# DESIGNER NOTES

*All notes to the designer are highlighted. Please read the notes carefully. This special provision has been developed by MassDOT and shall be used for precast concrete bridge elements. Please only modify content highlighted in yellow. Unhighlighted content shall not be modified.*

*This special provision does not apply to the following elements.*

* *Prestressed bridge elements*
* *Prefabricated bridge units (PBUs)*
* *Precast Deck Panels*

*Separate special provisions for these items are available for download using this link:* <https://www.mass.gov/info-details/bridge-construction-special-provisions-hundredth-anniversary-edition>

* *MSE Walls and other Proprietary Retaining Wall Systems are covered under the Precast Concrete Highway Products special provision.*

*Special provision content highlighted in yellow that may need to be modified includes the following:*

* *Replace the generic Special Provision Heading,* Precast Concrete Bridge Elements*, with the specific item headings that are being used on this project. Example headings: PRECAST ABUTMENT STEM UNITS, PRECAST ABUTMENT FOOTING UNITS, PRECAST APPROACH SLAB UNITS, PRECAST HIGHWAY GUARDRAIL TRANSITIONS, etc. (page 2)*
* *Under* A. General*, fill the blank line with the heading(s) used for the Special Provision Heading. See example headings above (page 2 – General)*
* *Construction Methods – Field Construction: modify this section as appropriate for project (page 4-7).*
* *Delete the entire* COMPENSATION *section when used as part of Item 995. (page 7 – COMPENSATION). However, the Unit of Measurement for a heading for the Item 995. Schedule of Basis for Partial Payment shall be each (EA) and the quantity shall be the number of individual units under that heading to be supplied and assembled into the bridge structure. DO NOT break the precast concrete bridge elements into their constitutive components (e.g. CY of concrete) and lump these quantities with the field installed materials as this creates needless work for the resident engineer to separate them when paying contractors. See Bridge Manual, Part I, Chapter 5 for more information.*
* *Delete* E. Box Culverts, Three-sided Frames and Arches *if the project does not use these precast concrete bridge elements (page 2)*

*General notes for designers:*

* *A pre-production meeting may be required (page 3 – Pre-Production Meeting).*
* *Fabricators may use Self-Consolidating Concrete (SCC) for the concrete mix.*
* *Include steel reinforcement size, grade, and coating on the plans.*
* *Include surface finish on the plans.*
* *Indicate requirements for closure pour concrete on the plans.*

*This Special Provision was revised to be consistent with Materials Specification M4 of Division III of the  2025 Standard Specifications.*

*DELETE ALL DESIGNER NOTES, AND REMOVE HIGHLIGHTING PRIOR TO SUBMITTAL*

## PRECAST CONCRETE BRIDGE ELEMENTS *(replace with item headings)*

### General.

The work under this Heading consists of fabricating, transporting and installing *­­­­­­­­­­­­\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (fill in with item headings)* and includes all necessary labor, materials, and equipment to complete the work as shown on the Plans. The Precast Concrete Bridge Elements shall meet the requirements of Section M4: Cement Concrete and Related Materials.

## MATERIALS

### Materials.

Materials shall conform to M4.09.1 and the following:

Non-Shrink Grout Products M4.04.5

Controlled Low-Strength Material – Structural Non-Excavatable M4.08.0

Welded Steel Wire Fabric M8.01.2

Mechanical Reinforcing Bar Splicer M8.01.9

Lifting Devices PCI MNL-116

Corrugated Metal Pipe AASHTO M 36

#### Vertical Adjustment Assembly.

Vertical Adjustment Assembly details and material requirements shall be as shown on the plans. Alternate devices may be used provided that they are adjustable and can support the anticipated loads. The design of the leveling devices, with necessary calculations, shall be submitted to the Engineer of Record for approval.

#### Threaded Inserts.

Threaded inserts are permissible to facilitate forming the keyway pours. Threaded inserts shall be hot dip galvanized or made of stainless steel. The number of threaded inserts shall be minimized, and the inserts shall not come in contact with the reinforcing steel.

