Iowa Department of Transportation

SPECIAL PROVISIONS
FOR
PRECAST CONCRETE SUBSTRUCTURE ELEMENTS

Pottawattamie County
BRF-092-1(64)--38-78

Effective Date
December 16, 2014

THE STANDARD SPECIFICATIONS, SERIES 2012, ARE AMENDED BY THE FOLLOWING MODIFICATIONS AND ADDITIONS. THESE ARE SPECIAL PROVISIONS AND THEY SHALL PREVAIL OVER THOSE PUBLISHED IN THE STANDARD SPECIFICATIONS.

120244.01 DESCRIPTION.

A. Furnish, erect, and install precast concrete substructure elements including Bridge Abutment Footings and Bridge Pier Caps, herein referred to as precast element(s). This work includes all necessary materials and equipment to complete the work as shown in the contract documents. Use of alternate cast-in-place concrete will be allowed as shown in the design plans.

B. Apply Sections 2403, 2404, 2407, and Division 41 of the Standard Specifications with the following modifications.

C. Submittals.
Submittals shall be provided to the Office of Bridges and Structures in electronic format, in accordance with Article 1105.03, F of the Standard Specifications.

The submittals requiring written approval from the Engineer are as follows:

1. Assembly Plan.

a. Prepare the Assembly Plan under the seal of a Professional Engineer licensed in the State of Iowa. Submit the Assembly Plan for approval 28 days before erection of modules.

b. The Assembly Plan shall pertain to construction operations including handling, lifting, placing, supporting and securing the precast elements. The Assembly Plan shall include, but not necessarily be limited to, the following:

- A work area plan, depicting temporary and permanent structures, haul roads, utilities and other temporary or permanent site features relevant to precast substructure assembly.
- Details of all equipment to be used to lift precast elements, including cranes, excavators, lifting slings, sling hooks, jacks, etc. Include crane locations, operation radii, lifting calculations, etc.

- Details of lifting devices and/or attachment points, with computations to demonstrate that all lifting devices have adequate capacity to resist lifting stresses.
- Construction load analyses, including computations to indicate the magnitude of stress in the precast concrete components during construction. The Contractor shall be responsible for demonstrating that all components to be lifted have adequate capacity to resist lifting stresses, and the erection equipment has adequate capacity for the work to be performed.
- Detailed sequence of construction and a CPM schedule for all operations. Account for setting and cure time for substructure components, pile pockets, and anchor bolts.
- Procedures for controlling tolerance of pile driving operations and/or performing minor adjustments to position of top of pile after driving. Contractor shall be responsible for proper alignment of supporting driven steel bearing piling with the formed pile pocket voids in the precast elements. Minor adjustments to top of pile position may be performed by jacking or other means approved by the Engineer. Adjustment methods that damage or permanently deform the pile or pile encasement shall not be permitted.
- Methods and details for temporary support of the precast substructure elements. Include methods of adjusting, bracing and securing the precast elements after placement. Field welding of brackets to the steel bearing piling shall not be permitted as a means of temporary support of the precast substructure elements. Drilling of holes through pile flanges shall not be permitted unless design calculations are provided demonstrating that location, size and placement of drilled holes will not impact the ability of the steel bearing piling to resist the design loads during construction or in service, subject to the approval of the Engineer. Contractor shall be responsible for the stability of the substructure during all construction operations.
- Procedures for controlling horizontal and vertical tolerance limits. Include details of any alignment brackets, jigs, templates, shims, leveling pads, etc.
- Methods and procedures for removing and patching lifting devices, attachment points, leveling devices and other inserts/blockouts, as applicable.

2. Shop Drawings for Precast Elements.

a. Prepare shop drawings under the seal of a Professional Engineer licensed in the State of Iowa. Submit the shop drawings for approval 28 days before fabrication of precast elements.

b. The shop drawings shall include, but not necessarily be limited to, the following:

- Show minimum compressive strength attained for precast elements prior to handling.
- Show all lifting devices and/or attachment points on the shop drawings for Engineer's review and approval. Provide design details of lifting devices and/or attachment points demonstrating sufficient capacity to accommodate proposed lifting procedures. Provide details of any auxiliary precast concrete reinforcing required for lifting operations. Provide removal details for lifting devices and/or attachment points that interfere with future construction activities. Provide patching details for lifting device and/or attachment point pockets/blockouts within reinforced concrete, as applicable.
- Provide details of any leveling and adjustment hardware.

c. Do not order materials or begin work until receiving final approval of the shop drawings. The Contracting Authority will reject any precast element fabricated before receiving written approval, or any modules that deviate from the approved drawings. The Contractor shall be responsible for costs incurred due to faulty detailing or fabrication.

