panel installation. For continuous applications, the ride requirements should be the same as for CIP concrete pavements. As necessary, typical specifications require elevation differences at joints and other irregularities in surface profile to be taken care of by grinding. Although the ground surface may be considered acceptable, grinding requires another operation and additional lane closure periods. Upon further development of the panel installation techniques, grinding may not be necessary as the elevation differences between the precast panels will meet all elevation tolerances immediately after placement.

Surface texture requirements for the installed panels should match that for new construction. However, as discussed, it is likely that the panel surface may be ground to meet profile requirements for repair projects and for continuous application projects. The ground surface should be considered acceptable. The controlled conditions of a precast plant also present the opportunity to imprint textures that are quieter and provide adequate friction or incorporate two-lift concrete placement that allows use of better quality and possibly more expensive aggregates in the thin top lift of the panel. However, this is effective only if the panels can be installed without requiring grinding to correct surface profile. Typically, precasters do provide some form of texture at the panel surface. This may include brooming, turf-drag, or tining transversely or longitudinally.

Jointing and Joint Load Transfer. Proper jointing and load transfer details are key to long life performance of jointed precast concrete pavements. The transverse joint spacing requirements for jointed precast pavements are very similar to conventional jointed concrete pavements. The typical requirements for intermittent and continuous applications include:

1. *Intermittent repairs* - Panels are typically single-lane width, and the panel length may range from a minimum of 6 ft (1.8 m) to about 15 ft (4.6 m). On many repair projects involving existing JRCPs with joint spacing of 60 to 78 ft (18 to 24 m), standard panel lengths of 8, 10, and 12 ft (2.4, 3.0, and 3.7 m) have been used to repair distressed cracking or joint areas. On the other hand, for JPCPs with shorter joint spacing, standard 6-ft-long panels may be used to correct joint-related distress, typically severe joint spalling.
2. *Continuous jointed applications* - A standard joint spacing that is widely used for CIP JCP is 15 ft. (4.6 m). This joint spacing is providing good performance throughout the United States and has significantly reduced the risk of early-age cracking for CIP JCP. The use of the 15-ft joint spacing is recommended for jointed PCP applications for panel thickness of 8 to 13 in. (200 to 330 mm).

Proper jointed load transfer systems require that a significant portion of the axle load be transferred across the joint and minimize the subgrade stresses. As an example, an axle load of 20,000 lb (9,072 kg) each wheel set (single or dual) carries 10,000 lb (4,536 kg) and about 5,000 lb (2,268 kg) of that needs to be transferred across the joint for a fully efficient joint-load transfer system. When the axle load is located at the corner, the outermost dowel bar transfers about 3,000 lb (1,361 kg) of the 5,000 lb that needs to be transferred at the outside wheel path. When the axle load is located at the lane edge for a 14-ft (4.3 m) widened lane or 2 ft (0.6 m) away from the edge of a 12-ft (3.7 m) wide lane, the maximum load transferred by a dowel is about 1,200 lb (544 kg). For intermittent repair or continuous applications, the dowel bar design is dependent on the axle load location. Use of 12-ft-wide precast panels

would require consideration of the 3,000-lbf load transferred by the critical dowel, and use of a widened panel would require consideration of only about 1,200-lbf load transferred by the critical dowel. It is important that the dowel bars be spaced such that the critical axle loading condition is accounted for. In any case, dowel bars should not be placed greater than 12 in. (0.3 m) from the outside corner location for a 12-ft (3.7-m) wide lane. The typical load transfer design recommendations are summarized in Table 2.

Table 2. Summary of Dowel Design Recommendations.

Dowel Design Property	Recommendations
Diameter	For precast panels less than 10 in. in thickness, dowel diameter of 1.25 in. is recommended. For slab thicknesses between 10 and 14 in., dowel diameter of 1.5 in. is recommended.
Length	Typical dowel length used in the United States is 18 in. However, since precise locations of the dowel bars are known, use of 16 in. long dowel bars is considered adequate, allowing for embedment of at least 7 in. at each side of the joint and accounting for a joint width of 0.5 to 1.0 in.
Spacing	Dowels are typically placed at a spacing of 12 in. However, the middle dowels do not contribute to the load transfer at a joint. Therefore, a cluster of 4 to 5 dowels per wheelpath, spaced at 12 in., are considered adequate for both applications.

