

## SECTION 2.4 - CAST-IN-PLACE CONCRETE

### **2.04.01 GENERAL**

- A. **Cementitious Materials:** Portland cement alone or in combination with one or more of blended hydraulic cement, pozzolans, and ground granulated blast-furnace slag. Materials shall be in accordance with ACI 232.2 R-96 and ACI 233 R-95.
- B. Contractor shall provide all labor, materials, and appurtenances for construction of concrete sidewalk, curb, and gutter where indicated in these standards and details.

### **2.04.02 SUBMITTALS**

**All submittals shall be approved by the Town prior to ordering concrete.**

- A. **Design Mixes:**
  - 1. **Sidewalk shall utilize MD-SHA Mix 3, air entrained, 3500 psi 28-day compressive strength.** Include alternate mix designs when characteristics of materials, project conditions, weather, test results, or other circumstances warrant adjustments.
  - 2. **Curb and gutter shall utilize MD-SHA Mix 7, air entrained, 4200 psi 28-day compressive strength.** Include alternate mix designs when characteristics of materials, project conditions, weather, test results, or other circumstances warrant adjustments.
- B. **Steel Reinforcement Shop Drawings:** Details of fabrication, bending, and placement, prepared according to ACI 315.
- C. **Material Test Reports:** From a qualified testing agency indicating and interpreting test results for compliance of the following, with requirements indicated, based on comprehensive testing of current materials: **Slump, temperature, air entrainment, and 7 and 28-day compressive strength. Three (3) cylinder break tests shall be performed for each truckload of concrete delivered. Slump, air entrainment and temperature shall be tested prior to placement.**
- D. **Material Certificates:** Each truckload delivered to the site shall provide a computer printed delivery ticket. Material Certificates shall be signed by manufacturers certifying that each of the following items complies with requirements:
  - 1. **Cementitious materials, aggregates, and water.**
  - 2. Form materials and form-release agents.
  - 3. Steel reinforcement and reinforcement accessories.
  - 4. Admixtures.
  - 5. Curing materials.
  - 6. Floor and slab treatments.
  - 7. Bonding agents.
  - 8. Adhesives.

9. Vapor retarders.
10. Joint-filler strips.
11. **Additives (no unapproved additives without prior approval).**
12. Time of mix (Maximum delivery time between adding water at the batch plant to placement shall not be greater than 1 ½ hours.)

#### 2.04.03 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 to conduct the testing indicated, as documented according to ASTM E 548.
  1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.
  2. **Qualifications for testing agency shall be submitted for review and approval.**
- B. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, each aggregate from one source, and each admixture from the same manufacturer.

#### 2.04.04 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.
- B. Epoxy-Coated Reinforcing Bars: ASTM A775/A775M (where indicated).
- C. Deformed-Steel Welded Wire Fabric: ASTM A 497, flat sheet.
- D. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
  1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.
- E. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials.
- F. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
  1. Shop- or field-weld reinforcement according to AWS D1.4, where indicated.
- G. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- H. Install welded wire fabric in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing.

Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

#### **2.04.05 REINFORCEMENT ACCESSORIES**

- A. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete or fiber-reinforced concrete of greater compressive strength than concrete, and as follows:
  - 1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected or CRSI Class 2 stainless-steel bar supports.
- B. Epoxy-Coated Joint Dowel Bars: ASTM A 775/A 775M; with ASTM A 615/A615M, Grade 60, (where indicated).
- C. Epoxy Repair Coating: Liquid, two part, epoxy repair coating; compatible with epoxy coating on reinforcement and complying with ASTM A 775/A775M.

#### **2.04.06 CONCRETE MATERIALS**

- A. Portland Cement: ASTM C 150, Type I/II.
- B. Normal-Weight Aggregate: ASTM C 33, uniformly graded, and as follows:
  - 1. Nominal Maximum Aggregate Size: 1-1/2 inches (38 mm).  
  
Combined Aggregate Gradation: Well graded from coarsest to finest with not more than eighteen (18) percent and not less than 8 percent retained on an individual sieve, except that less than eight (8) percent may be retained on coarsest sieve and on No. 50 (0.3 mm) sieve, and less than 8 percent may be retained on sieves finer than No. 50 (0.3 mm).
- C. Water: Potable and complying with ASTM C 94.
- D. All materials and construction methods shall be in accordance with the Maryland Department of Transportation Standard Specifications newest edition with all subsequent amendments. Concrete curb shall be constructed per Section 602, paragraphs 602.01 through 602.04.02. Concrete sidewalks shall be constructed per Section 603, paragraphs 603.01 through 603.04.02.

