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| REVIEW OF NEW SPECIFICATION OR SPECIFICATION CHANGE  | **Log No.: 618-1** |
| **Specification Section No.:** 618 | **Item:** Prestressed Concrete |
| **Originating Office:** Project Support | **By:** Kevin Howland |
| **Date Sent For Review:** November 9, 2018 | **Date Comments Due:** December 7, 2018 |
| Submit response to: Andrew Pihaly, Specifications Engineer, 3rd floor, CDOT HQ |
| **Vote****Y/N** | **Concurrent Reviews – Others Commenting** | The attached Draft Specification is submitted for your review and comments. If not returned by Date Comments Due, the draft specification will be considered to be approved unless the Standards and Specifications Unit of the Project Development Branch [(303) 757-9474, (303) 757-9402] is advised otherwise.**REMARKS:** If these proposed changes are approved, our unit will issue these in a new standard special provision. |
|  | **Spec Committee Members:** | **✓** |
|  | Co-Chairman: Neil Lacey | ✓ |
|  | Region 1: Telecia McCline | **✓** |
|  | Region 1: Jason Lucerna | **✓** |
|  | Region 2: Jody Pieper | **✓** |
|  | Region 3: Jarrett Spegele | **✓** |
|  | Region 4: Chris Boespflug | **✓** |
|  | Region 5: David Valentinelli | **✓** |
|  | Project Development: Neil Lacey | **✓** |
|  | Standards and Specifications: Shawn Yu | **✓** |
|  | Area Engineers: Straub, Zamora, & Ryburn | **✓** |
|  | Bridge: Hoang Bui | **✓** |
|  | Contracts & Market Analysis: Markos Atamo | **✓** |
|  | Materials: Mike Stanford | **✓** |
|  | Materials: Craig Wieden | **✓** |
|  | Traffic Engineering: Thomas Dinardo | **✓** | REVIEWER COMMENTS:( ) Approved ( ) Disapproved ( ) ModifiedIf disapproved or modified, give reason why and show any modifications on the attached draft copy: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_ Name/Signature Date |
|  | Maintenance: Tyler Weldon | **✓** |
|  | FHWA: Kelly Galardi | **✓** |
|  | Attorney General: Leo Milan | **✓** |
|  | **Others:** |  |
|  | Colorado Contractors Assoc.: Jim Moody | **✓** |
|  | **Technical Committees:** |  |
|  | Bridge |  |
|  | PDAC | **✓** |
|  | Drainage Advisory Committee (DAC) |  |
|  | Water Quality Advisory Committee (WQAC) |  |
|  | Joint Co-op, CDOT/CCA |  |

