



**ARIZONA DEPARTMENT OF TRANSPORTATION \* MATERIALS GROUP**

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**POLICY AND PROCEDURE DIRECTIVE**

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TO: ALL MANUAL HOLDERS	PPD NO. 22
SUBJECT:  QUALIFICATION AND SPECIFICATION REQUIREMENTS FOR THE MANUFACTURING OF PRECAST/PRESTRESS CONCRETE BRIDGE MEMBERS	EFFECTIVE DATE:  May 3, 2011

**1. GENERAL**

1.1 This Policy and Procedure Directive outlines the requirements for the manufacturing of Precast/Prestress concrete structural bridge members for the use on ADOT projects. These requirements are used in conjunction with, and in addition to, ADOT Specifications.

1.2 The manufacturer must designate in writing, a competent English-speaking superintendent or foreman(s) responsible for the manufacturing of bridge members during all phases of construction. The designee(s) must be experienced with the work being performed and capable of reading and understanding all pertinent contract documents. The manufacturer must ensure that the designee(s) is available at all times.

1.3 The manufacturer shall give the constant attention necessary to facilitate the production of concrete bridge members, and shall cooperate with the Structural Materials Testing Section inspectors at all times. All bridge members that do not conform to the requirements of the contract and approved drawings will be considered unacceptable.

1.4 ADOT Materials Group, Structural Materials Testing Section, will maintain an "Approved Precast/Prestress Manufacturers List" on its website. The approved manufacturer's name, address, and phone number will be included on that list. Only the manufacturers who are on the "Approved Precast/Prestress Manufacturers List" will be allowed to manufacture bridge members for ADOT construction projects.

**2. SAFETY**

2.1 Working in a Precast/Prestress manufacturing plant is inherently very hazardous because of the large tensioning forces, debris, heavy equipment, etc., necessary to the operations. The inspector(s) shall comply with all safety requirements at each plant, and shall take any steps they deem necessary for safety. All manufacturers shall comply with current OSHA requirements.

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### **3. MATERIALS**

3.1 All materials used in the manufacturing of Precast/Prestress bridge members shall meet the requirements shown on the approved shop drawings and shall conform to ADOT Specifications and other governing documents.

3.2 At no time will materials with chlorides be allowed to be incorporated into any Precast/Prestress bridge member.

3.3 A Certificate of Compliance or a Certificate of Analysis conforming to the requirements of Subsection 106.05 of the ADOT Specifications shall be submitted for all specified and applicable materials subject to the approved shop drawings prior to their incorporation into a Precast/Prestress bridge member. Such materials include, but are not limited to: reinforcing steel, prestress cable strand, bearing plates, embed materials, inserts, anchor plates, epoxy coated or galvanized materials, and mechanical lifting devices. Materials that fail to have the required certification will not be allowed.

3.4 All welding shall be performed by a welder certified for the type of welding required. The manufacturer shall submit the welding certifications to the Structural Materials Testing Section upon request.

### **4. PLANT AND PERSONNEL CERTIFICATIONS**

4.1 All Precast/Prestress concrete structural bridge members shall be manufactured in a plant certified by the Precast/Prestress Concrete Institute (PCI). The manufacturer shall be, at a minimum, certified for Product Group "B"- Bridge Products, Category B4.

4.2 Erection of Precast/Prestress bridge members shall be performed by a contractor, manufacturing plant, or erector which has an individual on staff who has attended and received a "Certification of Completion" from the PCI "Industry Erection Standards School" or is certified by PCI as a "Certified Field Auditor".

4.3 All plant and personnel certifications must be maintained throughout the production of all Precast/Prestress bridge members. Production will immediately stop if at any time the manufacturer's certification is revoked, regardless of the status of completion of contracted work. Production will not be allowed until certification has been re-established.

4.4 The manufacturer shall supply the Department with documentation of Plant Certifications and Personnel Certifications, and a copy of the plant's Quality Systems Manual (QSM). The manufacturer must provide the Department all documentation of any changes to the QSM or certified personnel within ten days.

4.5 The manufacturer must have a QC Manager or Engineer, who is certified by PCI as QC Level II or higher.

## 5. PLANT QUALITY CONTROL

### 5.1 Fabrication Details

5.1.1 The manufacturer shall submit fabrication details along with the concrete mix design(s) to the Structural Materials Testing Section for approval.