#### **2.04.07 ADMIXTURES**

- A. Air Entraining Admixture: ASTM C260, certified by manufacturer to be compatible with other required admixtures. Provide one of the following:

"AEA-92" or "Air Mix 200"	The Euclid Chemical Co.
"Pozzolith Normal"	Master Builders
"WRDA"	W.R. Grace Co.
"Plastocrete 160"	Sika Chemical Corp.

#### **2.04.08 RELATED MATERIALS**

- A. Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber.
- B. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
- C. Epoxy-Bonding Adhesive: ASTM C 881, two (2)-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class and grade to suit requirements, and as follows:
  - 1. Type: Class I and II, non-load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.
- D. Anti-Corrosion Epoxy Adhesive: Water-based epoxy resin for adhesion and corrosion protection of reinforcing members (Twenty-four (24)-hour maximum open time). Products: Subject to compliance with requirements, providing one of the following:
  - 1. Corr-Bond; Euclid Chemical Co.
  - 2. Armatec 110; Sika Corp.

#### **2.04.09 CONCRETE MIXES**

- A. Prepare design mixes for each type and strength of concrete determined by either laboratory trial mix or field test data bases, as follows:
  - 1. Proportion normal-weight concrete according to ACI 211.1 and ACI 301.
- B. Use a qualified independent testing agency for preparing and reporting proposed mix designs for the laboratory trial mix basis.
- C. **Sidewalks: Proportion normal-weight concrete mix as follows:**
  - 1. **Compressive Strength (Twenty-eight (28) days): 3500 psi.**
  - 2. **Minimum Cementitious Materials Content: 580 lb/cu. yd. for concretes with 57 stone.**
  - 3. **Maximum Slump: Four (4") inches. (For Slip Form curb Machines, slump shall be 1 ½ -2 inches)**
- D. **Curb & Gutter Proportion normal-weight concrete mix as follows:**
  - 1. **Compressive Strength (Twenty-eight (28) days): 4200 psi.**

2. **Minimum Cementitious Materials Content:** 611 lb/cu. yd. for concretes with 57 stone.
  3. **Maximum Slump:** Four (4") inches. (For Slip Form curb Machines, slump shall be 1 ½ -2 inches)
- E. Cementitious Materials: Limit percentage, by weight, of cementitious materials (in accordance with ACI 232.2R-96, and ACI 233R-95) other than Portland cement in concrete to Twenty-five (25) percent Combined Fly Ash and Pozzolan or Ground Granulated Blast-Furnace Slag.
- F. Maximum Water-Cementitious Materials Ratio:
1. All concrete unless otherwise noted 0.45
  2. Building slabs, footings, and sidewalks 0.50
- G. Air Content: Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content of 6% with a tolerance of plus or minus 1 percent, unless otherwise indicated.

#### **2.04.10 CONCRETE MIXING**

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94 and ASTM C 1116, and furnish batch ticket information.
1. When air temperature is between eighty-five (85) and ninety (90) deg F (30 and 32 deg C), reduce mixing and delivery time from 1-1/2 hours to seventy-five (75) minutes; when air temperature is above ninety (90) deg F (32 deg C), reduce mixing and delivery time to sixty (60) minutes.
- B. Time Limit: When either Type I or Type II Portland cements are in use, the elapse time between the initial contact of the cement with water and the discharge of the batch on the job shall not be more than 1 ½ hours or 300 revolutions.

#### **2.04.11 JOINTS**

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Install so strength, watertightness and appearance of concrete are not impaired, at locations indicated or as approved by Engineer. Maximum distance between construction joints shall be forty (40) feet.
1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints, unless otherwise indicated.
  2. Locate joints for beams, slabs, and walls in the middle third of spans.
  3. Space vertical joints in walls as indicated.

4. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
  5. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- C. **Contraction Joints in Slabs-on-Grade:** Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness, as follows:
1. **Grooved Joints:** For sidewalks and as indicated, form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
  2. **Sawed Joints:** Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch-(3-mm-) wide joints into concrete as soon as cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.
- D. **Isolation Joints in Slabs-on-Grade:** After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface, unless otherwise indicated.
- E. **Dowel Joints:** Install dowel sleeves and dowels or dowel bar and support assemblies at joints where indicated.
1. Use dowel sleeves or lubricate or asphalt-coat one-half of dowel length to prevent concrete bonding to one side of joint, unless noted otherwise.
- F. **Curb and Sidewalks** shall have proper control joints installed at ten (10) foot intervals for curb and five (5) foot intervals for sidewalk. Expansion joints shall be placed at one hundred (100) foot intervals for curb and at the point of tangent or curve. Expansion joints for sidewalk shall be at twenty (20) foot intervals and at changes in direction.

