

VIRGINIA DEPARTMENT OF TRANSPORTATION  
SPECIAL PROVISIONS FOR  
**PRECAST CONCRETE PAVEMENT**

January 6, 2009

**I. DESCRIPTION**

This provision shall cover the design, fabrication, installation, and grouting of precast concrete panels for pavement reconstruction.

**II. PRECAST PANEL DESIGN**

The Contractor shall be responsible for design all aspects of the precast concrete panels to replace existing pavement by matching existing pavement cross-slopes and grades. Where the existing pavement has minor variations in cross-slope from a uniform cross-slope, the contractor may propose a uniform cross-slope that most closely matches the average existing cross-slope, except where differences occur between super-elevated and normal sections. The precast panels shall be reinforced with steel and provide for a minimum design life of 30 years. For plain concrete slabs, the contractor shall include any reinforcing steel necessary to prevent damage during lifting, transportation and installation. Joint load transfer, equivalent to the load transfer identified on standard PR-2, shall be provided for all longitudinal and transverse joints including the joints between precast panels and the existing pavement. The Contractor shall submit shop drawings showing the proposed precast concrete slab design with supporting calculations within 21 days of Notice to Proceed for review and approval of the Engineer. The Engineer will accept, or reject, the shop drawings, **or re-submitted shop drawings**, within 21 days of receipt. The contract completion date will not be extended for rejection of shop drawings due to errors or omissions deemed to be the responsibility of the Contractor.

**III. PRE-CAST PANEL SYSTEM APPROVAL**

Pre-approved pre-cast concrete slab systems are listed on the Department's Materials Division's List No. 67, Approved Pre-cast Concrete Pavement Systems. Approval of other systems is contingent upon submission of the information outlined in the special provision for "Pre-cast Concrete Pavement System Approval". The Department estimates that review of alternate system submittals could take up to 4 weeks. The Contractor should consider the potential impact on schedule when making a decision to submit an alternate system.

**IV. MATERIALS**

Materials shall conform to the requirements of the 2007 VDOT Road and Bridge Specifications referenced herein, except where noted in these Special Provisions.

**V. PRECAST PANEL FABRICATION**

**A. Plant Certification**

The precast manufacture plant supplying the precast panels shall be on the Department's Materials Division's Approved List No. 34, "Concrete Precast producers on QA/QC Program".

**B. Tolerances**

Tolerances for precast panels, regardless of type shall be as shown below in Table 1.

**Table 1**

### Tolerances for Precast Panels

Length (parallel to long axis of panel)	+/- 1/4"
Width (normal to long axis of panel)	+/- 1/8"
Nominal Thickness	+/- 1/8"
Squareness (difference in measurement from corner to corner across top surface, measured diagonally)	+/- 1/8"
Horizontal Alignment (upon release of stress)—Deviation from straightness of mating edge of panels	+/- 1/8"
Vertical Alignment—Camber (upon release of stress)	+/- 1/8"
Deviation of ends (horizontal skew)	+/- 1/8"
Deviation of ends (vertical batter)	+/- 1/8"
Keyway Dimensional Tolerance	+/- 1/16"
Vertical Dowel Alignment (parallel to bottom of panel)	+/- 1/8" <sup>1</sup>
Horizontal Dowel Alignment (normal to expansion joint)	+/- 1/8"
Dowel Location (deviation from shop drawings)	+/- 1/4" Vertical <sup>1</sup> +/- 1/4" Horizontal
Dowel Embedment (in either side of expansion joint)	+/- 1"
Position of lifting anchors	+/- 3" <sup>2</sup>
Position of reinforcement, including tie-bars (unless tolerance otherwise provided in plans)	+/- 1/4" <sup>3</sup>

1. Measured from bottom of panel
2. From position shown in precast shop drawings
3. Unless different tolerance shown in plans

#### C. Concrete Mixture

The concrete mixture used shall meet the strength requirements set forth in Section 217.07 for Class A4 concrete. Class A4 concrete shall reach design strength prior to shipment. The mixture shall be workable enough to achieve the required surface finish as described below. The installation Contractor must approve the coarse aggregate to be used by the precast fabricator with specific consideration given to requirements for diamond grinding of the finished surface of the precast panels. Aggregate shall be non-polishing.

