

**SECTION 32 05 23
CEMENT AND CONCRETE FOR EXTERIOR IMPROVEMENTS**

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section shall cover site work concrete constructed upon the prepared subgrade and in conformance with the lines, grades, thickness, and cross sections shown. Construction shall include the following:
- B. Pedestrian Pavement: Walks

1.2 RELATED WORK

- A. Concrete Materials, Quality, Mixing, Design and Other Requirements: Section 03 30 53, SHORT FORM CAST-IN-PLACE CONCRETE.

1.3 DESIGN REQUIREMENTS

Design all elements with the latest published version of applicable codes.

1.4 WEATHER LIMITATIONS

Placement of concrete shall be as specified under Article 3.4 E., for Cold Weather Placement and Article 3.4 D., for Cold Weather Placement of Section 03 30 53, SHORT FORM CAST-IN-PLACE CONCRETE.

1.5 SUBMITTALS

- A. Furnish the following:
- B. Manufacturers' Certificates and Data certifying that the following materials conform to the requirements specified.
 - 1. Expansion joint filler
 - 2. Curing materials

1.6 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only. Refer to the latest edition of all referenced Standards and codes.
- B. American Association of State Highway and Transportation Officials (AASHTO):
 - M31M/M31-15..... Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
 - M55M/55M-09.....Welded Steel Wire Fabric for Concrete Reinforcement (ASTM A185)
 - M147-04.....Materials for Aggregate and Soil-Aggregate Subbase, Base and Surface Courses (R 1996)
 - M148-05.....Liquid Membrane-Forming Compounds for Curing Concrete (ASTM C309A)
 - M171-05.....Sheet Materials for Curing Concrete (ASTM C171

- M182-05.....Burlap Cloth Made from Jute or Kenaf
- M213-01.....Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction
(Non-extruding and Resilient Bituminous Type)
(ASTM D1751)

C. American Society for Testing and Materials (ASTM):

- C94/C94M-16.....Ready-Mixed Concrete
- C143/C143M-15a.....Slump of Hydraulic Cement Concrete
- C1116/C1116M-10a.....Fiber Reinforced Concrete
- D5893/D5893M-10 Cold Applied, Single Component, Chemically Curing Silicone Joint Sealant for Portland Cement Concrete Pavements.
- D6690-15 Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements.

PART 2 - PRODUCTS

2.1 GENERAL

Concrete shall be Type C, air-entrained as specified in Section 03 30 53, SHORT FORM CAST-IN-PLACE CONCRETE, with the following exceptions:

TYPE	MAXIMUM SLUMP*
Pedestrian Pavement	75 mm (3")
* For concrete to be vibrated: Slump as determined by ASTM C143. Tolerances as established by ASTM C94.	

2.2 REINFORCEMENT

- A. Welded wire fabric shall conform to AASHTO M55.
- B. Fiber Reinforcement-Polypropylene fibers designed for use in concrete pavement ASTM C1116 Type III 13 to 38 mm (1/2 to 1 1/2 inches) long. Use 2.27 Kg (5 lbs) per .76 M³ (1 cubic yard) of concrete in batch.
- C. Dowels shall be plain steel bars conforming to AASHTO M31 or M42. Tie bars shall be deformed steel bars conforming to AASHTO M31 or M42.

2.3 FORMS

- A. Use metal or wood forms that are straight and suitable in cross-section, depth, and strength to resist springing during depositing and consolidating the concrete, for the work involved.

- B. Do not use forms if they vary from a straight line more than 3 mm (1/8 inch) in any 3000 mm (ten foot) long section, in either a horizontal or vertical direction.
- C. Wood forms should be at least 50 mm (2 inches) thick (nominal). Wood forms shall also be free from warp, twist, loose knots, splits, or other defects. Use approved flexible or curved forms for forming radii.

2.4 CONCRETE CURING MATERIALS

- A. Concrete curing materials shall conform to one of the following:
 - 1. Burlap conforming to AASHTO M182 having a weight of 233 grams (seven ounces) or more per square meter (yard) when dry.
 - 2. Impervious Sheeting conforming to AASHTO M171.
 - 3. Liquid Membrane Curing Compound conforming to AASHTO M148 (ASTM C309), Type 1 and shall be free of paraffin or petroleum.

2.5 EXPANSION JOINT FILLERS

Material shall conform to AASHTO M213.

PART 3 - EXECUTION

3.1 SUBGRADE PENETRATION

- A. Prepare, construct, and finish the subgrade.
- B. Maintain the subgrade in a smooth, compacted condition and established grade until the succeeding operation has been accomplished.

