



Prestressing Concrete – General – Construction – Prestressing

Revision and Approval

Revision	Date	Nature of Changes	Approved By
0	11-16-2018	Original issue.	Steve Altman

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Background

Prestress (PS) operations and their required equipment and materials are a major element of structure construction work. This process establishes Structure Construction (SC) responsibilities and procedures for verifying the ability to meet contract requirements for all prestressing construction operation activities including:

1. Prestress force application, distribution, and maximum strand tensile stress requirements for post-tensioned members.
2. Cast-in-place PS anchorage installation details.
3. Prestress strand or tendon grouting and venting requirements to bond PS strand or tendons to post-tensioned members.
4. Prestress requirements for strand in pre-tensioned (precast) members, including debonded strands.

Review and authorization of pre-tensioning of precast concrete members under this process is usually performed in conjunction with Materials Engineering and Test Services (METS) and coordinated with the METS Representative.

The majority of this process is implemented during the prestressing operation, only after the following processes have been completed or completed concurrently as described in the following BCMs:

1. [50-1.01C](#), *Prestressing Concrete – General – Submittals*
2. [50-1.01D\(1-2\)](#), *Prestressing Concrete – General – Quality Assurance*
3. [50-1.01D\(3\)](#), *Prestressing Concrete – General – Department Acceptance*

4. [50-1.02](#), *Prestressing Concrete – General – Materials*
5. [50-1.03A](#), *Prestressing Concrete – General – Construction*

Process Inputs

1. Authorized prestressing system shop drawings
2. Certificates of compliance/material releases for: prestressing strand, anchoring systems, anchor wedges, and cement
3. Hydraulic jack and gauges calibration charts submittals
4. Compressive strength results for bridge superstructure concrete
5. Authorized grouting submittal
6. Pre-tensioned members submittal

Procedure

1. All work associated with this process is charged as [Project-Direct – Construction](#).
2. Inspection of field work for this process is:
 - a. [Continuous](#) for all PS activities
3. Before construction begins:
 - a. Pre-tensioned Precast Concrete Members:
 - i. Discuss pre-tensioning operations with the METS Representative.
 - ii. Pre-tensioning occurs in casting yards under supervision of the METS Representative.
 - b. Post-Tensioning Operation:
 - i. Post the required restricted work area signs and delineations required during stressing operations¹.
 - ii. Verify that the required concrete strength and age requirements are achieved prior to post-tensioning tendons.
 - iii. Inspect placement of anchorages in accordance with authorized shop drawings and test for any voids in the concrete near the anchorage areas. If voids are detected verify that they are properly repaired prior to stressing:
 1. See [Attachment 1](#), *Patching Concrete Under Prestress Bearing Plates*.
 2. See [Prestress Manual](#), Appendix C-*Inspection Checklist*.

¹ Cal/OSHA [Construction Safety Orders Section 1711](#), *Reinforcing Steel and Post-Tensioning in Concrete Construction*

- iv. Prepare [Form SC-4301](#), *Post Tensioning Field Monitoring Chart*, for monitoring the prestressing operation². Use actual manufacture A and E values for elongation calculations.
- c. Grouting Operation:
 - i. Review the authorized Grouting Plan.
 - ii. Verify that the Contractor has adequate grouting equipment, qualified personnel, authorized materials, and procedures ready for grouting.
- 4. During Construction:
 - a. Post-Tensioning Operation:
 - i. Read [Prestress Manual](#), Section 8, *Prestressing Operation* and Appendix C-*Inspection Checklist*.
 - ii. Inspect post-tensioning strand placement in the ducts and verify the number of strands in each tendon that matches with prestress shop drawing.
 - iii. Install the Department pressure cell and strain indicator on the Contractor's post-tensioning equipment.
 - iv. Verify the Contractor adheres to the post-tensioning sequences for the tendons in accordance with the authorized shop drawings.
 - v. Record and verify actual tendon or strand elongations and compare results to the theoretical values shown on Form SC-4301, *Post Tensioning Field Monitoring Chart*. When differences are greater 5%, do not cut strands and determine appropriate course of actions.
 - vi. Record any strand issues, such as breaking or slippage through the anchor wedges, on the daily reports. Determine mitigation resolution before proceeding.
 - vii. Verify the final force in the prestressing tendons matches the force shown on the authorized shop drawings and Form SC-4301, *Post Tensioning Field Monitoring Chart*.
 - viii. Verify that the Contractor properly seats the strand wedges and trims off excess strand lengths in order to fit inside grout cap or fit specific job purpose.
 - b. Grouting Operation:
 - i. Read *Prestress Manual*, Section 9, *Grouting Operation*.
 - ii. Verify that the Contractor uses correct grout mix proportions or follows manufacture recommendation for pre-bagged mix.
 - iii. Verify that the Contractor has standby grout mixer and pump.
 - iv. Verify that pumping of grout starts within 30 minutes of mixing.