#### Corrugated Metal Pipe.

Corrugated Metal Pipe to be used for forming voids as specified on the plans shall be fabricated from steel and shall have a protective metallic coating of zinc (galvanizing).

## CONSTRUCTION METHODS – PLANT FABRICATION

### Box Culverts, Three-Sided Frames and Arches. *(delete this section if your project does not use these precast concrete bridge elements)*

The Contractor shall submit design computations for the box culvert, rigid frame or arch bridge elements to the Engineer for review and approval. The computations shall be prepared in accordance with the latest AASHTO LRFD Bridge Design Specifications, the MassDOT Bridge Manual (Hundreth Anniversary Edition), and the Plans using English units and HL-93 live loading. The design computations shall consider all Strength, Extreme Event and Service Limit States as are appropriate for each stage of fabrication, shipment, construction, and for the final in-service condition. Design computations and shop drawings shall be prepared and stamped by a Professional Engineer licensed to practice in the Commonwealth of Massachusetts. The shop drawings shall be prepared and submitted in accordance with M4.09.2B.

The frame dimensions provided on the plans are shown to establish the size of the proposed opening. The width and thickness of each frame unit may vary depending upon the manufacturer's specifications provided that the opening size is maintained. The Contractor shall be responsible for modifying the dimensions of the frame bridge elements to compensate for elastic shortening, shrinkage, grade corrections, and other phenomena that make in-process fabricating dimensions different from those shown on the drawings. Approval of the shop drawings shall not relieve the Contractor from responsibility for the correctness of the dimensions shown.

#### Joints.

The precast reinforced concrete three-sided frame shall be produced with grout-filled keyways per the details on the plans, the manufacturer's recommendations, and as approved by the Engineer. The ends shall be manufactured such that when the sections are laid together they will make a continuous line of frames with a smooth interior surface free of appreciable irregularities, and in compliance with the permissible variations.

#### Marking.

The following information shall be clearly marked on the interior of each frame by indentation, waterproof paint, or other approved means:

1. Frame span and rise
2. Date of manufacture and lot number
3. Name and trademark of the manufacturer

### Pre-Production Meeting.

The Contractor shall notify the MassDOT Research and Materials Section to determine if a pre-production meeting will be required to review the specification, shop drawings, curing plan, schedule, and discuss any specific requirements. The meeting shall be held prior to scheduling a MassDOT Inspector (refer to M4.09.4 *Department Acceptance*), and at least seven (7) days prior to the scheduled casting of any Precast Concrete Bridge Element or control section. The Contractor shall schedule the meeting, which shall include representatives of the Fabricator and MassDOT.

### Reinforcement.

The reinforcing bars shall be installed in accordance with Subsection 901.35, including tolerances for cover and horizontal spacing of bars. Components of mechanical reinforcing bar splicers shall be set with the tolerances shown on the plans. The reinforcing bars and mechanical reinforcing bar splicers shall be assembled into a rigid cage that will maintain its shape in the form and which will not allow individual reinforcing bars to move during the placement of concrete. This cage shall be secured in the form so that the clearances to all faces of the concrete, as shown on the plans, shall be maintained.

Where reinforcing bars are to protrude from one Precast Concrete Bridge Element in order to mate with reinforcing bar splicers in a second precast concrete element, the fabricator shall set the reinforcing bars and the reinforcing bar splicers with a template in order to ensure proper fit up within the tolerances specified on the plans.

### Tolerances.

Fabrication shall comply with tolerances specified on the plans. Tolerances for steel reinforcement placement shall be in accordance with Subsection 901.35. In the absence of specifications on the plans, tolerances shall comply with the latest version of the PCI MNL 135, Precast Tolerance Manual.

