SECTION 02750 RIGID PAVEMENT- PORTLAND CEMENT CONCRETE

PART 1 – SCOPE

This work shall consist of constructing a pavement of portland cement concrete as specified, on a prepared subgrade or subbase, in accordance with these Specifications and in conformity with the lines, grades and typical cross-sections shown on the Plans or as directed by the Owner.

PART 2 – MATERIALS AND EQUIPMENT

2.01 MATERIALS

A. Concrete. Materials shall meet the requirements of Specification Section 03050 for Portland Cement Concrete Class B.

B. Steel Wire Fabric, Dowel Bars, and Tie Bars

1. Fabric for reinforcement shall conform to ASTM A 185, or as indicated on the Plans.

2. Dowel bars shall be plain and shall conform to the requirements of ASTM A 306, Grade 60. Corrosion resistant coated dowels shall meet the requirements of AASHTO M 254.

3. Tie bars shall be billet steel bars conforming to the requirements of ASTM A 615. Tie bars that are to be bent in the course of construction shall be of such quality that they may be straightened after bending without breaking.

C. Curing Materials

1. Water: Water used in curing portland cement concrete shall be free from any substance which may be injurious to concrete when applied to the surface as a curing agent.

2. Burlap: Burlap shall conform to AASHTO M 182, Class 3 or Class 4. If Class 1 or Class 2 burlap is permitted, at least two layers shall be used.

3. Cotton Mats: Cotton mats shall conform to AASHTO M 73.

4. Waterproof Paper: Paper for curing shall conform to AASHTO M 139.

5. Liquid Membrane – Forming Compounds: These compounds shall conform to AASHTO M 148, Type 2.

6. White Polyethelene Sheeting: This material shall conform to AASHTO M 171.

7. Linseed Oil: Linseed oil emulsion curing compound shall conform to Federal Specification TC 800 A or U.S. Army Corps of Engineers Specification CRD-C-302-68.

D. Preformed Joint Fillers (Nonextruding and Resilient)

1. Preformed fillers for joints shall be of the bituminous type unless otherwise specified on the Plans and, when required, shall be punched to admit dowels. Bituminous type preformed fillers for joints shall conform to the requirements of AASHTO M 213.

2. If nonbituminous types are specified, they shall conform to the requirements of AASHTO M 153, Type 3, unless otherwise specified.

3. The filler for each joint shall be furnished in a single piece for the full depth and width required for the joint unless otherwise allowed by the Owner. When splicing is necessary and authorized, the abutting ends shall be fastened securely and held accurately in position by stapling or other positive fastening satisfactory to the Owner.

E. Chemical Additives

1. Chemical additives such as water reducing, set retarding, set accelerating, or combination admixtures shall conform to the requirements of AASHTO M 194. No chemical additive will be used unless ordered or permitted by the Owner in writing, and no reduction in the cement content of the concrete as designed without chemical additives will be made when additives are permitted.

2. Air-entraining admixtures shall be used as specified in Specification Section 03050.

F. Joint Sealants

1. Type I shall be preformed elastomeric compression joint seals with lubricant adhesives. Seals shall be of the open cell compression type. All materials shall conform to the requirements of AASHTO M 220.

2. Type II sealants shall be hot poured elastic type concrete joint sealer. This sealer shall conform to the requirements of AASHTO M 173 with the following exceptions:

a. The joint sealer shall be a mixture of virgin synthetic rubber or reclaimed rubber or a combination of the two with asphalt and plasticizers and tacifiers.

b. Ground cured rubber scrap shall not be used.

c. The sealer shall be free of foreign material and when melted shall be free of lumps.

d. The Contractor shall furnish the Owner a certified statement showing compliance with the above composition.

3. The flow at 140^{o} F shall not exceed 1.0 centimeter in 5 hours. Ductility at 77^{o} F shall be not less than 40 centimeters, when tested in accordance with AASHTO T 51.

4. The Contractor shall furnish the Owner a certified copy of the test results, showing the batch number, indicating that the material supplied conforms to the requirements of the Specifications.

G. Proportioning

1. Class B concrete for concrete pavement will be a workable, well mixed concrete proportioned in accordance with Specification Section 03050.

2.02 EQUIPMENT

Equipment and tools necessary for handling materials and performing all parts of the Work shall be approved by the Owner as to design, capacity, and mechanical condition. All equipment shall be at the job site sufficiently ahead of the start of construction operations to be examined thoroughly by the Owner and approved.

