SECTION 03 38 00

POST-TENSIONED CONCRETE

PART 1 - GENERAL

1.01 DESCRIPTION

A. This Section describes the requirements for furnishing and installing post-tensioned slabs, jacks, jacking and anchors at Parking Structure, and record keeping, inspections and tests.

B. Related Sections:

1. Cast-in-place concrete is specified in Section 03 30 00.

1.02 SUBMITTALS

A. Shop Drawings:

1. Outline pour sequence and indicate anchorage blockouts and stressing pockets. Indicate tensioning sequence for each pour.

2. Include details of pre-stressing tendons including their arrangement in the members, tendon profile, tendon designation, types of post-tensioning enclosures, anchorage details, stressing data, and the following items:

a. Show tendon layout and dimensions locating tendons in horizontal plane of all points. Detail horizontal curvature of tendons at block-outs and anchorages. Show openings in slabs and beams.

b. Tendon profiles showing chair heights and locations, and required placement steel. Show the location of each tendon and the method of tendon support.

c. Show details of reinforcement around stressing pocket and closures, where interference with post-tension tendons may occur.

d. Include calculations of friction losses to determine that design forces are obtainable. Furnish calculations or test results, as to the adequacy of anchorage.

e. Show required elongation of each tendon at jacking pressures.

f. Furnish complete prestressing procedure, to include the following:

1) Jacking force and jacking pressure.

2) Maximum temporary jacking force and jacking pressures.

3) Certified jack calibrations and method of identification. Non-calibrated jack and pump combination will not be permitted. Submit certificates of calibration from approved testing laboratory to the Developer Design/Builder for all jacks used on project.

4) Method of determining slack.

5) Method of determining anchor force, or force remaining in tendons after anchor.

g. Furnish method of burning off excess tendon, after anchorage.

h. Provide method of sealing tendons.

i. Furnish manufacturer's written guarantee that post-tensioning material is of strength specified.

3. Show location and height of chairing devices, place sequence and elongation of strands. Coordinate with reinforcing bar drawings.

4. Show proposed locations of construction joints.

5. Show proposed formwork, shoring and reshoring sequence, including member sizes and load carry capacities.

B. Product Data: Specifications for each component of the system, subsystem and subassembly.

C. Samples: Complete anchorage systems, coupling systems, stressing strand together with its wrapping or coating, approximately 24-inches long, and other sub-assemblies required for the complete installation.

D. Test Reports: Submit mill test reports if requested.

E. Certificates: Submit of materials compliance if requested.

1.03 QUALITY ASSURANCE

A. Welding shall be performed by certified welders.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Prestressing Steel and Accessories:

1. Post-tensioned Reinforcing Steel: ASTM A416, 1/2-inch diameter, 7-wire, high-tensile, cold-drawn, stress relieved strand:

a. Minimal ultimate strength: 270,000- psi.

b. Nominal steel area: 0.153-square inches.

c. F (ult.): 41.3-kips.

d. E: 27,500- to 28,500-kips per square inch.

e. Normal weight of strands: 525-pounds per 1,000-feet.

2. Oil-tempered wire will not be permitted.

3. Tendon wires: Clean and free of corrosion of injurious marks. Sharp kinks in tendons will not be permitted.

4. Secure post-tensioning steel at the ends by means of anchoring devices capable of developing the minimum breaking strength of the strand.

5. Anchoring Hardware: ACI 318 or PCI "Standard Building Code for Prestressed Concrete".

6. Grease and wrap tendons in plastic sheath to prevent bond, reduce friction end resist corrosion. Before concreting begins, repair by rewrapping all tears or holes in the sheathing larger than 3-inches in length.

7. Remove and replace broken strands and strands showing severe fabrication defects.

B. Distribution Plates and Anchorages:

1. Secure post-tensioned prestressing steel at the ends with approved anchoring devices which will not kink, breakdown, or otherwise damage the wires.

2. When headed wires are used the outside edge of holes for prestressing wire in stressing washer shall be not less than 1/4-inch from the root of the thread at the edge of the anchor, or as otherwise approved according to acceptable laboratory tests.

3. Slip: Anchorage devices shall hold the prestressing steel without slip of more than 1/8-inch at a load equal to the applied load on the wire at prestressing.

4. Distribution Plates: Welded steel or cast steel bearing assemblies that will permanently support and distribute the load from the anchoring devices as follows:

a. Maximum concentrated bearing stress in concrete: Not to exceed that permitted by American Concrete Institute Building Code.

b. Bending Stresses in plates induced by the pull of prestressing steel: Not to exceed 20,000-psi for structural steel and 15,000-psi for cast steel, except as experimental data may indicate that higher stresses are satisfactory. For higher strength steel, corresponding higher stresses may be permitted.

c. Materials: ASTM A36 for structural shapes, or ASTM A148 for cast steel, or higher quality as required to meet stress requirements.

d. Design, fabrication and erection: AISC standards.

e. Welding: AWS Standards.

f. Welders: Qualified in accordance with qualification tests specified in AWS Standards.

g. Bolts and Nuts: ASTM A325, high strength, use where shown.

h. Distribution plates may be omitted, if the bearing area of any anchoring device is sufficiently large so that the local concentrated bearing compressive stresses do not exceed the stresses permitted above or cause local failure.

C. Bonded Reinforcing Steel: ASTM A615.

1. Ties, stirrups and accessories: Grade 40.

2. All other bars: Grade 60.

D. Concrete:

1. Before the post-tensioning tendons are stressed concrete shall have obtained 75-percent of its design strength or as otherwise dictated by a bearing stress design in accordance with ACI 318.