3.2 SETTING FORMS

- A. Base Support:
 - 1. Compact the base material under the forms true to grade so that, when set, they will be uniformly supported for their entire length at the grade as shown.
 - 2. Correct imperfections or variations in the base material grade by cutting or filling and compacting.
- B. Form Setting:
 - 1. Set forms sufficiently in advance of the placing of the concrete to permit the performance and approval of all operations required with and adjacent to the form lines.
 - 2. Set forms to true line and grade and use stakes, clamps, spreaders, and braces to hold them rigidly in place so that the forms and joints are free from play or movement in any direction.
 - 3. Forms shall conform to line and grade with an allowable tolerance of 3 mm (1/8 inch) when checked with a straightedge and shall not deviate from true line by more than 6 mm (1/4 inch) at any point.
 - 4. Do not remove forms until removal will not result in damaged concrete or at such time to facilitate finishing.
 - 5. Clean and oil forms each time they are used.

3.3 EQUIPMENT

- A. The COR shall approve equipment and tools necessary for handling materials and performing all parts of the work prior to commencement of work.
- B. Maintain equipment and tools in satisfactory working condition at all times.

3.4 PLACING REINFORCEMENT

- A. Reinforcement shall be free from dirt, oil, rust, scale or other substances that prevent the bonding of the concrete to the reinforcement.
- B. Before the concrete is placed, the COR shall approve the reinforcement, which shall be accurately and securely fastened in place with suitable supports and ties.
- C. Synthetic fiber in flatwork: Uniformly disperse in concrete mixture at a rate of not less than 5 lb/cy.

3.5 PLACING CONCRETE - GENERAL

- A. Obtain approval of the COR before placing concrete.
- B. Remove debris and other foreign material from between the forms before placing concrete. Obtain approval of the COR before placing concrete.
- C. Before the concrete is placed, uniformly moisten the subgrade, base, or subbase appropriately, avoiding puddles of water.
- D. Convey concrete from mixer to final place of deposit by a method which will prevent segregation or loss of ingredients. Deposit concrete so that it requires as little handling as possible.
- E. While being placed, spade or vibrate and compact the concrete with suitable tools to prevent the formation of voids or honeycomb pockets. Vibrate concrete well against forms and along joints. Over-vibration or manipulation causing segregation will not be permitted. Place concrete continuously between joints without bulkheads.
- F. Install a construction joint whenever the placing of concrete is suspended for more than 30 minutes and at the end of each day's work.
- G. Workmen or construction equipment coated with foreign material shall not be permitted to walk or operate in the concrete during placement and finishing operations.

3.6 PLACING CONCRETE FOR PEDESTRIAN PAVEMENT

- A. Place concrete in one layer conforming to cross section shown on drawings after consolidating and finishing.
- B. Deposit concrete near joints without disturbing joints. Do not place concrete directly onto joint assemblies.

- C. After concrete has been placed in forms, use a strike-off guided by side forms to bring surface to proper section to be compacted.
- D. Consolidate concrete thoroughly by tamping and spading, or with approved mechanical finishing equipment.
- E. Finish concrete surface to grade with wood or metal float.
- F. Construct concrete pads and pavements with sufficient slope to drain, preventing standing water.

3.7 CONCRETE FINISHING - GENERAL

- A. The sequence of operations, unless otherwise indicated, shall be as follows:
 - 1. Consolidating, floating, straight-edging, troweling, texturing, and edging of joints.
 - 2. Maintain finishing equipment and tools in a clean and approved condition.

3.8 CONCRETE FINISHING - PEDESTRIAN PAVEMENT

Walks:

- 1. Finish concrete surfaces to grade and cross section with metal float, troweled smooth and finished with a broom moistened with clear water.
- 2. Broom surfaces transverse to traffic direction.
- 3. Carefully finish slab edges, including at formed joints, with edger with radius as shown on drawings.
- 4. Unless otherwise indicated, edge transverse joints before brooming. Use brooming to eliminate flat surface produced by edger. Produce uniform corrugations, maximum 2 mm (1/16 inch) deep.
- 5. Provide surface uniform in color and free of surface blemishes, form marks, and tool marks.
- 6. Paving Tolerances:
 - a. Variation from Indicated Plane: Maximum 5 mm in 3000 mm (3/16 inch in 10 feet).
 - b. Variation from Indicated Thickness: Maximum 6 mm (1/4 inch).
- 7. Replace paving within joint boundary when paving exceeds specified tolerances.

3.9 JOINTS - GENERAL

- A. Place joints, where shown, conforming to the details as shown, and perpendicular to the finished grade of the concrete surface.
- B. Joints shall be straight and continuous from edge to edge of the pavement.