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| **COLORADO DEPARTMENT OF TRANSPORTATION****SUBMITTAL OF NEW SPECIFICATION OR SPECIFICATION CHANGE** | Log No. (Assigned by Standards and Specifications Unit)618-1 |
| TO: Standards & Specifications Unit Project Development Branch | FROM:HQ Bridge Construction Unit – Division of Project Support(Region, Branch or Technical Committee) |
| SPECIFICATION SECTION NO.618 | ITEMPRESTRESSED CONCRETE | PriorityRoutine x Fast |
| Reason for this new or changed specification:A number of sections in the 618 specification were outdated. Numerous comments were received from field personnel and prestressed concrete fabrication representatives.  |
| 618.02(b) - Contractor changed to Contractor/Fabricator to better define responsible party. 618.05(a) - Deleted "in writing" in second paragraph to be consistent with first paragraph.618.05(a) - Deleted "; Resubmit, revise as noted" so work cannot start until approved correct shop drawings are returned to contractor. 618.05(b) - Deleted "written" to be consistent with 618.5(a).618.05(c) - Deleted "in writing" to be consistent with 618.5(a).618.06(a) - Added Fabrication plant certification requirement to be current with industry best practices. 618.06(a) - Required QA Inspection personnel training and certifications in compliance with CDOT Fabrication Inspection Manual for Prestressed and Precast Concrete. 618.06(c) - Deleted “and” between “tests” and “forming” and add a comma for grammar correctness. 618.06(d)1. - Added calibration date to tensioning report. 618.06(d)2. - Deleted (7). Humidity within enclosures is not measured. 618.06(d)6 - Revised submittal requirements for length and camber measurements from precast fabricator. 618.06(d)8 – Changed air test verifier from Engineer to QA Representative. Not an item the Engineer needs to witness. 618.07(a)9 - Deleted duplicated portion of sentence, "if placement is moved…".618.07(c)1(5) - Added (iv) to require Contractor's designee to be an ASBI Certified Grouting Technician to meet current industry standards. 618.07(c)2(1) - Deleted reference to composite anchors. Composite anchors not to be used per CDOT technical memo 7/17/2000.618.07(c)3, 3rd paragraph - Changed ½” tolerance to ¼” to match current industry tolerances. 618.07(c)3, 6th paragraph - Revised language in second sentence to current industry standards. 618.08(1) - Deleted last sentence in paragraph because it was duplicated. 618.09 Table 618-1 - Volume Change, Expansion Efflux Time values updated to current industry recommendations. 618.09(b) - Deleted first paragraph on page 653. Updated sampling and testing criteria shown at the bottom of page 652.  |
| 618.09(d)(1) - Updated pressure bleed test requirements to current industry recommendations. 618.09(d) - Deleted "and held for one minute" second paragraph on page 654 to be consistent with current industry recommendations. 618.11(a) - Deleted information that is duplicated in Section 601. 618.11(b) - Implemented new mix design submittal criteria to be consistent with Section 601. 618.11(c) - Required equipment calibration and verification of testing apparatus. 618.11(e)5 - Revised inner form temperature and require it must also be free of ice. 618.11(g), 1st paragraph - Required Contractor's PC concrete tester to be ACI certified. 618.11(g)1 - Revised cylinder curing procedures.618.11(g)2 - Revised cylinder testing and coring procedures. 618.11(g)5, 7 through 9 - Revised criteria for concrete testing frequency. 618.12(a)3 - Revised concrete temperature monitoring frequency, procedures and submittal requirements. 618.12(c)4 - Revised temperature to be consistent and uniform with structural concrete requirements in Section 618. 618.13(b) - Required product repairs of structural defects be analyzed by the Contractor's Engineer and a PE stamped letter provided certifying the repairs meet design criteria. 618.14(a), 1st paragraph - Changed "concretious" to "concrete".618.14(c), 5th paragraph - Revised Girder Erection Plan submittal and review process. 618.14(c), 9th paragraph, 1st sentence- Deleted "record purposes only" and inserted "acceptance". 4th sentence - Deleted sentence and replaced with language requiring the Engineer's written acceptance of the plan. 618.14(c), 10th paragraph - Revised language to clarify definition of traffic as it relates to Contractor's Engineer's inspection and approval.  |
| New or Revised Specification:See attached. |
| NOTE: See Procedural Directive 513.1 for a description of appropriate specification development procedures. |

XXXXXX XX, 2018

REVISION OF SECTION 618
PRESTRESSED CONCRETE

**NOTICE**

This is a standard special provision that revises or modifies CDOT’s *Standard Specifications for Road and Bridge Construction.* It has gone through a formal review and approval process and has been issued by CDOT’s Project Development Branch with formal instructions for its use on CDOT construction projects. It is to be used as written without change. Do not use modified versions of this special provision on CDOT construction projects, and do not use this special provision on CDOT projects in a manner other than that specified in the instructions unless such use is first approved by CDOT’s Standards and Specifications Unit. The instructions for use on CDOT construction projects appear below.

Other agencies which use the *Standard Specifications for Road and Bridge Construction* to administer construction projects may use this special provision as appropriate and at their own risk.

**Instructions for use on CDOT construction projects:**

Use on projects having prestressed concrete.

Section 618 of the Standard Specifications is hereby revised for this project as follows:

In subsection 618.02(b) delete the second sentence and replace with the following:

The Contractor/Fabricator shall keep Certified Mill Test Reports (CMTR’s) on file for all steel and metal products used, and shall furnish copies of CMTR’s when requested.