#### D. Steel Reinforcement

Steel reinforcement shall conform to the requirements of Section 223. Provide a minimum 2" of cover for all reinforcement. Provide a mat of reinforcing steel with a minimum steel to concrete area of 0.0014 and a maximum center-to-center bar spacing of 18 inches in each direction.

#### E. Lifting Anchors

Lifting anchors shall be approved by the Engineer prior to use. Final locations of the lifting anchors shall be determined by the precast concrete producer and shown on the precast shop drawings. Unless otherwise approved, lifting anchors shall be galvanized threaded coil inserts which can be left unpatched prior to opening the pavement to traffic. The top of the

lifting anchors shall be recessed a minimum of 1/2-inch from the surface of the panel. All inserts shall be grouted prior to completion of the project.

#### **F. Dowels**

Dowels shall conform to the requirements of Section 316.04(g)(5), and may be epoxy coated, solid stainless steel, or stainless steel clad. The entire length of the dowel shall be coated with graphite grease or other approved bond breaker prior to placement of concrete for the Joint Panels.

Dowels shall remain parallel to the bottom surface of the panel and normal to the expansion joint during casting. Dowel baskets shall not be used to support the dowels in the forms. Dowel expansion caps shall provide for a minimum of 1.5 inches of free movement of the dowel end (within the expansion cap).

#### **G. Finishing**

Unless otherwise approved by the Engineer, the top surface of the panels (driving surface) shall receive a grooved texture finish typically used for portland cement concrete pavement in accordance with Section 316.04(h)(4). The texture shall be applied in a timely manner after final screeding such that the desired texture depth is achieved without disturbing the underlying concrete or turning over aggregate.

#### **H. Placement in forms**

Concrete formwork and placement procedures shall conform to the requirements of Section 405.05 with the exception that only metal (non-aluminum) forms will be permitted. Concrete shall be placed in a single lift (i.e., placed in a single operation) and distributed in such a manner that embedded items such as reinforcement, ducts, dowels, anchors, and lifting devices are not dislodged by the concrete mass. Proper consolidation must be achieved such that honeycombing or segregation of the concrete does not occur and all spaces around embedded items and around the panel forms are filled.

#### **I. Curing**

Curing of the precast panels shall conform to the requirements of Section 405.05. The Contractor shall submit the proposed curing methods and procedures for approval prior to placing concrete. Curing shall commence immediately after the surface finishing operation and as soon as marring of the concrete surface will not occur.

Membrane curing, in accordance with Section 316.04(j)(1), may be permitted at the discretion of the Engineer. A minimum two applications of the curing membrane, applied immediately after surface texture finishing, shall be required for membrane curing. Membrane curing residue shall be removed from all adjoining surfaces prior to shipment of the panels to the jobsite.

Curing shall be maintained on the sides and top surface of the panels for a minimum of 72 hours from the beginning of curing operations, or until the required 28-day compressive strength is achieved. While in the forms, the forms will be considered to provide adequate curing for the edges (vertical faces) of the panels. If any part of the form is removed, the exposed surface shall receive curing in accordance with Section 316.04(j). Removal of panels from the forms to a storage area shall be done in such a manner that curing is not interrupted for more than four hours for any member.

The precast panels shall be protected from cold and hot weather in accordance with Section 316.04(j).

#### **J. Form Removal and Storage**

Panels shall be removed from the forms in such a manner that no damage occurs to the panel. Form removal shall conform to the requirements of Section 405.05. Any materials forming blockouts in the panels shall be removed such that damage does not occur to the panel or the blockout.

Panels shall be stored in such a manner that adequate support is provided to prevent cracking or creep-induced deformation (sagging). Supports beneath the panels shall be located at approximately the same location as the lifting anchors. Panels shall be stacked no higher than five panels per stack, with adequate support between panels. Panels shall be stacked such that individual panels or stacks of panels are not touching one another. Panels stored for long periods of time (longer than one month) shall be checked at least once per month to ensure creep-induced deformation does not occur.