A. Forms

1. Straight side forms shall be made of metal having a thickness of not less than 7/32 inch and shall be furnished in sections not less than 10 feet in length. Forms shall have a depth at least equal to the prescribed edge thickness of the concrete, without horizontal joint, and a base width equal to not less than the depth of the forms. Flexible or curved forms of the proper radius shall be used for curves. Flexible or curved forms shall be of a design acceptable to the Owner. Forms shall be provided with adequate for secure setting so that

when in place they will withstand, without visible spring or settlement, the impact and vibration of the consolidating and finishing equipment. Flange braces shall extend outward on the base not less than 2/3 the height of the form. The top face of the form shall not vary from a true plane more than 1/8 inch in 10 feet, and the face of the form shall not vary more than 1/4 inch. The forms shall contain provisions for locking the ends of abutting form sections together tightly and for secure setting. Metal pins shall be of proper size and length to hold the forms rigidly and securely in place.

2. Built-up forms shall not be used except when approved by the Owner and shall have a minimum base width of 8 inches.

3. Forms with battered top surfaces and bent, twisted, or broken forms shall be removed from the Work. Repaired forms shall not be used until inspected and approved by the Owner.

4. The supply of forms, provided and maintained in satisfactory condition, shall not be less than that required for a full day's run.

B. Spreading and Finishing Equipment

1. Mechanical Power-Driven Spreader: Equipment shall include a mechanical power-driven spreader capable of uniformly spreading the concrete in front of the finishing machine. The mechanical finishing machine shall be equipped with at least 2 oscillating type transverse screeds.

2. Vibrators: Vibrators for full width and full depth vibration of concrete paving slabs shall be multiple spuds or other types approved by the Owner. They may be attached to the spreader or the finishing machine or may be mounted on a separate carriage. The frequency of the vibrators shall be that recommended by the manufacturer, subject to approval of the Owner. The Contractor shall furnish the Owner the manufacturer's recommendations for installing and operating the vibrators.

3. Longitudinal Floats: The mechanical longitudinal float shall be of a design approved by the Owner, and shall be in good working condition. It shall be so constructed as to provide for accurate adjustment to the required crown.

4. Bridges: The contractor shall furnish individual bridges as required by the Owner.

5. Finishing Straightedge: Straightedges, not less than 2, with handles at least 3 feet longer than 1/2 the width of the slab, shall be constructed of light metal; shall be not less than 10 feet long; and shall be maintained clean and straight.

6. Straightedge Templates: Straightedge templates, not less than 2, shall be provided for testing the completed surface. They may be of wood or metal; shall not be less than 12 feet long; and shall be maintained clean, straight, and free from warp.

7. Water Supply Equipment: Water supply equipment shall include pumps or tanks mounted on trucks, of adequate capacity to furnish more than sufficient water to accommodate the construction and at the required and necessary pressure. A pipe line appropriate to the requirements of the construction may be used.

8. Small Tools: Small tools, such as edgers, trowels, hand floats, and brushes shall be such as will produce the results required.

9. Special Equipment and Tools: Equipment and tools necessary for the construction of special features as indicated on the Plans shall be such as will produce the results required.

10. Transverse Grooving Equipment: Mechanical transverse grooving equipment shall consist of a steel tine comb with a minimum width of 6 feet, a vibrating beam roller, or other approved devises.

11. Concrete Saw:

a. When sawed joints are elected or specified, the Contractor shall provide sawing equipment adequate in number of units and power to complete the sawing to the required dimensions and at the required rate. The saws shall be equipped with water cooled diamond edge blades or abrasive wheels. Saws used for sawing longitudinal joints shall be equipped with guides to assure proper alignment of the joints.

b. The Contractor shall provide at least one standby saw in good working order. An ample supply of saw blades shall be maintained at the site of the Work at all times during sawing operations. The Contractor shall provide adequate artificial lighting facilities for night sawing. All of this equipment shall be on the job both before and continuously during concrete placement.

C. Slip Form Paver

1. The slip form paver, if used, shall be an approved self-propelled type equipped with a crawler type track of sufficient area to prevent track slippage under load. Length of ground contact per track and arrangement of track units shall be adequate to insure the established straightedge tolerance. When this method of construction is used, all provisions and requirements of the Specifications which are not in conflict shall be applicable.

2. Pavement alignment shall be controlled by means of an electronic sensing device in continuous contact with a sensing guide. The Contractor shall furnish equipment with electronic controls for the vertical adjustment of the paver strike-off and finishing components. Electronic controls, sensing devices, and sensing guides shall be furnished, installed, and maintained at the expense of the Contractor.

3. When a slip form paver is to be used the concrete shall have sufficient cohesion to prevent appreciable slumping of the pavement edges. When the concrete will not meet these requirements, production shall be stopped or slowed, and corrections to the mix shall be immediately made.

