

## 705 PRESTRESSED CONCRETE UNITS

### 705.01 DESCRIPTION

Prestressed concrete units shall be prestressed either by pretensioning or post-tensioning. Pretensioning is defined as any method of prestressing concrete members in which the reinforcement is tensioned before the concrete is placed. Post-tensioning is defined as any method of prestressing in which the reinforcement is tensioned after the concrete is placed.

Unless otherwise specified in the contract documents, the method of prestressing to be used and fabrication site shall be optional with the Contractor, subject to all requirements as outlined in [815.02](#) and as specified herein.

The precast concrete manufacturing plant shall be certified by the Prestressed Concrete Institute, Plant Certification Program, prior to the start of production. At the Contractor's option, in lieu of PCI certification, the manufacturer shall, at no cost to the District, meet the following requirements.

1. Retain an independent testing or consulting firm approved by the Chief Engineer.
2. The basis of inspection shall be the Prestressed Concrete Institute's "Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products," MNL-116 and "Manual for Quality Control for Plants and Production of Architectural Precast Concrete Products," MNL-117.
3. This firm shall inspect the precast plant at two week intervals during production and issue a report, certified by a registered Professional Engineer, verifying that materials, methods, products and quality control meet all the requirements of the specifications, drawings, and MNL-116 and/or MNL-117. If the report indicates to the contrary, the Chief Engineer will inspect and, at the Chief Engineer's option, may reject any or all products produced during the period of non compliance with the above requirements.

### 705.02 MATERIALS

Prestressing Reinforcement - [815.02](#)

Concrete - [817, Class D](#)

Reinforcing Steel - [812.02](#)

### 705.03 EQUIPMENT

The Contractor shall provide all equipment necessary for the construction and the prestressing. Prestressing shall be done with approved jacking equipment. Hydraulic jacks shall be equipped with accurate pressure gauges. The Contractor may elect to substitute screwjacks or other types for hydraulic jacks. In that case, proving rings or other approved devices shall be used in connection with the jacks. All devices, whether hydraulic jack gauges or otherwise, shall be calibrated and, if necessary, recalibrated so as to permit the stress in prestressing steel to be computed at all times. A certified calibration curve shall accompany each device.

Safety measures shall be taken by the Contractor to prevent accidents due to possible breaking of the prestressing steel or the slipping of the grips during the prestressing process.

#### 705.04 CONCRETE CONSTRUCTION

Necessary formwork, concrete placing, exposed surface finishing and other construction requirements shall conform to [703](#) unless otherwise stipulated.

The units shall be constructed on a rigid base which will not deflect or settle unevenly, to prevent any vertical distortion, and shall be braced transversely so as to prevent any buckling sideways. No concrete shall be deposited in the forms until the formwork, reinforcing, conduits, anchorages, prestressing steel and other appurtenances have been inspected and approved by the Chief Engineer. Approval, however, does not relieve the Contractor of his responsibility to produce a satisfactory unit, and any unit not meeting the requirements as specified herein will be rejected and the Contractor will be required to replace the unit at his expense.

If the Chief Engineer so directs, the Contractor will be required to vibrate the concrete externally as well as internally. Vibrating shall be done with extreme care and in such a manner as to prevent displacement, crushing or damaging of reinforcement, conduits, wires or any other appurtenances which are a part of the construction.

In post-tensioned construction, connections between end anchorages and conduits or other appurtenances shall be carefully sealed with friction tape or mastic or other satisfactory material, to exclude mortar from such appurtenances during concreting. The prestressing reinforcement shall be moved backward and forward a few inches several hours after pouring concrete to loosen any mortar which might have entered the conduit or other appurtenances.

Curing of concrete shall be per [703.18](#) except as follows:

- (A) **STEAM CURING.** Steam curing will be permitted and shall be done under a suitable enclosure to contain the live steam in order to minimize moisture and heat losses. The initial application of the steam shall commence 2 to 4 hours after the final placement of concrete to allow the initial set of the concrete to take place. If the use of retarders is approved, the waiting period before application of the steam shall be from 4 to 6 hours. The steam shall be at least 100 percent relative humidity to prevent loss of moisture and to provide excess moisture for proper hydration of the cement. Application of the steam shall not be directly on the concrete. During application of the steam, the temperature of the member shall increase at a rate not to exceed 40°F per hour until a maximum temperature of from 140°F to 160°F is reached. The maximum temperature shall be held until the concrete has reached the desired strength. Suitable probes shall be inserted into the members for monitoring the temperature.
- (B) **RADIANT HEAT CURING.** Precast members may be cured by the radiant heat method provided that the members are enclosed in approved rubberized canvass tarpaulins or other approved enclosures. The application of heat shall be as specified for steam curing.

The Contractor shall submit a curing plan which includes procedures to be used for approval by the Chief Engineer before curing may begin.

**705.05 PRETENSIONING**

The prestressing elements shall be accurately held in position, and stressed by jacks. A record shall be kept of the jacking force and the elongations produced thereby. Several units may be cast in one continuous line and stressed at one time. Sufficient space shall be left between ends of units to permit access for cutting after the concrete has attained the required strength. No bond stress shall be transferred to the concrete, nor end anchorages released, until the concrete has attained a compressive strength, as shown by tests on standard cylinders, made and cured identically with the members, of at least the minimum strength shown in the contract documents. The elements shall be cut or released in such an order that lateral eccentricity of pre-stress will be a minimum. If several strands are tensioned simultaneously, the jacking system shall provide for uniform stress in all strands. Pre-stress in the strands shall be transferred gradually to the concrete upon release.