#### **K. Lifting and Handling**

Panels shall be handled and shipped in accordance with Section 405.05. Lifting anchors cast into the panels shall be used for lifting and moving the panels at the fabrication plant. The angle between the top surface of the panel and the lifting line shall not be less than sixty degrees (60°), when measured from the top surface of the panel to the lifting line. Damage caused to any Joint Panel, including bending of dowel bars, as a result of inadequate bracing shall be repaired at the expense of the Contractor to the satisfaction of the Engineer.

#### **L. Transportation**

Panels shall be transported in such a manner that the panel will not be damaged during transportation. Panels shall be properly supported during transportation such that cracking or deformation (sagging) does not occur. If more than one panel is transported per truck, proper support and separation must be provided between the individual panels.

#### **M. Repairs**

Repairs of damage caused to the panels during fabrication, lifting and handling, or transportation shall be addressed on a case-by-case basis and must be approved by the Engineer prior to implementation. Damage within acceptable limits caused to the top surface (driving surface) or to keyed edges of the panels shall be repaired using an approved repair method at the fabrication plant at the expense of the Contractor. Repetitive damage to panels shall be cause for stoppage of fabrication operations until the cause of the damage can be remedied.

#### **N. Demonstration of Panel Fit**

The precast fabricator shall initially fabricate only three panels and assemble these panels at the fabrication plant to demonstrate the fit of the panels. The panels shall be assembled over a level surface that will not cause damage to the panels during or after assembly. Joints between panels should not be more than 1/8-inch wide when assembled. Any problems with fitting the panels caused by imperfections in the panels shall be corrected prior to proceeding with panel fabrication. Panel fabrication may commence following the trial assembly with approval from the Engineer.

## **VI. REMOVAL OF EXISTING PAVEMENT**

### **A. Removal Method**

Existing PCC pavement shall be removed by sawcutting and lifting out the existing pavement. Rubblization, power breaking, or other impact methods which may damage the underlying base shall not be used.

### **B. Timing of Removal**

Sawcutting the existing pavement for removal may be completed up to 7 days prior to commencement of removal. Sawcutting and removal shall be completed in accordance with Section 509. Sawcutting depth should not exceed the actual pavement slab thickness by more than 1 inch. **Oversawing into the adjacent slabs or shoulder shall be kept to the minimum amount necessary to ensure that full depth cuts in the corners have been achieved. All oversawing shall be cleaned and filled with joint sealant.**

### **C. Additional Removal**

No more than 12 inches of additional pavement may be removed beyond the amount of precast concrete panels to be installed during each operation. If the gap between the end of the precast concrete panels installed during a nightly operation and the existing pavement exceeds one inch, it shall be temporarily covered or filled with a suitable material such as bituminous cold-patch materials which can be removed prior to installing additional precast concrete panels. Temporary fill material shall be removed completely from the gap, and the end of the precast concrete panels shall be protected from adhesion of the temporary fill material. The cost of temporary fill materials shall be included in the price bid for precast concrete panels slabs.

## **VII. BASE PREPARATION**

The precast panels shall be placed over a prepared base. The surface shall be free from debris and other materials that prevent the panels from fully resting on the base. The Contractor may elect to place additional leveling material depending on the thickness of his slab design to facilitate base preparation.

### **A. Grade Control for Placement**

Grade control shall be established for placement of the base material using string lines, laser guidance, or other comparable methods.

### **B. Surface Test**

The finished surface of the base material directly beneath the precast pavement shall provide full support beneath the panels. The evenness of the surface of the base material shall be checked in both the longitudinal and transverse direction by the Contractor using 10-ft straightedge. The variation of the surface shall be such that a 6-inch diameter circular plate, 1/8-inch thick cannot be passed beneath the straightedge. Any areas of the base surface not conforming to this smoothness requirement must be corrected at the Contractor's expense; pay adjustments shall not be permitted.

