

## 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:
  - 1. Pedestrian Pavement: Flower/water stations.
  - 2. Curbs and gutters.

##### 1.2 RELATED WORK

- A. Laboratory and Field Testing Requirements: Section 01 45 29, TESTING LABORATORY SERVICES.
- B. Concrete Materials, Quality, Mixing, Design and Other Requirements: Section 03 30 00, CAST-IN-PLACE CONCRETE.
- C. Subgrade Preparation: Section 31 20 00, EARTH MOVING.

##### 1.3 DESIGN REQUIREMENTS

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

##### 1.4 WEATHER LIMITATIONS

- A. Placement of concrete shall be as specified under Articles for Cold Weather Placement and Hot Weather Placement of Section 03 30 00, CAST-IN-PLACE CONCRETE.

##### 1.5 JOB MIX

- A. The Contractor shall retain and reimburse a testing laboratory to design a select base material mixture and submit a job mix formula to the COR, in writing, for approval. The formula shall include the source of materials, gradation, plasticity index, liquid limit, and laboratory compaction curves indicating maximum density at optimum moisture.

##### 1.6 SUBMITTALS

- A. In accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, furnish the following:
- B. Manufacturers' Certificates and Data certifying that the following materials conform to the requirements specified:
  - 1. Expansion joint filler.
  - 2. Sealant.

3. Reinforcement.
  4. Curing materials.
- C. Data and Test Reports:
1. Base material.
  2. Job mix formula.
  3. Source, gradation, liquid limit, plasticity index, percentage of wear, and other tests as specified and in referenced publications.

## 1.7 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):
- |                |  |
|----------------|--|
| M31 .....      | Deformed and Plain Billet Steel Bars for Concrete Reinforcement (ASTM A615/A615M-96A)    |
| M42 .....      | Standard Specification for Rail-Steel Deformed and Plain Bars for Concrete Reinforcement |
| M55M/55M ..... | Welded Steel Wire Fabric for Concrete Reinforcement (ASTM A185)                          |
| M148 .....     | Liquid Membrane Forming Compounds for Curing Concrete (ASTM C309A)                       |
| M171 .....     | Sheet Materials for Curing Concrete (ASTM C171)  |
| M182 .....     | Burlap Cloth Made from Jute or Kenaf   |
- C. American Society for Testing and Materials (ASTM):
- |                  |                                    |
|------------------|------------------------------------|
| C94/C94M .....   | Ready Mixed Concrete               |
| C143/C143M ..... | Slump of Hydraulic Cement Concrete |

## PART 2 - PRODUCTS

### 2.1 GENERAL

- A. Concrete shall be Type C, air entrained (4% air, +/- 1.5%) as specified in Section 03 30 00, CAST-IN-PLACE CONCRETE, with the following exceptions:

TYPE	MAXIMUM SLUMP*
Curb and Gutter	3"
Pedestrian Pavement	3"

\* For concrete to be vibrated: Slump as determined by ASTM C143. Tolerances as established by ASTM C94.

### 2.2 REINFORCEMENT

- A. The type, amount, and locations of steel reinforcement shall be as shown on the Drawings and in the Specifications.

- B. Welded wire fabric shall conform to AASHTO M55.
- 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 AGGREGATE BASE

- A. Complying with California Department of Transportation Class 2 Aggregate Base, 3/4 inch gradation.
  - 1. Limit recycled content to no more than 50 percent.

## 2.4 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 1/8 inch in any 10 foot long section, in either a horizontal or vertical direction.
- C. Wood forms should be at least 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.

## 2.5 CONCRETE CURING MATERIALS

- A. Concrete curing materials shall conform to one of the following:
  - 1. Burlap conforming to AASHTO M182 having a weight of 7 ounces or more per square 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.

## 2.6 EXPANSION JOINT FILLERS AND SEALANT

- A. Material shall be as specified in Section 07 92 00, JOINT SEALANTS.
- B. Sealant color shall match adjacent concrete.

# PART 3 - EXECUTION

## 3.1 SUBGRADE PREPARATION

- A. Prepare, construct, and finish the subgrade as specified in Section 31 20 00, EARTH MOVING.
- B. Maintain the subgrade in a smooth, compacted condition, in conformance with the required section and established grade until the succeeding operation has been accomplished.

