DATE OF THIS VERSION (new)
May 1, 2013

TITLE OF DOCUMENT (new title if applicable):
Cement and Concrete for Exterior Improvements, 32 05 23

DATE OF VERSION BEING SUPERSEDED (old):
April 1, 2010

DESCRIPTION OF DOCUMENT (previous title, number, other identifying data):
Cement and Concrete for Exterior Improvements, 32 05 23

SUMMARY OF CHANGES IN THIS VERSION:

1.1 Referred to see the drawings. Added pedestrian in front of crossings, and added choices of patios, healing gardens, parking lots, loading docks, and generator pads to their respective sections.

1.2 Added reference to General conditions, Shop drawings, Cast in Place concrete, Metal fabrications, and earthwork.

Added notes to Section 1.4 on hot and cold weather rather than referring to other specification section.

Updated specification notes to refer to geotechnical engineer.

1.5 Added that cost of testing laboratory shall be part of Contractor’s cost.

1.6 Removed reference to shop drawing section and required contractor to submit the requirements and expanded to include more submittals regarding jointing, concrete, staking, etc.

1.7 Updated references to remove the outdated one and added new references that are applicable.

Part 2 Added the requirements for certain types of accepted concrete mix types. Added a spec writer note under reinforcement and removed the note on welded-wire fabric and dowels. Added information about grade requirements for base and subbase courses.

2.6 Updated reference
3.1.A Revised Specification title
3.2.C.3 Referenced the Earthwork specification.
3.2.D.2 Referred to the drawings.
3.2.E.2 Removed “VA” and added “Government.”
3.3 Added information about making corrections to forms. Added that staking notes are to be submitted so that discrepancies can be found early.
3.5 Added information about reinforcement placement.
3.6.H Added information about requirements for correction if there is cracked, chipped, or bird baths in the concrete.
3.10 Removed the choice for either curb or gutter. Section now applies to everything.
3.11 Added healing gardens as a choice.
3.11.A.7 Clarified that removals are at no additional cost to the Government.
Updated spec writer note and removed reference to Cast In place concrete specification.
3.12.G Finish surfaces shall be finish and in alignment.
3.14 Joints to be placed as per the shop drawings and drawings.
3.15.B Removed the choice for either curb or gutter. Section now applies to everything.
3.17 Joints to be placed as per the shop drawings and drawings.
SECTION 32 05 23
CEMENT AND CONCRETE FOR EXTERIOR IMPROVEMENTS

SPEC WRITER NOTE: Delete or add information between //----// and any other items applicable to project. Cover any item added to the text under Applicable Publications and Products and renumber the paragraphs. See Technical Notes at end of section.

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 on the Drawings. Construction shall include the following:

SPEC WRITER NOTE: Delete the items not required by the project or include any special items. See Technical Notes at end of this section.

B. // Curb, // gutter, // and combination curb and gutter // wheel stop //.
D. Vehicular Pavement: // Service courts // driveways // parking lots // loading docks //.
E. Equipment Pads: // Oxygen storage // transformers // propane tanks // generator pads //.

SPEC WRITER NOTE: If Section CONCRETE is not a portion of specification, cover items cross referenced thereto within this section, and delete all references to Section 03 30 00, CAST-IN-PLACE CONCRETE throughout this section.

1.2 RELATED WORK

A. Section 00 72 00, GENERAL CONDITIONS.
B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES
C. Section 01 45 29, TESTING LABORATORY SERVICES.
D. Section 03 30 00, CAST-IN-PLACE CONCRETE.
E. Section 05 50 00, METAL FABRICATIONS.
F. Section 31 20 00, EARTHWORK.

1.3 DESIGN REQUIREMENTS

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

A. Hot Weather: Follow the recommendations of ACI 305 or as specified to prevent problems in the manufacturing, placing, and curing of concrete that can adversely affect the properties and serviceability of the hardened concrete. Methods proposed for cooling materials and arrangements for protecting concrete shall be made in advance of concrete placement and approved by Resident Engineer.

