

## SECTION 03300

### CAST-IN-PLACE CONCRETE

#### PART 1 – GENERAL

##### 1.01 SECTION INCLUDES

- A. Cast-in-place concrete proportioning and design mixes, aggregates and cement types.
- B. Concrete Admixtures.
- C. Bonding and Curing Materials.
- D. Finishing.

##### 1.02 QUALITY ASSURANCE

- A. Codes and Standards: Comply with provisions of following codes, specifications and standards, except where more stringent requirements are shown or specified:
  - 1. ACI 301 – Specifications for Structural Concrete for Buildings.
  - 2. ACI 318 – Building Code Requirements for Reinforced Concrete.
- B. Concrete Testing Service: Engage a testing laboratory acceptable to Owner's Representative to perform material evaluation tests and to design concrete mixes.
- C. Materials and Installed Work Testing: The Owner's Representative may require testing and retesting at anytime during progress of work.
  - 1. Allow free access to material stockpiles and facilities.

##### 1.03 REFERENCES

- A. American Association of State Highway and Transportation Officials, AASHTO M182 Burlap cloth made from Jute or Kenaf.
- B. American Concrete Institute (ACI):
  - 1. ACI 301 – Specifications for Structural Concrete for Buildings.
  - 2. ACI 304 – Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete.
  - 3. ACI 305R – Hot Weather Concreting.
  - 4. ACI 306R – Cold Weather Concreting.
- C. American Society for Testing and Materials (ASTM):
  - 1. ASTM C31 – Making and Curing Concrete Test Specimens in the Field, Method of.
  - 2. ASTM C33 – Concrete Aggregates, Spec. for.
  - 3. ASTM C39 – Compressive Strength of Cylindrical Concrete Specimens, Test Method for.
  - 4. ASTM C42 – Obtaining and Testing Drilled Cores and Sawed Beams of Concrete, Method of.
  - 5. ASTM C94 – Ready-Mixed Concrete, Spec. for.

6. ASTM C143 – Slump of Portland Cement Concrete, Test Method for.
7. ASTM C150 – Portland Cement, Spec. for.
8. ASTM C171 – Sheet Materials for Curing Concrete, Spec. for.
9. ASTM C172 – Sampling Freshly Mixed Concrete, Method of.
10. ASTM C173 – Air Content of Freshly Mixed Concrete by the Volumetric Method, Test Method of.
11. ASTM C231 – Air Content of Freshly Mixed Concrete by the Pressure Method, Test Method of.
12. ASTM C260 – Air Entraining Admixtures for Concrete, Spec. for.
13. ASTM C494 – Chemical Admixtures for Concrete, Spec. for.
14. ASTM C881 – Epoxy-Resin-Base Bonding Systems for Concrete, Spec. for.
15. ASTM D1751 – Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types), Spec. for.

#### 1.04 SUBMITTALS

- A. Product Data: Submit manufacturer’s product data with application and installation instructions for proprietary materials and items named herein, as requested by Owner’s Representative.
- B. Samples: Submit samples of materials as specified and as otherwise requested by Owner’s Representative, including names, sources and descriptions.
- C. Laboratory Test Reports: Submit laboratory test reports for concrete materials and mix design test as specified.
- D. Materials Certificates: Provide materials certificates in lieu of materials laboratory test reports when permitted by Owner’s Representative. Material certificates shall be signed by manufacturer and Contractor, certifying that each material item complies with, or exceeds, specified requirements.
- E. Delivery Tickets: A delivery ticket shall accompany each load of concrete from the batch plant.
  1. Information presented on the ticket shall include the tabulation covered by ASTM C94, 16.1.1 through 16.2.8 as well as any additional information the local codes may require.
  2. Tickets must be signed by the Contractor’s representative, noted as to time and place of pour and kept in a record at the site. Make such records available for inspection upon request by the Owner’s Representative.

### PART 2 – PRODUCTS

#### 2.01 MATERIALS

- A. Portland Cement: ASTM C150 of the following Type(s):
  1. All concrete for driveways, curbs, gutters, and sidewalks shall be in accordance with the latest edition of Amity Township’s Code of Ordinances found in Chapter XXVI entitled “Streets, Sidewalks, Driveways, and Curbs”.
  2. Type II, Moderate Sulfate Resistance (manholes).
- B. Use one brand of cement throughout project, unless otherwise acceptable to Owner’s Representative.