5.1.2 The fabrication details shall contain at the minimum:

- a) Concrete strength requirements.
- b) Method of concrete placement.
- c) Method of concrete vibration.
- d) Method of curing.
- e) Tensioning method and calculations, including stressing jacks and pumps, gauge pressure values and theoretical elongations.
- f) De-tensioning method.
- g) Concrete finish requirements and method of finishing.
- h) Storage method.

5.1.3 When Requests for Information (RFI) are submitted to the ADOT Engineer, a copy of the RFI shall also be submitted to the Structural Materials Testing Section for informational purposes only.

### 5.2 Tensioning Operations

5.2.1 Stressing operations shall comply with Section 602 of the ADOT Specifications. Stressing will be accomplished by stressing single strands or by multiple cable tensioning. Stressing gauges, jacks, and other related equipment shall be calibrated annually, or more frequently if necessary. The manufacturer shall supply calibration reports when requested by the Department.

5.2.2 No more than one splice chuck may be used on a cable strand. Splice chucks will not be allowed within the member. When multiple cable tensioning is employed, the use of splice chucks shall be limited to ten percent of the cable strand to be tensioned or all cable strands to be tensioned.

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5.2.3 Each plant shall be required to supply load cells to measure force on each production bed as directed by the Department. This may include load cells placed on cable strand between chucks and the dead men (anchorage bulkheads) on both straight and harped strands, at both the live and dead ends. Load cells shall be used as necessary to monitor the gauge pressure during stressing operations, abutment rotation, and bed shortening. Load cells must be calibrated annually, or more frequently if necessary.

NOTE: The intent is not to place load cells between the stressing chucks and the anchorage on an every day basis unless loss of force is suspected, but rather to verify stressing forces for each production bed. When all loses have been verified for each production bed and stressing values are within tolerances, load cells will be used daily as needed to monitor stressing forces of each stressing jack. Periodically, load cells will be placed between strand chucks and anchorage as verification.

5.2.4 All cable strands must be placed within 1/4 inch of the strand locations indicated on the approved shop drawings. All hold downs and cable locations shall be clearly marked on the approved drawings.

5.2.5 At no time shall a cable strand which has been previously stressed and used outside a Precast/Prestress product or member be used at a later time within another Precast/Prestress member.

5.2.6 No more than one broken wire will be allowed in a single strand.

5.2.7 Elongations will be measured to the nearest 1/8 inch.

5.2.8 Cable strand shall be free of deleterious materials such as release agents, oils, grease, dirt, mud, or other foreign matters. Any cable found in such condition will be cleaned or removed, based on the inspector's observations.

5.2.9 Harped strand shall be tensioned from both the live and dead ends, except for the following:

- a) If one member is to be produced.
- b) If multiple strand tensioning is used and cables are vertically displaced into the correct height. Load cells must be used to verify the force.
- c) If load cell verifies force after stressing from the live end.

5.2.10 At no time will stressing operations exceed 80% of minimum ultimate tensile strength for the cable strand as listed in approved drawings or Section 602 of the ADOT Specifications.

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5.2.11 Initial stressing force will not exceed 25% of the final force.

5.2.12 De-tensioning of cables will not be performed until concrete test cylinders indicate release strength has been attained. De-tensioning will be performed in a manner that keeps the prestressing forces nearly symmetrical about the vertical axis of the product and:

- a) Minimizes shock to the member.
- b) Minimizes movement against restrained items such as forms, inserts and hold downs.
- c) Prevents overstressing or damaging members.
- d) Prevents shock and thermo-cracking that may be caused by using accelerated curing such as steam or radiant heat.
- e) De-tensioning must be performed immediately after curing and the removal of forms, curing blankets, tarps, or plastic coverings while the concrete is warm and moist.

### 5.3 Concrete Operations

5.3.1 Concrete mix designs shall be submitted and comply with the requirements of ADOT Materials Policy and Procedure Directive No. 15 "Submittal and Approval of Portland Cement Concrete Mix Designs", Section 1006 of the ADOT Specifications, and the requirements listed herein. Calibration reports for batch plants scales and measuring devices shall be supplied to ADOT when requested.