The typical load transfer currently used in JPCPs is summarized in Table 3.

Table 3. Precast Pavement Load Transfer Provisions

Precast pavement system	Method of load transfer installation
Fort Miller Super-Slab system	Using a drilled and epoxied dowel/slot system. The dowel bars are installed along the transverse joints in the existing pavement by drilling and epoxy grouting. The panels incorporate matching slots at the bottom. A <i>conventional dowel</i> layout is adopted.
Kwik Slab system	Includes Kwik <i>joint steel couplers</i> that interlocks precast concrete panels allowing rebar continuity throughout the connected panels.
Michigan method	The dowel bars are embedded in the precast concrete slab and the dowel slots are cut in the adjoining existing pavement joint face. The dowels are placed in <i>clusters of 3 or 4</i> along the wheel path. The finished product resembles a dowel retrofit installation.
Roman Road System	The dowel bars are not embedded in the panels, but are installed using the DBR technique after the panels are placed. The slots for dowel placement are cut in the existing concrete as well as in the panel after the panel is set in final position (elevation).

In general, the use of dowel caps are recommended when constructing JPrCP systems, especially when the dowel slots are on the surface and do not fill in the joint space with the grout material or if the panel is located at an expansion joint in an existing JRCp. The load-transfer system should allow for expansion and contraction of the precast panels and, if applicable, the adjacent existing concrete pavement. If expansion of the concrete pavement is prevented, joint spalling or cracking adjacent to the affected joints may develop. In addition, a potential for blowups during warm summer days will exist.

An approach developed under Project R05 is to use narrow-mouth surface slots, as shown in Figure 9. The slots are narrow, about 1 in. (25 mm) wide, at the surface and taper out to about 3 in. in width about an inch below panel mid-depth. The slots are about 18 in. (450 mm) long to accommodate a 16-in. (400 mm) long dowel bar within the slot. The concept is to slide dowel bars into the slot just before the slab is placed over the base/bedding. During the next lane closure, the dowel bars are then slid into the companion drilled holes in the existing pavement after the holes are partially filled with epoxy, for repair applications. For continuous applications, the dowels are slid into companion dowel slots and the dowel slots are then patched using the DBR technique.



Fig. 9. Narrow-mouth surface dowel slots (Tayabji, Ye, Buch, 2011).

Tie bars should be considered for the PCP longitudinal joints for any continuous PCP placement that exceeds about 50 ft (15.2 m) to minimize or eliminate lane drift. The tie bar use should be in accordance with the agency's practice for CIP concrete pavements with respect to tie bar size, length, and spacing. Tiebars should not be used under the following situations:

1. For single panels used for intermittent repairs.
2. When a JPrCP is used to rehabilitate a lane and the adjacent lane is a different pavement type, such as a JRCP or a CRCP.

Panel Support Considerations. For new construction as well as for repair applications, pavement support is critical to the long-term performance of PCP systems. The proper seating of the panels on the base is a critical design and construction element. The support under the panels needs to be firm (strong) as well as uniform. For most PCP repair or rehabilitation (reconstruction) applications, the following support alternatives may need to be considered:

1. Use of existing base:
 - a. Granular base may be reworked, graded, and compacted. The panel is placed on the compacted granular base.
 - b. Granular base may be reworked, trimmed, graded, and compacted; additional bedding material is then used to make up the difference in the base grade needed. The bedding material may be:
 - i. Thin layer of finely graded granular material or sand.
 - ii. Fast-setting flowable cementitious grout or flowable fill.
 - iii. Polyurethane foam material, applied after the panel is placed or set in position. For repair application, a foam thickness of up to 1 in. (25 mm) may be used.
 - c. Stabilized base, if not damaged in the existing slab removal process, may be used as is. A thin layer of finely graded granular material or sand may be used to provide a level surface for setting the panel.
 - d. Stabilized base may be trimmed, as necessary, to accommodate the panel thickness. A thin layer of finely graded granular material or sand is then used to provide a level surface for setting the panel.
2. New base use:
 - a. A new base may be used if it is determined that the existing base will not serve the long-term needs of the new PCP. Because of time

constraints, it is necessary that the new base material be of good quality and can be placed, graded, and compacted, if granular, fairly quickly within the same nighttime closure as the panel installation. This option is common when PCP is used to rehabilitate existing AC pavements. The new base type may include the following:

- i. Dense-graded, free-draining granular base.
- ii. Rapid-setting LCB (RSLCB).
- iii. Cement-treated or asphalt-treated bases are not considered viable options for PCP installed during nighttime lane closures, but may be considered if full-lane closure is available and duration of lane closure is not a concern.