### 3.2 AGGREGATE BASE

- A. Mixing: Proportion the select base by weight or by volume in quantities so that the final approved gradation, liquid limit, and plasticity index requirements will be met after base course has been placed and compacted. Add water in approved quantities, measured by weight or volume, in such a manner to produce a uniform blend.
- B. Placing:
  - 1. Place the aggregate base material on the prepared subgrade in a uniform layer to the required contour and grades, and to a loose depth not to exceed 8 inches, and that when compacted, will produce a layer of the designated thickness.
  - 2. When the designated compacted thickness exceeds 6 inches, place the material in layers of equal thickness. Remove unsatisfactory areas and replace with satisfactory mixture, or mix the material in the area.
  - 3. In no case will the addition of thin layers of material be added to the top layer in order to meet grade.
  - 4. If the elevation of the top layer is 1/2 inch or more below the grade, excavate the top layer and replace with new material to a depth of at least 3 inches in compacted thickness.
- C. Compaction:
  - 1. Perform compaction with approved equipment well suited to the material being compacted.
  - 2. Moisten or aerate the material as necessary to provide the moisture content that will readily facilitate obtaining the specified compaction with the equipment used.
  - 3. Compact each layer to at least 95 percent or 100 percent of maximum density as determined by AASHTO T180 or AASHTO T99 respectively.
- D. Smoothness Test and Thickness Control:
  - 1. Test the completed base for grade and cross section with a straight edge.
    - a. The surface of each layer shall not show any deviations in excess of 3/8 inch.
    - b. The completed thickness shall be within 1/2 inch of the thickness as shown.
- E. Protection:
  - 1. Maintain the finished base in a smooth and compacted condition until the concrete has been placed.
  - 2. When Contractor's subsequent operations or adverse weather disturbs the approved compacted base, excavate, and reconstruct it with new material meeting the requirements herein specified, at no additional cost to the Government.

### 3.3 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 1/8 inch when checked with a straightedge and shall not deviate from true line by more than 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.
- C. The Contractor's Registered Professional Land Surveyor, specified in Section 01 00 00, GENERAL REQUIREMENTS, shall establish and control the alignment and the grade elevations of the forms or concrete slipforming machine operations.
  - 1. Make necessary corrections to forms immediately before placing concrete.
  - 2. When any form has been disturbed or any subgrade or base has become unstable, reset and recheck the form before placing concrete.

### 3.4 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.

### 3.5 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. The type, amount, and position of the reinforcement shall be as shown.

### 3.6 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 or base 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.

### 3.7 PLACING CONCRETE FOR CURBS, GUTTERS, AND PEDESTRIAN PAVEMENTS

- A. Place concrete in the forms in one layer of such thickness that, when compacted and finished, it will conform to the cross section as shown.
- B. Deposit concrete as near to joints as possible without disturbing them; do not dump onto a joint assembly.
- C. After the concrete has been placed in the forms, use a strike off guided by the side forms to bring the surface to the proper section to be compacted.
- D. Consolidate the concrete thoroughly by tamping and spading, or with approved mechanical finishing equipment.
- E. Finish the surface to grade with a wood or metal float.
- F. All concrete pads and pavements shall be constructed with sufficient slope to drain properly.

### 3.8 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.

### 3.9 CONCRETE FINISHING – CURBS AND GUTTERS

- A. Round the edges of the gutter and top of the curb with an edging tool to a radius of 3/8 inch or as otherwise detailed.
- B. Float the surfaces and finish with a smooth wood or metal float until true to grade and section and uniform in textures.
- C. Finish the surfaces, while still wet, with a bristle type brush with longitudinal strokes.
- D. Immediately after removing the front curb form, rub the face of the curb with a wood or concrete rubbing block and water until blemishes, form marks, and tool marks have been removed. Brush the surface, while still wet, in the same manner as the gutter and curb top.
- E. Except at grade changes or curves, finished surfaces shall not vary more than 1/8 inch for gutter and 1/4 inch for top and face of curb, when tested with a 10 foot straightedge.
- F. Remove and reconstruct irregularities exceeding the above for the full length between regularly scheduled joints.
- G. Correct any depressions which will not drain.
- H. Visible surfaces and edges of finished combination curb and gutter shall be free of blemishes, form marks, and tool marks, and shall be uniform in color, shape, and appearance.

