SHRP 2 Renewal Project R05

**Model Specifications for Precast Concrete Pavement Systems**

 

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**Precast Concrete Pavement Systems**

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**Model Specifications for Precast Concrete Pavement Systems**

These model specifications were produced in SHRP 2 Renewal Project R05, which also produced *SHRP 2 Report S2-R05-RR-1: Precast Concrete Pavement Technology.*

One of the barriers to the systematic use of precast concrete pavement (PCP) systems has been the lack of available guidance on the design, construction, installation, and acceptance of PCP systems. In 2008, the AASHTO Technology Implementation Group (TIG) completed work on three documents (<http://tig.transportation.org/Pages/SpecificationClearinghouse.aspx>):

1. Generic Specification for Precast Concrete Pavement System Approval

2. Guidance and Considerations for the Design of Precast Concrete Pavement Systems

3. Generic Specification for Fabricating and Constructing Precast Concrete Pavement Systems

In recent years, several transportation agencies have also developed specifications on the use of PCP systems. These agencies include Caltrans, the New York State DOT, the New Jersey DOT, the Illinois Tollway Authority, and the Ontario Ministry of Transportation. The model specifications presented here are built on the specifications developed by the AASHTO TIG and on the more recent specifications developed by the transportation agencies.

**Model Specifications**

* Model Specification for Fabricating and Installing Jointed Precast Concrete Pavement Systems for Intermittent and Continuous Applications
* Model Specification for Fabricating and Installing Precast Prestressed Concrete Pavement Systems

**Model Specification for Fabricating and Installing**

**Jointed Precast Concrete Pavement Systems for Intermittent and Continuous Applications**

**[Insert Spec Number]**

# 1.0 SCOPE

## General

The jointed precast concrete pavement (JPrCP) system for intermittent and continuous applications shall be fabricated and installed in accordance with the contract plans (drawings). This specification details the requirements for materials and processes for fabrication and installation of JPrCP systems to be used for continuous rehabilitation of existing asphalt pavements and for intermittent and continuous rehabilitation of concrete pavements. The JPrCP system used must be the [AGENCY NAME]’s generic system [Include reference details] or an alternate system preapproved by the [Agency name].

The work shall include, but is not necessarily limited to, the following:

1. Saw-cutting and removal of existing pavement;
2. Existing or new base preparation;
3. Installation of approved bedding material, as required;
4. Fine grading of the base and bedding;
5. Installation of load-transfer devices at transverse joints;
6. Installation of tie bars along the longitudinal joints, as required;
7. Placement of precast panels;
8. Panel undersealing;
9. Patching of load-transfer device and tie bar slots (as required) and other designated blockouts and ports;
10. Grinding; and
11. Joint sawing, if applicable, and joint sealing.

In this specification, the term “Engineer” refers to the representative of the [AGENCY NAME], and the term “Contractor” refers to the general contractor who has been awarded the contract to perform the work. The following standard-making organizations are referred to in this specification:

* AASHTO – American Association of State Highway and Transportation Officials
* ASTM – American Society for Testing and Materials
* NPCA – National Precast Concrete Association
* PCI – Precast/Prestressed Concrete Institute

**1.2 End Product Requirements**

The end product for the work is the jointed precast concrete pavement constructed using materials, equipment, and processes specified in this specification. The end product shall be accepted or shall be considered defective on the basis of the following acceptance testing:

1. Fabricated precast panels
	1. Concrete requirements (see § 3.1)
	2. Panel dimensional tolerances (see § 5.8); and
2. Installed precast panels
	1. Vertical elevation difference at transverse joints (see § 7.1)
	2. Damaged or defective concrete (see § 7.3)
	3. Deflection testing (see § 7.2).

Defective panels and defective panel installation shall be mitigated in accordance with § 8.0 – Defective Panels and Defective Panel Installation.

**1.3 End Product Responsibility**

The Contractor is entirely responsible for the materials and processes that produce the end products specified in this specification. It is the Contractor’s responsibility to ensure that the processes for fabricating and installing the precast panels meet the requirements of this specification and can be satisfactorily performed.

The Engineer will determine if the Contractor’s materials and processes produce an end product that is in conformity with the plans and specifications. Tolerances to determine conformity for measurable components of the materials, processes, and end product are provided in this specification.

When the Engineer determines that the panels delivered to the project site, the panel installation process, or the installed panels are not in conformity with the plans and specifications and result in an unacceptable product, the affected work or materials shall be removed and replaced or otherwise corrected at the Contractor’s expense in accordance with § 8.0 – Defective Panels and Defective Panel Installation.

## 1.4 Preconstruction Conference

At least 7 days before and not more than 30 days before panel fabrication, the Contractor’s team members shall meet with the Engineer to review project specification requirements related to the panel fabrication, panel installation, and related project-planning activities. The following are the minimum agenda items:

1. Submittals and status of submittals;
2. Critical material availability issues;
3. Concrete requirements;
4. Fabrication and installation schedule;
5. Test section requirements;
6. Contractor process (quality control [QC]) testing;
7. Construction maintenance of traffic (MOT);
8. On-site safety and emergency management plan;
9. Agency acceptance (quality assurance [QA]) testing requirements;
10. Determination of which members of the Contractor’s staff have

stop work authority;

1. Determination of which members of the Engineer’s staff have

stop work authority; and

1. Issues and disputes resolution hierarchy.

Additional preconstruction meetings may be held at the request of the Engineer or the Contractor.

**1.5 Approved Precast Pavement Systems**

The following JPrCP systems are approved for use on intermittent repair projects:

1. [AGENCY NAME]’s generic system [Include reference details]; and
2. [List other approved systems].

The system approval is based on standard (generic) shop drawings for the JPrCP system. Final approval for the system will be based on fabricator shop drawings specifically developed for the project (INSERT PROJECT NAME AND/OR CONTRACT NUMBER).

Approval for use of JPrCP systems not on the above list will be contingent on the Contractor’s obtaining approval for use of the system before submitting the bid. Final approval for these systems will be based on fabricator shop drawings specifically developed for the project (INSERT PROJECT NAME AND/OR CONTRACT NUMBER).

# 2.0 SUBMITTALS

The Contractor shall provide, as a minimum, the submittals listed in the following sections. The personnel and laboratories conducting the aggregate- and concrete-related testing for the project shall meet the requirements of ASTM C 1077 for concrete testing personnel and concrete testing laboratory requirements.

**2.1 Preconstruction Submittals**

Preconstruction submittals shall be submitted to the Engineer before the prepaving meeting. Submittals include, but are not limited to, the following:

1. Panel fabrication–related submittals
	1. Concrete plant certification (from AGENCY, NPCA, or PCI)
	2. Concrete testing laboratory certification (per ASTM C 1077)
	3. Concrete testing personnel certification (per ASTM C 1077)
	4. Reinforcing steel certification
	5. Prestressing steel certification, if applicable
	6. Lifting anchor certification
	7. Dowel bar and tie bar certification
	8. Cement mill certificates
	9. Supplementary cementing material mill certificates
	10. Aggregate certification
	11. Admixture certification
	12. Water certification
	13. For each concrete mixture to be used
		1. Maximum aggregate size and target air content
		2. Concrete mixture proportions
		3. Concrete compressive strength data; and
2. Panel installation–related submittals
	1. Dowel bar and tie bar slot patching material or grout certification
	2. On-site equipment list
	3. Panel undersealing grout certification
	4. Existing concrete removal plan
	5. Maintenance of traffic (MOT) plan
	6. Contractor quality control/quality acceptance testing program
	7. Safety and emergency management plan
	8. Inclement weather plan.

**2.2 Contractor Process Control Testing Submittals**

Submittals related to process control testing shall be submitted to the Engineer in writing within 24 hours of completion of the tests. These submittals include the following process control tests:

1. Panel fabrication–related submittals
	1. Concrete air content
	2. Concrete compressive strength at time of panel form stripping
	3. Concrete compressive strength at time of panel shipment to the project site
	4. Concrete compressive strength at the specified age
	5. Panel dimensional tolerances
	6. Pretensioning tendon elongation, if applicable; and
2. Panel installation–related submittals
	1. Undersealing grout compressive strength at the specified age

(per AASHTO T-106)

* 1. Slot patching material compressive strength at the specified age
	2. Vertical elevation difference at transverse joint corners before and after grinding (if applicable)
	3. Dowel bar alignment [IF AGENCY REQUIRES DOWEL ALIGNMENT TESTING FOR NEW JOINTED CONCRETE PAVEMENTS].

**3.0 MATERIALS**

**3.1 Concrete**

Use concrete meeting the requirements of [insert REFERENCE TO AGENCY specifications] unless noted otherwise in the contract documents or approved fabricator shop drawings.

Note to Specifiers: The following concrete properties are recommended for precast panel concrete:

1. Design concrete flexural strength: 650 lbf/in.2 (4.5 MPa);
2. Concrete compressive strength at time of panel form stripping: 2,500 lbf/in.2

(17.2 MPa);

1. Concrete compressive strength at time of panel shipment to the project site:

4,000 lbf/in.2 (27.5 MPa) (minimum);

1. Concrete compressive strength at the specified age: 4,500 lbf/in.2

(31.0 MPa) (minimum);

1. Concrete air content: based on agency practice;
2. Concrete durability requirements: based on agency practice;
3. Concrete aggregate quality and gradation requirements: based on agency practice;
4. Cementitious materials requirements: based on agency practice; and
5. Concrete admixture requirements: based on agency practice.

**3.2 Reinforcement**

Use reinforcing bars meeting [insert REFERENCE TO AGENCY specifications]. Provide the minimum concrete cover between any reinforcement and exposed concrete surfaces as shown in the fabricator shop drawings.

For nonprestressed panels, provide a single or a double mat of reinforcement with a size and spacing of steel in both directions that result in a ratio of steel area to concrete area of at least 0.0018 and a maximum center-to-center bar spacing in both directions of 18 in. (450 mm).