- C. Normal Weight Aggregates: Meeting requirements of ASTM C33, and as specified herein. Provide aggregates from a single source for exposed concrete.
- D. Water: Potable quality, clean and free of injurious amounts of oil, acid, alkali, organic matter, suspended matter, and other deleterious substances.
- E. Concrete Admixtures:
  - 1. Air-Entraining Admixture: Use a product conforming to ASTM C260, certified by manufacturer to be compatible with other required admixtures.
    - a. Acceptable Manufacturers:
      - (1) Sika Aer; Sika Corp.
      - (2) MB-VR or MB-AE; Master Builders.
      - (3) Darex AEA or Daravair; W. R. Grace.
      - (4) Air-Mix; The Euclid Chemical Co.
      - (5) Or Equal.
  - 2. Water-Reducing Admixture: ASTM C494, Type A, and containing not more than 0.5% chloride ions.
    - a. Acceptable Manufacturers:
      - (1) WRDA Hycol; W. R. Grace.
      - (2) Pozzoloth Normal; Master Builders.
      - (3) Plastocrete 160; Sika Chemical Corp.
      - (4) Eucon WR-75; The Euclid Chemical Co.
      - (5) Or Equal.
  - 3. Non-Corrosive, Non-Chloride Accelerator: The admixture shall conform to ASTM C494, Type C or E, and not contain more chloride ions than are present in municipal drinking water. The admixture manufacturer must have long-term non-corrosive test data from an independent testing laboratory (of at least a year's duration) using an acceptable accelerated corrosion test method such as that using electrical potential measures.
    - a. Acceptable Manufacturers:
      - (1) Accelguard 80; The Euclid Chemical Co.
      - (2) Or Equal.
  - 4. Water-Reducing, Retarding Admixture: ASTM C494, Type D, and containing not more than 0.5% chloride ions.
    - a. Acceptable Manufacturers:
      - (1) Pozzoloth Retarder; Master Builders.
      - (2) Daratard; W.R. Grace.
      - (3) Plastiment; Sika Chemical Co.
      - (4) Eucon Retarder-75; The Euclid Chemical Co.
      - (5) Or Equal.
  - 5. Prohibited Admixtures: Calcium chloride thiocyanates or admixtures containing more than 0.5% chloride ions are not permitted.
- F. Preformed Expansion Joint Fillers (Sidewalks, Curbs & Driveways):
  - 1. Nonextruding and Resilient Bituminous Fiber Types (Exterior Use): ASTM D1751.
- G. Curing Compound (curing only, not sealing): Maximum moisture loss of 0.04 g/sq.cm.
  - 1. Acceptable Manufacturers:
    - a. Kurez DR by Euclid Chemical Company.
    - b. Or Equal.
- H. Absorptive Cover: Burlap cloth made from jute or kenaf, weighing approximately 9 ounces per square yard, complying with AASHTO M 182, Class 2.

- I. Moisture-Retaining Cover: One of the following, complying with ASTM C171.
  - 1. Polyethylene film.
- J. Epoxy Bonding Adhesive: ASTM C881, two component material suitable for use on dry or damp surfaces. Provide material "Type", "Grade", and "Class" to suit project requirements.
  - 1. Acceptable Manufacturers:
    - a. Epoxitite; A. C. Horn, Inc.
    - b. Sikadur Hi-Mod; Sika Chemical Corp.
    - c. Or Equal.