5.3.2 All concrete used in the production of Precast/Prestress bridge members at the manufacturer's plant or purchased from a Ready Mix supplier shall be batched with load cell indicating devices providing a digital readout and printed weights. Printed copies must be available when requested by ADOT.

5.3.3 The rate of concrete placement and consolidation shall be such that the formation of cold joints within monolithic sections of any bridge member will not occur, but at no time shall concrete placement be less than 25 cubic yards per hour.

5.3.4 Accelerated curing shall not commence until one hour after initial set or three hours after placement of concrete, whichever is longer. Initial set will be determined in accordance with AASHTO T197 and the results submitted with each mix design.

5.3.5 Concrete test cylinders shall be cured with, and in the same manner, as the bridge member being manufactured.

5.3.6 The concrete temperature during accelerated curing shall not exceed 170 degrees F. The manufacturer shall have a temperature measuring device(s) that allows the

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Department to monitor the concrete curing temperature at all times. A temperature measuring device shall be placed in each member. The location of each temperature measuring device will be chosen by the Department. The enclosure around each bridge member shall be adequate to ensure a consistent concrete curing temperature. The difference in the concrete curing temperature at the ends of each bridge member shall be no more than 20 degrees F. When box girders or voided slab lengths are less than 60 feet, the concrete curing temperature will be measured on every other bridge member. The manufacturer shall supply a report of the concrete curing temperatures for each concrete casting.

NOTE: It is intended that the curing enclosure procedure(s) be established such that the difference in the concrete curing temperature at the ends of each bridge member is no more than 20 degrees F. Once the curing enclosure procedure is established, the concrete curing temperature will be monitored at one location for each bridge member per casting, with the concrete curing temperature at the end of each bridge member being verified periodically.

5.3.7 When the ambient temperature falls below 50 degrees F, steam or radiant heat may be used to keep the enclosure at a temperature of not more than 90 degrees F until the accelerated curing period begins.

5.3.8 When ready mix trucks are used to mix concrete, the truck must be certified per ADOT Materials Policy and Procedure Directive No. 7, "Inspection of Concrete Batch Plants and Concrete Mixers Trucks".

5.3.9 When a concrete mix contains "Silica Fume", a curing plan must be submitted for approval.

5.3.10 When concrete placement is interrupted by rain, the forms shall be covered with tarps or plastic. If it is determined that concrete placement can proceed during rain, tarps or plastic shall be used to cover the forms ahead of and behind the concrete placement.

5.3.11 Self Consolidating Concrete (SCC)

5.3.11.1 Concrete must be able to flow under its own weight and completely fill the formwork, even in the presence of dense reinforcement, without the need of any vibration, while maintaining homogeneity. Placement is to be accomplished in one lift, with the placement equipment within 15 feet of the rolling edge that the SCC creates.

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5.3.11.2 Trial mixes will be observed by an ADOT representative. Trial mixes may include an inverted slump spread test, L-box, J-box, J-ring, Column Segregation test, or other tests as deemed necessary by the Department for the concrete mix approval. In addition the following is required:

- a) All admixtures must be on the ADOT Approved Products List (APL).
- b) Each mix will include a spread range of  $\pm 3$ ".
- c) The use of a Viscosity Modifying Agent (VMA) will be identified for each mix.
- d) The Visual Stability Index (VSI) shall be determined for each member being produced.

5.3.11.3 Concrete strength test cylinders shall be fabricated in the following manner:

- a) The concrete strength test cylinders will be fabricated in accordance with AASHTO T23 except the molds shall be filled with concrete in one lift to the rim. The concrete shall not be dropped into the mold from more than six inches above the rim. The rim shall be struck off and the lid placed on the test mold.

5.3.11.4 Concrete unit weight and air content tests shall be performed in the following manner:

- a) The unit weight and air content tests shall be performed in accordance with AASHTO T121 and AASHTO T152, respectively, except the unit weight/air content bowl shall be filled in one lift to the rim. The concrete shall not be dropped into the test bowl from more than six inches above the rim. The rim shall be struck off and the testing completed.

