

POLICY FOR PRECAST/PRESTRESSED CONCRETE PLANT INSPECTION  
FABRICATOR 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. Thus all inspectors shall obtain the required certification and should obtain the recommended certification.

- I. Identification, examination, acceptance and plant testing of materials and subassemblies.
  - A. All precast/prestressed concrete structural units shall be produced in a Precast/Prestressed Concrete Institute (PCI) certified plant.
  - B. The contractor shall provide the NDOR inspector a 4-week productions schedule that is updated as necessary. If the NDOR inspector is given less than 1 NDR workdays notice of a schedule change, then the fabricator may not precede until the Engineer has reviewed the change. The Engineer may observe any or all of the procedures and shall have access to all reported data at any time during fabrication. The NDOR inspector shall report any inconsistencies to the job superintendent and note them in the plant diary. (705.03 paragraph 5)
  - C. Quality control records should be identified with the same job number, piece number, and project number if known and other information as used to identify the product after inspection.
  - D. One sample of prestress strand twelve feet long from each reel shall be submitted to the NDOR inspector for testing 30 days before the anticipated time of use. (Sampling Guide,705.02 paragraph 14)
- II. Inspection and recording of tensioning.
  - A. Tensioning of all strands shall be done in the presence of the NDOR inspector.
  - 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)
- III. Inspection of beds and forms prior to concreting.
  - A. One of the most important inspections functions is the prepour inspection. It is much easier to make corrections before concrete is placed.

GENERAL (CONT'D):

- B. The overall length, width, thickness, and other basic dimensions should be checked on all sides of the form before concrete placement begins.
- IV. Checking of dimensions of members, numbers, size and positions of tendons, reinforcing steel, other incorporated materials, opening, blockouts, etc.
  - A. The quality control department shall notify the NDOR inspector when a set-up is ready to be reviewed.
  - B. All reinforcing steel shall be reviewed 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 checked.
  - D. The NDOR inspector may occasionally perform checks to verify the quality control department data.
- V. 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 ready mix 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
- VI. Preparation of concrete specimens for strength testing and performance of concrete tests (slump, air content, unit weight, etc.).
  - A. Concrete quality control shall be the responsibility of the Contractor. Concrete shall be sampled and tested as shown in Table 705.03.
- VII. Inspection of detensioning, product removal from beds, handling and storing operations.
  - A. Detensioning shall be done in the presence of the NDOR inspector.
    - 1. Detensioning shall be accomplished before the temperatures of the units drop more than 60 degrees from the peak cure strength temperature and while they are still moist. (705.03 paragraph 9.b.(9))
    - 2. After Detensioning prestressed concrete girder shall be inspected for cracking. If any cracks are discovered between quarter points 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, block outs, etc.
    - 1. The quality control department shall notify the NDOR inspector when the product is ready to be reviewed.
    - 2. The NDOR inspector may occasionally perform checks to verify the quality control department data.

GENERAL (CONT'D):

- C. Before products are moved into storage, the NDOR inspector shall evaluate the product for deficiencies. This may be done while in the storage area if the NDOR inspector has complete access to the product.
  - D. To identify the condition of a product as it moves through plant operations, paint marks shall be placed on the ends of the girders by the NDOR inspector.
    - 1. Products marked with red paint are to identify reject items.
    - 2. Products marked with yellow paint should have their defects evaluated and repaired. Once the repair is complete and accepted, the yellow paint is covered with green paint.
    - 3. Products marked with green paint are approved for shipment at the appropriate time.
  - E. Each precast/prestressed concrete structural unit shall be stamped or marked with an identification number and its manufacture date, by the NDOR inspector. (705.03 paragraph 8.10.g)
  - F. Initial camber should be recorded on all prestressed concrete products for which cylinders are made and initial camber measurement is appropriate.
  - G. 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.
- VIII. Final inspection of finished product prior to shipment, by NDOR inspector.
- 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.
- IX. General observation of plant equipment, working conditions, weather and other items, which have the potential for affecting the products.
- X. All products sent to state projects shall be accompanied by a shipping ticket. The NDOR inspector shall confirm the shipment before it leaves the plant.

## ELONGATION INSTRUCTIONS

Elongation shall follow the recommended practice of the Precast/Prestressed Concrete Institute except as out lined below or stated on the plans. Elongation calculations shall be preformed by the plant inspector 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 Modulus of Elasticity shall be determined by the Central Laboratory.
  - 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: \_\_\_\_\_

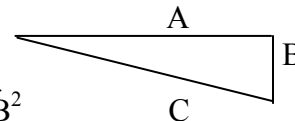
**Theoretical Elongation:  $E_T = (P \times L) / (A \times E)$**

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.

$\Delta$  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       $P_T = (E_C \times A \times E) / L$

**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 Location	Load			Elongation		
	High	Actual	Low	High	Actual	Low

Computed By: \_\_\_\_\_  
 (Plant Inspector)

Verified By: \_\_\_\_\_  
 (NDOR Inspector)

Verified By: \_\_\_\_\_

