Section 2419. Precast Concrete Units

2419.01 DESCRIPTION.

A. Provide precast concrete units produced in a plant for which equipment, procedures, and quality of concrete have been approved by the Contracting Authority.

B. Provide, or have fabricator provide, technical personnel experienced and skilled in application of precast system being used. Ensure technical personnel cooperate with Engineer in technical aspects of the work.

C. Apply provisions of this section to production and construction of precast concrete as defined in Section 1101.

D. Unless modified elsewhere in the contract documents, perform fabrication in precast fabrication plants that are approved prior to letting.

E. Requirements for specific precast units are found in the Materials I.M. 445 series, Materials I.M. 571, and in the following specification sections:
Section 4145: Concrete Culvert Pipe
Section 2415: Concrete Box, Arch, and Circular Culverts
Section 2416: Rigid Pipe Culverts
Section 2430: Modular Block Retaining Wall
Section 2431: Segmental Retaining Wall
Section 2432: Mechanically Stabilized Earth (MSE) Retaining Wall
Section 2513: Concrete Barrier (Precast)

2419.02 MATERIALS.

Use materials meeting requirements of Division 41 for respective material, and the following:

A. Aggregates.

1. Apply Sections 4110, 4111, 4115, and 4117, except gradation requirements of Articles 4110.02 and 4115.03.

2. Submit aggregate gradations and proportions with mix design to District Materials Engineer for approval.

3. Use aggregates similar to Class V only when 30% or more of total weight (mass) of aggregate is limestone.

B. Admixtures.
When authorized by Engineer, approved admixtures complying with Section 4103 may be used and shall be from an approved source identified in Materials I.M. 403.

C. Reinforcing Steel and Wire Fabric.
Comply with requirements of Section 4151 and ensure materials are from an approved source identified in Materials I.M. 451. Precast fabricator shall accept reinforcing steel with certified mill test reports for each heat delivered.

D. Cement.
Apply Section 4101, unless otherwise specified. If the use of Type III Portland cement has been authorized, use it in same proportions as specified for Type I Portland cement. Cement with total equivalent sodium oxide between 0.61% and 0.75% may be used, provided it is non-reactive with proposed aggregate when tested according to ASTM C 1260, C 1567, or C 1293.

E. Supplementary Cementitious Materials.

1. Apply Section 4108.

2. Fly ash may be substituted for Portland cement. Use a substitution rate of no more than 25% by weight (mass) for wet cast concrete only. Fly ash shall be from an approved source identified in Materials I.M. 491.17.

3. GGBFS may be substituted for Portland cement. Use a substitution rate of no more than 35% by weight (mass) for GGBFS as a mineral admixture. GGBFS shall be from an approved source identified in Materials I.M. 491.14.

4. The maximum total supplementary cementitious materials substitution shall not exceed 50%.

2419.03 CONSTRUCTION.

A. Equipment.
Use equipment meeting requirements of Section 2001 and the following:

1. Forms: Use forms for precast concrete true to dimensions shown in contract documents, true to line, mortar tight, and of sufficient rigidity to not sag or bulge out of shape under placement and vibration of concrete. Ensure inside surfaces are smooth and free of projections, indentations, or offsets that might restrict differential movements of forms and concrete.

2. Weighing and Proportioning Equipment.
Apply Article 2001.20, except that a vibrator will not be required on cement batch hopper.

3. Mixing Equipment.
Article 2001.21.

4. Bins.
Article 2001.06

B. Concrete.

1. For precast construction, use at least 610 pounds (360 kg) of total cementitious material per cubic yard (cubic meter) of concrete. Do not exceed maximum water-cementitious ratio, including free moisture in aggregate, of 0.450 pound per pound (0.450 kg/kg).

2. Intended air entrainment of finished wet cast concrete is 6%. To allow for loss during placement, use a target value of 6.5% for air content of fresh unvibrated concrete, with a maximum variation of ± 1.0%.