### Forms.

Concrete shall be cast in rigidly constructed forms, which will maintain the Precast Concrete Bridge Elements within specified tolerances to the shapes, lines and dimensions shown on the approved fabrication drawings. Forms shall be constructed from flat, smooth, non-absorbent material and shall be sufficiently tight to prevent the leakage of the plastic concrete. When wood forms are used, all faces in contact with the concrete shall be laminated or coated with a non-absorbent material. All worn or damaged forms, which cause irregularities on the concrete surface or damage to the concrete during form removal, shall be repaired or replaced before being reused. If threaded inserts are cast into the elements for support of formwork, the inserts shall be recessed a minimum of 1 inch and shall be plugged after use with a grout of the same color as that of the precast cement concrete.

## CONSTRUCTION METHODS – FIELD CONSTRUCTION

*(Delete the Quality Control Plan for Precast Concrete Bridge Element Assembly section and all highlighted references to it if the only precast concrete bridge elements are approach slabs and highway guardrail transitions)*

### General.

All of the Contractor’s field personnel involved in the erection and assembly of the Precast Concrete Bridge Elements shall have knowledge of and follow the approved Erection Procedure and Quality Control Plan for Precast Concrete Bridge Element Assembly.

Prior to installation, the following documentation shall be reviewed and confirmed by the MassDOT Resident Engineer or designee:

1. QC Compressive Strength Test Report Forms attaining Design Strength, f’c for the Precast Concrete Bridge Element’s representative sublot.
2. Certificate of Compliance generated by the Fabricator as described under the Fabricator Quality Control section.
3. QC Inspection Reports signed by the Quality Control Manager.

Field construction staff shall verify that the Resident Engineer has accepted all Precast Concrete Bridge Elements prior to installation.

### Erection Procedure and Quality Control Plan for Precast Concrete Bridge Element Assembly.

Prior to the erection, the Contractor shall submit an Erection Procedure and a Quality Control Plan for Precast Concrete Bridge Element Assembly for approval by the Engineer. This submittal shall include computations and drawings for the transport, hoisting, erection and handling of the Precast Concrete Bridge Elements. The Erection Procedure and Quality Control Plan for Precast Concrete Bridge Element Assembly shall be prepared and stamped by a Professional Engineer registered in the Commonwealth of Massachusetts with working knowledge of the Contractor’s equipment, approved shop drawings, and materials to build the bridge. The Erection Procedure and Quality Control Plan for Precast Concrete Bridge Element Assembly shall, at a minimum, include the following:

#### Erection Procedure

The Erection Procedure shall be prepared to conform to the requirements of 960.61, Design, Fabrication and Erection and the applicable sections in Chapter 8 of the PCI Design Handbook (eighth edition) for handling, erection, and bracing requirements. At a minimum, the Erection Procedure shall provide:

1. Minimum concrete compressive strength for handling the Precast Concrete Bridge Elements.
2. Concrete stresses during handling, transport, and erection.
3. Crane capacities, pick radii, sling geometry, and lifting hardware.
4. Verification that the equipment can handle all pick loads and weights with the required factor of safety.
5. Evaluation of construction sequence and evaluation of any geometric conflicts in the lifting of the Precast Concrete Bridge Elements and setting them as shown on the plans.
6. Design of crane supports including verification of subgrade for support.
7. Location and design of all temporary bracing that will be required during erection.

Non-shrink grout and concrete materials, approved by the Engineer, shall be placed as shown on the plans. Fill joints, keyways, and voids, in strict accordance with the specifications and manufacturer's recommendations and instructions.

For footings, approach slabs and highway guardrail transitions, once these Precast Concrete Bridge Elements have been set to the correct horizontal and vertical alignment, the void between them and the supporting soil shall be filled with Controlled Low-Strength Material – Structural Non-Excavatable to the limits as shown on the plans. Add additional grout ports in the footings to facilitate the bedding process if required.

Except in approach slabs, joints shall be filled flush to the top with non-shrink grout, and any vertical misalignment between adjacent elements shall be feathered out on a slope of 1 to 12.

Curing of grout or concrete shall be performed in strict accordance with the specifications and manufacturer's recommendations. Filling shall not be completed in cold weather when either the ambient temperature or the precast member's temperature is below the manufacturer's recommendation. No localized heating of either the precast members or of the air surrounding the element will be permitted in an attempt to reach application temperatures.