For prestressed panels that are pretensioned during fabrication, provide a mat of steel reinforcement in the nonprestressed direction that results in a ratio of steel area to concrete area of at least 0.0018.

Use prestressing steel that meets the requirements of [insert REFERENCE TO AGENCY specifications]. Prestressing tendons shall be either high-strength (Grade 270 or better), low-relaxation strand or high-strength (Grade 150 or better) threaded bars.

The panels may include additional reinforcement as required by jobsite loading conditions (e.g., when slabs must be loaded before undersealing grout is applied beneath the panels), irregular shape of panels, and at the location of lifting inserts and blockouts, as shown in the approved fabricator shop drawings.

**3.3 Patching Materials for Dowel Bar and Tie Bar Slots and for Grout and**

 **Lifting Insert Ports**

Patching materials shall be the material designated on the approved shop drawings or an equivalent material approved by the [AGENCY NAME]. The compressive strength of the patching material at the time of opening to traffic shall be at least 2,500 lbf/in.2 (17.2 MPa).

If approved patching materials are prepared in accordance with their manufacturer’s written instructions, no testing of the patching material is required. If the manufacturer’s written instructions are not followed, or if an alternative material is proposed for use, the material must meet the requirements of Table 1, Patching Material Requirements, when tested in accordance with [insert REFERENCE TO Agency Standard Specification for Concrete Repair Material].

**TABLE 1. Patching Material Requirements**

|  |  |  |
| --- | --- | --- |
| **Property** | **Minimum** | **Maximum** |
| Compressive strength, opening to traffic | 2,500 lbf/in.2 (17.2 MPa) | na |
| Compressive strength, 28-day | 4,000 lbf/in.2 (27.5 MPa) | na |
| Expansion | na | 0.40% |
| Contraction | na | 0.05% |
| Freeze–thaw loss (25 cycles at 10% NaCl) | na | 1.0% |
| Bond strength (to dry PCC), 28-day | 300 lbf/in.2 (2.1 MPa) | na |
| Initial set time | 15 minutes | na |
| Chloride content | na | 0.05% |
| Sulfate content |  na | 5.0% |

Note: PCC = portland cement concrete; na = not applicable.

**3.4 Panel Undersealing Grout**

The undersealing grout shall be the material designated on the approved shop drawings or an alternative prepackaged material approved for this purpose. The compressive strength of the undersealing grout at the time of opening to traffic shall be 500 lbf/in.2 (3.4 MPa).

**3.5 Fine-Grained Granular Bedding (for Bedding-Supported JPrCP Systems)**

If the JPrCP system requires the use of fine-grained granular bedding, use the gradation for the material that was approved in the JPrCP systems approval process. The bedding thickness shall not exceed 0.25 in. (6 mm).

**3.6 Cementitious Material Bedding (for Bedding-Supported JPrCP Systems)**

If the JPrCP system requires the use of cementitious bedding, use the mix design that was approved in the JPrCP systems approval process. The cementitious bedding material must develop a minimum compressive strength of 500 lbf/in.2 (3.4 MPa) at the time of opening to traffic. The bedding thickness shall not exceed 2.0 in. (50 mm).

**3.7 Polyurethane Bedding (for Bedding-Supported JPrCP Systems)**

If polyurethane is proposed for use as a bedding material, use the material that was approved in the JPrCP system approval process. If an alternative polyurethane material is proposed for use, the material must meet the requirements of Table 2, Polyurethane Material Requirements, when testing in accordance with [insert REFERENCE TO Agency Standard Specification for Concrete Repair Material].

The polyurethane shall reach 90% of its full compressive strength within 15 minutes of being injected. The bedding thickness shall not exceed 1.0 in. (25 mm).

**TABLE 2. Polyurethane Material Requirements**

|  |  |  |
| --- | --- | --- |
| **Cured Property** | **Minimum** | **Maximum** |
| Compressive strength (ASTM D-1621) (psi) | 60 | 130 |
| Flexural strength (ASTM D-790) (psi) | 80 | 180 |
| Shear strength (ASTM C-273) (psi) | 60 | 130 |
| Recommended density (in situ) (lb/ft3)  | 4.0 | 6.0 |

Note: 1 lbf/in.2 = 6.9 kPa; 1 lb/ft3 = 64 kg/m3.

**4.0 PANEL LAYOUT AND SHOP DRAWINGS**

The Contractor shall provide project-specific panel layout drawings and fabricator shop drawings from the panel fabricator for each contract. The fabricator shop drawings to manufacture the project precast concrete panels shall be based on the approved standard drawings for the JPrCP system proposed for use. Include the JPrCP system approval details on the fabricator standard drawings and the fabricator shop drawings. Copies of the approved fabricator shop drawings will be returned to the Contractor.

All Contractor-submitted drawings shall be signed by a registered professional engineer on the Contractor’s team licensed to practice in [AGENCY STATE].

**5.0 PANEL FABRICATION**

The panels for an approved JPrCP system shall be supplied by a precast concrete fabricator whose plant is certified by PCI, NPCA, or [AGENCY NAME].

**5.1 General Panel Fabrication–Related Requirements**

The following requirements shall be met for fabrication of the panels:

1. Panels shall be fabricated in accordance with the approved fabricator shop drawings. Install the reinforcement, lifting inserts, and grout ports in the amounts and at the locations designated in the fabricator shop drawings.
2. Dowel bars and tie bars shall be installed in the amount, at the alignment, and at the locations designated in the fabricator shop drawings.
3. Dowel bar and tie bar slots shall be installed in the amount, at the alignment, and at the locations designated in the fabricator shop drawings.
4. Tendons for pretensioning shall be installed in the amount and at the locations designated in the fabricator shop drawings.
5. Metal side forms and a metal bed to fabricate the panels shall be used. Use of nonmetallic forms and bed is not permitted.

**5.2 Panel Hardware Installation**

Panel hardware shall be embedded in the panel as designated in the approved fabricator shop drawings. The panel hardware may include the following:

1. Reinforcement placed in a single direction or both directions and in one or two layers;
2. Prestressing strands used for pretensioning;
3. Blockouts for the following
	1. Dowel bars and tie bars and any other load transfer devices
	2. Undersealing channels, per the approved fabricator shop drawings;
4. Grout tubes for the following
	1. Dowel bar slots
	2. Undersealing or bedding grout;
5. Lifting inserts; and
6. Panel setting bolt hardware, if required.

**5.3 Concrete Mixture and Concrete Placement**

Concrete shall be produced in accordance with the requirements of ASTM C94 [OR INSERT REFERENCE TO AGENCY SPECIFICATION]. Concrete plants supplying the concrete shall be certified by the [AGENCY NAME] or in accordance with the requirements of the National Ready Mixed Concrete Association’s QC3 checklist.

Slump concrete or self-consolidating concrete may be used. The concrete mixture to be used shall be the concrete mixture submitted to the [AGENCY NAME]. Any changes to the cementitious content, the aggregate source, the aggregate gradation, or the water-to-cementitious materials ratio shall require submission of a new mixture design for approval before the new concrete mixture can be used for panel fabrication.

Concrete shall be placed and consolidated, as necessary, to ensure that the concrete quality is uniform throughout the panel and the concrete aggregates do not segregate.

**5.4 Surface Texture**

Apply one of the following textures, in accordance with [insert REFERENCE TO Agency Specification], to the top surface of the panel:

1. [Longitudinal or transverse] tining; or
2. AstroTurf drag.

The texture shall be applied while the concrete is still in a plastic state, but without damaging the surface of the concrete and before application of any membrane curing compound.

**5.5 Concrete Curing**

**5.5.1 Conventional Curing of Panels**

Once the panel finishing details are taken care of, the panel surfaces and sides shall be sprayed with an approved concrete-curing compound. The curing compound shall be applied within 4 hours of panel stripping.

The curing compound used shall be a white-pigmented membrane curing compound from [the Agency]’s approved list.

**5.5.2 Steam Curing of Panels**

Steam curing, at atmospheric pressure, shall be done as a precaster option. When steam curing is used, it shall be done in accordance with industry-accepted standards and include the following items:

1. An initial period of curing, minimum of 3 hours, for the concrete to achieve an initial set.
2. A period for increasing the panel temperature. The temperature in the enclosure surrounding the concrete panels shall not be increased more than 40°F (22°C) per hour.
3. A period for holding the maximum temperature constant, not to exceed 140°F (60°C).
4. A period for decreasing the temperature. The temperatures in the enclosure surrounding the concrete panels shall not be decreased more than 40°F (22°C) per hour.
5. Once the steam curing has ended, the panels shall not be exposed to the ambient conditions until the concrete has cooled to about 30°F (17°C) above the ambient temperature.
6. The steam-cured panels shall be protected before exposing the panels to windy conditions.

For pretensioned panels, detensioning and flame-cutting of the tendons shall be done at the end of steam curing.

The conventional curing of the panel, in accordance with § 5.5.1, shall be applied within 60 minutes of exposure to ambient conditions.

**5.6 Pretensioning of Panels**

The panel design and the approved fabricator shop drawings may include requirements for pretensioning of the panels. Unless otherwise noted in the approved fabricator shop drawings, pretensioning shall be achieved using at least 0.5-in.- (13-mm-) diameter strands.

The strands shall be positioned at locations designated in the approved fabricator shop drawings. Pretensioning of the strands shall be accomplished in two steps as follows:

1. Initial tensioning shall be done to remove the slack in the strands and to allow for marking of reference points in the strands to measure the strand elongation resulting from final tensioning; and
2. Final tensioning shall be done per the requirements detailed in the approved fabricator shop drawings.

At about 15 to 20 hours, just before the formwork is stripped and after the concrete has attained the desired strength, the strands shall be released from the anchorage at the bulkheads. The strands may be released earlier from the anchorage if steam curing is used. The strands shall be flame-cut after the formwork is stripped.