When units are pre-tensioned, the Contractor shall notify the Chief Engineer a sufficient time in advance on any work to be performed on the units in order that the Chief Engineer or his representative can arrange for inspection.

**705.06 POST-TENSIONING**

- (A) **GENERAL.** Prestressing elements will be accurately placed in the position in the contract documents, and firmly held during the placing and setting of the concrete.
- (B) **ENCLOSURES.** All enclosures shall be metallic and shall be mortar-tight, with the exception that the Contractor, at his option, may form the enclosures by means of cores or ducts composed of rubber or other suitable material which can be removed prior to installing the prestressing reinforcement. Enclosures shall be strong enough to maintain their shape under such forces as will come upon them. They shall be between two and two and one-half times larger in internal diameter than the bar, cable, strand, or group of wires which they enclose. Cores or ducts shall be provided with pipes or other suitable connections for the injection of grout after the prestressing operations have been completed.
- (C) **TENSIONING.** Tensioning of the prestressing reinforcement shall not be commenced until tests on standard cylinders, made and cured identically with the members, show that the concrete has attained at least the minimum strength shown in the contract documents.

After the concrete has attained the required strength, the prestressing reinforcement shall be stressed by means of jacks to the desired tension and the stress transferred to the end anchorage.

The tensioning process shall be so conducted that the tension being applied and the elongation of the prestressing elements may be measured at all times. The friction loss shall be estimated as provided in the AASHTO Standard Specifications for Highway Bridges.

A record shall be kept of gage pressure and elongation at all times and submitted to the Chief Engineer for his approval.

- (D) **BONDING.** All prestressing reinforcement shall be bonded to the concrete and shall be free of dirt, loose rust, grease, or other deleterious substances. Before grouting, the ducts

shall be free of water, dirt or any other substance. The ducts shall be blown out with compressed air until no water or other substance comes through the duct. For long members with draped strands, an open tap at the low point of the duct may be necessary.

The annular space between the perimeter of the enclosure and the steel shall be pressure grouted after the prestressing process has been completed.

The grout shall be made to a consistency to permit adequate flow into the ducts. Proportions of the materials used to prepare the grout shall be based on tests made on the grout before operational grouting is begun, or may be selected based on prior documented experience with similar material and equipment under comparable field conditions. The water content shall be the minimum necessary for proper placement, and when Type I or Type II cement, as per [817](#), is used, shall not exceed a water-cement ratio of 0.45 or approximately 5 gallons of water per sack (94 lbs) of cement.

The pumpability of the grout may be determined by the Chief Engineer in accordance with the U.S. Corps of Engineers Method CRD-C611.80. When this method is used, the efflux time of the grout sample immediately after mixing shall not be less than 11 seconds.

Aluminum powder of the proper fineness and quantity may be used to obtain 5 to 10 percent unrestrained expansion of the grout.

During placement, grout shall be allowed to flow from the first vent after the inlet pipe until any residual flushing of water or entrapped air has been removed, at which time, the vent shall be capped or otherwise closed in sequence in the same manner.

The pumping pressure at the tendon outlet shall not exceed 250 psig.

If the actual grouting pressure exceeds the maximum recommended pumping pressure, grout may be injected at any vent which has been, or is ready to be, capped as long as a one-way flow of grout is maintained. If this procedure is used, then the vent which is to be used for injection shall be fitted with a positive shutoff.

When one-way flow of grout cannot be maintained, the grout shall be immediately flushed out of the duct with water.

Grout shall be pumped through the duct and continuously wasted at the outer pipe until no visible slugs of water or air are ejected and the efflux time of the ejected grout shall not be less than the injected grout. To insure that the tendon remains filled with grout, the outlet and/or inlet shall be closed. Plugs, caps or valves thus required shall not be removed or opened until the grout has set.

In temperatures below 32°F, ducts shall be kept free of water to avoid damage due to freezing.

The temperature of the concrete shall be 35°F or higher from the time of grouting until job cured 2 inch cubes of grout reach a minimum compressive strength of 800 psi.

Grout shall not be above 90°F during mixture or pumping. If necessary, the mixing water shall be cooled.

**705.07 TRANSPORTATION AND STORAGE**

Extreme care shall be exercised in handling and moving precast prestressed concrete members. Lifting hooks or other devices of approved design may be cast into the units. Precast girders and slabs shall be transported in an upright position and the points of support and directions of the reactions with respect to the member shall be approximately the same during transportation and storage as when the member is in its final position. If the Contractor deems it expedient to transport or store precast units in other than this position, it shall be done at his own risk and after notifying the Chief Engineer of his intention to do so.

Care shall be taken during storage, hoisting and handling of the precast units to prevent cracking or damage. Units damaged by improper storing or handling or in any other manner, shall be replaced by the Contractor at his expense.

**705.08 MEASURE AND PAYMENT**

The unit of measure for Prestressed Concrete Units will be each. The actual number of the several types and sizes of prestressed concrete units installed in place, completed and accepted, will be paid for at the contract unit price per each, which payment will include the concrete, reinforcing steel, prestressing reinforcement, enclosures for prestressing reinforcement, anchorages, plates, nuts, anchor dowels, bearing pad and plates, and other such material within or attached to the unit, including transverse diaphragms and transverse prestressing elements, and also, all labor, equipment, tools and incidentals necessary to complete the work as specified.