B. Cold Weather: Follow the recommendations of ACI 306 or as specified to prevent freezing of concrete and to permit concrete to gain strength properly. Use only the specified non-corrosive, non-chloride accelerator. Do not use calcium chloride, thiocyanates or admixtures containing more than 0.05 percent chloride ions. Methods proposed for heating materials and arrangements for protecting concrete shall be made in advance of concrete placement and approved by Resident Engineer.

SPEC WRITER NOTE: If select subbase material is required due to unstable conditions or frost action, or as required by the geotechnical engineer, include the following. Also, edit all other applicable portions of this section.

1.5 SELECT SUBBASE MATERIAL JOB-MIX

The Contractor shall retain a testing laboratory to design a select subbase material mixture and submit a job-mix formula to the Resident Engineer, 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. Cost of the testing laboratory to be included in the Contractor’s cost of project.

1.6 SUBMITTALS

Contractor shall submit the following.

A. Manufacturers' Certificates and Data certifying that the following materials conform to the requirements specified.
   1. Expansion joint filler
   2. Hot poured sealing compound
   3. Reinforcement
   4. Curing materials

B. Jointing Plan for all concrete areas.

C. Concrete Mix Design.

D. Concrete Test Reports

E. Construction Staking Notes from Surveyor.

F. Data and Test Reports: Select subbase material.
1. Job-mix formula.
2. Source, gradation, liquid limit, plasticity index, percentage of wear, and other tests as specified and in referenced publications.

SPEC WRITER NOTE: Update applicable publications to current issue at time of project specification preparation.

1.7 APPLICABLE PUBLICATIONS

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.

A. American Association of State Highway and Transportation Officials (AASHTO):
M147-65-UL ............... Materials for Aggregate and Soil-Aggregate Subbase, Base and Surface Courses (R 2004)
M148-05-UL ............... Liquid Membrane-Forming Compounds for Curing Concrete (ASTM C309)
M171-05-UL ............... Sheet Materials for Curing Concrete (ASTM C171)
M182-05-UL ............... Burlap Cloth Made from Jute or Kenaf and Cotton Mats

B. American Society for Testing and Materials (ASTM):
A82/A82M-07 ............... Standard Specification for Steel Wire, Plain, for Concrete Reinforcement
A185/185M-07 ............... Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete
A615/A615M-12 ............... Standard Specification for Deformed and Plain Carbon Steel Bars for Concrete Reinforcement
A653/A653M-11 ............... Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc Iron Alloy Coated (Galvannealed) by the Hot Dip Process
A706/A706M-09b ............... Standard Specification for Low Alloy Steel Deformed and Plain Bars for Concrete Reinforcement
A767/A767M-09 ............... Standard Specification for Zinc Coated (Galvanized) Steel Bars for Concrete Reinforcement
A775/A775M-07b ............... Standard Specification for Epoxy Coated Reinforcing Steel Bars
A820/A820M-11 ............... Standard Specification for Steel Fibers for Fiber Reinforced Concrete
C31/C31M-10 Standard Practice for Making and Curing Concrete Test Specimens in the field
C33/C33M-11a Standard Specification for Concrete Aggregates
C39/C39M-12 Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
C94/C94M-12 Standard Specification for Ready Mixed Concrete
C143/C143M-10a Standard Test Method for Slump of Hydraulic Cement Concrete
C150/C150M-12 Standard Specification for Portland Cement
C171-07 Standard Specification for Sheet Materials for Curing Concrete
C172/C172M-10 Standard Practice for Sampling Freshly Mixed Concrete
C173/C173M-10b Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
C192/C192M-07 Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory
C231/C231M-10 Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
C260/C260M-10a Standard Specification for Air Entraining Admixtures for Concrete
C309-11 Standard Specification for Liquid Membrane Forming Compounds for Curing Concrete
C494/C494M-12 Standard Specification for Chemical Admixtures for Concrete
C618-12 Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
D4397-10 Standard Specification for Polyethylene Sheeting for Construction, Industrial and Agricultural Applications

