

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. Subbase for concrete pavements.
 - 2. Curbs and combination curbs and gutters.
 - 3. Pedestrian Pavement: Walks and grade slabs.
 - 4. Vehicular Pavement: Driveways.

1.2 RELATED WORK

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

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 Article 3.8, COLD WEATHER and Article 3.7, HOT WEATHER of Section 03 30 00, CAST-IN-PLACE CONCRETE.

1.5 SELECT SUBBASE MATERIAL JOB MIX

- A. The Contractor shall retain and reimburse 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.

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. Hot poured sealing compound
 - 3. Reinforcement
 - 4. Curing materials
 - 5. Concrete protective coating
- C. 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.

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)
 - M55M/55M.....Welded Steel Wire Fabric for Concrete
Reinforcement (ASTM A185)
 - M147.....Materials for Aggregate and Soil-Aggregate
Subbase, Base and Surface Courses (R 1996)
 - 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
 - M213.....Preformed Expansion Joint Fillers for Concrete
Paving and Structural Construction
(Non-extruding and Resilient Bituminous Type)
(ASTM D1751)

M233.....Boiled linseed oil mixture for treatment of
Portland cement concrete.

T99.....Moisture-Density Relations of Soils Using a 2.5
kg. (5.5 lb) Rammer and a 305 mm (12 in.) Drop

T180.....Moisture-Density Relations of Soils Using a
4.54 kg (10 lb.) Rammer and a 457 mm (18 in.)
Drop

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

C94/C94M.....Ready-Mixed Concrete

C143/C143M.....Slump of Hydraulic Cement Concrete

1.8 PREINSTALLATION MEETINGS

A. Conduct preinstallation meeting at project site minimum 30 days before
beginning Work of this section.

SPEC WRITER NOTE: Edit participant list
to ensure entities influencing outcome
attend.

1. Required Participants:

- a. Contracting Officer's Representative.
- b. // Architect/Engineer. //
- c. // Inspection and Testing Agency. //
- d. Contractor.
- e. Installer.
- f. Other installers responsible for adjacent and intersecting
work, including excavation, plantings, traffic markings, and
// _____ //

SPEC WRITER NOTE: Edit meeting agenda to
incorporate project specific topics.

2. Meeting Agenda: Distribute agenda to participants minimum 3 days before meeting.

- a. Installation schedule.
- b. Installation sequence.
- c. Preparatory work.
- d. Protection before, during, and after installation.
- e. Installation.
- f. Terminations.

- g. Transitions and connections to other work.
 - h. Inspecting and testing.
 - i. Other items affecting successful completion.
3. Document and distribute meeting minutes to participants to record decisions affecting installation.

1.9 SUBMITTALS

- A. Submittal Procedures: Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Submittal Drawings:
 - 1. Show size, configuration, and fabrication and installation details.
 - 2. Show reinforcing.
 - 3. Include jointing plan for concrete pavements, curbs and gutters.
- C. Manufacturer's Literature and Data:
 - 1. Description of each product.
 - 2. Installation instructions.
- D. Samples:
 - 1. Exposed Aggregate Concrete Panel: 0.4 sq. m by 50 mm (4 sq. ft. by 2 inches) thick, 2 required, each color and finish.
 - 2. Colored Concrete Panel: As specified in Section 09 06 00, SCHEDULE FOR FINISHES, with mix data.
- E. Test reports: Certify products comply with specifications.
 - 1. Concrete materials.
 - 2. Select subbase materials.
 - 3. Field test reports.
- F. Certificates: Certify products comply with specifications.
 - 1. Expansion joint filler.
 - 2. Reinforcement.
 - 3. Curing materials.
 - 4. Concrete protective coating.
- G. Qualifications: Substantiate qualifications comply with specifications.
 - 1. Installer // with project experience list //.
 - 2. Land surveyor.
- H. Concrete mix design.
- I. Select subbase job-mix design.
- J. Proposed hot and cold weather concreting methods.
- K. Land surveyor's construction staking notes, before placing concrete.

1. Identify discrepancies between field conditions and Drawings.

1.10 QUALITY ASSURANCE

- A. Installer Qualifications:
 1. Regularly installs specified products.
 2. Installed specified products with satisfactory service on five similar installations.
 - a. Project Experience List: Provide contact names and addresses for completed projects.
- B. Land Surveyor: Professional land surveyor or engineer registered to provide land surveys in jurisdiction where project is located.
- C. Preconstruction Testing:
 1. Engage independent testing laboratory to perform tests and submit reports.
 - a. Deliver samples to laboratory in number and quantity required for testing.
 2. Concrete mix design.
 3. Select subbase job-mix design. Report the following:
 - a. Material sources.
 - b. Gradation.
 - c. Plasticity index.
 - d. Liquid limit.
 - e. Laboratory compaction curves indicating maximum density at optimum moisture content.