#### **2.04.12 CONCRETE PLACEMENT**

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed. The subgrade of all slabs shall be thoroughly wetted with water prior to placement of concrete, especially during hot, dry or windy conditions.
- B. Do not add water to concrete during delivery, at Project site, or during placement, unless approved by the Town Engineer.

- C. Deposit concrete continuously or in layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as specified. Deposit concrete to avoid segregation.
- D. Dropping of concrete over four (4) feet or through a cage of reinforcing steel will not be permitted.
- E. Concrete shall not be deposited during rain. Concrete shall not be deposited into areas of standing or running water.
- F. Maximum Pours: Maximum length of all pours shall be forty (40) feet (12.1 m), unless otherwise noted or approved by Engineer. All joints shall be as approved by the Engineer or as detailed on the drawings. All reinforcement, forms and ground with which concrete is to come in contact, shall be free of frost.
- G. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
  - 1. When air temperature has fallen to or is expected to fall below forty (40) deg F (4.4 deg C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than fifty (50) deg F (10 deg C) and not more than eighty (80) deg F (27 deg C) at point of placement.
  - 2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
  - 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators, unless otherwise specified and approved in mix designs.
  - 4. Protection After Placement: Suitable means as defined in ACI 306 shall be provided for maintaining a temperature in the concrete of at least fifty (50) degrees F for not less than three (3) days after the concrete is placed. For a period of seven (7) days, the concrete shall not be exposed to a temperature below forty (40) degrees F.
  - 5. Concrete placement shall be made when air temperature is at least thirty-two (32) degrees F and rising, unless special precautions acceptable to the Engineer,
- H. Hot-Weather Placement: Place concrete according to recommendations in ACI 305R and as follows, when hot-weather conditions exist:
  - 1. Cool ingredients before mixing to maintain concrete temperature below ninety (90) deg F (32 deg C) at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
  - 2. Cover steel reinforcement with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.

3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

#### **2.04.13 FINISHING FORMED SURFACES**

- A. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defective areas. Remove fins and other projections exceeding 1/8 inch (3 mm) in height.
  1. Apply to concrete surfaces exposed to public view or to be covered with a coating or covering material applied directly to concrete, such as waterproofing, dampproofing, veneer plaster, or painting.
  2. Do not apply rubbed finish to smooth-formed finish.
- A. Rubbed Finish: Apply the following to smooth-formed finished concrete:
  1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process and mortar used for concrete repair.
- B. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

#### **2.04.14 MISCELLANEOUS CONCRETE ITEMS**

- A. Filling In: Fill in holes and openings left in concrete structures, unless otherwise indicated, after work of other trades is in place. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete Work.
- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

#### **2.04.15 CONCRETE PROTECTION AND CURING**

- A. General: Take curing measures immediately after casting and extend period according to the Engineer's/Architect's recommendation based upon prevailing temperature, wind, and relative humidity.
  1. Keep concrete continuously moist for minimum fourteen (14) days after casting.
  2. Maintain concrete temperature at minimum fifty (50) degrees Fahrenheit for seven (7) days after casting.



3. Avoid alternate wetting and drying and fluctuations of concrete temperature.
  4. Protect fresh concrete from direct rays of sun, rain, drying winds, soiling, and damage.
  5. Do not permit curing method to affect adversely finished or treatments applied to finished concrete.
- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions will cause excessive moisture loss before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- C. Curing/Sealing Methods for Slabs: Cure all concrete surfaces with one or a combination of the following methods. Where a specific curing procedure is not specified, at the Contractor's selection, one or more of the following methods shall be used.
1. Water curing: Keep concrete surfaces continuously wet with clean water during the curing period by immersion, maintaining a continuous flow of water over the surface, continuous spraying, continuous sprinkling or a combination of these. For all curing methods, the difference in temperature between the water used for curing and the concrete shall not exceed twenty (20) degrees Fahrenheit.
  2. Wet Coverings: Cover the concrete surfaces with burlap, cotton mats, sand, earth, or other suitable moisture retaining materials and keep these materials saturated during the curing period. Lap all fabrics at least eight (8") inches at all joints. On exposed concrete, do not use any type covering which will discolor the concrete surface.
  3. Waterproof coverings: As soon as possible after finishing, thoroughly wet the concrete surfaces and cover the concrete surfaces with waterproof paper or plastic film immediately after wetting. For a period or at least eight (8) hours after the concrete has taken its initial set, maintain a continuous flow of clean water over the concrete surface under the covering. Lap all joints in the covering at least eight (8") inches and provide weights and other means and methods to keep the waterproof covering in direct contact with the concrete during the curing period.
  4. Membrane forming curing compounds: All exposed interior slabs, not receiving a liquid densifier, and troweled slabs receiving mastic applied adhesives or "shake-on" hardeners shall be cured with the specified curing and sealing compound. Exterior slabs, sidewalks, curbs, and architectural concrete, not receiving a penetrating sealer, shall be cured with the specified clear, non-yellowing curing and sealing compound. Maximum coverage shall be 200 ft<sup>2</sup>/gallon on steel troweled surfaces and 150 ft<sup>2</sup>/gallon on floated or broomed surfaces for the curing/sealing compound.
- D. Curing methods for Walls: Cure all concrete walls as follows: Keep forms wet during period forms are required to remain in place. Immediately after formed concrete has taken its initial set, start a gently uniform flow of clean water over concrete to thoroughly wet all concrete surfaces and formwork and maintain this flow of water until forms are