If the joints or voids are not filled within five days after the Precast Bridge Elements are erected, the Contractor shall cover and protect the openings from weather and debris until they are filled.

#### Quality Control Plan for Precast Concrete Bridge Element Assembly

The Quality Control Plan for Precast Concrete Bridge Element Assembly is a document prepared and submitted by the Contractor prior to the start of work which requires the Contractor to identify and detail the sequence of construction in accordance with the project schedule and which clearly identifies all stages of field construction. The assembly procedures for the Precast Concrete Bridge Elements shall be submitted in PDF format on 24”x36” sheets. This document will be treated as a Construction Procedure and will be reviewed by both the Designer and the District Construction Office. The approval of this document will serve as a guideline for setting interim concrete and grout strengths and curing procedures to allow construction to proceed without waiting for the final in-service strengths to be achieved.

The following list details the minimum criteria that should be included in the Quality Control Plan for Precast Concrete Bridge Element Assembly:

1. A detailed schedule showing the sequence of operations that the Contractor will follow. The schedule shall include a timeline for installation of all major elements of the bridge accounting for the installation of temporary works and cure times of grouts or closure pour concrete and other selected materials.
2. Calculations that support the schedule outlined above should be included verifying that the selected materials have adequate interim strength to proceed from one step to another. Final material strengths are not normally required until the bridge is opened to vehicular traffic. The minimum factor of safety of two (2) will be required for the interim strength of grouts and closure pour concrete before construction is allowed to proceed to subsequent steps. The factor of safety is applied to the service loads that are supported by the elements and materials during various stages of construction. For example, if the Contractor calculates that the grout between the precast pier cap and pier wall requires a strength of 100 psi to support the dead load of the beams in the next step, a cylinder break of 200 psi will be required prior to allowing the pier cap to be loaded with the beams. The required strength of materials for subsequent construction stages shall also be calculated and the material strength verified.
3. The Contractor is responsible for determining the center of gravity for all elements. Special care shall be used for unusual elements that are not symmetric. These elements may require special lifting hardware to allow for installation in a plumb or flat position.
4. Plan of the work area, depicting items such as temporary earth support, utilities within the immediate vicinity of the work, drainage structures, etc. The Contractor shall coordinate the various subcontractors that will need to occupy the same area and shall ensure that there are no conflicts. For example, if the Contractor is having different Subcontractors prepare and submit plans for temporary earth support and demolition, and the earth support is required to be installed prior to the demolition, it shall be the Contractor’s responsibility to ensure that the Quality Control Plan for Precast Concrete Bridge Element Assembly submission allows both operations to be performed without field modification.
5. Details of all equipment that shall be employed for the construction of the bridge.
6. Methods of providing temporary support of the elements. Include methods of adjusting and securing the element after placement.
7. Vertical Adjustment Assemblies to be used as a means of setting precast concrete footings to the correct elevations.
8. Procedures for controlling the overall horizontal dimensions and the vertical elevations as each precast concrete bridge element is erected by using the tolerance limits of the joints as detailed on the plans.
9. Methods for curing grout.
10. Proposed methods for installing non-shrink grout and the sequence and equipment for the grouting operation.
11. Methods for sealing the keyways in preparation for filling with non-shrink grout, including the use of backer rods. The Contractor shall not assume that the backer rods will restrain the pressure from the grout in vertical grout joints. Provide additional forming to retain the backer rod.

### Survey and Layout.

Working points, working lines, and benchmark elevations shall be established prior to placement of all elements. The Contractor is responsible for field survey as necessary to complete the work. MassDOT reserves the right to perform additional independent survey. If discrepancies are found, the Contractor may be required to verify previous survey data.

### Preparation of Closure Pours and Grouted Keyways.

Immediately prior to erecting the Precast Concrete Bridge Elements, the closure pours and grouted keyways shall be cleaned at the job site of all dust, dirt, carbonation, laitance, and other potentially detrimental materials which may interfere with the bonding of the closure pour concrete or grout and precast concrete using a high-pressure water blast. Any exposed reinforcing steel in the precast concrete shall be protected from damage during the cleaning of the keyways. Damaged epoxy coating of steel reinforcement shall be repaired, and the reinforcing steel shall be cleaned as directed by the Engineer. The surfaces of the closure pours and grouted keyways shall be wetted so that the surfaces shall have a Saturated Surface Dry (SSD) condition for at least 24 hours prior to the placement of the closure pour concrete.