For both intermittent and continuous repairs, the granular bedding material should be kept as thin as possible (not greater than 0.25 in. (6 mm)). If thicker bedding is necessary, then consideration should be given to the use of a fast-setting cementitious fill material. In addition, for lane replacement applications, *the use of new base should not result in a “bathtub” (draining into the pavement centerline) detail effect*. It should be noted that very little testing has been performed on site to ensure that the granular base used for PCP applications (repair or continuous) is adequately compacted. Poor compaction of the granular base or the fine-grained bedding layer can possibly lead to non-uniform settlement and early distress development in the PCP. As indicated previously, the support condition requirements for PCP systems should be as good as or better than required for CIP concrete pavements. Irrespective of the base type used or the bedding material applied, the final base surface should be well graded to achieve a smooth surface. Base surface variation should not exceed 1/8 in. (3 mm) in a 10-ft (3.0 m) straightedge. It is recommended that agencies specify quality control/quality assurance (QC/QA) testing of the granular bases to monitor the level of compaction using the light-weight deflectometer (LWD). The LWD was introduced in the United States during the 1990s, and several agencies use it for acceptance testing of granular paving material (base, subbase, and subgrade) (Minnesota DOT, 2008 and 2011).

If panels are not seated well or *voids or point loading* exist at the panel underside, there is a possibility that there will be early failure of the panels due to cracking or excessive faulting. Although sufficient precautions are taken during the base preparation to ensure a smooth and firm base, the base surface cannot precisely match the underside surface of the precast panels. As such, it is necessary to use panel bedding/seating material and to carry out undersealing after the precast panels are installed to ensure uniform and firm seating of the panels on the base. The use of thin bedding layers and thin undersealing layers will perform adequately over the long term only if the underlying base support is adequate.

Production Rates. The panel installation rate is one of the most critical factors for considering use of the PCP technology. The panel installation rate determines productivity and lane closure requirements. The panel installation includes all activities that are conducted during a given lane closure, as listed below:

1. Existing pavement removal - Existing pavement removal, including a portion or all of the existing base material. This operation may require milling of a stabilized base, as per design requirements.
2. Drilling and grouting of the dowel bars - For repair applications (based on system design).

3. Base preparation - Regrading the existing base or placing a new base and placing of a bedding material to achieve proper base grade. Base is compacted if granular or placed and finished if it is cementitious (rapid-setting LCB). The bedding material may be granular, fast-setting flowable fill or polyurethane foam material.
4. Panel-base interface treatment - Placement of the panel-base interface treatment, typically, polyethylene fabric or geotextile membrane.
5. Panel placement.
6. PCP to existing pavement transition - Use of a temporary transition at the end of the PCP installation for a given lane closure.

For an intermittent repairs location within a given lane closure area, the typical production rate is about 14 to 18 panels per 6- to 8-hour lane closure, or about one panel per 20 to 25 minutes. Ideally, two crews should be used for repair installations - one crew preparing the repair area, including drilling and epoxy-grouting the dowel bars, and the second crew installing the panels.

For continuous applications, a higher panel installation rate can be achieved since work is performed along a longer rehabilitation area. The typical production rate for panel installation is about 30 to 40 panels for jointed systems or about 400 to 600 ft (122 to 183 m) of installation length.

Summary and Conclusions

In this paper the authors have highlighted construction and technical considerations that have a significant impact on the performance of jointed concrete precast concrete systems. The load transfer provision at transverse joints and the support condition under the precast panels are two critical design features and must be addressed well for any PCP system.

The PCP technology is maturing and continues to evolve. Significant improvements have been made in the PCP technology over the last 10 years. The next 10 years are promising to be full of innovations that will ensure a permanent place for the application of the PCP technology for longer-lasting rapid repair and rehabilitation of existing pavements. These future innovations are expected to reduce the cost of panel fabrication and panel installation.

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