3. Concrete Requirements.

Submit concrete mix designs to the Engineer for approval.

4. Defects and Breakage of Precast Elements.

Submit proposed written repair procedures for approval.

120244.02 MATERIALS.

A. Concrete.

1. Fabrication Plant Casting.
Concrete materials for precast elements constructed at preapproved fabrication plant shall be in accordance with Section 2407 of the Standard Specifications, with a minimum 28-day compressive strength of 5.0 KSI. Concrete mix design must be approved by the District Materials Engineer prior to concrete placement.

2. Alternate Site Casting.
Concrete materials for precast elements constructed in accordance with "Alternate Site Casting Notes" in design plans shall conform to Developmental Specifications for High Performance Concrete for Structues, with a minimum 28-day compressive strength of 5.0 KSI. Concrete mix design must be approved by the District Materials Engineer prior to concrete placement.

3. Precast Substructure Pile Pocket Fill.

a. High early strength self-consolidating concrete mix designs shall be approved by the District Materials Engineer. Self-consolidating concrete shall comply with Materials I.M. 445, Appendix D.

b. High early strength self-consolidating concrete shall include the following properties:

- Maximum top size aggregate shall be limited to 1/2inch.
- Minimum 6-hour compressive strength shall be 2500 psi.
- Minimum 7-day compressive strength shall be 4000 psi.
- Minimum 28-day compressive strength shall be 5000 psi.
- Mix shall contain shrinkage compensating additives such that there will be no separation of pile pocket fill concrete from the adjacent precast elements. Shrinkage-compensative additive shall produce expansion in the high early strength concrete of no more than 3 %.

B. Reinforcing Steel.

1. Conform to Section 2404 of the Standard Specifications.

2. Use non-coated or epoxy coated reinforcing steel, as indicated in the design plans, for precast bridge abutment footing(s) and precast bridge pier cap(s).

3. Use reinforcing conforming to ASTM A 615 for precast bridge abutment footing(s) and precast bridge pier cap(s).

C. Corrugated Metal Pipe.
Use corrugated metal pipe to form pile pockets in precast substructure elements, of the diameter and length indicated in the design plans. Corrugated metal pipe shall be galvanized, Type 1, 16 gage, in accordance with Section 4141 of the Standard Specifications and Materials I.M. 441.

120244.03 CONSTRUCTION.

A. Quality Assurance.

1. Precast elements shall be provided by a Fabricator with experience in the manufacture of similar products, satisfactory to the Contracting Authority. Fabricator shall provide documentation demonstrating adequate staff, experience, equipment and quality control. Precast elements shall be constructed by a preapproved fabricator at a preapproved facility, in accordance with Materials I.M. 445, except as permitted in the "Alternate Site Casting Notes" in the design plans.

2. Each precast element shall be permanently marked with date of fabrication, supplier identification and unique component identification. Markings shall be readily visible for purposes of inspection and erection.

3. Precast elements shall be prevented from cracking, damage, or creep-induced deformation during storage and handling.

4. Repair defects and/or damage to precast elements in accordance with the following:
- Notify Engineer of suspected defects and/or damage. Precast elements that exhibit defects and/or damage may be subject to review or rejection by the Engineer.
- Submit repair procedures to Engineer for review and approval. Do not proceed with repair without written approval from the Engineer.
- Concrete repair work must reestablish the element's structural integrity, durability and aesthetics to the satisfaction of the Engineer.
- Determine cause of defects/damage and establish corrective action plan to prevent similar repetitive defects/damage. Repetitive defects/damage may be grounds for rejection of precast substructure elements.

5. Precast elements may be rejected for any of the following reasons:
- Fabrication not in conformance with the contract documents.
- Dimensions not within the allowable tolerances specified in the contract documents.
- Defects indicating concrete proportioning, placement and/or consolidation not in conformance with the contract documents.
- Concrete breakage, full-depth concrete cracking, extensive partial depth concrete cracking, or other damage determined to be significant by the Engineer.
- Other material, quality or condition concerns determined to be significant by the Engineer.