### 3.10 CONCRETE FINISHING – PEDESTRIAN PAVEMENT

- A. Flower/water stations:
  - 1. Finish the surfaces to grade and cross section with a metal float, trowled smooth and finished with a broom moistened with clear water.
  - 2. Brooming shall be transverse to the line of traffic.
  - 3. Finish all slab edges, including those at formed joints, carefully with an edger having a radius as shown on the Drawings.
  - 4. Unless otherwise indicated, edge the transverse joints before brooming. The brooming shall eliminate the flat surface left by the surface face of the edger. Execute the brooming so that the corrugation, thus produced, will be uniform in appearance and not more than 1/16 inch in depth.
  - 5. The completed surface shall be uniform in color and free of surface blemishes, form marks, and tool marks. The finished surface of the pavement shall not vary more than 3/16 inch when tested with a 10 foot straightedge.
  - 6. The thickness of the pavement shall not vary more than 1/4 inch.
  - 7. Remove and reconstruct irregularities exceeding the above for the full length between regularly scheduled joints.

### 3.11 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 concrete or pavement.
- C. To the extent practical, align joints of curbs and gutters with those of adjacent pavements.

### 3.12 CONTRACTION JOINTS

- A. Cut joints to depth as shown with a grooving tool or jointer of a radius as shown or by sawing with a blade producing the required width and depth.
- B. Construct joints in curb and gutter or pavement by inserting 1/8 inch steel plates conforming to the cross sections of the curb and gutter or pavement.
- C. Plates shall remain in place until concrete has set sufficiently to hold its shape and shall then be removed.
- D. Finish edges of all joints with an edging tool having the radius as shown.
- E. Score pedestrian pavement with a standard grooving tool or jointer.

### 3.13 EXPANSION JOINTS

- A. Use a preformed expansion joint filler material of the thickness as shown to form expansion joints.
- B. Material shall extend the full depth of concrete, cut and shaped to the cross section as shown, except that top edges of joint filler shall be below the finished concrete surface where shown to allow for sealing.
- C. Anchor with approved devices to prevent displacing during placing and finishing operations.
- D. Round the edges of joints with an edging tool.
- E. Form expansion joints as follows:
  - 1. With or without dowels, as indicated, about features that project through, into, or against any site concrete construction.
  - 2. Using joint filler of the type, thickness, and width as shown.
  - 3. Installed in such a manner as to form a complete, uniform separation between the structure and the site Work concrete item.

### 3.14 CONSTRUCTION JOINTS

- A. Locate construction joints between slabs of pavement as shown.



- B. Place transverse construction joints of the type shown, where indicated and whenever the placing of concrete is suspended for more than 30 minutes.
- C. Use a butt type joint with dowels if the joint occurs at the location of a planned joint.
- D. Use keyed joints with tiebars if the joint occurs in the middle third of the normal joint interval.

### 3.15 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.

### 3.16 CURING OF CONCRETE

- A. Cure concrete by one of the following methods appropriate to the weather conditions and local construction practices, against loss of moisture, and rapid temperature changes for at least seven days from the beginning of the curing operation. Protect unhardened concrete from rain and flowing water. All equipment needed for adequate curing and protection of the concrete shall be on hand and ready to install before concrete placement begins. Provide protection as necessary to prevent cracking of the pavement due to temperature changes during the curing period. If any selected method of curing does not afford the proper curing and protection against concrete cracking, remove and replace the damaged pavement and employ another method of curing as directed by the COR.
- B. Burlap Mat: Provide a minimum of two layers kept saturated with water for the curing period. Mats shall overlap each other at least 6 inches.
- C. Impervious Sheeting: Use waterproof paper, polyethylene coated burlap, or polyethylene sheeting. Polyethylene shall be at least 4 mils in thickness. Wet the entire exposed concrete surface with a fine spray of water and then cover with the sheeting material. Sheets shall overlap each other at least 12 inches. Securely anchor sheeting.
- D. Liquid Membrane Curing:
  - 1. Apply pigmented membrane forming curing compound in two coats at right angles to each other at a rate of 200 square feet per gallon for both coats.
  - 2. Do not allow the concrete to dry before the application of the membrane.
  - 3. Cure joints designated to be sealed by inserting moistened paper or fiber rope or covering with waterproof paper prior to application of the curing compound, in a manner to prevent the curing compound entering the joint.
  - 4. Immediately re-spray any area covered with curing compound and damaged during the curing period.

### 3.17 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.

### 3.18 PROTECTION

- A. The Contractor shall protect the concrete against all damage prior to final acceptance by the Government. Remove concrete containing excessive cracking, fractures, spalling, or other defects and reconstruct the entire section between regularly scheduled joints, when directed by the COR, and at no additional cost to the Government. Exclude traffic from vehicular pavement until the concrete is at least seven days old, or for a longer period of time if so directed by the COR.

### 3.19 FINAL CLEAN UP

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

END OF SECTION