C. Proportioning, Mixing, and Placing Concrete.

1. Proportion and mix concrete according to applicable requirements of Article 2403.02, D, 3.

2. Do not place concrete when ambient temperature is below 35°F (2°C) unless Engineer has approved plant for cold weather concrete placement. When necessary, heat aggregate or water, or both, so temperature of concrete when deposited in forms is 40°F to 90°F (4°C to 32°C). Do not use frozen material in concrete.

3. When a series of units is cast in a line, cast entire series in one continuous operation, or as directed by Engineer. Place successive batches before preceding batch has perceptibly hardened or dried. Do not allow more than 45 minutes to pass between placement of successive batches of concrete in a unit. Do not retemper concrete or add water to interface of the concrete between batches.

4. Carefully work and consolidate concrete around reinforcement without displacing it. Ensure formation of honeycomb, stone pockets, or similar defects have not occured. Consolidate concrete using small diameter vibrators or by other means approved by Engineer. Overfill forms during consolidation. Screed off excess concrete and finish surface to desired texture.

D. Curing.

1. Use a method of curing that prevents loss of moisture and maintains an internal concrete temperature at least 40°F (4°C) during curing period. Obtain Engineer's approval for this method.

2. In all cases, cover concrete and leave covered until curing is completed. Side forms and pans forming underside of channel shapes may be removed during this period if cover is immediately replaced. Do not, under any circumstances, remove units from casting bed until strength requirements are met.

3. When accelerated heat is used to obtain temperatures above 100°F (38°C):
   - **a.** Record temperature of interior of concrete using a system capable of automatically producing a temperature record at intervals of no more than 15 minutes during entire curing period.
   - **b.** Space systems at a minimum of one location per 100 feet (30 m) of length per unit or fraction thereof, with a maximum of three locations along each line of units being cured.
   - **c.** Ensure all units, when calibrated individually, are accurate within ± 5°F (3°C).

d. Do not artificially raise temperature of concrete above 100°F (38°C) for a minimum of 2 hours after units have been cast. After 2 hour period, temperature of concrete may be raised to a maximum temperature of 160°F (71°C) at a rate not to exceed 25°F (15°C) per hour.

e. Hold maximum temperature for a period sufficient to develop strength required for release of prestress or for post tensioning, as the case may be.

f. Lower temperature of concrete at a rate not to exceed 40°F (22°C) per hour by reducing amount of heat applied until interior of concrete has reached the temperature of surrounding air.

E. Placing Reinforcement.

Place reinforcement carefully, accurately, and secure in proper position according to contract documents. Apply Article 2404.03.

F. Removal of Forms.

If forms are removed before concrete has attained strength which will permit units to be moved or stressed, remove protection only from immediate section from which forms are being removed. Immediately replace protection and resume curing following form removal. Do not remove protection any time before units attain specified compressive strength when surrounding air temperature is below 20°F (-7°C).

G. Tolerances.

Limit variation from dimensions shown in contract documents to no more than 1/8 inch (3 mm). For overruns, greater deviation may be accepted if, in Engineer's opinion, it does not impair suitability of member for its intended use.

H. Handling and Storage.

During fabrication, storage, handling, and hauling take care to prevent cracking, twisting, unnecessary roughness, or other damage. In particular, do not allow tiedowns to come in direct contact with concrete surfaces. Do not subject units to excessive impact. Replace, at no additional cost to Contracting Authority, units that are, in Engineer's opinion, damaged in a way to impair their strength or suitability for their intended use.

I. Finish.

Finish surfaces which will be exposed in finished structure as provided in Article 2403.03, P, 2, b.

2419.04 METHOD OF MEASUREMENT.

For precast units, Engineer will determine quantity of each of the various respective sizes, lengths, and types per the sections listed in Article 2419.01, E.

2419.05 BASIS OF PAYMENT.

Payment will be per the sections listed in Article 2419.01, E.