### Erection.

The elements shall be placed in the sequence and according to the methods outlined in the Erection Procedure and Quality Control Plan for Precast Concrete Bridge Element Assembly. As the erection proceeds, the Contractor shall constantly monitor the assembly to ensure that the precast concrete bridge element is within proper horizontal and vertical location and tolerances prior to releasing it from the crane and setting the next unit. The Contractor may use shims to maintain proper setting tolerances.

The concrete elements shall be lifted only by the lifting devices, and the utmost care shall be taken to prevent distortion of the elements during handling, transportation or storage.

This approval will be contingent on the Contractor demonstrating by calculations, prepared by a Professional Engineer registered in Massachusetts, that the elements will not be damaged by the non-vertical lifting force and by documentation that the capacity of the lifting devices is adequate for the non-vertical lifting force.

After all Precast Concrete Bridge Elements have been placed, the actual overall dimensions of the structure both horizontal and vertical, as laid out shall not deviate from the nominal dimensions shown on the plans beyond a tolerance of +0 inches and -1 inches. Once the layout of Precast Concrete Bridge Elements has been accepted by the Engineer, the Contractor shall cut all lifting devices off below the surfaces of the elements.

### Box Culverts, Three-Sided Frames and Arches. *(delete this section if your project does not use these precast concrete bridge elements)*

Backfilling operations shall not begin until the following checks have been made:

1. The frame to footing key joints are grouted as shown on the plans;
2. The joints between exterior frame bridge elements and wingwall stems are complete as shown on the plans;
3. All joint seals are properly placed.

Backfill shall be paid for under separate items. The backfilling procedures shall be in accordance with Sections 120, 150, and 170 of the Standard Specifications and Supplemental Specifications modified as follows:

1. Fill shall be placed and compacted in layers not exceeding one foot in depth;
2. Dumping of fill shall not be allowed any nearer to the structure than 3.25 feet from a vertical plane extending from the back of the footing;
3. Backfill shall be placed as symmetrically as possible around the structure with differential depths of backfill on each side of the structure not exceeding 1.5 feet with respect to each other;
4. Compaction shall be achieved using hand compaction equipment for all fill within one foot of the structure;
5. The bare structure shall not be crossed by any equipment heavier than that specified by the frame manufacturer. All damage resulting from equipment damage shall be rectified to the satisfaction of the Engineer at no cost to the Department;
6. Construction equipment will not be permitted atop an uncompleted structure;
7. Construction equipment whose weight exceeds the design capacity shall not be permitted atop the completed structure under any circumstances;
8. The use of vibratory rollers for compaction purposes will not be permitted.

A representative of the manufacturer shall be on site at the commencement of the installation, at no cost to the Department, to assist the Contractor. The representative shall offer advisory assistance only and shall not supplant the Contractor's representative, or the Engineer.

### Filling of Blockouts for Lifting Devices and Threaded inserts.

If the blockouts in the Precast Concrete Bridge Elements where the lifting devices were located will be exposed and visible after assembly is complete, the Contractor shall fill these blockouts with Mortar (M4.04.5).

After the formwork has been removed, all threaded inserts that have been cast into the precast concrete bridge deck for support of the formwork shall be filled with a grout of the same color as that of the precast concrete.

## COMPENSATION

**A. Basis of Payment.**

The furnishing, fabricating, and erecting of all Precast Concrete Bridge Elements for the structure shall be paid for at the contract unit price EACH, complete in place.

**B. Payment Items.**

(Precast Bridge Element Heading 1) EA

(Precast Bridge Element Heading 2) EA

(Precast Bridge Element Heading 3) EA

(Precast Bridge Element Heading 4) EA