4. The slip form paver shall be designed to spread, consolidate, screed, and float finish the concrete in one complete pass of the machine in such a manner that a minimum of hand finishing will be necessary to provide a dense and homogeneous pavement. The machine shall vibrate the concrete for the full width and depth being placed. The vibration shall be accomplished internally by vibrating tubes or arms working in the concrete or with a vibrating screed or pan operating on the surface of the concrete. The slip form paver shall be equipped with forms of sufficient length and rigidity to adequately support the edges of the slab so as to permit any necessary hand finishing and the installation of joints when joints are required.

5. The paver shall be operated with a continuous forward movement, and all operations of mixing, delivering, and spreading the concrete shall be coordinated to provide uniform progress with stopping and starting of the paver held to a minimum. If for any reason it is necessary to stop the forward movement of the paver, the vibratory and tamping elements shall also be stopped immediately.

6. Surface smoothness and texture shall meet the requirements of Specification Section 02750 Paragraphs 3.09 and 3.10 except that a longitudinal straightedge tolerance of 1/4 inch in 10 feet will apply to the area within 6 inches of the edge of the pavement.

7. An edge slump of 1/2 inch will be permitted, except that where additional concrete pavement is to be placed adjacent to the edges the edge slump shall be not more than 1/4 inch.

8. The Contractor shall have available at all times materials for the protection of the edges of the unhardened concrete. Such protective materials shall consist of either standard metal forms or wood plank having a nominal thickness of not less than 2 inches. The depth of the forms of plank shall not be less than the thickness of the pavement. When rain appears imminent, all paving operations shall stop, and all available personnel shall assist in placing forms against the sides of the pavement in addition to placing a covering over the surface of the unhardened concrete.

PART 3 – CONSTRUCTION REQUIREMENTS

3.01 SUBGRADE PREPARATION

Subgrade preparation shall be performed as provided for under Specification Section 02335 Paragraph 3.03.

3.02 CONSTRUCTION OF BASE

Base, when called for on the Plans, shall be constructed in accordance with the provisions of the applicable portions of Specification Sections under 02700, Bases, Ballasts, Pavements, and Appurtenances, and shall be completed not less than 500 linear feet in advance of paving. The Contractor shall construct or correct the base to such grade tolerances as will insure the concrete pavement thickness required. The base grading machine and slip form paver shall be equipped with automatic line (guidance) and grade controls.

3.03 SETTING FORMS

A. Base Support: The foundation under the forms shall be firm and true to grade so that each form, when set, will be firmly in contact for its whole length and at the specified grade. Any grade at the form line found below established grade shall be filled to grade with suitable material in lifts of 1/2 inc or less for a distance of 18 inches on each side of the base of the form and thoroughly compacted. Any grade at the form line found above grade shall be corrected by tamping or by cutting as necessary. Pedestals of earth or other material upon which to rest the forms to bring them to grade will not be permitted.

B. Form Setting: Forms shall be set and approved for the placing of concrete in advance of the point where concrete is being placed as approved by the Owner. After the forms have been set to correct grade, the material supporting the forms shall be thoroughly tamped, mechanically or by hand, at both the inside and outside edges of the base of the forms. Forms shall be staked into place with not less than three pins for each 10 foot section. A pin shall be placed at each side of every joint. Form sections shall be tightly locked and free from play or movement in any directions. The forms shall not deviate from true line by more than 1/4 inch at any point. Forms that settle or spring under the spreading and finishing equipment shall be reset or removed as directed. The top and face of forms shall be cleaned and oiled prior to the placing of concrete.

C. Grade and Alignment: The alignment and grade elevations of the forms shall be checked and corrections made by the Contractor immediately before placing the concrete. When any form has been disturbed or any grade has become unstable, the form shall be reset and rechecked.

3.04 CONDITIONING OF SUBGRADE OR BASE

A. After the forms have been set and approved, the subgrade or base shall be brought to proper grade and cross-section. High areas shall be trimmed. Low areas in subgrade or base may be filled with subgrade or base materials, respectively, and compacted to correspond with the

surrounding areas, except that low areas in cement treated bases shall be filled with concrete integral with the pavement.

B. Unless waterproof cover is specified, the subgrade shall have been previously wetted and shall be in a moist condition at the time of placing concrete. If it subsequently becomes dry previous to the actual placing of the concrete, it shall be sprinkled, but the formation of pools of water shall be avoided. The subgrade shall not be muddy or soft.

C. In addition to all applicable provisions mentioned previously, the slip form method of paving shall required that the subgrade or base be placed and compacted to the required density and to a width beyond the pavement limits sufficient to support all paving equipment. If any traffic is allowed to use the prepared grade, the grade shall be checked and corrected immediately prior to the placing of the concrete.