C. American Welding Society (AWS):
PART 2 - PRODUCTS

2.1 GENERAL

A. Concrete Type: Concrete shall be as per Table 1 - Concrete Type, air entrained.

<table>
<thead>
<tr>
<th>Concrete Type</th>
<th>Concrete Strength</th>
<th>Non-Air-Entrained</th>
<th>Air-Entrained</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Min. 28 Day Comp. Str.</td>
<td>Min. Cement lbs/c. yd (kg/m³)</td>
<td>Max. Water Cement Ratio</td>
</tr>
<tr>
<td>Type A</td>
<td>5000 (35)¹,³</td>
<td>630 (375)</td>
<td>0.45</td>
</tr>
<tr>
<td>Type B</td>
<td>4000 (30)¹,³</td>
<td>550 (325)</td>
<td>0.55</td>
</tr>
<tr>
<td>Type C</td>
<td>3000 (25)¹,³</td>
<td>470 (280)</td>
<td>0.65</td>
</tr>
<tr>
<td>Type D</td>
<td>3000 (25)¹,²</td>
<td>500 (300)</td>
<td>*</td>
</tr>
</tbody>
</table>

1. If trial mixes are used, the proposed mix design shall achieve a compressive strength 1200 psi (8.3 MPa) in excess of the compressed strength. For concrete strengths above 5000 psi (35 Mpa), the proposed mix design shall achieve a compressive strength 1400 psi (9.7 MPa) in excess of the compressed strength.

2. For concrete exposed to high sulfate content soils maximum water cement ratio is 0.44.

3. Determined by Laboratory in accordance with ACI 211.1 for normal concrete or ACI 211.2 for lightweight structural concrete.

B. Maximum Slump: Maximum slump, as determined by ASTM C143 with tolerances as established by ASTM C94, for concrete to be vibrated shall be as shown in Table II.

<table>
<thead>
<tr>
<th>TYPE</th>
<th>MAXIMUM SLUMP*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Curb &amp; Gutter</td>
<td>3 inches (75 mm)</td>
</tr>
<tr>
<td>Pedestrian Pavement</td>
<td>3 inches (75 mm)</td>
</tr>
<tr>
<td>Vehicular Pavement</td>
<td>2 inches (50 mm) (Machine Finished)</td>
</tr>
<tr>
<td></td>
<td>4 inches (100 mm) (Hand Finished)</td>
</tr>
<tr>
<td>Equipment Pad</td>
<td>3 to 4 inches (75 to 100 mm)</td>
</tr>
</tbody>
</table>

* 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.

SPEC WRITER NOTE: Check need for special subbase material and thickness required. If Subbase is selected delete the phrase (where required).

2.3 SELECT SUBBASE (WHERE REQUIRED)
A. Subbase material shall consist of select granular material composed of sand, sand-gravel, crushed stone, crushed or granulated slag, with or without soil binder, or combinations of these materials conforming to AASHTO M147, as follows.

<table>
<thead>
<tr>
<th>Sieve Size (mm)</th>
<th>Percentage Passing by Mass</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade Requirements for Soils Used as Subbase Materials, Base Courses and Surfaces Courses</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>AASHTO M147</th>
<th>Percentage Passing by Mass</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sieve Size (in)</td>
<td>A</td>
</tr>
<tr>
<td>50</td>
<td>2</td>
</tr>
<tr>
<td>25</td>
<td>1</td>
</tr>
<tr>
<td>9.5</td>
<td>3/8</td>
</tr>
<tr>
<td>4.47</td>
<td>No. 4</td>
</tr>
<tr>
<td>2.00</td>
<td>No. 10</td>
</tr>
<tr>
<td>0.425</td>
<td>No. 40</td>
</tr>
<tr>
<td>0.075</td>
<td>No. 200</td>
</tr>
</tbody>
</table>

B. Materials meeting other gradations than that noted will be acceptable whenever the gradations are within a tolerance of three to five percent, plus or minus, of the single gradation established by the job-mix formula, or as recommended by the geotechnical engineer and approved by the Resident Engineer.

C. Subbase material shall produce a compacted, dense-graded course, meeting the density requirement specified herein.

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 (3 mm) in any ten foot (3000 mm) long section, in either a horizontal or vertical direction.
C. Wood forms should be at least 2 inches (50 mm) 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 having a weight of seven ounces (233 grams) or more per yard (square meter) when dry.
   2. Impervious Sheeting conforming to ASTM C171.

