

**1. DESCRIPTION:**

- 1.01 The work shall consist of furnishing and installing reinforced pre-cast highway pavement slabs as shown on the plans and in accordance with this specification. The work shall include placement of slabs, installing dowel grout into grout tubes as shown on the plans until tubes and grout pockets are full, and installing bedding grout under the slabs as required for leveling in accordance with this specification.
- 1.02 The work shall include the pre-casting of the Treadle Frames for Fiber Optic Axle Sensors into the pavement slabs as shown on the Contract Plans and in accordance with their respective specifications.

**2. MATERIALS:**

- 2.01 The pre-cast concrete pavement slabs shall be in accordance with Section 704-03 with the following exceptions:
  - A. Coarse aggregate shall be sandstone, granite, chert, basaltic traprock, ore tailings, slag, or other similar non-carbonate materials. Non carbonate particles are defined as those having a minimum acid insoluble residue content of 80%.
  - B. The minimum compressive strength shall be 4,000 psi at 28 days.
- 2.02 Working drawings shall be prepared as required in Section 704-03 and shall specifically include the following:
  - A. Slab layout drawing that shows the location of slabs appropriately mark numbered
  - B. Reinforcing size and position
  - C. Detailed piece drawings showing the locations and sizes of dowels, tie bars, grout tubes & pockets, and all three dimensional geometry related to widths, lengths and warps of each slab.
  - D. Production note sheet showing the source of materials, testing methods, weights of each slab, tolerances and all details relating to yard storage, shipping and handling
  - E. Texture of the top surface of the slabs
- 2.03 5% of the Portland Cement, by weight, in the precast slab shall be replaced with microsilica pozzolan.
- 2.04 All reinforcement shall be Glass Fiber Reinforced Polymer (GFRP) in accordance with the following properties:
  - A. Minimum Tensile Strength – 95 ksi.
  - B. Minimum Shear Strength – 22 ksi
  - C. Minimum Concrete Bond Strength – 1700 psi
  - D. Barcol Hardness – 60 (per ASTM D2583)
  - E. Glass Fiber Content – 70% by weight (per ASTM D2584)

Certifications from the supplier shall be submitted indicating the reinforcing bars meet the above requirements.

- 2.05 The bedding material shall be crusher run limestone (stone dust) meeting the following gradation: All materials furnished shall be well graded and free from unsuitable materials. All processing shall be completed at the source.

**2. MATERIALS:** (cont'd)

## 2.05 (cont'd)

A. **Gradation**

<b><u>Sieve Size Designation</u></b>	<b><u>Percent Passing by Weight</u></b>
1/2" max.	100
No. 4	80-100
No. 10	55-75
No. 40	10-40
No. 200	0-20

- 2.06 Each load transfer device shall consist of one Glass Fiber Reinforced Polymer (GFRP) dowel bar. The dowel element shall meet the following requirements:

- A. Minimum Shear Strength – 22 ksi
- B. Barcol Hardness – 60 (per ASTM D2583)
- C. Glass Fiber Content – 70% by weight (per ASTM D2584)

Certifications from the supplier shall be submitted indicating the dowel elements meet the above requirements.

- 2.07 Grouting material for the dowels grout pockets shall be Dayton Superior's HD-50, HD-50 EPS, or Pre-Blend's Pre-cast Slab Dowel Grout. The final mix must be capable of being pumped into the slots and attain a minimum compressive strength of 2,500 psi before the slabs are opened to traffic. The prepackaged material shall be mixed and used in strict accordance with the manufacturer's instruction.

Fourteen (14) days prior to installation of the pre-cast pavement, mix a minimum of one trial batch of the dowel grout in strict accordance with the manufacturer's recommendations under the same time and temperature conditions expected during actual installation. The trial batch shall be a demonstration to the Engineer that required compressive strength can be achieved. The recipe used during the trial will become the recipe used during actual installation.

- 2.08 Grout material for bedding shall be a mixture of cement, water, Master Builder's Flowcable admixture and accelerator as required to attain a flow rate of 30 seconds in a standard ASTM C939 flow cone. Bedding grout material shall be designed, mixed and used in strict accordance with the instructions provided by the manufacturer of the Flowcable admixture and must be capable of attaining a compressive strength of 300 psi before the slabs are opened to traffic. A mix design and pump equipment to be used shall be submitted to the Engineer for approval. Test cylinders may be required for proof of compressive strength.

Fourteen (14) days prior to installation of the pre-cast pavement, mix a minimum of one (1) trial batch of the bedding grout in strict accordance with the recommendations of the manufacturer of the bedding grout admixture under the same time and temperature conditions expected during actual installation. The trial batch shall be a demonstration to the Engineer that required flowability and compressive strength can be achieved. The recipe used during the trial will become the recipe used during actual installation.