1.11 DELIVERY

- A. Deliver steel reinforcement to prevent damage.
- B. Before installation, return or dispose of distorted or damaged steel reinforcement.
- C. Bulk Products: Deliver bulk products away from buildings, utilities, pavement, and existing turf and planted areas. Maintain dry bulk product storage away from contaminants.

1.12 STORAGE AND HANDLING

- A. Store products indoors in dry, weathertight facility.
- B. Protect products from damage during handling and construction operations.

1.13 FIELD CONDITIONS

- A. Hot Weather Concreting Procedures: ACI 305R.
- B. Cold Weather Concreting Procedures: ACI 306R.
 - 1. Use non-corrosive, non-chloride accelerator admixture.
 - 2. Do not use calcium chloride, thiocyanates or admixtures containing more than 0.05 percent chloride ions.

1.14 WARRANTY

- A. Construction Warranty: FAR clause 52.246-21, "Warranty of Construction."

PART 2 - PRODUCTS**2.1 CONCRETE MATERIALS**

- A. Concrete shall be Type C, air-entrained as specified in Section 03 30 00, CAST-IN-PLACE CONCRETE, with the following exceptions:

<u>TYPE</u>	<u>MAXIMUM SLUMP*</u>
Curb & Gutter	75 mm (3")
Pedestrian Pavement	75 mm (3")
Vehicular Pavement	50 mm (2") (Machine Finished) 100 mm (4") (Hand Finished)
Equipment Pad	75 to 100 mm (3" to 4")
* 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 SELECT SUBBASE

- 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, Grading E or F. Thickness of subbase shall be as shown on Drawings.
- 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 Contracting Officer's Representative.
- 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 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.

2.5 CONCRETE CURING MATERIALS

- A. Concrete curing materials, 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.

2.6 EXPANSION JOINT FILLERS

- A. Material shall conform to AASHTO M213.

2.7 CONCRETE PROTECTION MATERIAL

- A. Linseed oil mixture shall conform to AASHTO M233.

2.8 CONCRETE MIXES

- A. Design concrete mixes according to ASTM C94/C94M, Option C.
- B. Concrete Type: // Non-air-entrained // Air-entrained //. See Table I.

TABLE I - CONCRETE TYPES					
Concrete Type	Minimum 28 Day Compressive Strength f'c MPa (psi)	Non-Air-Entrained		Air-Entrained	
		Min. Cement kg/cu. m (lbs./cu. yd.)	Max. Water Cement Ratio	Min. Cement kg/cu. m (lbs./cu. yd.)	Max. Water Cement Ratio
A	35 (5000)1,3	375 (630)	0.45	385 (650)	0.40
B	30 (4000)1,3	325 (550)	0.55	340 (570)	0.50
C	25 (3000)1,3	280 (470)	0.65	290 (490)	0.55
D	25 (3000)1,2	300 (500)	*	310 (520)	*
Footnotes:					
1. If trial mixes are used, achieve compressive strength 8.3 MPa (1,200 psi) in excess of f'c. For concrete strengths greater than 35 MPa (5,000 psi), achieve compressive strength 9.7 MPa (1,400 psi) in excess of f'c.					
2. For Concrete Exposed to High Sulfate Content Soils: Maximum water cement ratio is 0.44.					
3. Laboratory Determined according to ACI 211.1 for normal weight concrete.					

- C. Maximum Slump: ASTM C143/C143M. See Table II.

TABLE II - MAXIMUM SLUMP	
APPLICATION	MAXIMUM SLUMP
Curb & Gutter	75 mm (3 inches)
Pedestrian Pavement	75 mm (3 inches)
Vehicular Pavement	50 mm (2 inches) Machine Finished
	100 mm (4 inches) Hand Finished
Equipment Pad	75 to 100 mm (3 to 4 inches)

2.9 ACCESSORIES

- A. Equipment and Tools: Obtain Contracting Officer's Representative's, approval of equipment and tools needed for handling materials and performing work before work begins.
- B. Maintain equipment and tools in satisfactory working condition.

C. Sealants:

1. Concrete Paving Expansion Joints: ASTM D5893/D5893M, Type SL, single component, self-leveling, silicone joint sealant.
2. Concrete Paving Joints: ASTM D6690, Type IV, hot-applied, single component joint sealant.

D. Concrete Protective Coating: AASHTO M233 linseed oil mixture.

PART 3 - EXECUTION

3.1 SUBGRADE PENETRATION

- A. Examine and verify substrate suitability for product installation.
- B. Protect existing construction and completed work from damage.
- C. Prepare, construct, and finish subgrade. See Section 31 20 00, EARTHWORK.
- D. Maintain subgrade in smooth, compacted condition, in conformance with the required section and established grade until the succeeding operation has been accomplished.