**5.7 Formwork Stripping and Panel Finishing**

The panels shall be stripped of formwork after the concrete has attained a minimum compressive strength of 2,000 lbf/in.2 (13.7 MPa) to ensure that the concrete will not be damaged during the stripping process and to allow for lifting of the panels. The stripped panels may be moved to other areas within the plant to take care of the panel finishing details. These finishing details may include the following:

1. Clean-up of the blockouts;
2. Installation of foam strips (gaskets) along the bottom edges of the panel, along the undersealing slots, and along the perimeter of the dowel slots per the approved fabricator shop drawings;
3. Applying project- and panel-specific marking on each panel;
4. Cutting of pretensioning tendons, if applicable;
5. Checking for any damage to the panel, repairing minor surface damage, and filling small surface voids over 0.5 in. (13 mm) in diameter using a sand–cement paste or an approved proprietary patching material;
6. Rounding the top edges of the panels with a hand stone to prevent chipping during handling and installation;
7. Checking for dowel bar alignment; and
8. Checking for dimensional tolerances.

All forms and casting-bed areas should be cleaned after each use.

**5.8 Dimensional Tolerances**

The dimensional tolerances applicable to JPrCP panels are listed in Table 3. These tolerances are in relation to the specific dimensions indicated in the approved panel fabricator shop drawings.

**TABLE 3. Precast Panel Dimensional Tolerances**

|  |  |
| --- | --- |
| **Panel Feature** | **Tolerance** |
| Length and width | ±1/4 in. |
| Thickness | ± 1/16 in. |
| Squareness of corner in plan view  | ±1/4 in. over 12 in. |
| Squareness of sides in section view | ±1/4 in. over the thickness |
| Local smoothness of any surface | ±1/4 in. over 10 ft in any direction |
| Vertical location of reinforcement | ±1/2 in.  |
| Vertical location of pretensioning strand | ±1/4 in. |
| Blockout dimensions (if applicable) | ±1/4 in. |
| Location of lifting inserts | ±1/2 in. |

Note: 1 in. = 25.4 mm; 1 ft = 305 mm.

**5.9 Panel Marking**

Panel marking shall be applied to a longitudinal edge face to include the following information as a minimum:

1. Fabrication date;
2. Manufacturer information;
3. Panel number;
4. Panel type;
5. Panel weight; and
6. Panel dimensions (thickness, length, and width).

**5.10 Panel Inspection**

Each fabricated panel shall be inspected, after removal from the form and before the panel is moved to the plant storage area, for the following:

1. Dimensional tolerances as specified in § 5.8;
2. Surface defects;
3. Improper surface texture;
4. Damage to the concrete;
5. Embedded dowel bar and tie bar alignment, if applicable; and
6. Pretensioning based on strand elongation.

Panels not meeting the specified dimensional and dowel bar alignment tolerances; exhibiting poor surface texture, surface defects, and damage; or having improperly tensioned strands shall be considered defective.

Defective panels shall be mitigated per § 8.1 – Defective Panels.

Embedded dowel bars and tie bars, if present in the panels, shall be protected against damage during panel lifting, handling, and shipping.

**5.11 Panel Storage and Shipping**

The panels shall be stored at the plant site for at least 14 days before they are shipped to the project site. The panels shall be stacked on solid dunnage at locations that minimize panel warping due to self-weight and creep. The dunnage arrangement shall be as shown on the approved fabricator shop drawings.

The panels shall be shipped with due care to ensure that the panels do not suffer any damage during the transfer to the project site. The panels may be stored near the project site for an additional period of time using the procedures used at the plant location.

**6.0 PANEL INSTALLATION**

**6.1 Technical Assistance**

If the precast pavement system proposed for use features installation processes that must be performed in accordance with the system designer’s instructions, the system designer shall provide on-site technical assistance at the beginning of the panel installation for complete installation of at least 10 panels.

**6.2 Weather Limitations**

The Contractor shall ensure that undersealing grout and patching materials are suitable (based on the manufacturers’ recommendations) for the weather conditions that may exist at the time of installation. Contingency instructions and alternate materials shall be provided for potential installation during extreme weather events. Extreme weather events are defined as steady rain during installation or air temperature lower than 32°F (0°C).

**6.3 Existing Pavement Removal**

The existing pavement may be an asphalt pavement or a concrete pavement. The existing pavement area shall be readied for removal.

Not more than 7 days before panel installation at a designated location, the existing concrete pavement areas to be removed shall be saw-cut full-depth in a grid pattern approved by the Engineer. During the lane closure for the panel installation, the existing concrete pavement within a given work area shall be removed using the lift-out method, taking care to minimize damage to the existing base. Other existing pavement removal methods shall not be used unless approved by the Engineer. If during the pavement removal process any adjacent existing concrete pavement is damaged, the damaged pavement section shall be repaired as directed by the Engineer.

The removal of the existing asphalt pavement in a given work area shall be done during the lane closure for the panel installation in the work area.

Disposal of all removed existing concrete pavement or the existing asphalt pavement shall be in accordance with the requirements of [INSERT REFERENCE TO AGENCY SPECIFICATION].

**6.4 Base Preparation**

**6.4.1 Existing Base**

The existing base to be left in place may be a granular base or a stabilized base.

If the existing base is a granular base, the base shall be regraded and compacted using vibratory roller compaction in accordance with [INSERT REFERENCE TO AGENCY SPECIFICATION]. The moisture content in the upper 6 in. of the granular base shall be adjusted, as necessary, to allow the compacted base to achieve dry density of 92% of the AASHTO T-180 maximum dry density for that material.

The Contractor shall test the compacted base using a lightweight deflectometer (LWD), calibrated for the base type, in accordance with [INSERT REFERENCE TO AGENCY SPECIFICATION].

As required by the project plans and/or the approved JPrCP system requirements, one of the following treatments shall be applied to the compacted granular base or an existing stabilized base:

* + - 1. Fine-grained granular bedding, applied per § 3.5. The bedding material shall be compacted and graded;
			2. Cementitious material bedding, applied per § 3.6. The cementitious material may be placed directly over the compacted existing base before panel placement or applied using grout ports using one of the panel placement methods listed in § 6.5 – Panel Placement; or
			3. Polyurethane bedding, applied per § 3.7. The polyurethane bedding material shall be injected under the panel after the panel is placed in the repair area using one of the panel placement methods listed in § 6.5 – Panel Placement.

The fine-grained granular and the cementitious bedding material, if placed directly over the base, shall be finished to the required grade and compacted to provide a smooth surface for panel placement. A fine-grading trimmer shall be used to trim the granular bedding surface to ensure that the panels can be placed at the correct surface elevation. Cementitious bedding material placed directly over the existing base shall be finished to the designated grade using concrete-finishing tools.

The finished bedding surface shall have no areas in excess of 2 ft2 at the bedding surface that exhibit low spots in excess of 0.125 in. (3 mm). The prepared bedding surface shall not be disturbed before placement of the panel.

**6.4.2 New Base**

A new base shall be constructed as required by the project plans. The new base shall be constructed to the width and thickness designated in the project plans. The new base shall be constructed in accordance with the requirements of [INSERT REFERENCE TO AGENCY SPECIFICATION].

The new base surface shall be finished to ensure that the panels can be placed at the correct surface elevation. The finished base surface shall have no areas in excess of 2 ft2 at the bedding surface that exhibit low spots in excess of 0.125 in. (3 mm). The prepared bedding surface shall not be disturbed before placement of the panel.

The Contractor shall test the compacted base using a lightweight deflectometer (LWD), calibrated for the base type, in accordance with [INSERT REFERENCE TO AGENCY SPECIFICATION].

**6.5 Panel Placement**

Each panel shall be placed to the line and grade depicted in the contract layout plans, within the tolerances specified in this specification, and in accordance with the system designer’s instructions (if applicable). The panels shall be removed and reset prior to placement of slot patching material and undersealing grout if the vertical elevation difference at the panel transverse joints is greater than 0.25 in. (6 mm).

The panels shall be placed using one of the methods described in § 6.5.1 through § 6.5.4 or per the method designated for the approved PCP system.

* + 1. **Panels Placed Directly on Prepared Base or Bedding**

The dowel and tie bar slots (at the panel surface or at the panel bottom), if used, and/or the embedded dowel bars and tie bars, if used, shall be positioned to match the locations of the corresponding embedded or drilled and grouted dowel bars and tie bars or corresponding dowel bar or tie bar slots, as applicable, in accordance with the details shown in the panel layout plans and the fabricator shop drawings.

* + 1. **Panels Set at Desired Elevation Using Setting Bolts**

The panels shall be set at the desired elevation using four symmetrically located threaded setting bolts to control the elevation of the panel. Four steel plates, 6 × 6 in. (150 × 150 mm) and 0.75 in. (19 mm) thick, shall be prepositioned on the prepared base before placing the panel at the designated location. The plates shall be positioned to coincide with the location of the setting bolts in the panel. The cementitious or the polyurethane bedding material, as designated for the approved PCP system, shall be used in conjunction with this placement method to fill the gap between the compacted base and the panel bottom. The setting bolts can be removed from the panel as soon as the cementitious bedding material has attained a compressive strength of 50 lbf/in.2 (344 kPa) or within 15 minutes after injection of the polyurethane material.

This panel placement technique requires fabricating threaded sleeves in the panel. The sleeves must be properly anchored (secured) in the concrete as detailed in the fabricator shop drawings to resist pop-out of the sleeves during the panel-setting operation.

* + 1. **Panels Supported by Strongback Beams at Desired Elevation**

**(for Repair Applications)**

The panels shall be set at the desired elevation using the elevation of the existing pavement at each side of the repair area by fastening each panel to two strongback beams that extend about 2 ft (0.6 m) beyond the repair area. The beams shall be fastened to the panel using the lift inserts and long bolts with the lifting hooks while the panel is on the delivery truck. Cementitious or polyurethane bedding material may be used in conjunction with this placement method to fill the gap between the compacted base and the panel bottom. The strongback beams can be removed from the panel as soon as the cementitious bedding material has attained a compressive strength of 50 lbf/in.2 (344 kPa) or within 15 minutes after injection of the polyurethane material.