3.05 MIXING LIMITATIONS AND PLACING CONCRETE

A. Mixing Limitations: Limitations of mixing of concrete due to weather shall be in accordance with the limitations specified in Specification Section 03050 Paragraph 5.02, “Limitations on Concrete Operations”.

B. Placing Concrete

1. The concrete shall be unloaded into an approved spreading device, or deposited on the subgrade or subbase, and spread in such manner as to prevent segregation of the materials. As deposited, the mixture shall be placed where it will require as little re-handling as possible.

2. Placing shall be continuous between transverse joints without the use of intermediate bulkheads. Necessary hand spreading shall be done with shovels or other approved tools. Workmen shall not be allowed to walk in the freshly mixed concrete with boots or shoes coated with earth or other foreign substances.

3. Where concrete is to be placed adjoining a previously constructed lane of pavement and mechanical equipment will be operated upon the existing lane of pavement, that lane shall meet the requirements for opening to traffic stipulated in Specification Section 02750 Paragraph 3.15. If only finishing equipment is carried on the existing lane, paving in adjoining lanes may be permitted after 7 days.

4. Concrete shall be thoroughly consolidated against and along the faces of all forms and along the full length and on both sides of all joint assemblies, by means of vibrators inserted in the concrete. Vibrators shall not be permitted to come in contact with a joint assembly, the grade, or a side form. In no case shall the vibrator be operated longer than 5 seconds in any one location.

5. The use of hand operated vibrators will be permitted. Vibrators mounted on a machine shall be operated only while the machine is in motion.

6. Concrete shall be deposited as near to expansion and contraction joints as possible without disturbing them but shall not be dumped from the discharge bucket or hopper onto a joint assembly unless the hopper is well centered on the joint assembly.

7. Should any concrete materials fall on or be worked into the surface of a completed slab, they shall be removed immediately.

3.06 TEST SPECIMENS

The Contractor shall furnish the concrete necessary for casting test specimens in the field. The Owner will supply all molds and labor necessary to cast and test the specimens. The Owner will designate the

frequency of sampling the fresh concrete. The method of making and curing test specimens will be in accordance with AASHTO T 23. Test cores shall be drilled by the Contractor at his expense if required by the Owner at locations selected by the Owner. When so directed, test cores shall be taken at a rate of one core per unit, with one unit defined as a poured lane or lanes 1,000 feet in length, a street intersection, an interchange ramp, or small areas such as crossovers and entrances of 1,000 square yards or less.

3.07 STRIKE-OFF OF CONCRETE AND STEEL FABRIC PLACEMENT

A. Following the placing of the concrete, it shall be struck off to conform to the cross-section shown on the Plans and to an elevation such that when the concrete is properly consolidated and finished, the surface of the pavement will be in conformity with the elevation shown on the Plans or established by the Owner. When steel fabric reinforced concrete pavement is placed in 2 layers, the entire width of the bottom layer shall be struck off to such length and depth that the sheet of fabric may be laid full length on the concrete in its final position without further manipulation. The steel fabric shall be placed in strips transversely with the roadway at the depth and with the lap shown on the Plans. The fabric shall extend to within 2 inches of the ends and sides of the slab. The reinforcement shall be placed directly upon the concrete, after which the top layer of the concrete shall be placed, struck off, and screeded. Any portion of the bottom layer of concrete which has been placed more than 30 minutes without being covered with the top layer shall be removed and replaced with freshly mixed concrete at the Contractor's expense.

B. Reinforcing steel fabric shall be free from dirt, oil, paint, grease, mill scale, and loose or thick rust which could impair bond of the steel with the concrete.

3.08 JOINTS

A. Joints shall be constructed of the type and dimensions and at the locations required by the Plans and in accordance with the provisions of these Specifications.

B. Longitudinal joints shall be perpendicular to the pavement surface and shall be along or parallel to the centerline of the pavement, unless otherwise specified. Transverse joints shall be straight, perpendicular to the pavement surface and, unless otherwise specified, shall be at right angles to the centerline of the pavement.

C. Longitudinal Joints

1. Deformed steel tie bars of specified length, size, spacing, and materials shall be placed across and perpendicular to the longitudinal joints. They shall be placed by approved mechanical equipment or rigidly secured by chars or other approved supports to prevent displacement.

2. When adjacent lanes of pavement are constructed separately, a keyway shall be formed along the construction joint of the first lane constructed by the use of one of the alternate metal center strip types as detailed on the Plans, or as directed by the Owner. Tie bars may be bent at right angles against the form and straightened into final position before the concrete of the adjacent lane is placed, or they may be placed in holes drilled through the forms. Construction joints shall be tooled to a 1/4 inch radius during finishing operations and later sawed as detailed on the Plans or as directed by the Owner.