In subsection 618.05(a) delete the second paragraph and replace with the following:

The anticipated production schedule, including the start of work, phase work and shipment dates shall be submitted to the QA Representative before any work begins. Fabrication shall not be started until the shop drawings have been returned with the Engineer’s review stamp, indicating Reviewed, no exception taken; or Reviewed, revise as noted in accordance with subsection 105.02, and delivered to the Contractor’s site of fabrication.

Delete subsection 618.05(b) and replace with the following:

(b) *Production Schedule Changes.* Accelerated changes to the proposed production schedule, including start of work, phase work, and shipment dates, shall require advance notification be provided to the Engineer and the QA Representative. The Notice of change shall be received at least 48 hours before fabrication begins, unless otherwise approved in writing by the Engineer or the QA Representative.

Delete subsection 618.05(c) and replace with the following:

(c) *Notice of Shipment.* The QA Representative shall be notified at least 72 hours before shipment of prestressed members to the job site.

Delete subsection 618.06(a) and replace with the following:

1. *Process Control and Quality Assurance*. Process Control (PC) of prestressed concrete fabrication is the responsibility of the Contractor. The fabrication plant shall possess and maintain a current Precast/Prestressed Concrete Institute (PCI) certification for Prestressed Concrete. The Contractor shall designate a PC Manager who shall be responsible for product quality requirements as defined in the specifications and the Contractor’s approved PC plan (PCP). The PC Manager shall possess and maintain certification at Level II minimum, from the Prestressed Concrete Institute (PCI), and shall have one year minimum of construction related experience. The PC Manager shall not be supervised by the Contractor’s production section. If grouting for post-tensioning ducts of combination tensioned members is done by the precast girder fabricator, the PC Manager shall possess and maintain an American Segmental Bridge Institute (ASBI) Certified Grouting Technician Certificate. If prestressing, duct and anchorage installation, duct and anchorage inspection, stressing of tendons, air testing of ducts, or grouting of ducts of bonded tendons of the post-tensioning system is done by the precast girder fabricator the PC Manager shall possess a PTI Level I – Bonded Tendon Training Certificate. The PC manager shall perform the inspection or directly supervise all phases.

Quality Assurance inspection shall be performed on all pretensioned, post-tensioned, and combination tensioned members. The QA Representative acts for and on behalf of the Engineer on all matters within the scope of the contract documents, as delegated by the Engineer. QA administration will be performed to the extent necessary to assure contract compliance. Fabrication inspection QA personnel shall have training, certification and work experience as described in Section 3.0 of the CDOT Staff Bridge Fabrication Inspection Manual.

Repeated out of tolerance work, including dimensional non-conformance, shall be considered as recurring deficiencies. Recurring deficiencies shall be considered as evidence that required PC is not being provided. When the QA Representative determines that fabrication operations are producing recurring defects that do not conform to the Contract and PCP requirements, the Contractor will be notified in writing that the present work is unacceptable. Work shall not continue until the PC Manager has submitted a written proposal addressing corrective procedures that the Contractor will take to prevent recurrence of the non-conforming work. Fabrication shall not resume until the proposal has been reviewed and accepted in writing by the QA Representative.

Delete subsection 618.06(c) and replace with the following:

(c) Frequency. PC inspection and testing at all intervals of duct and anchorage placement, duct splices at closure pours, onsite duct air pressure tests, forming, tensioning, steel and concrete placement, curing, and storage operations shall be performed in accordance with the accepted PCP. The PCP shall contain provisions for increased frequencies of inspection and testing when operations or products do not conform to the Contract.

Delete subsection 618.06(d)1 and replace with the following:

1. Prestressing Steel - Tensioning reports for each setup, showing the jacking force calculations; initial and final jacking force used; calculated and final net measured elongation; applicable stressing corrections for seating, slippage, shortening, rotation movement, and temperature; Certified Mill Test Reports for prestressing steel used; jack identification number and calibration date; and date and time of stressing.

In subsection 618.06(d)2 delete the following item from the list:

(7) Actual curing enclosure humidity charts or graphs

Delete subsection 618.06(d)6 and replace with the following:

1. Product camber and length measurements shall be submitted to the QA Representative a minimum of seven calendar days prior to shipping. Deviation from this requirement shall require advance written notification to the QA Representative.