**6.5.4 Panels Raised to Desired Elevation Using Urethane Polymer (for Repair Applications)**

The panels shall be placed in the repair area and raised to the correct elevation by injecting polyurethane material under the panels using grout holes. This technique requires care to ensure that there is no excessive uplift of the panel, that the panel is raised up uniformly across the full panel, and that the polyurethane provides uniform support under the panel.

This method requires grading the compacted base about 0.5 to 1 in. (13 to 25 mm) below the design elevation of the panel bottom.

**6.6 Joints**

**6.6.1 Joint Gap**

The panels shall be placed so that the width of the transverse joints incorporating the panels shall not exceed 0.5 in. The width of the longitudinal joints shall be set to be within 0.5 in. of the width shown in the project layout plans or as directed by the Engineer.

If the panels are opened to traffic before the dowel slots are grouted or patched, shims shall be used at the approach joint side of the panels to prevent forward drift of the panels under traffic.

**6.6.2 Load Transfer at Transverse Joints**

Load transfer at transverse joints shall be provided using the method used for the approved PCP system or as shown in the approved fabricator shop drawings. The following methods may be used to provide load transfer at transverse joints:

1. Using panels with dowel slots at the panel bottom at one transverse edge and embedded dowels at the other transverse edge, as detailed in the approved fabricator shop drawings. For repair applications, dowels are drilled and installed in the existing pavement.
2. Using panels with conventional dowel slots at one transverse edge and embedded dowels at the other transverse edge, as detailed in the approved fabricator shop drawings. In this method, the dowel slots have wider mouths, about 2.5 in. (63 mm) wide at the surface. These surface slots shall be patched during the same lane closure as the one used for placing the panels using the details provided in the approved fabricator shop drawings.
3. Using panels with narrow-mouthed dowel slots at the surface, as detailed in the approved fabricator shop drawings. This technique allows the panels fabricated with surface dowel slots to be left in place in the repair area without immediately patching the slots. This technique requires the following steps:
	1. For repair applications, drill the dowel holes in the existing pavement before the placement of the panel.
	2. The dowels are positioned in the longer surface slots in the panel before panel placement.
	3. During the same or the next lane closure, the dowel bars are slid into the corresponding narrow-mouth surface slots. The dowel bars are held in place, at proper alignment, using a magnetic clamp or a similar device.
	4. The slot patching is then done during the same lane closure as the panel placement or during the next lane closure.

**6.6.3 Tie Bars Along Longitudinal Joints**

Tie bars shall be installed along the longitudinal joints as detailed in the approved fabricator shop drawings. The following methods, as approved by the Engineer, may be used to install tie bars:

1. Drilling and installing tie bars in the existing pavement. Tie bars shall be located as shown in the approved fabricator shop drawings. This method requires the use of panels with the tie bar slots at the slab bottom.
2. Using the cross-stitching technique as detailed in the approved fabricator shop drawings.

**6.6.4 Dowel and Tie Bar Slot Patching or Grouting**

The dowel and tie bar slots shall be patched or grouted using one of the following methods, as designated for the approved PCP system:

1. For PCP systems with dowel slots at the panel bottom, the approved rapid-setting dowel slot grout is poured through grout ports into each slot. The grout also must be poured into the panel perimeter joint gap until the grout material is at the top of the joints. Using this system, a joint gap does not exist around the perimeter of the panel. This technique requires the use of bond-breaking material on the joint faces of the existing pavement so the dowel grout material will not bond to the existing pavement.
	1. During the joint sawing for the sealant reservoir, care must be taken to align the saw-cut along the existing pavement beside the joint; otherwise, spalling of the dowel grout material will result, and the joint sealant will be ineffective.
2. For the systems with conventional or narrow-mouth dowel slots at the surface, the dowel bar retrofit method per [INSERT REFERENCE TO AGENCY SPECIFICATION] shall be used to patch the dowel slots. The Contractor shall take care to ensure that no patch material flows into the joint gap.

The provisions for load transfer at the joints at the beginning and the end of the project work area shall be as detailed in the approved fabricator shop drawings.

Whether a grout material or a rapid-setting patching material is used for the dowel slots, the material shall attain the required compressive strength of 2,500 lbf/in.2 (17.2 MPa) before opening the repair area to traffic.

The grout material or the dowel patching material or other approved material shall be used to fill the lift insert holes and to repair any surface damage to the panel.

**6.7 Panel Undersealing**

For panels placed directly over the granular or cementitious bedding material, the Contractor shall underseal all panels using the approved cementitious undersealing grout material. Grout ports shall be uniformly distributed across the panel area as shown in the approved fabricator shop drawings. A minimum of four grout ports shall be used per panel.

The undersealing grout shall attain a compressive strength of 500 lbf/in.2 (3.4 MPa) at the time of opening to traffic. When the grout is pumped, the grout flow rate should be within the range specified. The grout shall be mixed in a batch pump in batches and pumped continuously from a grout hopper.

The undersealing grout ports shall be filled to middepth with the undersealing grout. The rest of the port depth shall be filled with the slot patching grout or patching material or other approved higher-strength rapid-setting patching material.

**6.8 Opening to Traffic**

The repair areas shall be opened to traffic only after the following applicable conditions are met:

1. At the end of the first lane closure
	1. When a system with slots at the panel bottom is used or narrow-mouth surface slots are used, the repair areas can be opened to traffic even if the slots have not been grouted or patched.
	2. When conventional dowel slots are used at the surface, the completed repair areas shall be opened to traffic only after the grout for dowels and tie bars (if applicable) and the bedding grout have reached the minimum acceptable strength; and
2. At the end of the next lane closure after the panels with the bottom slots are grouted, or the narrow-mouth slots are patched and the panels are undersealed and the materials have reached the minimum acceptable strength.

Work should be scheduled to minimize the exposure of precast panels to traffic prior to patching or grouting the dowel slots. Panels without effective load transfer at transverse joints or without panel undersealing (for panels placed directly on the bedding) shall not be exposed to traffic for a period of more than 3 days.

**6.9 Grinding**

The vertical elevation difference at transverse joints between the panel and the existing pavement or another panel shall not exceed 0.25 in (6 mm). If the elevation difference is larger, the joint areas shall be ground full width to bring the repair area under compliance. Grinding shall be performed as directed by the Engineer.

**6.10 Joint Sealing**

All transverse and longitudinal joints of the JPrCP pavement shall be sealed. Joint widths will vary from repair area to repair area, and joint widths may range from 0.25 to 0.50 in. (6 to 13 mm) or more. This variation should be kept in mind if backer rods are used as part of the joint sealing operation. The backer rods should be sized for a specific joint width.

**7.0 INSTALLED PANEL Acceptance Testing**

The acceptance of the installed panels shall be based on the following requirements.

**7.1 Vertical Elevation Difference at Transverse Joints**

For each installed panel, measure the vertical difference at the transverse joint between the panel and the existing concrete pavement or another panel at 2 ft (0.61 m) and 10 ft (3.05 m) from the outside edge of each panel. The measurement may be conducted using a straightedge or a Georgia faultmeter. Panels exhibiting a vertical elevation difference greater than 0.25 in. (6 mm) shall be considered as defectively installed and treated per § 8.2.

If approved by the Engineer, the defectively installed precast panels may be opened to traffic if all installed panels are required to be ground per the project requirements or if grinding is approved for each defectively installed posttensioned section.

**7.2 Deflection Testing**

At the discretion of the agency, a selected number of precast panels may be tested for load-transfer effectiveness at transverse joints using a falling weight deflectometer and an applied load level of 9,000 lb (40 kN). The measure of the load-transfer effectiveness is the relative deflection (RD) across the tested joint between a precast panel and the existing concrete pavement or another adjacent precast panel. The acceptable RD value is 2 mils (0.05 mm). If the Engineer determines that the measured RD values indicate poor load-transfer effectiveness at the tested joints, the Engineer may elect to test all precast panel joints. All panels exhibiting RD values at the transverse joints greater than 2 mils (0.05 mm) shall be considered defective and treated per § 8.2.

**7.3 Damaged or Defective Concrete**

The Contractor shall repair or replace all damaged panels prior to final acceptance. These repairs shall be performed as described in [INSERT AGENCY REFERENCE FOR CONCRETE PAVEMENT REPAIR] at no cost to the [AGENCY NAME]. Damage and defects include, but are not limited to, cracking and spalling caused by inadequate panel protection during installation, use by construction traffic, after opening to regular traffic, and/or construction practices.

**8.0 DEFECTIVE PANELS AND DEFECTIVE PANEL INSTALLATION**

**8.1 Defective Panels**

If the Engineer determines that the defective panels, as fabricated or with the Contractor-proposed mitigation treatment, will result in an unacceptable product, the affected panels will be rejected.

**8.2 Defective Panel Installation**

If the Engineer determines that the defective panel installation, as originally installed or with the Contractor-proposed mitigation treatment, will result in an unacceptable product, the affected panels will be removed and replaced.

**9.0 METHOD OF MEASUREMENT**

The work will be measured for payment as the number of square yards of accepted precast concrete panels, measured to the nearest 0.1 yd2 (0.1 m2).

**10.0 BASIS OF PAYMENT**

The unit price bid shall include the cost of all engineering, design, fabrication, quality control, labor, material, and equipment necessary to satisfactorily perform the work described in this specification, including technical assistance from the JPrCP system designer, as necessary.

Payment will be made under

|  |  |  |
| --- | --- | --- |
| **Item Number**  | **Item** | **Pay Unit** |
| [Insert item number] | Precast Concrete Pavement Panel  | Square Yards (Meters) |

**Model Specification for Fabricating and Installing Precast Prestressed**

**Concrete Pavement Systems**

**[Insert Spec Number]**

# 1.0 SCOPE

## 1.1 General

The precast prestressed concrete pavement (PPCP) system for continuous applications shall be fabricated and installed in accordance with the contract plans (drawings). This specification 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. The PPCP system used must be the [AGENCY NAME]’s generic system [Include reference details] or an alternative system preapproved by the [Agency name].

