

NEBRASKA DEPARTMENT OF ROADS

Policies

Materials Sampling Guide, Section 29

POLICY FOR PRECAST/PRESTRESSED CONCRETE PLANT INSPECTION NDOR INSPECTOR

REQUIRED CERTIFICATION: ACI Field Test Technician Grade 1; NDOR Field Technician; NDOR Plant Technician; PCI Quality Control Personnel Certification Level 1 & 2

RECOMMENDED CERTIFICATION: ACI Strength Test Technician Grade 1

GENERAL: Refer to Section 705 in the 2007 Standard Specification for Highways, and all Supplements to the Standard Specifications.

Each inspector is expected to perform any or all tasks within the non-administrative area of prestressed concrete inspection and control. NDOR inspectors may observe and/or verify their assigned tasks. Production tasks may continue even though an NDOR inspector is not present to observe the task, provided the production schedule has been given to the NDOR inspector and the work is proceeding according to schedule. The definition of “Verify” is that NDOR inspectors will review Plant inspectors written documentation of the task or perform separate tests. All inspectors shall obtain the required certification and should obtain the recommended certification.

Inspectors shall comply with all of the safety programs prescribed by the facility. All personnel are required to wear safety hard hats, safety footwear and safety glasses while observing and/or verifying the work in the production area.

- I. One sample of prestress strand twelve feet long from each reel shall be submitted to Materials and Research for testing 30 days before the anticipated time of use. (Sampling Guide, 705.02 paragraph 14)
- II. Inspection and recording of tensioning.
 - A. The NDOR inspector shall observe and/or verify the tensioning of all strands.
 - B. A small number of broken wires are acceptable in a setup as long as the number is limited to not more than 2%.
 1. The area of broken wires shall not exceed 2% of the cross sectional area of the stressing strand.
 2. No more than 1 broken wire will be allowed in a single strand. (705.02 paragraphs 10 & 12)

GENERAL (CONT'D):

- III. Checking of dimensions of members, numbers, size and positions of tendons, reinforcing steel, other incorporated materials, opening, blockouts, etc.
 - A. After the Plant inspector has notified NDOR inspector the bed is ready to be reviewed the NDOR inspector may observe and/or verify the bed.
 - B. All reinforcing steel shall be observed or verified to ensure the bars are of the correct type and size and have been placed in the proper location.
 - C. The type, size, anchorage and location of all embedded items shall be observed and/or verified.
 - D. The NDOR inspector should perform checks as needed to verify the quality control department data.
- IV. Regular inspection of batching, mixing, conveying, placing, compacting, finishing and curing of concrete.
 - A. Precast/Prestressed Portland cement concrete production facilities shall comply with the requirements in the Precast/Prestressed Concrete Institute (PCI) for certified plants.
 - 1. Whenever there is reason to suspect a problem with the equipment, any or all of the equipment may be inspected.
 - B. Precast plants that are not PCI certified will be NRMCA certified.
- V. Preparation of concrete specimens for strength testing and performance of concrete tests (slump, air content, unit weight, etc.).
 - A. Concrete testing verification shall be the responsibility of the NDOR inspector. Table 705.03 shows the minimum required sampling and testing, the Engineer may make more correlation test samples if the quality of the plants testing is deemed inadequate.
 - B. The NDOR inspector shall observe and/or verify the sampling, fabrication and testing for all specimens.

GENERAL (CONT'D):

- VI. Inspection of detensioning, product removal from beds, handling and storing operations.
 - A. The NDOR inspector shall observe and/or verify the detensioning.
 - 1. Detensioning shall be accomplished before the temperatures of the units drop more than 60 degrees from the maximum cure strength temperature and while they are still moist. (705.03, 9)
 - 2. After Detensioning prestressed concrete girder shall be inspected for cracking. If any cracks are discovered in the middle of the girder on the bottom flange face, the girder shall be rejected. (703.03,9.9.C)
 - B. Verifying of dimensions of members, camber, numbers, opening, blockouts, etc.
 - 1. The quality control department shall notify the NDOR inspector when the product is ready to be reviewed.
 - 2. The NDOR inspector may perform checks to verify the quality control department data.
 - C. Each precast/prestressed concrete structural unit shall be stamped or marked with an identification number and its manufacture date. (705.03 paragraph 8.10.g)
 - D. Initial camber should be recorded on all prestressed concrete products for which cylinders are made and initial camber measurement is appropriate.
 - E. Visual inspection of the product for strand slippage should be monitored and evaluated. If slippage occurs, the Construction Division shall be notified and the girder will be evaluated.
- VII. Final inspection of finished product prior to shipment.
 - A. Verified the product has been marked with a number and date related to shop drawings and product records for accurate identification. Green label is placed on end of girder for final approval.
 - B. Visual inspection of the product for general appearance should be made. Cracking is frequently indicative of incorrect procedures in design, production, or handling.
 - C. The NDOR inspector shall observe and/or verify the post-pour inspection.
- VIII. General observation of plant equipment, working conditions, weather and other items, which have the potential for affecting the products.
- IX. All products sent to state projects shall be accompanied by a shipping ticket. The NDOR inspector will be given the opportunity to perform a final inspection before it leaves the plant.

PRECAST/PRESTRESS INSPECTION RECORDS AND REPORTS

The filing pattern outlined below has been devised to ensure the integrity and uniformity of files kept in the inspector's plant file. It is expected that all such files will be kept in order and up to date.