2. Admixtures: Use only with prior written approval the Developer Design/Builder. Admixtures containing chloride ions will not be permitted.

3. Concrete Work: Comply with Section 03 30 00.

4. Concrete Compressive Strength at 28-days: Minimum 4,000-psi.

PART 3 - EXECUTION

3.01 FIELD QUALITY CONTROL

A. Testing and Inspection: County will select and pay for the services of an independent testing and inspection laboratory.

B. Testing and Inspection Laboratory's Duties:

1. Inspect tendons and slab reinforcing prior to placing of concrete.

2. Observe placing of concrete.

3. Report immediately deviations from work.

4. Verify tensioning records prepared by Developer Design/Builder and monitor tensioning.

5. Take random samples of prestressing strands and submit for testing. Include with samples strand manufacturer's certification stating that samples are representative of strands furnished for the Work.

6. Test prestressing steel for tensile strength and elongation at rupture. Two tests shall be made for each real, heat or lot number. Each size of wire strand to be shipped to site shall be assigned an individual lot number and tagged accordingly.

7. Perform testing of concrete as specified in Section 03 30 00, except as follows:

a. Take 6 cylinders (2 cylinders to be field cured) for each day's pour or for each 50-cubic yards or fraction therefor.

b. Before stressing of slab test 2 field cured and 2 lab cured cylinders.

c. Test at 28-days 2 lab cured cylinders.

D. Developer Design/Builder shall appoint a qualified person to be in charge of prestressing operations, including the following:

a. Check tendon placement before, and during pouring of concrete. Be present during pours and check for tendons being moved out of position.

b. Mark tendons prior to stressing.

c. Record tendon elongation after stressing.

d. Not allow burning off of tendons until approval is received.

E. Instructions: Schedule and make arrangements with the manufacturer of post-tensioning strands for initial job site instruction of his personnel in placing strands.

3.02 INSTALLATION

A. Placing Concrete:

1. Comply with the requirements specified in Section 03 30 00, except as otherwise specified.

2. Do not place concrete until the tendons and slab reinforcing have been inspected the by the Testing Laboratory.

3. Place concrete to ensure alignment of post-tensioning strands and conventional reinforcement remains unchanged. Ensure compaction of concrete around spread plates and bearing plates.

B. Placing Strands: Support strands securely to ensure their remaining in position during the placing of concrete.

C. Post-Tensioning:

1. Post-tension Forces: The compression stress of concrete at the time of tensionIng shall be a minimum of 3,000-psi as determined by standard cylinder tests. Anchorage bearing shall be provided so that it does not produce stresses in excess of paragraph 18-11, ACI 318, Building Code Commentary, and as follows:

a. Maximum temporary forces to overcome friction: 33.0-kips.

b. Maximum anchor force: 29.0-kips.

c. Maximum effective force: 25.0-kips.

d. Unit elongation: 0.079-inches per foot.

e. Losses due to creep, shrinkage, elastic shortening and steel stress relaxation: 27-kips per square inch.

2. All prestressing steel shall be stressed by means of hydraulic jacks, equipped with accurate reading calibrated hydraulic pressure gauge to permit the stress in the prestressing steel to be computed at any time. A certified calibration curve from an approved testing laboratory shall accompany each jack. If inconsistencies between the measured elongation and the jack gauge reading occur, the jack gauges shall immediately be calibrated.

3. Do not tension until prestressing steel is reasonably free and unbonded in the enclosure.

4. Jack from both ends of post-tensioned prestressing steel when there is excessive friction between the prestressing steel and the sides of the enclosures.

5. Anchor prestressing steel at "Initial Stress" that will result in the ultimate retention of working forces or stresses of not less than those specified, but in no case shall the steel be tensioned above 80-percent of the ultimate strength of the strand. The anchor force shall not exceed 70-percent of the ultimate strength of the wire, strand or bars.

6. Uniformly distribute end bearing forces or provide a properly designed and reinforced end block for induced stresses.

7. Maintain records of elongation and tension applied to each strand and submit to the Testing Laboratory upon completion of each member. Obtain permission from the Testing Laboratory before cutting, burning or capping any prestressing anchorage.

8. Drape post-tensionIng tendons to approximately a parabolic curve between control points. Vertical Placement Tolerances shall be 1/8-inch on slabs and 1/4-inch in beams. Slab tendons may be moved up to 6-inches horizontally from their theoretical locations to miss openings or penetrations.

D. Removal of Forms:

1. Do not remove forms in post-tensioned areas until concrete is fully stressed.

2. Supported floor below the floor that is to have concrete placement shall have been stressed before this concrete is placed, unless otherwise approved the Developer Design/Builder.

3.03 CONCRETE PROTECTION SCHEDULE

A. For Strand and Bar Reinforcement, Post-tensioned Members:

	Not Exposed	Exposed
Slabs	3/4 inch	1 inch
Beams	1-1/2 inch	1-1/2 inch
Mat	1 inch	1 inch

B. For Bar Reinforcement, Non Post-tensioned Members:

	Not Exposed	#5 or smaller	#6 or larger	Earth Formed
Slabs	3/4 inch	1-1/2 inch	2 inches	2 inches
Beams	1-1/2 inch	1-1/2 inch	2 inches	3 inches
Columns	1-1/2 inch	1-1/2 inch	2 inches	----
Walls	3/4 inch	1-1/2 inch	2 inches	----

END OF SECTION