In subsection 618.06(d)8, second paragraph, delete the second sentence and replace with the following:

In the presence of the QA Representative, the Contractor shall pressurize the duct to 30 psi and lock-off the outside air source.

In subsection 618.07(a)9 delete the first paragraph and replace with the following:

Hold-down devices shall be placed: within a 20 inch horizontal tolerance from the locations shown on the plans if placement is moved toward the center of the girder; or within a 40 inch horizontal tolerance from the locations shown on the plans if placement is moved toward the girder ends. If minimum or maximum placement locations are shown on the plans, the placement tolerances shall not encroach beyond those locations.

In subsection 618.07(c)1, first paragraph, item (5) shall include the following:

(iv) Be a holder of a current Certified Grouting Technician Certificate from the American Segmental Bridge Institute (ASBI).

Delete subsection 618.07(c)2(1) and replace with the following:

Alternative anchorage systems, including all associated anchor zone reinforcing steel associated with the alternative anchorage system, and all details of the alternative anchorage system shall be shown on approved shop drawings and signed and sealed by a Professional Engineer who is registered in the State of Colorado and who is an employee of the post-tensioning system supplier or anchorage supplier.

In subsection 618.07(c)3, third paragraph, delete the first sentence and replace with the following:

The ducts shall be mortar tight and accurately placed within ¼ inch of the positions shown on the approved shop drawings.

In subsection 618.07(c)3, sixth paragraph, delete the third sentence and replace with the following:

In addition, at draped tenon high points, two additional high point grout vents shall be located three feet beyond all high points in both directions.

In subsection 618.08(1), last paragraph, delete the third and fourth sentences and replace with the following:

Construction joints shall not pass under distribution plates or anchors.

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In subsection 618.09(b) delete the third and fourth rows in Table 618-1 and replace with the following:

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| **Property** | **Test Value** | **Test Method** |
| Volume Change at 24 hours and 28 days | 0.0% to + 0.2% | ASTM C1090 1 |
| Expansion | 0.0% (minimum) 2% (maximum) | ASTM C940 |

In subsection 618.09(b) delete the last paragraph.

In subsection 618.09(d), second paragraph, Item (1), delete the second sentence and replace with the following:

The Gelman filtration funnel shall be pressurized to a minimum of 50 psi and the maximum percent bleed shall be zero.

In subsection 618.09(d)(4) delete the second sentence and replace with the following:

The efflux time shall be within the values established in Table 618-1.

In subsection 618.09(d) delete the second sentence of the sixth paragraph and replace with the following:

To ensure that the tendon remains filled with grout, the outlet shall be closed and the pumping pressure allowed to build to a minimum of 75 psi before the inlet vent is closed.

In subsection 618.09(d) delete the last sentence of the seventh paragraph and replace with the following:

After the grout has hardened, the standpipe shall be replaced with a cap.

In subsection 618.09(e) the second paragraph shall include the following:

Ice may be used to cool the water, but shall not be added directly to the mixed grout. Dry ice and liquefied carbon dioxide shall not be used for cooling purposes.

Delete subsection 618.11(a) and replace with the following:

1. *Classification*. Concrete shall be Class PS.

Delete subsection 618.11(b) and replace with the following:

1. *Concrete Mix Components.* The Contractor shall develop a mix design for Class PS concrete. The mix design shall conform to the requirements of Section 601 and CP-62. Materials sources shall be listed on the Contractor’s mix design. The PC manager must notify the QA Representative in writing before changing the sources as listed in the PCP. Changes in mix design material sources or proportions, except for admixtures, require a new mix design to be submitted to the Engineer for approval at least five days prior to the new mix being used in production.

Delete subsection 618.11(c) and replace with the following:

1. *Equipment Calibration and Verification.* The Contractor shall implement a plan for equipment calibration and verification of testing apparatus in compliance with ASTM C1077. The calibration records shall be made available to the QA Representative upon request.

Delete subsection 618.11(e)5 and replace with the following:

5. Minimum inner form temperature shall be 32 °F and free of ice at the time of concrete placement.

In subsection 618.11(f) delete the first sentence of the first paragraph and replace with the following:

*Finishing Fresh Concrete.* Open surfaces of fresh concrete shall be worked as little as possible to obtain the finish shown on the plans.