- I. Correspondence File material shall be filed by date with current data at the front of the file and cross referenced by date of letter, date received, person receiving, also those acting upon correspondence.
 - A. State of Nebraska
 - B. Producer
 - C. Miscellaneous
- II. Materials and Tests Section
 - A. Field Gradations
 1. Fine Aggregate
 2. Coarse Aggregate
 - B. Sampling Identification material shall be filed by date/report number (Certifications are filed with report.)
 1. Fine Aggregate
 2. Coarse Aggregate
 3. Portland Cement
 4. Admixtures
 5. Prestressed Strand
 6. Concrete Reinforcing Steel
 7. Cold Rolled Steel
 8. Welded Steel Wire Fabric
 9. Neoprene Bearing Pads
 10. Miscellaneous

PRECAST/PRESTRESS INSPECTION RECORDS AND REPORTS (CONT'D)

III. Materials and Research shall be sent reports on a regular basis and shall include:

A. Compressive Strength and Stress/Strain Data

1. Project Number if known
2. Unit Identification from plans
3. Date Fabricated
4. Proportioning Report Number
5. Test Date
6. Maximum Machine Load
7. Compressive Strength
8. Stress/ Strain Data

B. Shipping Report

1. Project Number
2. Unit Identification from plans
3. Date Fabricated
4. Date Shipped
5. Length of each Pile

NDOR INSPECTOR CHECKLIST FOR STEAM CURING

- I. Verify temperature sensor or thermometer locations.
 - A. One approved continuous recording thermometer or sensor for each 115 feet of casting bed, with a minimum of 2 thermometers or sensors located in each enclosure.
- II. Verify that steam jets are not directed at the forms.
- III. Anything that causes the forms to heat up at a faster rate than the concrete can cause problems.
 - A. Verify that the temperature of the concrete is maintained near placement temperature until the concrete has reached initial set.
 - B. Verify that the temperature rate of rise does not exceed 60°F per hour after initial set.
 - C. Verify that the temperature did not exceed 175°F.
- IV. Verify that the relative humidity inside the enclosure is maintained between 70% and 100%.
- V. Verify that the temperature in the concrete is maintained so that the difference between highest and lowest temperature station readings will not be more than 30°F.
 - A. A dial thermometer pushed through the holes in the tarp works well for checking the temperature along the unit(s).
 - B. There must be adequate room, 3 inches minimum, for the steam to circulate all the way around the forms.
 - C. Wind can blow the tarps against the forms and completely stop the steam from circulating around the units.
 - D. Make sure the end of the bed is well protected and that there is as much steam getting to the ends as the rest of the bed.
 - E. Wind blowing in the end of the bed can drastically reduce the temperature.

ELONGATION INSTRUCTIONS

Elongation shall follow the recommended practice of the Precast/Prestressed Concrete Institute except as out lined below or stated on the plans. The plant inspector shall preform elongation calculations with a report submitted to the NDOR inspector for verification.

- I. Calculate the elongations using the equation on page 36 of the PCI Quality Control Technician/Inspector Training Manual.
 - A. The Central Laboratory shall determine the Modulus of Elasticity.
 - B. Initial Tension should be from 5% to 25% of the final load, to pull the slack strand taut.
 - C. Strands are tensioned to approximately 70% of their ultimate capacity, except where the plans indicate otherwise.
 - D. Tolerance based on the PCI Quality Control Manual is $\pm 5\%$ from the desired value. This relates to the actual gage pressure and elongation verses the calculated values of each. It also relates to an algebraic comparison of the variation of the gage pressure to variations in elongations.
- II. Tensioning Corrections for elongation and load are:
 - A. Strand Seating
 1. Dead End Seating
 2. Live End Seating
 3. Splice Chuck Seating
 - B. Bed Shortening for self-stressing beds
 - C. Abutment Rotation of movement of anchorages for fixed abutment beds
 - D. Elongation of abutment anchor rods
 - E. Thermal Effects
 - F. Drape

ELONGATION WORKSHEET

PROJECT: _____ POUR ID.: _____
 STATION: _____ DATE ELONGATED: _____
 BED: _____ TIME ELONGATED: _____

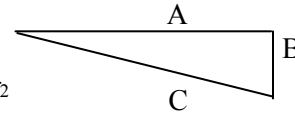
Theoretical Elongation: $E_T = (P \times L) / (A \times E)$

Where: P = Load Applied to Strand = $P_f - P_i$ A = Area of Strand
 L = Length of Strand Between Anchorages E = Modulus of Elasticity of Strand

The Physical Tests Laboratory shall determine the modulus of elasticity and area of strand.

Load Corrections

If draped strand are used, the applied load shall be corrected because the draping process will add load.



Change in elongation for draping $E_d = C - A$ $C = \sqrt{A^2 + B^2}$

A correction for temperature will be made if the temperature increases 25°F or more from the time of stressing to the time of initial set.

Δ Elongation $E_t = 0.0000065 \times T_{\Delta} \times L \times 12$ Corrected Load $P_t = (1 + E_{\Delta} / E_T) \times P \leq \% \text{ Ultimate Strength}$

Corrected Elongation $E_c = E_T + E_t - E_d$ Target Load $P_T = (E_c \times A \times E) / L$

1-8

Elongation Corrections

Strand Seating = S = Dead End + Live End + Splice Chuck

Bed Shortening = B

Abutment Rotation, or Anchorage Movement = R

Elongation of Abutment Anchor Rods = A

Final Theoretical Elongation: $E_F = E_c + S + B + R + A$

Strand Load / Elongation Table

Strand	Load			Elongation		
	High	Actual	Low	High	Actual	Low

Computed By: _____
 (Plant Inspector)

Verified By: _____
 (NDOR Inspector)