3. Longitudinal sawed joints shall be cut by means of approved concrete saws to the depth, width, and line shown on the Plans, or as directed by the Owner, not later than 10 days after placing concrete and before any equipment or vehicles are allowed on the pavement.

4. Inserts that are to be sawed shall be an approved rigid material of the thickness and width shown on the Plans or as directed by the Owner, with a length equal to one-half the

pavement width for transverse joints and not less than 10 feet for longitudinal joints. Insert material that cracks, shatters, warps during installation, or that leaves a residue from sawing that will prevent seal material from adhering to the concrete will not be acceptable.

5. After the concrete has sufficiently set, the insert shall be sawed to the width and depth shown on the Plans or as directed by the Owner, leaving the remainder of the insert in place.

6. Immediately after sawing, all longitudinal contraction and construction joints shall be thoroughly cleaned of all residue by flushing with water under pressure.

7. As an alternate to sawing, the longitudinal contraction joints may consist of forming the joints by placing a permanently installed continuous strip of polyethylene sheeting having a minimum thickness of 10 mils (0.010 inches) and a width equal to 1/3 of the total thickness of portland cement concrete being placed. The joint material shall be such that it will not react adversely with the chemical constituents of the concrete.

8. The joint insert material shall be such that when placed perpendicular to the pavement surface, it will not bond with the concrete and will form an effective weakened plane joint of the specified depth. The joint material shall be inserted with an approved mechanical device that places the material in a continuous strip, except where intervening structures break the continuity of paving. Splices in the joint material will be permitted provided they are effective in maintaining the continuity of the joint material as placed. The joint material shall be placed in such manner that the top of the strip is not more than 1/4 inch below the finished surface of the concrete. The joint material shall not be deformed from a position perpendicular to the surface, either in the installation or in subsequent finishing operations performed on the concrete. The mechanical installation device shall vibrate the concrete during placing the strip sufficiently to cause the concrete to flow evenly about the joint material producing homogeneous concrete free of segregation and rock pockets or voids. The alignment of the finished joint shall meet the approval of the Owner.

D. Transverse Expansion Joints

1. Dowels shall be prepared and placed across transverse expansion joints as indicated on the Plans or as directed by the Owner.

2. Dowels shall be held in position, parallel to the surface and centerline of the slab, by an approved metal device that is left in the slab. Dowels that are not corrosion resistant shall be painted with on coat of approved primer. When the paint has dried and immediately before placing the dowel in position, the dowel shall be thoroughly coated with a thick film of heavy grease. Bond breaker for corrosion resistant dowels shall be a s recommended by the coating manufacturer. One end of each dowel shall be covered with a close fitting, closed end metal sleeve, no less than 4 inches long, with a flange or other approved device to separate the end of the sleeve and the end of the dowel during the placing of the concrete so that a space of not less than the proposed thickness of the joint plus 1/4 inch will be provided for subsequent movement of the dowel in the sleeve. The type of metal sleeve to be used on the dowel bars shall meet the approval of the Owner. Dowels shall have ends free from burrs and distortions.

3. Transverse expansion joints shall be of the kind and type shown on the Plans or as directed by the Owner. When pre-molded joint filler is used, it shall be installed by the use of one of the alternate expansion joint and dowel assembly devices shown on the Plans, or other approved expansion joint assemblies may be used. The installing device shall have a length 1/2 inch less than the width of the slab. Assemblies shall be a rigid metal device capable of holding dowels and filler firmly in position during the entire construction operation and shall remain in place. The top of the filler shall be set below the surface of the proposed slab to accommodate the type sealant specified, as detailed on the Plans or directed by the

Owner. When in position, the filler shall be perpendicular to the surface of the slab. The top edge of the filler shall be protected, while the concrete is being placed, by an approved metal channel cap. The assembly device may be designed with this cap self-contained.

E. Transverse Contraction Joints

1. Transverse contraction joints shall be placed at the intervals specified and shall be of the plain sawed groove or insert and sawed groove type, as detailed on the Plans or as directed by the Owner and in accordance with these Specifications.

2. Formed contraction joints shall not be used unless specified or required by the Owner to control random cracking. Unless otherwise directed or shown on the Plans, all joints shall be at right angles to the centerline of the pavement and perpendicular to the surface. When called for on the Plans or directed by the Owner, contraction joints shall include load transfer assemblies.

3. In lieu of using dowel assemblies at contraction joints, dowel bars may be placed in the full thickness of pavement by a mechanical device approved by the Owner.