SPEC WRITER NOTE: Choice below is Type 1 contains clear additive, and Type 2 contains white pigmented additive.

   3. Liquid Membrane Curing Compound conforming to ASTM C309, Type 1 // Type 2 // and shall be free of paraffin or petroleum.

2.6 EXPANSION JOINT FILLERS

Material shall conform to ASTM D1751-04.

PART 3 - EXECUTION

3.1 SUBGRADE PENETRATION

A. Prepare, construct, and finish the subgrade as specified in Section 31 20 00, EARTHWORK.

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.

SPEC WRITER NOTE: Use Paragraph 3.2 only if SELECT SUBBASE is specified. If Subbase is selected delete the phrase (where required).

3.2 SELECT SUBBASE (WHERE REQUIRED)

A. Mixing: Proportion the select subbase by weight or by volume in quantities so that the final approved job-mixed formula gradation, liquid limit, and plasticity index requirements will be met after subbase 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 mixed 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 (200 mm), and that when compacted, will produce a layer of the designated thickness.
   2. When the designated compacted thickness exceeds 6 inches (150 mm), 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 (13 mm) or more below the grade, excavate the top layer and replace with new material to a depth of at least 3 inches (75 mm) in compacted thickness.

C. Compaction:
1. Perform compaction with approved hand or mechanical 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 specified in Section 31 20 00, EARTHWORK.

D. Smoothness Test and Thickness Control: Test the completed subbase for grade and cross section with a straight edge.
1. The surface of each layer shall not show any deviations in excess of 3/8 inch (10 mm).
2. The completed thickness shall be within 1/2 inch (13 mm) of the thickness as shown on the Drawings.

E. Protection:
1. Maintain the finished subbase 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 subbase, 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 (3 mm) when checked with a straightedge and shall not deviate from true line by more than 1/4 inch (6 mm) 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.

6. Make necessary corrections to forms immediately before placing concrete.

7. When any form has been disturbed or any subgrade or subbase has become unstable, reset and recheck the form before placing concrete.

   SPEC WRITER NOTE: See TECHNICAL NOTES at end of this section for slipforming machine option.

C. The Contractor’s Registered Professional Land Surveyor, specified in Section 00 72 00, GENERAL CONDITIONS, shall establish the control, alignment and the grade elevations of the forms or concrete slipforming machine operations. Staking notes shall be submitted for approval to the Resident Engineer prior to placement of concrete. If discrepancies exist between the field conditions and the Drawings, Contractor shall notify Resident Engineer immediately. No placement of concrete shall occur if a discrepancy greater than 1 inch (25 mm) is discovered.

3.4 EQUIPMENT
   A. The Resident Engineer 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. All reinforcement shall be supported for proper placement within the concrete section.
   B. Before the concrete is placed, the Resident Engineer shall approve the reinforcement placement, 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 on the Drawings.
3.6 PLACING CONCRETE – GENERAL
A. Obtain approval of the Resident Engineer before placing concrete.
B. Remove debris and other foreign material from between the forms 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.
H. Cracked or Chipped Concrete Surfaces and Bird Baths. Cracked or chipped concrete and bird baths will not be allowed. Concrete with cracks or chips and bird baths will be removed and replaced to the nearest joints, and as approved by the Resident Engineer, by the Contractor with no additional cost to the Government.

3.7 PLACING CONCRETE FOR CURB AND GUTTER, PEDESTRIAN PAVEMENT, AND EQUIPMENT PADS
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 but 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 PLACING CONCRETE FOR VEHICULAR PAVEMENT
A. Deposit concrete into the forms as close as possible to its final position.
B. Place concrete rapidly and continuously between construction joints.
C. Strike off concrete and thoroughly consolidate by a finishing machine, vibrating screed, or by hand-finishing.
D. Finish the surface to the elevation and crown as shown.
E. Deposit concrete as near the joints as possible without disturbing them but do not dump onto a joint assembly. Do not place adjacent lanes without approval by the Resident Engineer.

3.9 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.