## **VIII. PANEL INSTALLATION ON SITE**

The Contractor shall allow up to 4 site visits by large groups of up to 50 people per visit for the purposes of reviewing on-site installation procedures and processes. The Contractor shall also co-ordinate with representatives of the Federal Highway Administration (FHWA) for the purposes of documenting construction processes and procedures.

#### **A. Equipment**

The Contractor shall have all equipment required for panel installation, and grouting on-site prior to beginning panel installation. Lifting and transporting equipment shall not damage the prepared base material prior to or during panel installation. Any damage to the prepared base material will be repaired at the Contractor's expense to the satisfaction of the Engineer.

#### **B. Placement Technique**

Panels shall be installed one at a time, and shall be installed in such a manner that the base material is not damaged during installation. The angle between the top surface of the panel and the lifting line attached to each lifting anchor shall not be less than 60 degrees (60°), when measured from the horizontal surface of the panel to the lifting line.

Panels may be aligned in the longitudinal direction (parallel to the roadway centerline) using the face of the adjacent existing pavement as the control line. Alternatively, the centerline of the panels shall be aligned to a line laid out by a surveyor (provided by the Contractor) on the surface of the base prior to installation of the panels. Panels may be offset to correct horizontal misalignment of the centerline of the panels, but not more than 1/4-inch between any two adjacent panels. Shims may not be used in the joints between panels to correct alignment.

#### **C. Placement Tolerances**

Alignment of adjacent panels, as indicated by the reference marks on the top surface of the panels, shall not deviate more than 1/4-inch if the existing remaining pavement is used as the control line. If a pre-surveyed centerline is used for alignment, the panels shall be within 1/4-inch of the pre-surveyed centerline marked on the surface of the base.

Vertical alignment of the panels shall be such that the top surface of an individual panel is no more than 3/16-inch higher or lower than the top surface of an adjoining panel at any point along the joint between the panels.

#### **D. Expansion Joints**

Expansion joint seals shall be provided, where necessary, and shall conform to the requirements of Standard PR-2 and Section 316. The seal for the expansion joints shall be selected by the Contractor and approved by the Engineer. The seal shall be installed according to manufacturer's recommendations. Expansion joints may be sawcut to the necessary width to receive the seal prior to installing the seal. Sawcuts shall not be greater than 3 inches deep to avoid contact with dowel bars.

Unless otherwise approved by the Engineer, expansion joint seals shall be installed prior to opening the pavement to traffic. Any debris in the joint shall be removed using compressed air or other approved technique prior to installing the joint seal.

#### **E. Longitudinal Joints**

Longitudinal joint widths shall not exceed the widths identified on standard PR-2. The longitudinal joints between precast concrete panels and the existing pavement shall be sealed according to Section 316.04(m) using a hot-poured joint sealant or low-modulus

silicone rubber joint sealant conforming to the requirement of Section 212.02. The longitudinal joint may be sawcut if necessary to receive the joint sealant, according to Section 326.04(g)(1c).

#### **F. Transverse Joints**

Transverse joints shall not exceed the widths identified on standard PR-2. Transverse joints shall be aligned, wherever possible, with transverse joints in the existing pavement. Where existing panel lengths are greater than proposed precast slab lengths and intermediate joints are required, provide a bond breaking material 12" on either side of the mis-matched joint. Tie bars should not be placed between, or within 16" of mis-matched joints.

Transverse joints between the precast concrete panels and the existing pavement shall be sealed according to Section 316.04(m) using hot-poured joint sealant or low-modulus silicone rubber joint sealant conforming to Section 212.02. The joints may be sawcut if necessary to receive the joint sealant, according to Section 326.04(g)(1c).

#### **G. Repairs**

Damage caused to the precast panels during any part of the panel installation process shall be repaired at the Contractor's expense to the satisfaction of the Engineer. Repairs of damaged areas will be addressed on a case-by-case basis by the Engineer and must be approved by the Engineer prior to implementation. Damage within acceptable limits caused to the top surface (driving surface) or to keyed edges of the panels shall be repaired using approved repair methods and materials. Repetitive damage to panels shall be cause for stoppage of installation operations until the cause of the damage can be remedied.