**3. CONSTRUCTION DETAILS:****3.01 Fabrication:**

- A. Fabrication of the panels shall be in accordance with Section 704.03 of the General Specifications. Layout and shop drawings shall be required.
- B. The concrete pavement shall be cast in panels of the length and width shown on the plans.
- C. The bottom surface shall be smooth; the top surface shall be finished in accordance with the details shown on the Contract Plans.
- D. Load transfer dowels shall be installed as shown on the Contract Plans.
- E. Grout tubes and pockets for the dowels shall be cast in the panels to accommodate dowels as shown on the plans square to the edge of the slab to within  $\pm 1/8$  inch.
- F. The lifting devices shall be designed to lift the panels from the topside. Each lifting device in the panel shall be recessed a minimum of 1 inch, and a minimum of 2 inches below the surface.
- G. The slabs shall be cast to the following tolerances:

Length	$\pm 3/16$ inch
Width	$\pm 3/16$ inch
Thickness	$\pm 1/8$ inch
Difference in diagonals	not to exceed $3/16$ inch
Edge Squareness	$1/16$ inch in 10 inches (in relation to top and bottom)

- 3.02 **Pre-Placement Meeting:** A pre-placement meeting shall be held 10 to 14 calendar days before the planned start of slab installation with the Engineer, Inspection Personnel, Project Superintendent, Project Foreman, Project Surveyor, Grout Installers, the Technical Representative of the slab system, pre-cast panel fabricator, and any other Subcontractor who will be involved in the pre-cast pavement construction work.

The Contractor shall provide a facility for the meeting as agreed upon by the Engineer and the Contractor. The Engineer shall conduct the meeting. The technical representative of the slab system shall provide training on the installation and inspection techniques and requirements of the precast slab.

- 3.03 **INSTALLATION PLAN:** A detailed installation plan shall be prepared by the contractor and presented to the Engineer, or his assigned representative, and the Technical Representative of the slab system at least 10 days prior to the planned start of slab installation. The plan shall indicate, as a minimum, following information as required to meet the requirements of this Specification:

**3. CONSTRUCTION DETAILS:** (cont'd)**3.03 Fabrication:** (cont'd)

- A. Size and location of the placement crane
- B. Rigging to be used for lifting the slabs
- C. Routes to be used by the delivery trucks
- D. Plans for maintenance and protection of traffic
- E. Proposed method and equipment used for fine grading
- F. Materials proposed for dowel and bedding grout
- G. Grout mix designs to be used for each grout
- H. Equipment to be used for mixing and installing the grouts

**3.04 Installation Process:** The installation of the panels shall include:

- A. **Subbase Preparation.** The existing subbase shall not be disturbed except to remove (if necessary) existing material to a required surface 1/4 inch to 1/2 inch below the theoretical bottom of the new concrete slab unless directed on the contract plans or by the Engineer. The fine grade of the existing subbase shall meet the requirements of Section 304-3.
- B. **Placement and Fine Grading Of T&L Bedding Material.** All fine grading of the bedding material shall be accomplished using a laser or otherwise mechanically-controlled screeding device. The screeding device shall be capable of grading fully compacted bedding material and of being adjusted to the required cross slope and to the required profile of each pavement slab. Other grading devices and methods may be used provided the contractor demonstrates they are capable of grading fully compacted bedding material to the required tolerance. Hand grading under string lines shall be permitted only with the authorization of the Engineer.

It is the intent to provide a pavement slab bed that serves as the grade control for the slabs placed upon it such that slabs need not be adjusted for grade after they have been placed. The surface shall be graded and checked to insure it does not vary from the theoretical plane more than  $\pm 1/8$  inch over a length of each slab. The operator of the screeding device shall be experienced in the use of the device.

The bedding material shall be placed in one layer over the subbase and fine graded in two passes. In the first pass it shall be graded with the screeding device set to a plane 1/4 inch (or as required) above the theoretical bottom of slab. The bedding material shall be dampened with water and compacted with two (2) passes of a vibratory roller. The compacted plane of the "first pass" shall be at least 1/8 inch above the theoretical bottom of the slab.

During the second and final pass the screeding device shall be set to the theoretical plane of the bottom of the slab and shall then provide the final fine graded surface for the slab. This final grading pass is intended to remove any grade changes created by the compaction operation. The final fine graded surface shall **not** be rolled or compacted after the final grading pass. The final surface shall be dampened just prior to the placement of the slab. This dampening is needed to facilitate the grouting operation.