4. Sawed Contraction Joints

a. Sawed contraction joints shall be made by sawing grooves in the surface of the pavement of the dimensions shown on the Plans.

b. Sawing of the joints shall commence as soon as the concrete has hardened sufficiently to permit sawing without excessive raveling – usually 6 to 12 hours. All joints shall be sawed before uncontrolled shrinkage cracking takes place. If necessary, the sawing operations shall be carried on both day and night, regardless of weather conditions. The sawing of any joint shall be omitted if a crack occurs at or near the joint location prior to the time of sawing. The sawing of a joint shall be discontinued when a crack develops ahead of the saw. In general, all joints shall be sawed in sequence.

c. All contraction joints in lanes adjacent to previously constructed lanes shall be sawed before uncontrolled cracking occurs. If extreme conditions exist which make it impractical to prevent erratic cracking by early sawing, a contraction joint groove shall be formed at intervals of every third or fourth joint or as often as required prior to initial set of concrete as provided for under paragraph 4.d below. Immediately after sawing, the joints shall be thoroughly cleaned of all residue by flushing with water under pressure.

5. Transverse Contraction Joints: Transverse contraction joints made by the insert and sawed groove method shall comply with the applicable requirements of Specification Section 02750 Paragraph 3.08 C for the longitudinal contraction joint.

6. Formed Contraction Joints: Formed contraction joints shall be formed during the placing of the concrete. These joints shall be formed by placing inserts in the plastic concrete, at right angles to the centerline of the pavement and perpendicular to the surface. When the concrete has attained its initial set and after the joint has been carefully finished, the insert shall be removed. The groove so formed shall maintain its full width and depth as shown on the Plans, and the pavement at the joint shall meet surface requirements.

F. Transverse Construction Joints

1. Transverse construction joints shall be constructed as detailed on the Plans. Grooves shall be formed by one of the methods specified under Paragraph 3.08 E.4 or E.5 of this Specification Section. The joints shall be constructed when there is an interruption of more than 30 minutes in the concreting operations. No transverse joint shall be constructed within

10 feet of an expansion joint, contraction joint, or plane of weakness. If sufficient concrete has not been mixed at the time of interruption to form a slab at least 10 feet long, the excess concrete back to the last preceding joint shall be removed and disposed of as directed.

G. Expansion Joints at Structures

1. Expansion joints shall be formed about all structures and features projecting through, into, or against the slab by the use of pre-molded joint filler. Unless otherwise indicated such joints shall be 1/2 inch in width.

3.09 FINAL STRIKE-OFF, CONSOLIDATION AND FINISHING

A. Sequence

1. The sequence of operations shall be the strike-off and consolidation, floating and removal of laitance, straightedging, and final surface finish.

B. Finishing at Joints

1. The concrete adjacent to joints shall be compacted or firmly placed without voids or segregation against the joint material and under and around all load transfer devices, joint assembly units, and other features designed to extend into the pavement.

2. After the concrete has been placed and vibrated adjacent to the joints as required in Specification Section 02750 Paragraph 3.05, the finishing machine shall be brought forward, operating in a manner to avoid damage or misalignment of joints. If uninterrupted operation of the finishing machine, to, over, and beyond the joints causes segregation of concrete, damage to, or misalignment of the joints, the finishing machine shall be stopped when the front screed is approximately 8 inches from the joint. Segregated concrete shall be removed from in front of and off the joint; the front screed shall be lifted and set directly on top of the joint, and the forward motion of the finishing machine resumed. When the second screed is close enough to permit the excess mortar in front of it to flow over the joint, it shall be lifted and carried over the joint. Thereafter, the finishing machine may be run over the joint without lifting the screeds, provided there is no segregation in the concrete immediately between the joint and the screed or on top of the joint.

C. Machine Finishing.

1. The concrete shall be distributed or spread as soon as placed. As soon as the concrete has been spread, it shall be struck off and screeded by an approved finishing machine meeting the requirements specified under Specification Section 02750 Paragraph 2.02 B. When the pan-float finisher combination machine is used for finishing the pavement, longitudinal floats will not be required. The machine shall go over each area of pavement as many times and at such intervals as necessary to give the proper compaction and to leave a surface of uniform texture. Excessive operation over a given area shall be avoided. The tops of the forms shall be kept clean by an effective device attached to the machine, and the travel of the machine on the forms shall be maintained true without lift, wobbling, or other variation tending to affect the precision finish.

2. During the first pass of the finishing machine, a uniform roll of concrete shall be maintained ahead of the front screed for its entire length. The moving of rolls of concrete in excess of 6 inches with the finishing machine will not be permitted.

3. Vibrators, for full width and depth vibration of concrete paving slabs, shall meet the requirements specified in Specification Section 02750 Paragraph 2.02 B. If uniform and satisfactory density of the concrete is not obtained by the vibratory method at joints, along

forms, at structures, and throughout the pavement, the Contractor will be required to furnish equipment and methods which will produce satisfactory work.