3.10 CONCRETE FINISHING CURB AND GUTTER
A. Round the edges of the gutter and top of the curb with an edging tool to a radius of 1/4 inch (6 mm) 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 (3 mm) for gutter and 1/4 (6 mm) for top and face of curb, when tested with a 10 foot (3000 mm) 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. See Article 3.6, Paragraph H, above.
H. Visible surfaces and edges of finished curb, gutter, and/or combination curb and gutter shall be free of blemishes, form marks, and tool marks, and shall be uniform in color, shape, and appearance.

3.11 CONCRETE FINISHING PEDESTRIAN PAVEMENT
A. Walks, Grade Slabs, Lawn Mower Crossings, Wheelchair Curb Ramps, Terraces, Healing Gardens:
   1. Finish the surfaces to grade and cross section with a metal float, troweled 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 (2 mm) 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 (5 mm) when tested with a 10 foot (3000 mm) straightedge.

6. The thickness of the pavement shall not vary more than 1/4 inch (6 mm).

7. Remove and reconstruct irregularities exceeding the above for the full length between regularly scheduled joints at no additional cost to the Government.

SPEC WRITER NOTE: Site steps are those exterior steps not attached to a building or structure. Edit subparagraph to include metal components (nosing and railing), when required.

B. Steps: The method of finishing the steps and the sidewalls is similar to above except as herein noted.

1. Remove the riser forms one at a time, starting with the top riser.

2. After removing the riser form, rub the face of the riser with a wood or concrete rubbing block and water until blemishes, form marks, and tool marks have been removed. Use an outside edger to round the corner of the tread; use an inside edger to finish the corner at the bottom of the riser.

3. Give the risers and sidewall a final brush finish. The treads shall have a final finish with a stiff brush to provide a non-slip surface.

4. The texture of the completed steps shall present a neat and uniform appearance and shall not deviate from a straightedge test more than 3/16 inch (5 mm).

3.12 CONCRETE FINISHING FOR VEHICULAR PAVEMENT

A. Accomplish longitudinal floating with a longitudinal float not less than 10 feet (3000 mm) long and 6 inches (150 mm) wide, properly stiffened to prevent flexing and warping. Operate the float from foot bridges in a sawing motion parallel to the direction in which the pavement is being laid from one side of the pavement to the other, and advancing not more than half the length of the float.
B. After the longitudinal floating is completed, but while the concrete is still plastic, eliminate minor irregularities in the pavement surfaces by means of metal floats, 5 feet (1500 mm) in length, and straightedges, 10 feet (3000 mm) in length. Make the final finish with the straightedges, which shall be used to float the entire pavement surface.

C. Test the surface for trueness with a 10 foot (3000 mm) straightedge held in successive positions parallel and at right angles to the direction in which the pavement is being laid and the entire area covered as necessary to detect variations. Advance the straightedge along the pavement in successive stages of not more than one half the length of the straightedge. Correct all irregularities and refinish the surface.

D. The finished surface of the pavement shall not vary more than 1/4 inch (6 mm) in both longitudinal and transverse directions when tested with a 10 foot (3000 mm) straightedge.

E. The thickness of the pavement shall not vary more than 1/4 inch (6 mm).

F. When most of the water glaze or sheen has disappeared and before the concrete becomes nonplastic, give the surface of the pavement a broomed finish with an approved fiber broom not less than 18 inches (450 mm) wide. Pull the broom gently over the surface of the pavement from edge to edge. Brooming shall be transverse to the line of traffic and so executed that the corrugations thus produced will be uniform in character and width, and not more than 1/8 inch (3 mm) in depth. Carefully finish the edge of the pavement along forms and at the joints with an edging tool. The brooming shall eliminate the flat surface left by the surface face of the edger.

G. The finish surfaces of new and existing abutting pavements shall be flush and in alignment at their juncture.

3.13 CONCRETE FINISHING EQUIPMENT PADS

A. After the surface has been struck off and screeded to the proper elevation, provide a smooth dense float finish, free from depressions or irregularities.

B. Carefully finish all slab edges with an edger having a radius as shown in the Drawings.

C. After removing the forms, rub the faces of the pad with a wood or concrete rubbing block and water until blemishes, form marks, and tool marks have been removed. The finish surface of the pad shall not vary more than 1/8 inch (3 mm) when tested with a 10 foot (3000 mm) straightedge.