² [Prestress Manual](#), Section 4, *Prestressing Strands/Bars*, and Section 8, *Prestressing Operation*

- v. Verify that grout is flowable in extreme ambient conditions and that, if ambient conditions will affect flow, adjustments are made to maintain the temperatures of the grout ingredients needed to assure consistent grout flow.
 - vi. Verify that grouting pressures stay consistent. Note actual grouting pressures and verify that they remain within specified ranges allowed.
 - vii. When grouting pressures reach 150 psi (possible blockage exists), the Contractor stops injecting grout and develops mitigation plans.
 - viii. Verify that flow of grout injection is one-way flow only when moving to the “next-vent” and if not, stop the grouting operation³.
 - ix. Verify that quantity of grout placed in each duct substantially matches expected grout volumes. When grout leaks are observed, or quantity exceeds theoretical values, stop the operation and determine mitigation plans.
 - x. Verify there is no cross grouting between ducts. When cross grouting is observed, develop mitigation plans.
 - xi. Verify that the consistency of the effluent grout through vents and grout caps is equivalent to the consistency of the injected grout.
 - xii. Test that effluent grout using California Test Method [\(CTM\) 541](#), *Method for Flow of Grout Mixtures (Flow Cone Method)*, at specified intervals.
 - xiii. Perform CTM 541 at both the inlet and outlet(s).
 - xiv. Verify that the Contractor locks off at 5-psi of grout pressure when the inlet valve is closed.
 - xv. Verify cleanup and disposal is in accordance with the contract documents and authorized Water Pollution Control Program (WPCP)/Stormwater Pollution Prevention Plan (SWPPP).
- c. Document all inspection, construction, and quality assurance activities in the Daily Reports per [BCM C-4.04](#), *Daily and Weekly Reports*.
5. Following construction:
- a. Post-Tensioning Operations:
 - i. Take administration deduction if broken or slipped prestress strands occurs.
 - b. After Grouting Operation:
 - i. Verify that excessive Contractor-produced vibrations are not occurring within 100 feet of the grouted ducts in the frame for 24 hours after grouting.
 - ii. Allow grout to cure for a period of 24 hours.
 - iii. Receive and review Daily Grouting Reports.

³ *Prestress Manual*, Section 9, *Grouting Operation*

- iv. File all post-tensioning forms and reports in the project records.
- 6. Payment:
 - a. Refer to future [BCM 9-1.16](#), *Payment – Progress Payments*, for:
 - i. Materials on hand.
 - ii. Monthly progress payments (partial payments for lump sum item).
 - iii. Broken or slipped strands (administrative deduction).
- 7. Stressing incomplete bridges:
 - a. On rare occasions, usually due to unforeseen emergency situations, the Contractor may desire to post-tension partially completed bridges. All requests to stress partially completed bridges should be discussed with the Bridge Construction Engineer, Area Construction Manager, and Structure Design (SD) Project Engineer.
 - b. Refer to future SD [Bridge Memo to Designers](#) (MTD) for stressing incomplete bridges.

Process Outputs

- 1. [Form SC-4301](#), *Post Tensioning Field Monitoring Chart*
- 2. Daily Reports

Attachments

- 1. [BCM 50-1.03B, Attachment 1](#), *Patching Concrete Under Prestress Bearing Plates*