#### 5.4 Plant Operations

5.4.1 The manufacturer shall give the Structural Materials Testing Section a minimum of one week written notification before production may begin. The manufacturer shall supply a written schedule of the date and time for the start of production along with scheduled times for inspection and a pour schedule with the product ID or marked number for casting. It may be advisable to have a meeting between the manufacturer's QC Manager, Production Manager, and Structural Materials Testing Section personnel to discuss scheduling and potential issues regarding the bridge members to be manufactured.

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5.4.2 The manufacturer shall give a minimum of one week written notice to the Structural Materials Testing Section prior to delivery of bridge members for final inspection and approval.

5.4.3 When lifting Precast/Prestress bridge members from the production bed, setting in storage, loading for delivery, or erecting bridge members at the project, each bridge member will be lifted from the lifting points in a manner that will not cause structural damage to the bridge member due to stresses, torsion, or other forces.

5.4.4 Precast/Prestress members shall be stored on suitable supports placed on level, well compacted material with adequate drainage. Bridge members shall be stored in a manner that will prevent sweeps or damage. When requested by the Department, the manufacturer shall re-set any bridge member that is not level.

5.4.4.1 Unless bridge members have been preapproved, they must be stored in a manner that allows the inspector full access around each member to perform inspections.

5.4.5 When Precast/Prestress bridge members are to be stored for extended periods, the manufacturer shall coordinate with the general contractor to address any potential camber issues. The Structural Materials Testing Section shall be given written notification of precautions taken.

5.4.6 All minor repairs, such as bottom corner spalls and hold-down holes, shall be made with a "High Strength, Non-Shrink" grout which is listed on the Department's APL. Prior to patching, hold-down holes must be cleaned of deleterious materials, grease, oil, and laitance. All repairs must match the color of the concrete being repaired. Patching materials used shall be free of chlorides and meet or exceed the 28-day concrete strength requirement(s) shown on the approved shop drawings. Cracks at the end of girders shall be pressure injected with an epoxy which is listed on the APL.

5.4.7 All major repairs will require the submittal of a repair procedure for review and approval. Examples of a major repair are: exposed cable strand, concrete voids, missing inserts or pipes, and required projected strand that has been cut off. The manufacturer shall notify the Department immediately of these or other defects before submitting a repair procedure. All repairs must match the color of the concrete being repaired. Patching materials used shall be free of chlorides and meet or exceed the 28-day concrete strength requirement(s) shown on the approved shop drawings.



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5.4.8 Within one week after the production of a bridge member, the manufacturer shall submit a post-pour checklist report to the Structural Materials Testing Section. All dimensions shall meet the requirements given in Subsection 601-4.02 of the ADOT Specifications.

5.4.8.1 The following items shall be listed in the checklist report:

- a) Lengths.
- b) Widths.
- c) Heights.
- d) Camber (camber must be measured within twenty-four hours after de-tensioning).
- e) Sweeps.
- f) Insert and imbed locations.
- g) Projected strand locations.
- h) Lifting device locations.
- i) Damage requiring a repair procedure submittal.
- j) Patched hold-down holes.

## **6. STRUCTURAL MATERIALS TESTING SECTION RESPONSIBILITIES**

6.1 The Structural Materials Testing Section will review all Precast/Prestress concrete mix designs and fabrication details. Upon review and approval, Structural Materials Testing Section will forward a copy of the approved mix design and fabrication details to the manufacturer and the construction project office.

6.2 The Structural Materials Testing Section will sample and test reinforcing steel, prestress cable strand, aggregates, concrete (for release strength and 28-day strength), and other materials as necessary.

6.3 The Structural Materials Testing Section will perform the inspection of tensioning and de-tensioning operations, reinforcing steel placement, void placement, insert and imbed placement, and concrete placement.

6.4 The Structural Materials Testing Section will approve, for delivery, all bridge members which meet the Specifications. All bridge members approved will be stenciled "ADOT".

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**7. PROJECT RESPONSIBILITIES**

7.1 The project will supply the Structural Materials Testing Section with a set of the approved shop drawings. The size of the drawings shall be 22" x 34".

7.2 The project will verify with the Structural Materials Testing Section, the quantity of bridge members that have been produced for partial payment.

7.3 The project will notify Structural Materials Testing Section of any RFI's or changes to the approved drawings.



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