The work shall include, but is not necessarily limited to, the following:

1. Saw-cutting and removing existing pavement;
2. Existing or new base preparation;
3. Installation of approved bedding material, as required;
4. Fine grading of the base and bedding;
5. Installation of load-transfer devices at transverse expansion joints;
6. Installation of tie bars along the longitudinal joints, as required;
7. Placement of precast panels;
8. Posttensioning of panels;
9. Panel undersealing;
10. Patching of load-transfer device and tie bar slots (as required) and other designated blockouts and ports;
11. Grinding; and
12. Expansion joint sealing.

In this specification, the term “Engineer” refers to the representative of the [AGENCY NAME] and the term “Contractor” refers to the general contractor who has been awarded the contract to perform the work. The following standard-making organizations are referred to in this specification:

* AASHTO – American Association of State Highway and Transportation Officials
* ASTM – American Society for Testing and Materials
* NPCA – National Precast Concrete Association
* PCI – Precast/Prestressed Concrete Institute

**1.2 End Product Requirements**

The end product for the work is the PPCP constructed using materials, equipment, and processes specified in this specification. The end product shall be accepted or shall be considered defective on the basis of the following acceptance testing:

1. Fabricated precast panels
2. Concrete requirements (see § 3.1)
3. Panel dimensional tolerances (see § 5.8); and
4. Installed precast panels
5. Vertical elevation difference at intermediate transverse joints (see § 7.1)
6. Vertical elevation difference at expansion joints (see § 7.1)
7. Deflection testing (see § 7.2)
8. Prestressing tendon elongation (see § 7.3)
9. Damaged or defective concrete (see § 7.4).

Defective panels and defective panel installation shall be mitigated in accordance with § 8.0 – Defective Panels and Defective Panel Installation.

**1.3 End Product Responsibility**

The Contractor is entirely responsible for the materials and processes that produce the end products specified in this specification. It is the Contractor’s responsibility to ensure that the processes for fabricating and installing the precast panels meet the requirements of this specification and can be satisfactorily performed.

The Engineer will determine if the Contractor’s materials and processes produce an end product that is in conformity with the plans and specifications. Tolerances to determine conformity for measurable components of the materials, processes, and end product are provided in this specification.

When the Engineer determines that the panels delivered to the project site, the panel installation process, or the installed panels are not in conformity with the plans and specifications and result in an unacceptable product, the affected work or materials shall be removed and replaced or otherwise corrected at the Contractor’s expense in accordance with § 8.0 – Defective Panels and Defective Panel Installation.

## 1.4 Preconstruction Conference

At least 7 days before and not more than 30 days before panel fabrication, the Contractor’s team members shall meet with the Engineer to review project specification requirements related to the panel fabrication, panel installation, and related project-planning activities. The following are the minimum agenda items:

1. Submittals and status of submittals;
2. Critical material availability issues;
3. Concrete requirements;
4. Fabrication and installation schedule;
5. Posttensioning details;
6. Test section requirements;
7. Contractor process (quality control [QC]) testing;
8. Construction maintenance of traffic (MOT);
9. On-site emergency management plan;
10. Agency acceptance (quality assurance [QA]) testing requirements;
11. Determination of which members of the Contractor’s staff have

stop work authority;

1. Determination of which members of the Engineer’s staff have

stop work authority; and

1. Issues and disputes resolution hierarchy.

Additional preconstruction meetings may be held at the request of the Engineer or the Contractor.

**1.5 Approved Precast Prestressed Pavement Systems**

The following PPCP systems are approved:

1. [AGENCY NAME]’s generic system [Include reference details]; and
2. [List other approved systems].

The final approval for the PPCP system will be based on fabricator shop drawings specifically developed for the project (INSERT PROJECT NAME AND/OR CONTRACT NUMBER).

Approval for use of a PPCP system not on the above list will be contingent on the Contractor’s obtaining approval for use of the system before submitting the bid. Final approval for these systems will be based on fabricator shop drawings specifically developed for the project (INSERT PROJECT NAME AND/OR CONTRACT NUMBER).

# 2.0 SUBMITTALS

The Contractor shall provide, as a minimum, the submittals listed in the following sections. The personnel and laboratories conducting the aggregate- and concrete-related testing for the project shall meet the requirements of ASTM C 1077 for concrete testing personnel and concrete testing laboratory requirements.

**2.1 Preconstruction Submittals**

Preconstruction submittals shall be submitted to the Engineer before the prepaving meeting. Submittals include, but are not limited to, the following:

1. Panel fabrication–related submittals
	1. Concrete plant certification (from AGENCY, NPCA, or PCI)
	2. Concrete testing laboratory certification (per ASTM C 1077)
	3. Concrete testing personnel certification (per ASTM C 1077)
	4. Reinforcing steel certification
	5. Prestressing steel certification
	6. Posttensioning duct certification
	7. Lifting anchor certification
	8. Dowel bar and tie bar certification
	9. Cement mill certificates
	10. Supplementary cementing material mill certificates
	11. Aggregate certification
	12. Admixture certification
	13. Water certification
	14. For each concrete mixture to be used
		1. Maximum aggregate size and target air content
		2. Concrete mixture proportions
		3. Concrete compressive strength data; and
2. Panel installation–related submittals
	1. Panel–base interface friction-reducing material certification
	2. Patching material or patching grout certification
	3. Posttensioning duct grout certification
	4. Panel undersealing grout certification
	5. Intermediate transverse keyway joint epoxy certification, if applicable
	6. Intermediate transverse keyway joint duct coupler certification,

if applicable

* 1. Posttensioning anchorage hardware certification
	2. Expansion joint sealant and/or system certification
	3. On-site equipment list
	4. Existing concrete removal plan
	5. Maintenance of traffic (MOT) plan
	6. Contractor quality control/quality acceptance testing program
	7. Safety and emergency management plan
	8. Inclement weather plan.

**2.2 Contractor Process Control Testing Submittals**

Submittals related to process control testing shall be submitted to the Engineer in writing within 24 hours of completion of the tests. These submittals include the following process control tests:

1. Panel fabrication–related submittals
2. Concrete air content
3. Concrete compressive strength at time of panel form stripping
4. Concrete compressive strength at time of panel shipment to the project site
5. Curing temperature for accelerated curing
6. Concrete compressive strength at the specified age
7. Panel dimensional tolerances
8. Pretensioning tendon elongation, if applicable; and
9. Panel installation–related submittals
10. Posttensioning tendon elongation
11. Undersealing grout compressive strength at the specified age,

per AASHTO T-106

1. Posttensioning duct grout compressive strength at the specified age
2. Intermediate transverse keyway joint patching or grout material compressive strength at the specified age
3. Patching material compressive strength at the specified age
4. Vertical elevation difference at transverse joint corners before and after grinding (if applicable)
5. Dowel bar alignment [IF AGENCY REQUIRES DOWEL ALIGNMENT TESTING FOR NEW JOINTED CONCRETE PAVEMENTS].

**3.0 MATERIALS**

**3.1 Concrete**

Use concrete meeting the requirements of [insert REFERENCE TO AGENCY specifications] unless noted otherwise in the contract documents or approved fabricator shop drawings.

Note to Specifiers: The following concrete properties are recommended for precast panel concrete:

1. Design concrete flexural strength: 650 lbf/in.2 (4.5 MPa);
2. Concrete compressive strength at time of panel form stripping: 2,500 lbf/in.2 (17.2 MPa);
3. Concrete compressive strength at time of panel shipment to the project site: 4,000 lbf/in.2 (27.5 MPa) (minimum);
4. Concrete compressive strength at the specified age: 4,500 lbf/in.2 (31.0 MPa) (minimum);
5. Concrete air content: based on agency practice;
6. Concrete durability requirements: based on agency practice;
7. Concrete aggregate quality and gradation requirements: based on agency practice;
8. Cementitious materials requirements: based on agency practice; and
9. Concrete admixture requirements: based on agency practice.

**3.2 Reinforcement**

Use reinforcing bars meeting [insert REFERENCE TO AGENCY specifications]. Provide the minimum concrete cover between any reinforcement and exposed concrete surfaces as shown in the fabricator shop drawings.

For nonprestressed panels, provide a single or a double mat of reinforcement with a size and spacing of steel in both directions that result in a ratio of steel area to concrete area of at least 0.0018 and a maximum center-to-center bar spacing in both directions of 18 in. (450 mm).

For prestressed panels that are pretensioned during fabrication, provide a mat of steel reinforcement in the nonpretensioned direction that results in a ratio of steel area to concrete area of at least 0.0018.

Use prestressing steel that meets the requirements of [insert REFERENCE TO AGENCY specifications]. Prestressing tendons shall be either high-strength (Grade 270 or better), low-relaxation strand or high-strength (Grade 150 or better) threaded bars.

The panels may include additional reinforcement based on jobsite loading conditions, (e.g., when slabs must be loaded before undersealing grout is applied beneath the panels), irregular shape of panels, and at the location of lifting inserts and blockouts, as shown in the approved fabricator shop drawings.

**3.3 Patching and Grout Material for Blockouts, Keyways, and Dowel Bar and**

 **Tie Bar Slots and for Grout and Lifting Insert Ports**

Patching materials shall be the material designated on the approved shop drawings or an equivalent material approved by the [AGENCY NAME]. The compressive strength of the patching material at the time of opening to traffic shall be at least 2,500 lbf/in.2 (17.2 MPa).

If approved patching materials are prepared in accordance with their manufacturer’s written instructions, no testing of the patching material is required. If the manufacturer’s written instructions are not followed, or if an alternative material is proposed for use, the material must meet the requirements of Table 1, Patching Material Requirements, when tested in accordance with [insert REFERENCE TO Agency Standard Specification for Concrete Repair Material].