3.2 SELECT SUBBASE

- 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 200 mm (8 inches), and that when compacted, will produce a layer of the designated thickness.
 2. When the designated compacted thickness exceeds 150 mm (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 13 mm (1/2 inch) or more below the grade, excavate the top layer and replace with new material to a depth of at least 75 mm (3 inches) 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 determined by AASHTO T180 or AASHTO T99 respectively.

Subbase Tolerances:

4. Variation from Indicated Grade: Maximum 9 mm (3/8 inch).
5. Variation from Indicated Thickness: Maximum 13 mm (1/2 inch).

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 10 mm (3/8 inch).
2. The completed thickness shall be within 13 mm (1/2 inch) of the thickness as shown.

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 VA.

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 substrate imperfections and variations by cutting, 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 before each use.
- C. The Contractor's Registered Professional Land Surveyor 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 subbase has become unstable, reset and recheck the form before placing concrete.

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.
- B. Install reinforcement shown on drawings.
- C. Support and securely tie reinforcing steel to prevent displacement during concrete placement.
- D. Before the concrete is placed, the Resident Engineer 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 JOINTS - GENERAL

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

3.7 CONSTRUCTION JOINTS

- A. Locate longitudinal and transverse construction joints between slabs of vehicular pavement as shown.
- B. Place transverse construction joints of type shown, where indicated, and whenever concrete placement is suspended for more than 30 minutes.
- C. Provide butt-type joint with dowels in curb and gutter if the joint occurs at the location of a planned joint.
- D. Provide keyed joints with tie bars when joint occurs in middle third of planned curb and gutter joint interval.

3.8 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 3 mm (1/8 inch) steel plates conforming to curb and gutter cross sections of the curb and curb gutter
 - 1. Plates shall remain in place until concrete has set sufficiently to hold its shape and shall then be removed.
- C. Finish edges of all joints with an edging tool having the radius as shown.
- D. Score pedestrian pavement with grooving tool or jointer.

3.9 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.

3.10 PLACING CONCRETE - GENERAL

- A. Preparation before Placing Concrete:
 - 1. Obtain approval of the Resident Engineer before placing concrete.
 - 2. Remove debris and other foreign material from between the forms before placing concrete. Obtain approval of the Resident Engineer before placing concrete.
 - 3. Uniformly moisten the subgrade, base, or subbase appropriately, avoiding puddles of water.
- B. 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.
- C. While being placed, spade or vibrate and compact the concrete with suitable tools to prevent the formation of voids or honeycomb pockets.
 - 1. Vibrate concrete well against forms and along joints.
 - 2. Over-vibration or manipulation causing segregation will not be permitted.
- D. Place concrete continuously between joints without bulkheads.
- E. 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.
- F. Replace concrete with cracks, chips, bird baths, and other defects to nearest joints, approved by Contracting Officer's Representative.
- 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.

3.11 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 concrete thoroughly by tamping and spading or with approved mechanical finishing equipment.
- E. Finish concrete surface with wood or metal float.
- F. All Concrete pads and pavements shall be constructed with sufficient slope to drain properly.

3.12 PLACING CONCRETE FOR VEHICULAR PAVEMENT

- A. Deposit concrete into the forms as close as possible to its final position.
- B. Place concrete continuously and rapidly between construction joints without cold 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.

3.13 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 FINISHING - GENERAL

- A. The sequence of operations, unless otherwise indicated, shall be as follows:
 - 1. Consolidating, floating, striking (straight-edging?), troweling, texturing, and joint edging.
- B. Use edging tool with 6 mm (1/4 inch) radius, unless otherwise shown.
- C. Maintain finishing equipment and tools in a clean and approved condition.

3.15 CONCRETE FINISHING - PEDESTRIAN PAVEMENT

A. Walks, Grade Slabs:

1. Finish concrete surfaces with metal float, troweled smooth, and finished with a broom moistened with clear water.
2. Finish all slab edges, including those at formed joints, carefully with an edger having a radius as shown.
3. Brooming shall be transverse to the line of traffic.
 - a. Unless otherwise indicated, edge the transverse joints before brooming. The brooming shall eliminate the flat surface left by the surface face of the edger.
 - b. Execute the brooming so that the corrugation, thus produced, will be uniform in appearance and not more than 1.5 mm (1/16 inch) in depth.
4. The completed surface shall be uniform in color and free of surface blemishes, form marks, and tool marks.
5. Paving Tolerances:
 - a. The finished surface of the pavement shall not vary more than 5 mm (3/16 inch) when tested with a 3000 mm (10 foot) straightedge.
 - b. The thickness of the pavement shall not vary more than 6 mm (1/4 inch).
6. Replace paving within joint boundary when paving exceeds specified tolerances.
7. Remove and reconstruct irregularities exceeding the above for the full length between regularly scheduled joints.