## 2.02 PROPORTIONING AND DESIGN OF MIXES

- A. Prepare design mixes for each type and strength of concrete by either laboratory trial batch or field experience methods as specified in ACI 301. If trial batch method used, use an independent testing facility acceptable to Owner's Representative for preparing and reporting proposed mix designs. The testing facility shall not be the same as used for field quality control testing. If trial batches are used, the mix design shall be prepared by an independent testing laboratory and shall achieve an average compressive strength 1,200 psi higher than the specified strength. This over-design shall be increased to 1,400 psi when concrete strengths over 5,000 are used.
- B. Submit written reports to Owner's Representative of each proposed mix for each class of concrete at least 15 days prior to start of work. Do not begin concrete production until mixes have been reviewed by Owner's Representative.
- C. Design Mixes: Provide normal weight concrete with the following properties, as indicated on drawings and schedules:
  - 1. 4,000 psi 28-day compressive strength (Manhole Construction).
  - 2. 3,000 psi 28-day compressive strength (Pipe Encasement, Cradles, Thrust Blocks, Miscellaneous Concrete, and Channel Fill).
  - 3. Design mixes for driveways, curbs, gutters, and sidewalks shall be in accordance with the latest edition of Amity Township's Code of Ordinances found in Chapter XXVI entitled "Streets, Sidewalks, Driveways, and Curbs".
- D. Admixtures:
  - 1. Use water-reducing admixture or high range water-reducing admixture (super plasticizer) in concrete as required for placement and workability.
  - 2. Use non-corrosive, non-chloride accelerating admixture in concrete slabs placed at ambient temperatures below 50°F (10°C).
  - 3. Use high-range water-reducing admixture in pumped concrete, concrete for industrial slabs, architectural concrete, parking structure slabs, concrete required to be watertight, and concrete with water/cement ratios below 0.50.
  - 4. Use air-entraining admixture in exterior exposed concrete, unless otherwise indicated. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having total air content with a tolerance of  $\pm 1\frac{1}{2}$  percent within following limits:
    - a. Concrete structures and slabs exposed to freezing and thawing, deicer chemicals, or subjected to hydraulic pressure:
      - (1) 4.5 percent (moderate exposure); 5.5 percent (severe exposure) 1-1/2" max. aggregate. 4.5 percent (moderate exposure); 6.0 percent (severe exposure) 1" max. aggregate.

- (2) 5.0 percent (moderate exposure); 6.0 percent (severe exposure) 3/4" max. aggregate.
    - (3) 5.5 percent (moderate exposure); 7.0 percent (severe exposure) 1/2" max. aggregate.
  - b. Other Concrete (not exposed to freezing, thawing, or hydraulic pressure): 2 percent to 4 percent air.
- E. Use admixtures for water-reducing and set-control in strict compliance with manufacturer's directions. Admixtures must be included in initial mix design approved by Owner's Representative and cannot be either added or deleted from the mix without prior approval of Owner's Representative.
- F. Water-Cement Ratio: Provide concrete for following conditions with maximum water-cement (W/C) ratios as follows:
  - 1. Subjected to freezing and thawing; W/C 0.50.
  - 2. Subjected to deicers/watertight; W/C 0.45.
- G. Slump Limits: Proportion and design mixes to result in concrete slump at point of placement as follows:
  - 1. Ramps, slabs, and sloping surfaces: Not more than 3".
  - 2. Reinforced foundation systems: Not less than 1" and not more than 3".
  - 3. Other concrete: Not less than 1" nor more than 4".

## 2.03 CONCRETE MIXES

- A. Job-Site Mixing: Mix materials for concrete in appropriate drum type batch machine mixer. For mixers of one cubic yard, or smaller capacity, continue mixing at least 1½ minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released. For mixers of capacity larger than one cubic yard, increase minimum 1½ minutes of mixing time by 15 seconds for each additional cubic yard, or fraction thereof.
  - 1. Provide batch ticket for each batch discharged and used in work, indicating project identification name and number, date, mix type, mix time, quantity and amount of water introduced.
- B. Ready-Mix Concrete: Comply with requirements of ASTM C94, and as herein specified.
  - 1. During hot weather, or under conditions contributing to rapid setting of concrete, a shorter mixing time than specified in ASTM C94 may be required.
  - 2. When air temperature is between 85°F (30°C) and 90°F (32°C), reduce mixing and delivery time from 1½ hours to 75 minutes, and when air temperature is above 90°F (32°C), reduce mixing and delivery time to 60 minutes.
  - 3. Provide batch ticket for each batch delivered and used indicating project identification name and number, date mix type, admixtures, mix time, quantity and amount of water used.
  - 4. Production of Concrete (Ready-Mixed):
    - a. Plant equipment and facilities shall conform to the Check List for Certification of Ready Mixed Concrete Production Facilities of the National Ready Mixed Concrete Association.

## PART 3 – EXECUTION

### 3.01 PREPARATION

- A. Inspect work to receive cast-in-place concrete for deficiencies which would prevent proper execution of the finished work. Do not proceed with placing until such deficiencies are corrected.
- B. Embedded Items: Place piping and other embedded items required for adjoining work prior to concreting. Place accurately, and support against displacement.
  - 1. Apply Epoxy bonding Compound over prepared surfaces of embedded items where required under other Sections of these Specifications.
- C. Coordinate the installation of joint materials with placement of forms and reinforcing steel.
- D. Prepare formwork in advance and remove snow, ice, water and debris from within forms. Formwork as specified in Section 03100.
- E. Sprinkle subgrades sufficiently to eliminate water loss from concrete.
- F. Pre-position joint materials, anchors and embedded items.