**TABLE 1. Patching Material Requirements**

|  |  |  |
| --- | --- | --- |
| **Property** | **Minimum** | **Maximum** |
| Compressive strength, opening to traffic | 2,500 lbf/in.2 (17.2 MPa) | na |
| Compressive strength, 28-day | 4,000 lbf/in.2 (27.6 MPa) | na |
| Expansion | na | 0.40% |
| Contraction | na | 0.05% |
| Freeze–thaw loss (25 cycles at 10% NaCl) | na | 1.0% |
| Bond strength (to dry PCC), 28-day | 300 lbf/in.2 (2.1 MPa) | na |
| Initial set time | 15 minutes | na |
| Chloride content | na | 0.05% |
| Sulfate content | na | 5.0% |

Note: PCC = portland cement concrete; na = not applicable.

**3.4 Posttensioning-Related Materials**

**3.4.1 Prestressing Tendons**

Use prestressing tendons meeting [insert REFERENCE TO AGENCY specifications].

When prestressing strands are used, the strands shall be a low-relaxation, 7-wire strand conforming to ASTM A 416.

When threaded prestressing bars are used, the bars shall be hot-rolled and proof-stressed alloy steel conforming to ASTM A722.

**3.4.2 Posttensioning Duct Grout**

Approved cementitious or proprietary grouts shall be used to fill the void between the tendon and the posttensioning duct. The grout properties shall be as designated in the approved fabricator shop drawings. The grout must be chloride free.

**3.4.3 Posttensioning Duct**

Corrugated ducts shall be used as the housing for the prestressing strands or bars in the precast panels. The ducts shall cover the prestressing steel from anchorage to anchorage. The ducts shall be made from approved galvanized steel or plastic material. The duct size shall be selected to accommodate a single strand or multiple strands, as designated in the approved fabricator shop drawings.

**3.4.4 Posttensioning Duct Couplers and Gaskets**

Duct couplers, to connect ducts of adjacent panels, shall be of the type designated in the approved fabricator shop drawings.

Compressible gaskets used to prevent any grout leaks at the intermediate transverse joints shall be of the type designated in the approved fabricator shop drawings.

**3.4.5 Prestressing Anchorage**

For prestressing systems that use strands, the prestressing anchorage system shall include a bearing plate and a chuck assembly that grips the strand and holds it in place, as detailed in the approved fabricator shop drawings.

For prestressing systems that use bars, the anchorage system shall include a bearing plate and an anchor nut that holds the bar in place, as detailed in the approved fabricator shop drawings.

**3.5 Panel Undersealing Grout**

The undersealing grout shall be the material designated on the approved shop drawings or an alternative prepackaged material approved for this purpose. The grout can be a slurry or a flowable fill. The compressive strength of the undersealing grout at the time of opening to traffic shall be 500 lbf/in.2 (3.4 MPa).

**3.6 Fine-Grained Granular Bedding (for Bedding-Supported PPCP Systems)**

If the PPCP system requires the use of fine-grained granular bedding, use the gradation for the material that was approved in the PPCP systems approval process. The bedding thickness shall not exceed 0.25 in. (6 mm).

**3.7 Cementitious Material Bedding (for Bedding-Supported PPCP Systems)**

If the PPCP system requires the use of cementitious bedding, use the mix design that was approved in the PPCP systems approval process. The cementitious bedding material can be a flowable fill material and must develop a minimum compressive strength of 100 lbf/in.2 (0.7 MPa) at the time of placement of panels and 500 lbf/in.2 (3.4 MPa) at the time of opening to traffic. The bedding thickness shall not exceed 2.0 in. (50 mm).

**4.0 PANEL LAYOUT AND SHOP DRAWINGS**

The Contractor shall provide project-specific panel layout drawings and fabricator shop drawings from the panel fabricator for each contract. The fabricator shop drawings to manufacture the project precast concrete panels shall be based on the approved standard drawings for the PPCP system proposed for use. Include the PPCP system approval details on the fabricator standard drawings and the fabricator shop drawings. Copies of the approved fabricator shop drawings will be returned to the Contractor.

All Contractor-submitted drawings shall be signed by a registered professional engineer on the Contractor’s team licensed to practice in [AGENCY STATE].

**5.0 PANEL FABRICATION**

The panels for an approved PPCP system shall be supplied by a precast concrete fabricator whose plant is certified by PCI, NPCA, or [AGENCY NAME].

**5.1 General Panel Fabrication–Related Requirements**

The following requirements shall be met for fabrication of the panels:

1. Panels shall be fabricated in accordance with the approved fabricator shop drawings. Install the reinforcement, lifting inserts, and grout ports in the amounts and at the locations designated in the fabricator shop drawings.
2. Dowel bars and tie bars shall be installed in the amount, at the alignment, and at the locations designated in the fabricator shop drawings.
3. Dowel bar and tie bar slots shall be installed in the amount, at the alignment, and at the locations designated in the fabricator shop drawings.
4. Tendons for pretensioning shall be installed in the amount and at the locations designated in the fabricator shop drawings.
5. Metal side forms and a metal bed to fabricate the panels shall be used. Use of nonmetallic forms and bed is not permitted.

**5.2 Panel Hardware Installation**

Panel hardware shall be embedded in the panel as designated in the approved fabricator shop drawings. The panel hardware may include the following:

1. Reinforcement placed in a single direction or both directions and in one or

two layers;

1. Posttensioning ducts;
2. Prestressing strands used for pretensioning;
3. Blockouts for the following
	1. Posttensioning anchorage system
	2. Posttensioning duct couplers or duct gaskets
	3. Dowel bars and tie bars and any other load-transfer devices
	4. Undersealing channels, per the approved fabricator shop drawings;
4. Grout tubes for the following
	1. Grouting of the posttensioning ducts
	2. Dowel bar slots
	3. Undersealing grout; and
5. Lifting inserts.

**5.3 Concrete Mixture and Concrete Placement**

Concrete shall be produced in accordance with the requirements of ASTM C94 [OR INSERT REFERENCE TO AGENCY SPECIFICATION]. Concrete plants supplying the concrete shall be certified by the [AGENCY NAME] or in accordance with the requirements of the National Ready Mixed Concrete Association’s QC3 checklist.

Slump concrete or self-consolidating concrete may be used. The concrete mixture to be used shall be the concrete mixture submitted to the [AGENCY NAME]. Any changes to the cementitious content, the aggregate source, the aggregate gradation, or the water-to-cementitious materials ratio shall require submission of a new mixture design for approval before the new concrete mixture can be used for panel fabrication.

Concrete shall be placed and consolidated, as necessary, to ensure that the concrete quality is uniform throughout the panel and the concrete aggregates do not segregate.

**5.4 Surface Texture**

Apply one of the following textures, in accordance with [insert REFERENCE TO Agency Specification], to the top surface of the panel:

1. [Longitudinal or transverse] tining; or
2. AstroTurf drag.

The texture shall be applied while the concrete is still in a plastic state, but without damaging the surface of the concrete and before application of any membrane curing compound.

**5.5 Concrete Curing**

**5.5.1 Conventional Curing of Panels**

Once the panel finishing details are taken care of, the panel surfaces and sides shall be sprayed with an approved concrete-curing compound. The curing compound shall be applied within 4 hours of panel stripping.

The curing compound used shall be a white-pigmented membrane curing compound from [the Agency]’s approved list.

**5.5.2 Steam Curing of Panels**

Steam curing, at atmospheric pressure, shall be done as a precaster option. When steam curing is used, it shall be done in accordance with industry-accepted standards and include the following items:

1. An initial period of curing, minimum of 3 hours, for the concrete to achieve an initial set before steam curing is initiated.
2. A period for increasing the panel temperature. The temperature in the enclosure surrounding the concrete panels shall not be increased more than 40°F (22°C) per hour.
3. A period for holding the maximum temperature constant, not to exceed 140°F (60°C), measured near the source of steam within the enclosure.
4. A period for decreasing the temperature. The temperatures in the enclosure surrounding the concrete panels shall not be decreased more than 40°F (22°C) per hour.
5. Once the steam curing has ended, the panels shall not be exposed to the ambient conditions until the concrete has cooled to about 30°F (17°C) above the ambient temperature.
6. The steam-cured panels shall be protected before exposing the panels to windy conditions.

For pretensioned panels, detensioning and flame-cutting of the tendons shall be done at the end of steam curing.

The conventional curing of the panel, in accordance with § 5.5.1, shall be applied within 60 minutes of exposure to ambient conditions.

**5.6 Pretensioning of Panels**

The panel design and the approved fabricator shop drawings may include requirements for pretensioning of the panels. Unless otherwise noted in the approved fabricator shop drawings, pretensioning shall be achieved using strands with a minimum diameter of 0.5 in. (13 mm).

The strands shall be positioned at locations designated in the approved fabricator shop drawings. Pretensioning of the strands shall be accomplished in two steps as follows:

1. Initial tensioning shall be done to remove the slack in the strands and to allow for marking of reference points in the strands to measure the strand elongation resulting from final tensioning.
2. Final tensioning shall be done per the requirements detailed in the approved fabricator shop drawings.

At about 15 to 20 hours, just before the formwork is stripped and after the concrete has attained the desired strength, the strands shall be released from the anchorage at the bulkheads. The strands may be released earlier from the anchorage if steam curing is used. The strands shall be flame-cut after the formwork is stripped.

**5.7 Formwork Stripping and Panel Finishing**

The panels shall be stripped of formwork after the concrete has attained a minimum compressive strength of 2,000 lbf/in.2 (5.7 MPa)to ensure that the concrete will not be damaged during the stripping process and to allow for the safe lifting of the panels. The stripped panels may be moved to other areas within the plant to take care of the panel finishing details. These finishing details may include the following:

1. Clean-up of the blockouts;
2. Installation of foam strips (gaskets) around conduit openings in accordance with the approved fabricator shop drawings;
3. Applying project- and panel-specific marking on each panel;
4. Cutting of pretensioning tendons, if applicable;
5. Checking for any damage to the panel, repairing minor surface damage, and filling small surface voids over 0.5 in. (13 mm) in diameter using a sand–cement paste or an approved proprietary patching material;
6. Rounding the top edges of the panels with a hand stone to prevent chipping during handling and installation, as required by the approved fabricator shop drawings;
7. Checking for dowel bar alignment; and
8. Checking for dimensional tolerances.