D. Correct irregularities exceeding the above. See Article 3.6, Paragraph H, above.
3.14 JOINTS – GENERAL

A. Place joints, where shown on the Shop Drawings and Drawings, 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.

3.15 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 curbs and gutters by inserting 1/8 inch (3 mm) steel plates conforming to the cross sections of the curb and gutter.

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.

3.16 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. Without dowels, about structures and features that project through, into, or against any site work 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.

3.17 CONSTRUCTION JOINTS

A. Locate // longitudinal // and transverse // construction joints between slabs of vehicular pavement as shown on the Shop Drawing jointing plan and Drawings.
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 in curb and gutter 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 curb and gutter joint interval.

3.18 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.

3.20 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 actual 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 Resident Engineer.
B. Burlap Mat: Provide a minimum of two layers kept saturated with water for the curing period. Mats shall overlap each other at least 150 mm (6 inches).
C. Impervious Sheeting: Use waterproof paper, polyethylene-coated burlap, or polyethylene sheeting. Polyethylene shall be at least 4 mils (0.1 mm) 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 (300 mm). 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 (5 m²/L) 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.

3.21 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 specified.
4. Clean the entire concrete of all debris and construction equipment as soon as curing and sealing of joints has been completed.

3.22 PROTECTION

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 Resident Engineer, 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 Resident Engineer.

3.23 FINAL CLEAN-UP

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

SPEC WRITER NOTES:
(These Technical Notes are intended as a guide in preparing this specification section and the detail drawings. Delete these notes before typing the Contract Specifications. Modify this specification section and appropriate details and finishes included on the drawings for site work concrete, such as, other methods of construction (when aesthetics is of prime importance), or special game areas (shuffleboard, horseshoe, game tables, etc.). If any of the following items are used, include the referenced publication and paragraphs in the appropriate portion of the contract specification.)

A. When the project is located in an area where winter damage from deicing chemicals and freeze-thaw cycles pose a serious problem, the Spec Writer shall check the need for a special protective coating of linseed oil mixture. The coating protects only against the action of urea, sodium chloride, and calcium chloride used for
deicing purposes. Protection against these chemicals is not required for concrete that will be in place for a cumulative time of six weeks at a continuous minimum temperature of 5 °C (40 °F), excluding the curing time. Otherwise, give concrete protective coating. Referenced paragraphs: APPLICABLE PUBLICATION: AASHTO M233. Boiled Linseed Oil Mixture for Treatment of Portland Cement Concrete. MATERIALS: Concrete Protection Material—Linseed Oil mixture shall conform to AASHTO M233.

CURING AND PROTECTION: Protective Coating—apply protective coating of linseed oil mixture to exposed-to-view concrete surfaces, drainage structures, and features that project through, into, or against the items constructed under this section to protect the concrete against the action of deicing materials.

1. Application: Complete backfilling and curing operation prior to applying protective coating. Concrete shall be surface dry and thoroughly clean before each application. Give the concrete surface at least two applications. Coverage shall not be more than 11 m²/L (50 square yards per gallon) for first application, and not more than 16 m²/L (70 square yards per gallon) for the second application, except when the number of applications and coverage for each application for commercially prepared mixture shall be in accordance with the manufacturer's instructions. Protect coated surfaces from vehicular and pedestrian traffic until dry.

2. Precautions: 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 50 deg F (10 deg C).

SUBMITTALS: Certificates—Concrete Protective Coating.

B. In some case it may be practical and economical to build concrete vehicular pavement with an integral curb section. The integral curb being constructed simultaneously with the pavement slab in a one-step operation avoids a longitudinal joint between the curb and gutter, and pavement. The curb is easily formed with a template and straightedge. The only joints generally required in the integral curbs are continuations of the transverse joints in the pavement slab. Another option for concrete curb or curb and gutter not required to be constructed integral with
or tied to a concrete pavement, is the use of a self-propelled machine (slipforming machine) to place the concrete. This type of construction is most advantageous when the drawing details indicate a "mountable" (rolled) type curb and gutter. However, use of these machines on small jobs is generally not cost justifiable. Include the following paragraph and additional requirements for the integral curb template, extrusion equipment, and self-propelled machine in the appropriate portions of the Contract Specification, when an integral curb is indicated on the drawings or the use of a curb-forming machine is justified.