In subsection 618.11(g) add the following after the first sentence of the first paragraph:

The Contractor’s PC representative casting QA concrete cylinders shall be ACI Concrete Field Testing Technician – Grade I certified.

Delete subsection 618.11(g)1 and replace with the following:

1. Test cylinder specimens shall be prepared in accordance with ASTM C31.

Delete subsection 618.11(g)2 and replace with the following:

1. Cylinders will be tested in accordance with ASTM C39 by the Engineer. The average strength of at least two test cylinders shall be equal to or greater than the specified strength. When evaluating a single test consisting of three 28-day standard cured cylinders, if the compressive strength of any one cylinder differs from the average by more than 10 percent, that cylinder will be discarded and the average strength determined using the strengths of the remaining two cylinders. If the compressive strength of more than one cylinder differs from the average by more than 10 percent, all three cylinders will be used to determine the compressive strength.

When the compressive strength of the concrete is less than that specified in the contract, the structural adequacy of the element will be evaluated by the Engineer. The Contractor may request to core the element represented by the low strength results. If approved by the Engineer, the locations of the cores shall be as directed by the Engineer. Coring shall be at the expense of the Contractor and witnessed by the Project Engineer or designee. Coring shall take place no more than 45 days after casting. A minimum of three cores shall be collected with a minimum diameter of 3 inches. The cores shall be obtained by the Contractor and immediately turned over to the Engineer for compressive strength testing. Cores shall be obtained in accordance with AASHTO T24 with the exception that immediately after removal from the structure, cores will be cured at a temperature between 60 to 80 °F and at a relative humidity below60 percent for 24 to 48 hours prior to testing. When evaluating a single test consisting of three cores, if the compressive strength of any one core differs from the average by more than 10 percent, that core shall be discarded and the average strength determined using the strengths of the remaining two cores. If the compressive strength of more than one core differs from the average by more than 10 percent, all three cores will be used to determine the compressive strength. If the average core compressive strength is greater than the average of the cylinder compressive strength, the core strength will be used in the Engineer’s evaluation. If the core compressive strength is less than the cylinder compressive strength, the cylinder strength will be used in the Engineer’s evaluation.

Final determination of acceptance or rejection of the element shall be at the sole discretion of the Engineer based on evaluation of the cylinders and/or core strengths. If the element is accepted, the core holes shall be filled with a non-shrink grout or mortar approved by the Engineer. Patching of the core holes shall be at the expense of the Contractor/Fabricator.

In subsection 618.11(g)5 add the following after the last sentence of the paragraph:

This test shall be conducted for each load of concrete in which compressive strength specimens are cast in accordance with ASTM C39.

In subsection 618.11(g)6 add the following after the last sentence of the paragraph:

This test shall be conducted for each load of concrete in which compressive strength specimens are cast in accordance with ASTM C39.

In subsection 618.11(g)7 add the following after the last sentence of the paragraph:

This test shall be conducted for each load of concrete in which compressive strength specimens are cast in accordance with ASTM C39.

In subsection 618.11(g)8 add the following after the last sentence of the paragraph:

This test shall be conducted for each load of concrete in which compressive strength specimens are cast in accordance with ASTM C39.

In subsection 618.11(g)9 add the following after the last sentence of the paragraph:

This test shall be conducted for each load of concrete in which compressive strength specimens are cast in accordance with ASTM C39.

In subsection 618.12(a)3 add the following after the last sentence of the paragraph:

The Contractor shall monitor the internal concrete temperature using thermocouples with concrete temperature recorded at intervals not to exceed 15 minutes.  A minimum of two thermocouples shall be installed in the element at a maximum spacing of 75 feet with a maximum distance from either end of 40 feet.  Thermocouples shall be installed at the center of mass of the element as uniformly as practical to provide accurate temperature monitoring information.  An element is defined as a single precast prestressed concrete girder or beam or cast-in-place span. When multiple elements are cast simultaneously in a single bed, the temperature monitoring thermocouples shall be at a maximum spacing of 75 feet. Temperature logs shall be submitted to the Engineer prior to transporting the element to the project site. When the internal temperature of the element exceeds 160 °F, the Contractor shall submit a mitigation plan to ensure future castings do not exceed the 160 °F maximum temperature requirement. The mitigation plan shall also include procedures for sampling and testing the element to identify the potential risk for Delayed Ettringite Formation, and/or waterproofing applications to protect against moisture intrusion. The mitigation plan shall be submitted to the Engineer for review and approval. Acceptance or rejection of the element exceeding the temperature specification will be based on review and assessment of the specific curing temperature logs and the submitted documentation. The element shall not be shipped until the Contractor receives written acceptance from the Engineer.