All forms and casting bed areas should be cleaned after each use.

**5.8 Dimensional Tolerances**

The dimensional tolerances applicable to PPCP panels are listed in Table 2. These tolerances are in relation to the specific dimensions indicated in the approved panel fabricator shop drawings.

**TABLE 2. Precast Panel Dimensional Tolerances**

|  |  |
| --- | --- |
| **Measurement** | **Tolerance** |
| Length and width | ±1/4 in. |
| Nominal thickness | ±1/16 in. |
| Squareness (difference in measurement from corner to corner across top surface, measured diagonally) | ±1/8 in. |
| Horizontal alignment: deviation from straightness of mating edge of panels (upon release of pretensioning stress) | ±1/8 in. |
| Vertical alignment: camber (upon release of pretensioning stress) | ±1/8 in. |
| Deviation of ends (horizontal skew) | ±1/8 in. |
| Deviation of ends (vertical batter) | ±1/8 in. |
| Keyway dimensional tolerance | ±1/8 in. |
| Position of strands  | ±1/8 in. vertical*a*±1/4 in. horizontal |
| Position of posttensioning ducts at mating edges | ±1/8 in. vertical*a*±1/8 in. horizontal |
| Straightness of posttensioning ducts | ±1/4 in. vertical*a*±1/4 in. horizontal |
| Vertical dowel alignment (parallel to bottom of panel) | ±1/8 in. |
| Horizontal dowel alignment (normal to expansion joint) | ±1/8 in. |
| Dowel location (deviation from shop drawings) | ±1/4 in. vertical*a*±1/4 in. horizontal |
| Dowel embedment (in either side of expansion joint) | ±1.0 in. |
| Position of lifting anchors | ±3.0 in. |
| Position of nonprestressing reinforcement | ±1/4 in. |
| Straightness of expansion joints | ±1/8 in. |
| Initial width of expansion joints | ±1/8 in. |
| Dimensions of blockouts and pockets | ±1/8 in. |

Note: 1 in. = 25.4 mm.

 *a*Measured from bottom of panel.

**5.9 Panel Marking**

Panel marking shall be applied to a longitudinal edge face to include the following information as a minimum:

1. Fabrication date;
2. Manufacturer information;
3. Panel number;
4. Panel type;
5. Panel weight; and
6. Panel dimensions (thickness, length and width).

**5.10 Panel Inspection**

Each fabricated panel shall be inspected, after removal from the form and before the panel is moved to the plant storage area, for the following:

1. Dimensional tolerances as specified in § 5.8;
2. Surface defects;
3. Improper surface texture;
4. Damage to the concrete;
5. Embedded dowel bar and tie bar alignment, if applicable; and
6. Pretensioning based on strand elongation.

Panels not meeting the specified dimensional and dowel bar alignment tolerances; exhibiting poor surface texture, surface defects, and damage; or having improperly tensioned strands shall be considered defective.

Defective panels shall be mitigated per § 8.1 – Defective Panels.

Embedded dowel bars and tie bars, if present in the panels, shall be protected against damage during panel lifting, handling, and shipping.

**5.11 Panel Storage and Shipping**

The panels shall be stored at the plant site for at least 14 days before they are shipped to the project site. The panels shall be stacked on solid dunnage at locations that minimize panel warping due to self-weight and creep. The dunnage arrangement shall be as shown on the approved fabricator shop drawings.

The panels shall be shipped with due care to ensure that the panels do not suffer any damage during the transfer to the project site. The panels may be stored near the project site for an additional period of time using the procedures used at the plant location.

**6.0 PANEL INSTALLATION**

**6.1 Technical Assistance**

If the precast pavement system proposed for use features installation processes that must be performed in accordance with the system designer’s instructions, the system designer shall provide on-site technical assistance at the beginning of the panel installation for complete installation of at least 10 panels.

**6.2 Weather Limitations**

The Contractor shall ensure that undersealing grout and patching materials are suitable (based on manufacturers’ recommendations) for the weather conditions that may exist at the time of installation. Contingency instructions and alternate materials shall be provided for potential installation during extreme weather events. Extreme weather events are defined as steady rain during installation or air temperature lower than 32°F (0°C).

**6.3 Existing Pavement Removal**

The existing pavement may be an asphalt pavement or a concrete pavement. The existing pavement area shall be readied for removal.

Not more than 7 days before panel installation at a designated location, the existing concrete pavement areas to be removed shall be saw-cut full-depth in a grid pattern approved by the Engineer. During the lane closure for the panel installation, the existing concrete pavement within a given work area shall be removed using the lift-out method, taking care to minimize damage to the existing base. Other existing pavement removal methods shall not be used unless approved by the Engineer. If during the pavement removal process any adjacent existing concrete pavement is damaged, the damaged pavement section shall be repaired as directed by the Engineer.

The removal of the existing asphalt pavement in a given work area shall be done during the lane closure for the panel installation in the work area.

Disposal of all removed existing concrete pavement or the existing asphalt pavement shall be in accordance with the requirements of [INSERT REFERENCE TO AGENCY SPECIFICATION].

**6.4 Base Preparation**

**6.4.1 Existing Base**

The existing base to be left in place may be a granular base or a stabilized base.

If the existing base is a granular base, the base shall be regraded and compacted using vibratory roller compaction in accordance with [INSERT REFERENCE TO AGENCY SPECIFICATION]. The moisture content in the upper 6 in. of the granular base shall be adjusted, as necessary, to allow the compacted base to achieve dry density of 92% of the AASHTO T-180 maximum dry density for that material.

The Contractor shall test the compacted base using a lightweight deflectometer (LWD), calibrated for the base type, in accordance with [INSERT REFERENCE TO AGENCY SPECIFICATION].

As required by the project plans and/or the approved PPCP system requirements, one of the following treatments shall be applied to the compacted granular base or an existing stabilized base:

* + - 1. Fine-grained granular bedding, applied per § 3.5. The bedding material shall be compacted and graded.
			2. Cementitious material bedding, applied per § 3.6. The cementitious material shall be placed directly over the compacted existing base before panel placement.

The granular and the cementitious bedding material, if placed directly over the base, shall be finished to the required grade and compacted to provide a smooth surface for panel placement. A fine-grading trimmer shall be used to trim the granular bedding surface to ensure that the panels can be placed at the correct surface elevation. Cementitious bedding material placed directly over the existing base shall be finished to the designated grade using concrete-finishing tools.

The finished bedding surface shall have no areas in excess of 2 ft2 at the bedding surface that exhibit low spots in excess of 1/8 in. (3 mm). The prepared bedding surface shall not be disturbed before placement of the panel.

**6.4.2 New Base**

A new base shall be constructed as required by the project plans. The new base shall be constructed to the width and thickness as designated in the project plans. The new base shall be constructed in accordance with the requirements of [INSERT REFERENCE TO AGENCY SPECIFICATION].

The finished base surface shall be finished to ensure that the panels can be placed at the correct surface elevation. The finished base surface shall have no areas in excess of 2 ft2 at the bedding surface that exhibit low spots in excess of 1/8 in. (3 mm). The prepared bedding surface shall not be disturbed before placement of the panel.

The Contractor shall test the compacted granular base using a lightweight deflectometer (LWD), calibrated for the base type, in accordance with [INSERT REFERENCE TO AGENCY SPECIFICATION].

**6.5 Panel**–**Base Interface Treatment**

A panel–base interface friction-reducing material shall be used to reduce panel–base interface friction, as detailed in the approved fabricator shop drawings. The material may be an approved minimum 6-mil- (0.15-mm-) thick, low-friction, polyethylene sheet (film) (ASTM D2103) or an approved nonwoven geotextile fabric. The polyethylene sheet or the geotextile fabric shall be placed over the full width and full length of the base or bedding area being worked on. If the materials need to be lapped, a minimum 2-ft (0.6-m) overlap shall be used in the longitudinal direction and a minimum 4-ft (1.2-m) overlap shall be used in the transverse direction.

The friction-reducing material shall be held in place without folds or ridges, and its edges must be held down against wind.

**6.6 Panel Placement**

Each panel shall be placed to the line and grade depicted in the contract layout plans, within the tolerances specified in this specification, and in accordance with the system designer’s instructions (if applicable). The panels shall be removed and reset prior to temporary posttensioning if the vertical elevation difference at the previously placed adjacent panel transverse joint is greater than 0.125 in. (3 mm) or the horizontal difference between the previously placed adjacent panel is greater than 1/4 in. (6 mm).

For each posttensioned section comprising several panels, the panels shall be placed over the friction-reducing material in the order designated in the approved fabricator shop drawings. An expansion joint shall be established at the beginning and end of each work area and at intermediate locations within the work area as detailed in the panel layout plan. A work area may incorporate one or more posttensioned sections. Each posttensioned section may incorporate the following:

1. A beginning and an end expansion joint panel incorporating the following
	1. Posttensioning hardware
	2. Dowel bars with expansion caps
	3. Reservoir for joint sealant;
2. A set of central prestressing panels; and
3. Standard panels.

**6.6.1 Intermediate Transverse Joints**

The successive intermediate transverse joints between adjacent panels shall be treated as follows:

1. Apply epoxy along the transverse keyway joint face of the previously placed panel. Care should be taken not to place epoxy in the tendon ducts. The epoxy shall be putty-like in consistency and shall be spread liberally along the keyway sides that are to be bonded to the corresponding sides of the adjacent panel to ensure that the sides to be bonded will be fully bonded, without leaving a gap.
2. Align the new panel adjacent to the previously placed panel so that the placement is within the specified tolerances for vertical elevation and horizontal alignment at the joint.
3. Apply a duct sealing treatment to ensure a tight seal around each connected duct between adjacent panels per the details in the approved fabricator shop drawings. This treatment may include a gasket at each tendon duct, a heat-shrink wrap, or a commercially available gasket, seal, or connector device.