CURB-FORMING MACHINES: Curb-forming machines for constructing // integral curbs // curbs // and gutter // will be approved based on trail use on the job. If the equipment produces unsatisfactory results, discontinue use of the equipment at any time during construction and accomplish the work by hand method construction as specified. Remove unsatisfactory work and reconstruct the full length between regularly scheduled joints. Dispose of removed portions off the Station.

C. When aesthetics is of prime importance and certain areas are shown to have a special finish and texture, such as an exposed aggregate surface or to have colored concrete, the Spec Writer shall consider the use of the following data:

1. Contact the Portland Cement Association district office in the area of the project for advice in specifying and detailing the finish and texture desired.

2. Exposed Aggregate Concrete: For use by the physically handicapped, the texture of an exposed aggregate surface shall be smooth and the aggregate size shall not produce a rough finish. There are a number of ways to obtain exposed aggregate finishes, so base the method selected on local materials and construction practices. The following is a suggested paragraph:

EXPOSED AGGREGATE CONCRETE: When concrete is shown to have an exposed aggregate surface, the finish shall be as follows: Apply mix and mark off surface as indicated with surface joints at least 3/8 inch (10 mm) deep. Level off finish to a true surface and compact with a wood float, working as little as possible so that coarse material will remain at the top. Before finish has set, treat top surface with cement retarding material.

When body of concrete finish has set,
remove retarded surface film by wire brushes and fine water spray to remove the mortar from the top of the colored aggregate. Continue washing and brushing until flush water runs clear and there is no noticeable cement film left on the aggregate. Specify color of aggregate in Section 09 06 00, SCHEDULE FOR FINISHES. Prior to starting work, submit a sample of exposed aggregate concrete panel to the Resident Engineer for approval.

Edit the above paragraph to describe the "seeding method" of preparing a concrete base 3/8 to 1/2-inch (10 to 13 mm) lower than the finish grade to accommodate the aggregate to be scattered over the concrete base surface and embedded therein by use of a hand float, straight edge, or darby. After the aggregate is embedded, the usual procedures are followed to expose the aggregate.

D. Colored Concrete - Two method of producing colored concrete finishes are: By integral color or by the dry-shake method. For durability, uniformity of color and lower cost, the Department of Veterans Affairs preference is the integral color method. The amount of pigment used to achieve integral colored concrete should be the minimum amount necessary to produce the desired color, but never more than 10 percent by weight of the cement. The use of white Portland cement produces cleaner, brighter colors and is the preference to normal gray Portland cement, except for black or dark gray colors. The following is a suggested paragraph:

COLORED CONCRETE: Pedestrian pavement designed to be colored shall have the coloring introduced into the concrete mix at the batch plant. Introduce sufficient quantities of // carbon black // mineral oxide pigment // to produce the color specified in Section 09 06 00, SCHEDULE FOR FINISHES. Prior to starting work, submit a sample of the colored concrete with type of coloring additive and the amount of additive per cubic yard (m3) of concrete mix to the Resident Engineer for approval. Some coloring materials affect air entrainment while others do not, the Spec Writer will make certain that the color and mixtures used do not produce a concrete having less than the desired air content specified. Edit the above paragraph and drawing details as required to cover mixing, placing, preparation, equipment, finish, and any special construction.
E. Include under the SUBMITTALS portion of Contract Specifications the following paragraphs(s) as applicable:

Samples:
1. Exposed aggregate concrete panel, 4 square feet by 2 inches (0.4 m² by 50 mm) thick, 2 required, each color and finish.
2. Color concrete panel, as specified in Section 09 06 00, SCHEDULE FOR FINISHES, with mix data.
3. Snow Melting Systems - Specify snow melting systems as required by the HVAC design manual in a separate section and that section title referenced in this section. The site plan drawings shall indicate the areas to be provided with the snow melting systems.

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