#### **H. Voids Beneath Pavement**

The pavement shall be inspected during panel installation for voids beneath the precast panels. At the discretion of the Engineer, the Contractor shall be required to stop panel installation and correct imperfections in the base material causing voids beneath the precast panels.

#### **I. Matching Existing Pavement**

The precast panels shall be tied into the existing pavement. The top surface of the precast pavement shall no more than 1/4 inch above or below the surface of the existing pavement. Diamond grinding shall be used bring the top surface of the existing pavement and precast pavement into tolerance if necessary. A single pass of diamond grinding has been specified on the plans for the entire length of the precast concrete slab placement area as well as an additional 50' on either end. All grinding required to achieve a smooth transition between the precast concrete slab and the existing pavement and to meet the requirements of the special provision for rideability shall be included in the price bid for diamond grinding. A maximum of one pass of diamond grinding will be paid.

#### **J. Trial Installation**

The initial on-site panel installation shall be considered a trial installation and limited to a total of 6 panels or a maximum of 80 square yards. The Contractor shall provide a minimum 15 days advance notice of the trial installation and shall allow the Engineer a minimum of 10 working days to evaluate the trial installation. Additional panels may not be installed until the trial installation has been approved by the Engineer. The Contractor shall install the trial installation and perform all testing required for trial installations as detailed in the Special Provision for Precast Concrete Pavement System Approval. Trial installations that fail to meet

contract specifications shall be removed and replaced at no cost to the Department. Payment will only be made for 1 (successful) trial installation.

## **IX. UNDERSLAB GROUTING**

Underslab grouting shall be used to fill any voids beneath the precast panels that may be present after placing the panels over the prepared base. Underslab grouting shall utilize grout ports cast into each of the panels, spaced so as to provide at least one grout port per 30 sf of slab with grout ports no further than 2 feet from a panel edge. The Contractor shall attempt to pump grout at each port location.

### **A. Materials**

Grout materials shall consist of a mixture of Type I, II or III Portland cement, a fluidifier, fly ash and water. All materials shall be furnished by the Contractor.

The fluidifier shall be a cement dispersing agent possessing such characteristics that will inhibit early stiffening of the pumpable mortar, tend to hold the solid constituents of the fluid mortar in suspension and prevent completely all setting shrinkage of the grout.

Class C fly ash shall be selected from the Department's list of approved Fly Ash sources.

Alternate grout materials may be submitted for review by the Department.

### **B. Equipment**

Equipment for underslab grouting shall consist of at least the following:

- Equipment for accurately measuring and proportioning by volume or weight the various materials composing the grout,
- A colloidal mixer, capable of operating in a range from 800 rpm to 2,000 rpm and thoroughly mixing the various components of the grout in an approved manner,
- The discharge line shall be equipped with a positive cut-off valve at the nozzle end, and a bypass return line for recirculating the grout back into a holding tank or mixer unless otherwise approved, and
- A stop watch and flow cone conforming to the dimensions and other requirements of ASTM C 939, "Standard Method for Flow of Grout for Preplaced-Aggregate Concrete (Flow Cone Method)."

### **C. Proportioning Grout Mixture**

The mixture used in underslab grouting shall consist of proportions of Portland cement, fly ash, fluidifier and water. The Contractor shall furnish the Engineer the proposed mixture design meeting the following requirements:

- The grout slurry shall remain fluid and not exhibit a resistance to flow for a minimum of one hour,
- The time of efflux from the flow cone shall be between 11 and 20 seconds. The flow test shall be performed in accordance with ASTM C 939, "Standard Method for Flow of Grout for Preplaced-Aggregate Concrete (Flow Cone Method),"
- The grout slurry shall achieve initial set in less than 4 hours. The grout slurry shall not be allowed to carry traffic until which time it has set to the satisfaction of the Engineer; or until which set time, as determined by ASTM C 266, "Time of Setting of Hydraulic Cement Paste by Gillmore Needles," has been reached, and
- The 7 day compressive strength of the grout slurry shall not be less than 200 psi.

#### **D. Procedures**

Underslab grouting shall be completed as soon as possible after installation, but not more than 7 days after placement of the precast panels. The Engineer may require grouting to be completed prior to opening the pavement to traffic if significant voids are observed during panel placement.