**6.6.2 Load Transfer at Transverse Expansion Joints**

Load transfer at transverse expansion joints shall be provided as detailed in the approved fabricator shop drawings. When dowel bars are used, appropriately sized dowel bar expansion caps shall be used at both ends of the dowel bars. The dowel bars shall be aligned properly within the tolerances specified under [INSERT REFERENCE TO AGENCY SPECIFICATION].

**6.6.3 Tie Bars Along Longitudinal Joints**

Tie bars shall be installed along the longitudinal joints as detailed in the approved fabricator shop drawings.

**6.6.4 Transverse Expansion Joint Width**

Transverse expansion joints accommodate daily and seasonal expansion and contraction of the posttensioned sections. The expansion joint width to be set during the panel installation is a function of the posttensioning section length and ambient temperature at the time of the expansion joint panel placement or the expansion joint gap slab placement [OR CONSTRUCTION]. The expansion joint width shall be set per the details provided in the approved fabricator shop drawings.

**6.7 Posttensioning**

**6.7.1 Temporary Longitudinal Posttensioning**

Temporary posttensioning shall be applied after each panel is placed to ensure that the adjacent panels fit tightly at the transverse intermediate joints. A minimum of two tendons, located at one-quarter to one-third of the distance along the panel width, shall be used, as detailed in the approved fabricator shop drawings. Unless otherwise directed in the approved shop drawings, the tendon load applied shall correspond to an average panel cross-section prestress level of at least 50 lbf/in.2 (344 kPa).

**6.7.2 Final Longitudinal Posttensioning**

Final longitudinal posttensioning shall be applied as detailed in the approved fabricator shop drawings. The following three methods are approved for final posttensioning:

1. Central panel posttensioning. Posttensioning is performed using pockets in the central panels, as shown in the approved fabricator shop drawings.
2. Joint panel posttensioning. Posttensioning is performed using pockets in the joint panels, as shown in the approved fabricator shop drawings.
3. End (joint face) posttensioning. Posttensioning is performed at the joint face, as shown in the approved fabricator shop drawings. This approach requires use of a gap panel (filler panel). The gap panel shall be at least 4 ft (1.2 m) long and may have provisions for a single expansion joint or two expansion joints, one on each side of the gap slab.

**6.7.3 Transverse Posttensioning**

Transverse posttensioning shall be applied as detailed in the approved fabricator shop drawings.

**6.7.4 Tendon Duct Grouting**

Duct grouting, using the approved grout material and equipment, shall be carried out as soon as possible after the final posttensioning of the tendons is accomplished, but no later than 7 days after the final posttensioning of the tendons. The grouting operation shall be supervised or performed by a person who is certified under the American Segmental Bridge Institute’s Grouting Certification Training Program or an equivalent approved program.

The grouting shall be done continuously (uninterrupted) from the low end of the posttensioned section until the grout completely fills the duct. Grouting of each tendon shall be completed in one operation. Grouting may be done using a grout port near the end anchorage or using a port in the end anchorage assembly. When grout ports are used, the filling of the duct enclosure shall be monitored using grout ports spaced at regular intervals along the length of the posttensioned section. When end anchorage ports are used, grout flow out of the uphill end anchorage grout port shall be monitored to determine the complete filling of the duct with grout.

**6.8 Dowel and Tie Bar Slot Patching or Grouting**

The dowel and tie bar slots shall be patched or grouted as detailed in the approved fabricator shop drawings.

The provisions for load transfer at transverse joints at the beginning and end of the work area shall be as detailed in the approved fabricator shop drawings.

Whether a grout material or a rapid-setting patching material is used for the dowel slots, the material shall attain the required compressive strength of 2,500 lbf/in.2 (17.2 MPa) before opening the repair area to traffic.

The grout material or the dowel patching material or other approved material shall be used to fill blockouts, the lift insert holes, and grout port holes and to repair any surface damage to the panels.

**6.9 Panel Undersealing**

For panels placed directly over a granular or cementitious bedding material, the Contractor shall underseal all panels using the approved cementitious undersealing grout material. Grout ports shall be uniformly distributed across the panel area as shown in the approved fabricator shop drawings.

The undersealing grout shall attain a compressive strength of 500 lbf/in.2 (3.4 MPa) at the time of opening to traffic. When the grout is pumped, the grout flow rate should be within the range specified. The grout shall be mixed in a batch pump in batches and pumped continuously from a grout hopper.

The undersealing grout ports shall be filled to middepth with the undersealing grout. The rest of the port depth shall be filled with the slot patching grout or patching material or other approved higher-strength rapid–setting patching material.

**6.10 Posttensioned Section Anchoring**

An anchoring system to secure the center of each posttensioned section in place shall be installed as detailed in the approved fabricator shop drawings.

The midsection anchors may be installed before or after the final posttensioning process. However, the anchors shall be installed before any diamond grinding to correct the surface profile.

**6.11 Opening to Traffic**

The work areas shall be opened to traffic only after each placed panel has been temporarily posttensioned in the longitudinal direction or after the final posttensioning has been applied to the placed panels. A temporary gap panel or a transition panel may be used between adjacent posttensioned sections or between a posttensioned section and the existing pavement.

Work shall be scheduled to minimize the exposure of precast panels to traffic prior to final longitudinal posttensioning and prior to patching or grouting the dowel slots at the expansion joints. Panels without effective load transfer at transverse expansion joints or without panel undersealing shall not be exposed to traffic for a period of more than 3 days.

**6.12 Grinding**

The vertical elevation difference at the transverse joints between the panel and the existing pavement or another panel shall not exceed 0.25 in. (6 mm). The vertical elevation difference at intermediate transverse joints between adjacent panels shall not exceed 0.125 in. (3 mm). If the elevation difference is larger, the joint areas shall be ground full width to bring the repair area under compliance. Grinding shall be performed as directed by the Engineer.

**6.13 Joint Sealing**

All longitudinal joints of the rehabilitated section shall be sealed as detailed in the approved fabricator shop drawings. Longitudinal joint widths will vary and may range from 0.25 to 0.5 in. (6 to 13 mm) or more.

The transverse expansion joints shall be sealed as detailed in the approved fabricator shop drawings.

**7.0 INSTALLED PANEL Acceptance Testing**

The acceptance of the installed panels shall be based on the following requirements.

**7.1 Vertical Elevation Difference at Transverse Joints**

For each installed panel, measure the vertical difference at the intermediate transverse joint between adjacent panels and at the expansion joints between the existing concrete pavement and the expansion joint panel or between two adjacent expansion joint panels. Measure the difference at 2 ft (0.61 m) and 10 ft (3.05 m) from the outside edge of each lane. The measurement may be conducted using a straightedge or a Georgia faultmeter. Panels exhibiting a vertical elevation difference greater than 0.25 in. (6 mm) at the expansion joints or greater than 0.125 in. (3 mm) at the intermediate transverse joints shall be considered as defectively installed and treated per § 8.2.

If approved by the Engineer, the defectively installed precast panels may be opened to traffic if all installed panels are required to be ground per the project requirements or if grinding is approved for each defectively installed posttensioned section.

**7.2 Deflection Testing**

At the discretion of the agency, a selected number of precast panels may be tested for load-transfer effectiveness at the intermediate transverse joints and at transverse expansion joints using a falling weight deflectometer and an applied load level of 9,000 lb (40 kN). The measure of the load-transfer effectiveness is the relative deflection (RD) across the tested joint between a precast panel and the existing concrete pavement or another adjacent precast panel. The acceptable RD value is 2.5 mils (0.06 mm). If the Engineer determines that the measured RD values indicate poor load-transfer effectiveness at the tested joints, the Engineer may elect to test all precast panel joints. All panels exhibiting RD values at the designated transverse joints greater than 2.5 mils (0.06 mm) shall be considered defective and treated per § 8.2.

**7.3 Posttensioning Tendon Elongation**

The prestressing tendon elongation shall be reported. If the prestressing tendon elongation is not within the tolerance established in the approved fabricator shop drawings, the affected posttensioned sections shall be considered defective and treated per § 8.2.

**7.4 Damaged or Defective Concrete**

The Contractor shall repair or replace all damaged panels prior to final acceptance. These repairs shall be performed as described in [INSERT AGENCY REFERENCE FOR CONCRETE PAVEMENT REPAIR] at no cost to the [AGENCY NAME]. Damage and defects include, but are not limited to, cracking and spalling that may develop during panel installation and during use by construction traffic.

**8.0 DEFECTIVE PANELS AND DEFECTIVE PANEL INSTALLATION**

**8.1 Defective Panels**

If the Engineer determines that the defective panels, as fabricated or with the Contractor-proposed mitigation treatment, will result in an unacceptable product, the affected panels will be rejected.

**8.2 Defective Panel Installation**

If the Engineer determines that the defective panel installation, as originally installed or with the Contractor-proposed mitigation treatment, will result in an unacceptable product, the affected panels will be removed and replaced.

**9.0 METHOD OF MEASUREMENT**

The work will be measured for payment as the number of square yards of accepted precast concrete panels, measured to the nearest 0.1 yd2 (0.1 m2).

**10.0 BASIS OF PAYMENT**

The unit price bid shall include the cost of all engineering, design, fabrication, quality control, labor, material, and equipment necessary to satisfactorily perform the work described in this specification, including technical assistance from the PPCP system designer, as necessary.

Payment will be made under

|  |  |  |
| --- | --- | --- |
| **Item Number** | **Item**  | **Pay Unit** |
| [Insert item number] | Precast Concrete Pavement Panels  | Square Yards (Meters) |