Delete subsection 618.12(c)4 and replace with the following:

1. The internal and surface temperature of the concrete shall not exceed 160 °F.

In subsection 618.13 delete the last sentence of the second paragraph and replace with the following:

The QA Representative will accept, or reject, the finished repair work in writing.

In subsection 618.13 delete the third sentence of the fourth paragraph and replace with the following:

The proposal shall include a detailed description of repair materials, and the methods the Contractor intends to use to evaluate the finished repair work.

In subsection 618.13(b) delete the second paragraph and replace with the following:

Repair methods shall adequately restore structural integrity of the product. When repairs have been completed, the Contractor’s Engineer shall examine and analyze the product for construction and service load capacity. A PE stamped letter shall be provided by the Contractor’s Engineer certifying that the repair work meets all design serviceability criteria. Evaluation and test data shall be submitted along with the written certification. The finished repair work, including aesthetic acceptability, shall meet the approval of the Engineer.

Delete subsection 618.14(a) and replace with the following:

1. *Finishing Hardened Concrete Products.* Finished and repaired areas shall reasonably match the coloration and profile characteristics of the adjacent concrete. Loose concrete laitance shall be removed from the product before storage.

In subsection 618.14(c) delete the fifth paragraph and replace with the following:

At least one week prior to the Pre-Erection Conference, the Contractor shall submit an Erection Plan to the Engineer. The Erection Plan will be reviewed by the Engineer and comments will be submitted in writing within one week. The Engineer’s comments shall be addressed in the final plan. The Final Erection Plan shall be signed and sealed by the Contractor’s Engineer and marked “Approved for Construction”. If falsework is required, falsework drawings shall conform to and be submitted in accordance with subsection 601.11.

In subsection 618.14(c) delete the third sentence of the seventh paragraph and replace with the following:

The erection subcontractor shall review and verify that the piece marks are properly located on the components to be erected, their orientation in the erected structure, and the shop drawing piece mark convention used by the girder fabricator at the Pre-Erection Conference.

In subsection 618.14(c) delete the last sentence of the eighth paragraph and replace with the following:

Additional conferences may also be requested by the Contractor, if approved by the Engineer.

In subsection 618.14(c) delete the ninth paragraph and replace with the following:

The Contractor shall submit a final Erection Plan to the Engineer prior to girder erection for acceptance. The Contractor’s Engineer shall sign and seal (1), (5) and (7) listed above in the final Erection Plan. The final Erection Plan shall be stamped “Approved for Construction” and signed by the Contractor. The Contractor shall not proceed with the Erection Plan until the Engineer has provided written acceptance of the plan.

In subsection 618.14(c) delete the tenth paragraph and replace with the following:

When a bridge spans traffic of any kind, including those where vehicles, railroad, watercraft, or pedestrians have access onto, underneath, or adjacent to the bridge, the Contractor’s Engineer shall inspect and provide stamped written approval of the stability of the erected girders prior to opening the area beneath the girders to traffic. The Contractor shall perform daily inspections of the erected girders and other permanent and temporary bridge elements until the deck concrete has attained the full design compressive strength. The Contractor’s Engineer shall provide an inspection form to the Engineer that lists the items the Contractor will document during the daily inspection of the erected girders. The inspection form shall include inspection items specific to each bridge being constructed. The Contractor shall provide the Engineer and the Contractor’s Engineer with written documentation of these inspections within 24 hours of each inspection.

In subsection 618.15 delete the first sentence of the third paragraph and replace with the following:

The cores shall be delivered in a wrapped and moist condition to the certified test laboratory as listed in the PCP.