6. The Fabricator shall document all test results for precast element concrete. The quality control file shall contain at least the following information:
- Element identification
- Date and time of concrete placement
- Concrete cylinder test results
- Quantity of used concrete and the batch printout
- Form-stripping date and repairs if applicable
- Location/number of blockouts, inserts and lifting devices, as applicable
- Temperature and moisture conditions during curing period

B. Fabrication.

1. Precast element fabrication procedures shall conform to one of the following:
- **a.** Fabrication at preapproved casting plant, in accordance with Section 2507 of the Standard Specifications and Materials I.M. 445.
- **b.** Fabrication at alternate site, in accordance with "Alternate Site Casting Notes" in the design plans.

2. The Engineer shall be provided with notice 14 days prior to the anticipated date of shipping of precast elements to the project site (for plant-cast elements) or placement of concrete for precast elements (for alternate site-cast elements), to allow coordination of inspection and testing. The Contractor shall follow up with a confirmation notice to the Engineer 2 days prior to the scheduled date for these activities. Concrete placement for alternate site-cast elements shall not proceed until Engineer has inspected and approved the deck forming and reinforcing steel placement.

3. Forms for precast elements shall not be removed until the applicable concrete strength, age and curing requirements are met, as set forth by the contract documents.

4. Continuously wet cure the precast elements for 7 days commencing immediately after final finishing, with all exposed surfaces covered. The precast elements shall have a minimum cure of 14 days prior to erection.

5. Supply applicable test data for the fresh concrete for concrete slump, air entrainment, unit weight, and as required by the contract documents. Provide compressive strength testing of the hardened concrete at 7, 14, and 28 days, or until design strength is achieved.

6. Finish the precast elements according to Section 2407 of the Standard Specifications. The top surface of precast elements shall receive a smooth, troweled finish.

C. Handling, Storing, and Transportation.

1. Handling and Storing.

- **a.** Handling and erection bracing shall be the responsibility of the Contractor and shall be in accordance with Chapter 5 of the PCI Design Handbook.
- **b.** Precast elements damaged during handling and/or storage shall be repaired or replaced as described herein and as directed by the Engineer, at no cost to the Contract Authority.
- **c.** Precast elements shall be lifted at the designated points by approved lifting devices properly attached to the element, utilizing proper hoisting procedures. The Contractor is responsible for design of the lifting devices and all necessary precast concrete modifications to accommodate handling stresses in the precast elements.
- **d.** Storage areas shall be smooth and sufficiently rigid to prevent damage due to differential settlement.
- **e.** Precast elements shall be protected from freezing temperatures (32°F) for 5 days or until precast concrete attains the design compressive strength indicated in the contract documents, whichever comes first. Removal of concrete protection shall not be permitted at any time before the elements attain the specified compressive strength when the surrounding air temperature is below 20°F.
- **f.** The precast elements shall not be subject to damaging torsional, dynamic, or impact stresses at any point during handling, storage, transportation, and/or erection.

2. Transportation.

- **a.** Precast elements shall not be transported from the casting site until the precast concrete has reached a minimum age of 7 days and the concrete attains the minimum 28 day compressive strength specified in the contract documents, as verified by test cylinders cured in accordance with AASHTO T 23.
- **b.** Precast elements may be loaded on a trailer that is capable of supporting the element during transport without inducing axial, torsional or dynamic stresses to the module. Shock-absorbing cushioning material shall be provided at all bearing points during transportation. Tie-down straps or other means of securing shall be positioned only at designated locations of sufficient bracing and/or blocking.
- **c.** Material, quality and condition of the precast elements will be inspected after transport to the project site. This inspection and any previous inspection(s) will constitute only partial acceptance of the precast elements.

D. General Procedure for Installation of Precast Substructure Elements.

1. Review the approved Assembly Plan. Sequence of construction shall be as shown in the Assembly Plan and as approved by the Engineer. If changes are warranted due to varying site conditions, revise the Assembly Plan and resubmit for review and approval.