removed. Immediately after form removal cure concrete surfaces with one of the curing methods specified above.

- E. Other Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing by one or a combination of the following methods listed in paragraph F below.
- F. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces, by one or a combination of the following methods:
  - 1. Moisture Curing: Keep surfaces continuously moist for not less than seven (7) days with the following materials:
    - a. Water.
  - 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least twelve (12") inches (300 mm), and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
    - a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
    - b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
    - c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer recommends for use with floor coverings.
  - 3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
  - 4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process twenty-four (24) hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.
- G. Do not apply loads to elevated slabs, walls, and beams for twenty-eight (28) days or until approved concrete tests document concrete has reached 100% of specified minimum compressive strength.

#### **2.04.16 FILLING**

- A. Prepare, clean, and install joint filler according to manufacturer's written instructions.
- B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.
- C. Install semirigid epoxy joint filler full depth in saw-cut joints and at least two (2") inches (50 mm) deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

#### **2.04.17 FIELD QUALITY CONTROL**

- A. Testing Agency: Contractor shall, at his discretion, engage a qualified independent testing and inspecting agency to sample materials, perform tests, and submit test reports during concrete placement. Agency shall be approved by the Town Engineer.
- B. The Town shall have the right to hire an outside agency to perform independent testing as the Town sees fit. The Contractor shall coordinate and schedule all sampling in advance.
- C. Testing Services: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
  - 2. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mix exceeding five (5) cu. yd. (4 cu. m), but less than twenty-five (25) cu. yd. (19 cu. m), plus one (1) set for each additional fifty (50) cu. yd. (38 cu. m) or fraction thereof.
  - 3. Slump: ASTM C 143; one (1) test at point of placement (prior to pumping) for each truck delivered. Perform additional tests when concrete consistency appears to change.
  - 4. Air Content: ASTM C 231, pressure method, for normal-weight concrete; ASTM C 173, volumetric method, for structural lightweight concrete; one (1) test for each truck delivered (prior to pumping).
  - 5. Concrete Temperature: ASTM C 1064; one (1) test hourly when air temperature is forty (40) deg F (4.4 deg C) and below and when eighty (80) deg F (27 deg C) and above, and one (1) test for each truck delivered (prior to pumping).
  - 6. Unit Weight: ASTM C 567, fresh unit weight of structural lightweight concrete; one (1) test for each composite sample, but not less than one (1) test for each day's pour of each concrete mix.
  - 7. Compression Test Specimens: ASTM C 31/C 31M;
    - a. Cast and laboratory cure one (1) set of four (4) standard cylinder specimens for each truck delivered.
    - b. Cast and field cure one (1) set of four (4) standard cylinder specimens for each day's pour.

- c. Cast extra two (2) cylinders for each day's pour (fourteen (14) day compressive strength)
  - d. Cast two (2) extra cylinders per pour.
- 8. Compressive-Strength Tests: ASTM C 39;
  - a. Test two (2) laboratory-cured specimens at seven (7) days, two (2) at fourteen (14) days, and two (2) at twenty-eight (28) days.
  - b. Test two (2) field-cured specimens at seven (7) days, two (2) at fourteen (14) days, and two (2) at twenty-eight (28) days.
  - c. A compressive-strength test shall be the average compressive strength from two (2) specimens obtained from same composite sample and tested at age indicated.
- D. When strength of field-cured cylinders is less than eighty-five (85) percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
- E. Strength of each concrete mix will be satisfactory if every average of any three (3) consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 250 psi (3.4 MPa).
- F. Test results shall be reported in writing to Engineer, concrete manufacturer, and Contractor within forty-eight (48) hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work per plan stationing, design compressive strength at Seven (7) and twenty-eight (28) days, concrete mix proportions and materials, compressive breaking strength, and type of break for all tests.
- G. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Engineer but will not be used as sole basis for approval or rejection of concrete.
- H. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Engineer. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42 or by other methods as directed by Engineer. Contractor shall pay for cored cylinder collections and testing if standard cylinder specimens fail to confirm conformance with the specifications.
- I. Testing agency shall verify that the subgrade is properly compacted prior to placing concrete.