### 3.02 CONCRETE PLACEMENT

- A. General: Comply with ACI 304 “Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete”, and as herein specified.
- B. Conveying:
  - 1. Handle concrete from mixer to final deposit rapidly by methods which will prevent segregation or loss of ingredients to maintain required quality of concrete.
  - 2. Do not convey concrete through aluminum or aluminum alloy.
  - 3. Do not place concrete by pumps or other similar devices without prior written approval of Owner’s Representative.
- C. Depositing:
  - 1. Do not allow concrete to drop vertically more than 4 feet.
  - 2. Deposit in approximately horizontal layers of 12 to 18 inches.
  - 3. Do not allow concrete to flow laterally more than 3 feet.
  - 4. Make placement continuously to produce monolithic unit.
  - 5. Carry on placing at such a rate that concrete which is being integrated with fresh concrete is still plastic.
  - 6. Do not deposit concrete on concrete which has hardness sufficiently to cause the formation of seams or planes of weakness within sections.
  - 7. Do not use concrete which has partially hardened or has been contaminated by foreign materials.
  - 8. Do not subject concrete to procedures which will cause segregation.
  - 9. Do not place concrete in forms containing standing water.
  - 10. Do not place concrete on frozen ground.

- D. Cold Weather Placing: Protect concrete work from physical damage or reduced strength which could be caused by frost, freezing actions, or low temperatures, in compliance with ACI 306 and as herein specified.
1. If water or aggregate is heated above 100°F, combine water with aggregate in the mixer before cement is added. Do not mix cement with water or with mixtures of water and aggregate having a temperature greater than 100°F.
  2. Provide materials and methods for protecting concrete from freezing during freezing or near-freezing weather. Do not use frozen materials or materials containing snow or ice.
  3. Surfaces which the concrete is to come in contact with must be free of frost, snow and ice.
  4. Concrete placed in forms shall have a temperature of 50°F or higher after placement.
- E. Hot Weather Placing: When hot weather conditions exist that would seriously impair quality and strength of concrete, place concrete in compliance with ACI 305 and as herein specified.
1. Temperature of concrete delivered at the job-site shall not exceed 90°F.
  2. Cool ingredients before mixing to prevent temperature in excess of 90°F.
  3. Make provisions for windbreaks, shading, fog spraying, sprinkling or wet cover when necessary.
- F. Consolidation:
1. Consolidate concrete by vibration, spading, rodding, or other manual methods. Work concrete around embedded items and eliminate air or stone pockets and other causes of honeycombing, pitting, or planes of weakness.
  2. Use vibration equipment of internal type and not the type attached to forms and reinforcement.
  3. Use vibrators capable of transmitting vibration to concrete in frequencies sufficient to provide satisfactory consolidation.
  4. Do not leave vibrators in one spot long enough to cause segregation. Remove concrete segregated by vibrator operation.
  5. Do not use vibrators to spread concrete.
  6. Have sufficient reserve vibration equipment to guard against shutdown of work occasioned by failure of equipment in operation.

### 3.03 FINISHING

- A. Floated Finish: After concrete has been placed, consolidated, struck off and leveled, do not work further until ready for floating. Begin floating when water sheen has disappeared and when the surface has stiffened sufficiently to permit the operation. During or after first floating, check planeness of surface with a ten foot straightedge applied at not less than two different angles. Cut down high spots and fill low spots during this procedure to produce a surface with true planes within 1/4-inch in ten feet as determined by a ten foot straightedge placed anywhere on the slab in any direction. Following straightedge checking, refloat slab immediately to a uniform sandy texture.
- B. Trowel and Fine Broom Finish: Apply trowel finish to monolithic slab surfaces to be exposed-to-view, such as sidewalks and driveways.
1. After floating, begin first trowel finish operation using a power-driven trowel. Begin final troweling when surface produces a ringing sound as trowel is moved over surface.
  2. Consolidate concrete surface by final hand-troweling operation, free of trowel marks, uniform in texture and appearance.