Slab edges shall be backfilled or sealed to prevent grout leakage from beneath the slab during underslab grouting. The bottom of all expansion joints shall be sealed prior to underslab grouting to prevent grout leakage into the joints. The sealant material shall be compressible such that it will not inhibit free movement of the expansion joints.

Underslab grouting shall require minimal pressure to force the grout beneath the pavement slab. Under no circumstances should underslab grouting cause the pavement slab to lift. Grout shall be pumped into each underslab grout port of each panel. Grout shall be pumped until it flows out of an adjacent grout port or until the line pressure on the grout pump reaches 5 psi. Grouting pressure of 5 psi may be exceeded if the Contractor can demonstrate that slab lift is not occurring at higher pressures.

The fluidity of the grout shall be checked at the beginning of each grouting operation and after each time the grout pump is flushed. Grout fluidity shall be checked in accordance with ASTM C 939, "Standard Method for Flow of Grout for Preplaced-Aggregate Concrete (Flow Cone Method)." Fluidity shall be adjusted to achieve the necessary flow requirements to achieve full undersealing. If excessive bleeding of the grout is observed, the Engineer may require the Contractor to adjust the grout mixture.

#### **E. Cleanup**

Upon completion of grouting, recesses in the surface of the panels at the grout ports shall be filled with an approved mortar and finished flush with the surface of the surrounding pavement. Any grout that flows onto the finished surface of the pavement during the grouting operation shall be immediately flushed from the surface. Any residual grout which hardens on the pavement surface shall be removed using an approved technique to the satisfaction of the Engineer at the expense of the Contractor.

#### **X. FINISHED SURFACE**

The finished pavement surface (after installation of all precast panels) shall have an average IRI of less than 70 inches per mile with no individual 0.01 mile section having an IRI greater than 80 inches per mile when tested for rideability in accordance with the Special Provision for Section 316 Rideability for Hydraulic Cement Concrete Pavement. Corrective action to improve the rideability and any necessary re-texturing shall be completed in accordance with the Special Provision for Section 316 Rideability for Hydraulic Cement Concrete Pavement. The pavement may be opened to traffic prior to meeting the final surface smoothness requirements unless the surface conditions are deemed to be hazardous by the Engineer.

#### **XI. MEASUREMENT AND PAYMENT**

Pre-cast concrete pavement will be measured in square yards of pavement surface area, complete-in-place, and will be paid for at the contract unit price per square yard for the depth specified, which price shall be full compensation for design, transportation, saw cutting existing pavement to the required depth, removing and disposing of existing concrete, furnishing and placing leveling material, preparation of sub-layer, furnishing and installing reinforcing steel, preformed expansion material (if applicable), furnishing and installing steel dowels, furnishing and installing reinforcing steel, furnishing, placing, finishing, and curing pre-cast concrete, furnishing

and installing concrete patching material, furnishing and installing under slab and other grout, designing, furnishing and installing expansion joints (if applicable), furnishing and installing mechanical couplers (if applicable), furnishing and installing epoxy (if applicable), furnishing and joint sealants, cleaning and sealing joints, **demonstration of panel fit at the plant** and for all materials, labor, tools, equipment, and incidentals necessary to complete the work as well as allowing on-site visitors and representatives of FHWA.

Payment for Trial Installation includes any additional items not covered under precast concrete pavement such as coring slabs, materials sampling/testing, allowing time for the Department to perform FWD testing and any delays or reduction in productivity associated with the trial installation.

Payment will be made under:

<b>Pay Item</b>	<b>Pay Unit</b>
Pre-cast Pre-stressed Concrete Pavement (9" Min. Depth) Trial Installation	Square Yard Each

In areas where the Engineer deems the sublayer insufficient to support the PPCP, the sublayer shall be excavated to sound material and replaced with Aggregate Base Material, Type I, Size No. 21B at a cost of \$30 per ton. This shall be full compensation for excavation and disposal of unsuitable sublayer, and for furnishing, placing, and compacting aggregate material.