- J. The Engineer or his representative shall verify that the area of concrete work is properly prepared, free of water, free of unstable materials and that the reinforcement at driveways, ramps, valley gutters, etc. is in place and properly supported.

#### **2.04.18 Sidewalks, Curbs and Driveways**

A. Methods and Materials:

1. Minimum ultimate compressive strength of concrete shall be 3500 pounds per square inch (psi) at the end of 28 days per Maryland State Highway Administration Standard for sidewalk, Mix No. 3, and 4200 psi for curb and gutter, Mix No. 7. Submit mix design for approval. All concrete shall be air entrained.
2. Curbs shall be depressed at all existing driveway and handicapped ramp locations in accordance with both the Maryland Department of Transportation and Americans with Disabilities Act Standards, including proper preparation of subgrade and proper placing and spacing of joint and joint materials.
3. The Contractor shall permanently repair or relay all curbs, sidewalks and driveways that have been removed, broken, or otherwise injured in excavating any of the work under the contract or injured by settlement of any backfilled excavation at any time prior to termination of the contract and guarantee period.
4. New curb and sidewalk or replacement of areas damaged during construction shall be installed in accordance with the Standard Details. Install wheelchair curb ramps at all street corners constructed.

#### **2.04.19 SUBBASE**

- A. Base for concrete curbing shall be select borrow as detailed on the plans. Compact subgrade to at least 95% (percent) of maximum density as determined by ASTM D1557 at or near optimum moisture.
- B. Where subgrade is unsuitable, the Contractor shall excavate below subgrade and install crusher run as required to stabilize prior to placing curb.

#### **2.04.20 RECONSTRUCTION OF PRIVATE DRIVEWAYS**

Saw cut existing driveways if sections are acceptable for re-use. Prior to replacement of driveways, the Contractor, Engineer and Town shall review field conditions. The Town will designate the extent of additional removal and replacement. Upon completion of utility construction, the Contractor shall reconstruct private driveways in kind except as follows:

A. Concrete Driveways

1. Concrete driveways shall be replaced and reconstructed upon a properly prepared, graded and compacted subgrade and in compliance with MD-SHA requirements.
2. Driveways shall be constructed to a minimum thickness of 6-inches and shall be reinforced with 6-inch by 6-inch wire mesh of 10-10 gauge if materials removed were reinforced before.
3. Restoration shall provide for a smooth transition from back of sidewalk or driveway construction to undisturbed areas and shall be free of all localized depressions or abrupt changes in grade that may trap or otherwise misdirect surface drainage or represent possible damage to vehicular travel.

**2.04.21 SIDEWALK CONSTRUCTION**

- A. Concrete sidewalks shall be replaced as required, or as directed, in accordance with the Standard Details. Handicapped ramps shall be installed where shown on the plans, in accordance with current ADA requirements.
- B. Sidewalks in areas not subject to vehicular loading shall have a minimum thickness of 4-inches of concrete placed upon a properly prepared, graded and compacted subgrade.
- C. Sidewalks in vehicular loading areas and Handicapped ramps shall be a minimum thickness of 6-inches reinforced with 6-inch by 6-inch W1.4 by W1.4 wire mesh. Subgrade shall be prepared as stated for non-load areas.
- D. Brick sidewalks shall have 4" graded aggregate, compacted to 95% of ASTM 1557, with 1/2" sand between the aggregate and brick.
- E. In driveway and handicapped ramp locations, 4" of graded aggregate, compacted to 95% of ASTM 1557, shall be placed beneath a 6" reinforced concrete slab with a 1/2" sand bedding beneath the brick sidewalk.
- F. Replacements of partial sections of concrete sidewalk, where so directed, shall be extended to the nearest existing joint in each direction.
- G. Sidewalks shall be replaced to a width equal to that existing prior to start of construction and such width shall be maintained throughout the entire length of the block.
- H. A broom finish shall be applied perpendicular to the direction of traffic. Trowel picture frame finish at each control or expansion joint.
- I. Cold weather construction shall conform to the Maryland SHA standards.

END OF SECTION