D. Hand Finishing

1. Unless otherwise specified, hand finishing methods will not be permitted except under the following conditions:

a. In the event of breakdown of the mechanical equipment, hand methods may be used to finish the concrete already deposited on the grade when the breakdown occurs.

b. Ramps and variable width sections, where the use of finishing machines is impractical, may be finished by hand methods.

2. When hand finishing is permitted, the concrete as soon as placed shall be struck off and screeded. The screed shall be at least 2 feet longer than the maximum width of the slab to be struck off. It shall be of approved design and sufficiently rigid to retain its shape.

3. Consolidation shall be attained by the use of a suitable vibrator and other approved equipment.

4. Screeding shall be repeated until the surface is of uniform texture, true to grade and cross-section, and free from porous areas.

E. Floating

1. After the concrete has been struck off and consolidated, it shall be further smoothed, trued, and consolidated, using one of the following methods as specified or permitted:

a. Hand Method: When hand finishing is permitted as provided for under Specification Section 02750 Paragraph 3.09 D, the Contractor shall use equipment and methods approved by the Owner.

b. Mechanical Method: The mechanical float described under Specification Section 02750 Paragraph 2.02 B.3 shall be used unless otherwise specified. The tracks from which the float operates shall be accurately adjusted to the required cross-section. The float shall be accurately adjusted and coordinated with the adjustments of the transverse finishing machine so that a small amount of mortar is carried ahead of the float at all times. The forward speed shall be adjusted so that the float will lap the distance specified by the Owner on each transverse trip. The float shall pass over each area of pavement at least two times, but excessive operation over a given area will not be permitted. Any excess water or soupy material shall be wasted over the side forms on each pass. After floating, any excess water and laitance shall be removed from the surface of the pavement by a straightedge 10 feet or more in length. Successive drags shall be lapped one-half the length of the blade.

F. Straightedge Testing and Surface Correction

1. After the floating has been completed and the excess water removed, but while the concrete is still plastic, the surface of the concrete shall be tested for trueness. For this purpose the Contractor shall furnish and use and accurate metal straightedge, not less than 10 feet in length, swung from handles at least 3 feet longer than one-half the width of the slab. The straightedge shall be held in contact with the surface in successive positions parallel to the road centerline, and the whole area gone over from one side of the slab to the other as necessary. Advance along the road shall be in successive stages of not more than one-half the length of the straightedge. Any depressions found shall be immediately filled

with freshly mixed concrete, struck off, consolidated, and refinished. High areas shall be cut down and refinished. Special attention shall be given to assure that the surface across joints meets the requirements for smoothness. Straightedge testing and surface corrections shall continue until the entire surface is found to be free from observable departures from the straightedge and the slab conforms to the required grade and cross-section.

2. When in the opinion of the Owner, superficial water is required to assist in finishing, it shall be applied by lightly fogging.

3. Straightedging shall be followed by belting with an approved belt or hose. Belts shall not be permitted to rest on the pavement.

G. Final Finish

1. The surface texture shall be a burlap drag finish. The drag shall consist of a seamless strip of damp burlap which, when dragged longitudinally along the full width of pavement, will produce a uniform surface of gritty texture. For pavement 24 feet or more in width, the drag shall be mounted on a bridge. The dimensions of the drag shall be such that a strip of burlap at least 3 feet wide is in contact with the full width of pavement surface while the drag is used. The drag shall consist of not less than 2 layers of burlap with the bottom layer approximately 6 inches wider than the upper layer. The drag shall be maintained in such condition that the resultant surface is of uniform appearance and reasonably free from grooves over 1/16 inch in depth. Drags shall be maintained clean and free from encrusted mortar. Drags that cannot be cleaned shall be discarded and new drags substituted.

2. After the pavement has been finished by the burlap drag, the surface shall be textured by the formation of transverse grooves. The transverse grooves shall be formed by mechanical equipment using a comb made of steel tines, vibrating beam roller, or other approved device. Manual tools such as rakes with spring steel tines may be used on areas inaccessible to mechanical equipment.

3. The grooves shall be formed in the concrete at an appropriate time during the setting of the concrete mixture, so that in the hardened concrete, the grooves will be between 0.09 inch and 0.13 inch in width, between 0.12 inch and 0.19 inch in depth, and will be spaced at random intervals between 0.3 inch and 1.0 inch.

4. Regardless of the method used to form the grooves, the grooves shall be relatively smooth and uniform and shall be formed without excessive tearing of the surface or without bringing pieces of the coarse aggregate to the top of the surface.

5. In the event of mechanical failure or equipment breakdown, manual tools may be used for grooving, provided all placing operations cease until proper repairs are made.