3.16 CONCRETE FINISHING - VEHICULAR PAVEMENT

- A. Align finish surfaces where new and existing pavements abut.
- B. Accomplish longitudinal floating with a longitudinal float not less than 3000 mm (10 feet) long and 150 mm (6 inches) 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.
- C. 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, 1500 mm (5 feet) in length, and

straightedges, 3000 mm (10 feet) in length. Make the final finish with the straightedges, which shall be used to float the entire pavement surface.

- D. Test the surface for trueness with a 3000 mm (10 foot) 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.
- E. 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 450 mm (18 inches) 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 3 mm (1/8 inch) 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.
- F. Pavement Tolerances:
 - 1. The finished surface of the pavement shall not vary more than 6 mm (1/4 inch) in both longitudinal and transverse directions when tested with a 3000 mm (10 foot) straightedge.
 - 2. The thickness of the pavement shall not vary more than 6 mm (1/4 inch).
- G. Replace paving within joint boundary when paving exceeds specified tolerances.
- H. The finish surfaces of new and existing abutting pavements shall coincide at their juncture.

3.17 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 6mm (1/4 inch) or as otherwise detailed.
- B. Gutter and Curb Top:
 - 1. Float the surfaces and finish with a smooth wood or metal float until true to grade and section and uniform in textures.

2. Finish the surfaces, while still wet, with a bristle type brush with longitudinal strokes.

C. Curb Face:

1. 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.
2. Brush the surface, while still wet, in the same manner as the gutter and curb top.

D. Curb and Gutter Tolerances: Except at grade changes or curves.

1. Variation from Indicated Plane and Grade:

- a. Finished surfaces shall not vary more than 3 mm (1/8 inch) for gutter and 6 mm (1/4 inch) for top and face of curb, when tested with a 3000 mm (10 foot) straightedge.

E. Replace curbs and gutters within joint boundary when curbs and gutters exceed specified tolerances.

F. Correct any depressions which will not drain.

G. Visible surfaces and edges of finished curb, and combination curb and gutter shall be free of blemishes, form marks, and tool marks, and shall be uniform in color, shape, and appearance

3.18 CONCRETE CURING

A. Concrete Protection:

1. 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. 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 a minimum of two layers kept saturated with water for the curing period. Mats shall overlap each other at least 150 mm (6 inches).
 2. Impervious Sheeting:
 - a. Use waterproof paper, polyethylene-coated burlap, or polyethylene sheeting. Polyethylene shall be at least 0.1 mm (4 mils) in thickness. Wet the entire exposed concrete surface with a fine spray of water and then cover with the sheeting material.
 - b. Sheets shall overlap each other at least 300 mm (12 inches).
 - c. Securely anchor sheet materials preventing displacement.
 3. Liquid Membrane Curing:
 - a. Apply pigmented membrane-forming curing compound in two coats at right angles to each other at a rate of 5 m²/L (200 square feet per gallon) for both coats.
 - b. Do not allow the concrete to dry before the application of the membrane.
 - c. 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.
 - d. Immediately re-spray any area covered with curing compound and damaged during the curing period.

3.19 CONCRETE PROTECTIVE COATING

- A. Curing and Protection: 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. Application: Complete backfilling and curing operation before applying protective coating.
- C. Concrete shall be surface dry and thoroughly clean before each application.

- D. 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.
- E. Protect coated surfaces from vehicular and pedestrian traffic until dry.
- F. Precaution: Do not heat protective coating, and do not expose 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).

3.20 FIELD QUALITY CONTROL

- A. Field Tests: Performed by testing laboratory specified in Section 01 45 29, TESTING LABORATORY SERVICES.
 - 1. Compaction.
 - a. Pavement subgrade.
 - b. Curb, gutter, and sidewalk.
 - 2. Concrete:
 - a. Delivery samples.
 - b. Field samples.
 - 3. Slip Resistance: Steps and pedestrian paving.

3.21 CLEANING

- A. After completing curing:
 - 1. Remove burlap and sheet curing materials.
 - 2. Sweep concrete clean, removing foreign matter from the joints.
 - 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.

3.22 PROTECTION

- A. Protect exterior improvements from traffic and construction operations.
 - 1. 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.
- B. Remove protective materials immediately before acceptance.

C. Repair damage.

1. 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.

3.23 FINAL CLEAN-UP

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

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