**3. CONSTRUCTION DETAILS:** (cont'd)**3.04 INSTALLATION PROCESS:** (cont'd)**B. Placement and Fine Grading of T&L Bedding Material** (cont'd)

Prior to placing the slabs the subgrade surface shall be examined by the Contractor and the Engineer using a straight-edge and depth gage approved by the Engineer. The straight-edge shall not be less than 10 feet long and the depth gage not less than 6 feet long with the depth set equal to the thickness of the slab. The straight edge and the depth gage shall be provided by the Contractor, and maintained in good, usable condition, at the placement site at all times. Surface variations greater than  $\pm 1/8$  inch in the bedding material shall be corrected prior to placement of the slab.

**C. Pavement Slab Placement.** Prior to placement of any slabs the Project Surveyor shall mark out the leading ends and leading edges of all slabs to ensure proper placement and fit. The marks shall account for proper joint widths as indicated in the Contract Plans.

Dowel bars and the vertical edge of the slab from which they are protruding shall be coated with bond breaker prior to setting any slabs to break the bond between the concrete slab and the dowel grout. The longitudinal edge of any previously set slab shall also be coated with bond breaker.

The slab shall be set in a manner such that all corners of the slab contacts the fine graded surface uniformly at the same time to avoid disturbing the finished fine graded surface unnecessarily and to avoid damaging the edges of the concrete slab. Tie off ropes and guide bars inserted in grout port holes shall be used to align the slabs to the marks during the placement process. The use of pry bars or wedges in joints for alignment purposes commonly result in spalling and shall not be allowed.

For pavements remaining concrete surfaced, the vertical differential across any joint is to be  $1/4$  inch or less. After the slab has been placed, check the vertical differential before setting the next slab. If the differential exceeds  $1/4$  inch, remove the slab and re-grade the subgrade until the differential is less than  $1/4$  inch before setting the next slab. Any edge differentials greater than  $1/4$  inch will require diamond grinding.

For pavements receiving hot mix asphalt (HMS) overlays, install slabs such that the vertical differential across any joint is  $1/2$  inch or less.

If dowels are exposed at the end of a setting period they shall be protected with an approved method. The method shall protect the bars against bending or breakage. It shall also provide protection to the final fine graded surface under the bars.

**D. Placing New Slabs Next to Existing Pavement.** If new slabs are placed adjacent to existing concrete and dowel bars shall be epoxy anchored into holes drilled into the existing concrete at locations that coincide with the slots in the new slabs. If required, transitions from the pre-cast slabs to existing pavement shall be paved with asphalt.

**E. Placement of Dowel Grout.** Prior to installing dowel grout install foam grout dams at the open end of the joint to be grouted to prevent grout from escaping. Mix grout in strict accordance with the manufacturer's directions and as demonstrated in the trial batching procedure.

**3. CONSTRUCTION DETAILS:** (cont'd)**3.05 INSTALLATION PROCESS:** (cont'd)**E. Placement of Dowel Grout.** (cont'd)

Start installing grout by inserting the grout nozzle into the port of the lowest pocket on the joint. Pump grout into the first port until it comes out of the grout tube. Proceed to next port and repeat the same procedure. Continue to monitor the grout level in previously grouted ports and add as required to keep the grout level even with the top of the slab.

Finish off the top of the grout port with the same finish as the rest of the slab surface. Do not allow traffic on the slab until the grout has reached a minimum strength of 2,500 psi.

**Opening slabs to traffic.** It is highly desirable that the following has occurred before the pre-cast slabs are open to traffic:

- Dowel grout has been installed and has reached a strength of 17 MPa
- Bedding grout has been installed and has reached a strength of 2 MPa

If slabs must be open to traffic before dowel and bedding grouts cannot be installed a minimum of two incompressible shims in each transverse joint to prevent ungrouted slabs from hitting and spalling under traffic conditions. If ungrouted slabs settle or develop edge differentials under traffic conditions that are greater than 6 mm they shall be removed, the subgrade re-graded and the slabs re-set prior to grouting. If the settled slab can not be removed because it is in the middle of a run of new slabs, the surface of the pavement shall be diamond ground until the edge differential is less than the allowable 6 mm.

Once dowel grout has been installed it shall reach a strength of 17 MPa before the slabs are open to traffic.

**F. Sealing of Transverse and Longitudinal Joints.** If panels are to be put in service before the permanent joint seals are installed, the unsealed joints are to be sealed with a silicone caulking material at the top of the slab.

All longitudinal and transverse joints shall be permanently sealed as shown on the contract plans.

**4. METHOD OF MEASUREMENT:**

4.01 Measurement shall be made by square foot.

**5. BASIS OF PAYMENT:**

5.01 The unit price bid per square foot shall include the cost of furnishing all labor, materials, and equipment necessary to satisfactorily complete the work. The price bid shall include, but not limited to the design, fabrication, quality control, transportation, installation and final inspection of the slab units.