3.10 CONTRACTION JOINTS

- A. Cut joints to depth as shown by sawing with a blade producing the required width and depth.
- B. Finish joint edges with edging tool having radius as shown on drawings.
- C. Score pedestrian pavement with standard grooving tool or jointer.

3.11 EXPANSION JOINTS

- A. Form expansion joints with preformed expansion joint filler material of thickness shown on drawings.
 - 1. Without dowels, locate joints around perimeter of structures and features abutting site work concrete.
 - 2. Create complete, uniform separation between structure and site work concrete.
- B. Extend expansion joint material full depth of concrete with top edge of joint filler below finished concrete surface where sealant is indicated on drawings.
- C. Cut and shape material matching cross section.
- D. Anchor with approved devices to prevent displacing during placing and finishing operations.
- E. Round the edges of joints with an edging tool.

3.12 CONSTRUCTION JOINTS

- A. Use a butt-type joint with dowels in curb and gutter if the joint occurs at the location of a planned joint.
- B. Use keyed joints with tiebars if the joint occurs in the middle third of the normal curb and gutter joint interval.

3.13 FORM REMOVAL

- A. Forms shall remain in place at least 12 hours after the concrete has been placed. Remove forms without injuring the concrete.
- B. Do not use bars or heavy tools against the concrete in removing the forms. Promptly repair any concrete found defective after form removal.

3.14 CONCRETE

- A. Concrete Protection:
 - 1. Protect unhardened concrete from rain and flowing water.
 - 2. Ensure sufficient curing and protection materials are available and ready for use before concrete placement begins.
 - 3. Protect concrete to prevent pavement cracking from ambient temperature changes during curing period.
 - a. Replace pavement damaged by curing method allowing concrete cracking.
 - b. Employ another curing method as directed by COR.

- B. Cure concrete for minimum 7 days by one of the following methods appropriate to weather conditions preventing moisture loss and rapid temperature change:
 - 1. Burlap Mat: Provide minimum two layers kept saturated with water during curing period. Overlap mats minimum 150 mm (6 inches).
 - 2. Impervious Sheeting: Provide waterproof paper, polyethylene-coated burlap, or polyethylene sheeting.
 - a. Wet exposed concrete surface with fine water spray and cover with sheet materials.
 - b. Overlap sheets minimum 300 mm (12 inches).
 - c. Securely anchor sheet materials preventing displacement.
- C. Liquid Membrane Curing Compound:
 - 1. Protect joints indicated to receive sealants preventing contamination from curing compound.
 - 2. Insert moistened paper or fiber rope into joint or cover joint with waterproof paper.
 - 3. Apply curing compound before concrete dries.
 - 4. Apply curing compound in two coats at right angles to each other.
 - 5. Application Rate: Maximum 5 sq. m/L (200 sq. ft./gal.), both coats.
 - 6. Immediately reapply curing compound to surfaces damaged during curing period.

3.15 CONCRETE PROTECTIVE COATING

- A. Apply protective coating of linseed oil mixture to exposed-to-view concrete surfaces, drainage structures, and features that project through, into, or against concrete exterior improvements to protect the concrete against deicing materials.
- B. Complete backfilling and curing operation before applying protective coating.
- C. Dry and thoroughly clean concrete before each application.
- D. Apply two coats, with maximum coverage of 11 sq. m/L (50 sq. yds./gal.) for first coat, and maximum 16 sq. m/L (70 sq. yds./gal.) for second coat, except apply commercially prepared mixture according to manufacturer's instructions.
- E. Protect coated surfaces from vehicular and pedestrian traffic until dry.
- F. Do not heat protective coating, and do not expose the protective coating to open flame, sparks, or fire adjacent to open containers or applicators. Do not apply material at temperatures lower than 10 degrees C (50 degrees F).

3.16 CLEANING

- A. After completion of the curing period:

1. Remove the curing material (other than liquid membrane).
2. Sweep the concrete clean.
3. After removal of all foreign matter from the joints, seal joints as herein specified.
4. Clean the entire concrete of all debris and construction equipment as soon as curing and sealing of joints has been completed.

3.17 PROTECTION

- A. Protect exterior improvements from traffic and construction operations.
 1. Prohibit traffic on paving for minimum seven days after placement, or longer as directed by COR.
- B. Remove protective materials immediately before acceptance.
- C. Repair damage.
 1. When directed by COR, replace concrete containing cracking, fractures, spalling, and other defects within joint boundary, at no additional cost to Government.

3.18 FINAL CLEAN-UP

Remove all debris, rubbish and excess material from the Station.

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