2. Establish working points, working lines, and benchmark elevations prior to placement of all precast elements.

3. Check the condition of the receiving bonding/bearing surface prior to placement and/or connection of precast elements. Take necessary measures to remove dust, rust, debris, etc. as necessary to provide proper support of precast element and satisfactory connection to structure.

4. Lift precast substructure elements in accordance with the approved Assembly Plan using the lifting devices and/or attachment points detailed in the approved shop drawings. Aligning the pile pocket voids in the precast elements over the supporting steel bearing piling. The Contractor shall be permitted to make minor adjustments to position of the tops of the steel bearing piling, in accordance with the approved Assembly Plan. Contractor is advised to keep the precast substructure element rigged and supported by the crane(s) until final placement and adjustment is completed, as described herein.

5. Support the precast substructure elements in position in accordance with the approved Assembly Plan.
   a. **Bridge Abutment Footing.**
      Precast bridge abutment footings shall be supported on a level and sufficiently firm prepared bearing pad, unless other means of support are approved in the Assembly Plan. Support system for bridge abutment footing shall accommodate some approved method of adjusting vertical and horizontal position of the precast element to within acceptable tolerances of intended design position.
   b. **Bridge Pier Cap.**
      Precast bridge pier caps shall be supported by the steel bearing piling that will become permanently connected to the pier cap as a part of the design. Methods for attaching to the steel bearing piling shall be as detailed and as approved in the Assembly Plan. Support system for bridge pier cap shall accommodate some approved method of adjusting vertical and horizontal position of the precast element to within acceptable tolerances of intended design position.

6. Survey the position and elevation of the precast substructure element as placed and supported. Utilize adjustment devices (jigs, templates, shims, leveling devices, etc.) as detailed in the approved Assembly Plan, as required to establish the design horizontal and vertical position of the precast substructure element.

7. Install temporary bracing as specified and as required in the Assembly Plan. Stability of the precast substructure element and comprehensive substructure system shall be the responsibility of the Contractor for the duration of construction.

8. Ensure that piles extend into the pile pockets at least the minimum embedment length specified in the design plans. When required by the design plans, position pile reinforcing bars as specified. Ensure pile pocket voids are properly and sufficiently formed for placement of self-consolidating concrete materials.

9. Place approved self-consolidating high early strength concrete within the pile pocket voids. Finish the top of the pile pocket fill with a smooth, troweled finish. Corrugated metal pipe for pile pocket formed blockouts shall be prevented from extending above the finished surface of the precast concrete portion of the substructure element. Pile pocket fill for bridge abutment footings shall be allowed to flow partially under the precast element (the entire underside of the precast footing need not be filled). Pile pocket fill for bridge pier caps shall be formed flush with the bottom of the cap.

10. Ensure that designated bearing locations for future placement of superstructure components are level and true within acceptable construction tolerances, allowing for proper performance

of neoprene leveling pads and laminated neoprene bearings in accordance with the Manufacturer's recommendations.

11. Temporary supports and/or bracing required by the Assembly Plan for the purposes of precast substructure element placement shall remain in place until self-consolidating concrete used for permanent attachment of the component has achieved a minimum design strength of 4000 psi.

120244.04 METHOD OF MEASUREMENT.

A. Bridge Abutment Footing.
The quantity by count of Bridge Abutment Footings will be the plan quantity.

B. Bridge Pier Cap.
The quantity by count of Bridge Pier Caps will be the plan quantity.

120244.05 BASIS OF PAYMENT.

A. Bridge Abutment Footing.
Payment will be full compensation for the manufacturing, furnishing and placement of each Bridge Abutment Footing, including high performance structural concrete, self-consolidating (high early strength) structural concrete, non-coated reinforcing steel, epoxy coated reinforcing steel, epoxy coated mechanical splice assemblies, galvanized corrugated metal pipe, lifting devices, prepared bearing pad, leveling devices, porous backfill, floodable backfill (includes water for flooding), geotextile fabric for abutment backfill, and subdrains.

B. Bridge Pier Cap.
Payment will be full compensation for the manufacturing, furnishing and placement of each Bridge Pier Cap, including high performance structural concrete, self-consolidating (high early strength) structural concrete, non-coated reinforcing steel, epoxy coated reinforcing steel, galvanized corrugated metal pipe, lifting devices, leveling devices, anchor bolt assemblies, and anchor bolt grout materials.