3. Immediately after trowel finishing, slightly roughen concrete surface by brooming with fiber bristle broom perpendicular to main traffic route. Coordinate required final finish with Owner's Representative before application.

C. Manhole Channel:

1. Steel Trowel Finish: Obtained by hand troweling a Floated Finish. First troweling after floating shall produce a smooth surface which is relatively free of defects but which may still show some trowel marks. Perform additional trowelings by hand after the surface has hardened sufficiently. Perform final troweling when a ringing sound is produced as the trowel is moved over the surface. Thoroughly consolidate surface by hand trowel operations. Produce finished surface essentially free of trowel marks and uniform in texture and appearance.

### 3.04 CONCRETE CURING AND PROTECTION

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

1. Start initial curing as soon as free water has disappeared from concrete surface after placing and finishing. Weather permitting, keep continuously moist for not less than 7 days.

B. Curing Methods: Perform curing of concrete by curing and sealing compound, by moist curing, by moisture-retaining cover curing, and by combinations thereof, as herein specified.

1. Provide moisture curing by following methods.
  - a. Continuous water-fog spray.
  - b. Covering concrete surface with specified absorptive cover, thoroughly saturating cover with water and keeping continuously wet. Place absorptive cover to provide coverage of concrete surfaces and edges, with 4" lap over adjacent absorptive covers.
2. Apply specified curing and sealing compound to concrete slabs as soon as final finishing operations are complete (within 2 hours).
3. Apply uniformly in continuous operation by power-spray or roller in accordance with manufacturer's directions.
4. Recoat areas subjected to heavy rainfall within 3 hours after initial application.
5. Maintain continuity of coating and repair damage during curing period.

C. Curing Formed Surfaces: Cure formed concrete surfaces, including undersides of beams, supported slabs and other similar surfaces by moist curing with forms in place for full curing period or until forms are removed. If forms are removed, continue curing by methods specified above, as applicable.

### 3.05 QUALITY CONTROL

A. Contractor will employ a testing laboratory to perform tests and to submit test reports.

B. Sampling and testing for quality control during placement of concrete may include the following, as directed by Owner's Representative.

1. Sampling Fresh Concrete: ASTM C172, except modified for slump to comply with ASTM C94.
2. Slump: ASTM C143; one test at point of discharge for each load of each type of concrete; additional tests when concrete consistency seems to have changed.



3. Air Content: ASTM C173, volumetric method for lightweight or normal weight concrete; ASTM C231 pressure method for normal weight concrete; one for each day's pour of each type of air-entrained concrete.
  4. Concrete Temperature: Test hourly when air temperature is 40°F (4°C) and below, and when 80°F (27°C) and above; and each time a set of compression test specimens made.
  5. Compression Test Specimen: ASTM C31; one set of four standard cylinders for each compressive strength test, unless otherwise directed. Mold and store cylinders for laboratory cured test specimens except when field-cure test specimens are required.
  6. Compressive Strength Tests: ASTM C39; one set for each day's pour exceeding 5 cu. yds. plus additional sets for each 50 cu. yds. over and above the first 25 cu. yds. of each concrete class placed in any one day; one specimen tested at 7 days, two specimens tested at 28 days, and one specimen retained in reserve for later testing if required.
    - a. When total quantity of a given class of concrete is less than 50 cu. yds., strength test may be waived by Owner's Representative if, in his judgment, adequate evidence of satisfactory strength is provided.
    - b. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, evaluate current operations and provide corrective procedures for protecting and curing the in-place concrete.
    - c. Strength level of concrete will be considered satisfactory if averages of sets of three consecutive strength test results equal or exceed specified compressive strength, and no individual strength test result falls below specified compressive by more than 500 psi.
- C. Test results will be reported in writing to Owner's Representative and Contractor within 24 hours after tests. Reports of compressive strength tests shall contain the project identification name and number, date of concrete placement, name of concrete testing service, concrete type and class, location of concrete batch in structure, design compressive strength at 28 days, concrete mix proportions and materials; compressive breaking strength and type of break for both 7-day tests and 28-day tests.
- D. Additional Tests: The testing service will make additional tests of in-place concrete when test results indicate specified concrete strengths and other characteristics have not been attained in the structure, as directed by Owner's Representative. Testing service may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42, or by other methods as directed. Contractor shall pay for such tests when unacceptable concrete is verified.

END OF SECTION