6. Any individual areas of 50 square yards or larger of the hardened grooved concrete which do not conform to these requirements shall be corrected at the Contractor's expense, by the cutting of acceptable grooves in the hardened surface with an approved cutting machine, or by other approved methods.

H. Edging at Forms and Joints

1. After the final finish, but before the concrete has taken its initial set, the outside edges of the pavement shall be rounded to a 3/4 inch radius. When pavement is formed along a lane line, the edges shall be rounded to a 1/4 inch radius. The edges of the pavement on each side of transverse expansion joints, formed joints, and transverse construction joints shall be rounded to a 1/4 inch radius. Edging shall be performed with an approved edging tool which

will produce a well defined and continuous radius. All tool marks formed by the edging tool shall be eliminated by brushing to form a texture similar to the burlap drag finish.

3.10 SURFACE TEST

A. As soon as the concrete has hardened sufficiently, the pavement surface shall be tested with a 12 foot steel straightedge provided by the Contractor or other specified device. When the straightedge is placed parallel to the centerline of the pavement, the surface shall not vary more than 1/8 inch from the lower edge of the straightedge. Areas showing high spots of more than 1/8 inch, but not exceeding 1/2 inch in 12 feet, shall be marked and immediately ground down with an approved grinding tool to an elevation where the area will not show surface deviations in excess of 1/8 inch when tested with a 12 foot straightedge. The ground area shall then be sealed with an epoxy resin system meeting the requirements of AASHTO M 200, Class I, as approved by the Owner. Grinding and sealing shall be at the Contractor's expense. Where surface deviation exceeds 1/2 inch, the pavement shall be removed and replaced by and at the expense of the Contractor.

B. Any area or section removed shall be not less that 10 feet in length nor less than the full width of the lane involved. When it is necessary to remove and replace a section of pavement, any remaining portion of the slab adjacent to the joints that is less than 10 feet in length shall also be removed and replaced.

3.11 CURING

A. In all cases in which curing requires the use of water, the curing shall have prior right to all water supply or supplies. Failure to provide a sufficient quantity of one of the curing materials described under Specification Section 02750 Paragraph 2.01 C or lack of water to adequately take care of both curing and other requirements shall be cause for immediate suspension of concreting operations. The concrete shall not be left exposed for more than one-half hour between stages of curing or during the curing period. Immediately after the finishing operations have been completed and as soon as marring of the concrete will not occur, the entire surface of the newly placed concrete shall be covered and cured in accordance with one of the following methods.

1. Cotton or Burlap Mats: The surface of the pavement shall be entirely covered with mats. The mats used shall be of such length (or width) that, as laid, they will extend at least twice the thickness of the pavement beyond the edges of the slab. The mats shall be placed so that the entire surface and both edges of the slab are completely covered. Prior to being placed, the mats shall be saturated thoroughly with water. The mats shall be so placed and weighted down as to cause them to remain in intimate contact with the surface covered, and the covering shall be maintained fully wetted and in position for 72 hours after the concrete has been placed unless otherwise specified.

2. Waterproof Paper: The top surface and sides of the pavement shall be entirely covered with waterproofed paper. The units shall be lapped at leas 18 inches. The paper shall be so placed and weighted down as to cause it to remain in intimate contact with the surface covered. The paper shall have such dimensions that each unit as laid will extend beyond the edges of the slab at least twice the thickness of the pavement, or it shall be of pavement width with 3 foot strips of paper for the edges. If laid longitudinally, paper not manufactured in sizes which will provide this width shall be cemented together in such a manner that the joints do not open up or separate during the curing period. Unless otherwise specified, the covering shall be maintained in place for 72 hours after the concrete has been placed. The surface of the pavement shall be thoroughly wetted prior to the placing of the paper.

3. Impervious Membrane Method

a. The entire surface of the pavement shall be sprayed uniformly with white pigmented curing compound immediately after the finishing of the surface and before the set of the concrete has taken place, or if the pavement is cured initially with jute or cotton mats, it may be applied upon removal of the mats. The curing compound shall not be applied during rainfall.

b. Curing compound shall be applied under pressure by mechanical sprayers at the rate recommended by the manufacturer but in no case at a rate less than one gallon to each 150 square feet. The spraying equipment shall be of the fully atomizing type equipped with a tank agitator. At the time of use, the compound shall be in a thoroughly mixed condition with the pigment uniformly dispersed throughout the vehicle. During application, the compound shall be stirred continuously by effective mechanical means. Hand spraying of odd widths or shapes and concrete surfaces exposed by the removal of forms will be permitted. Curing compound shall not be applied to the inside faces of joints to be sealed. Should the film become damaged from any cause within a 72 hour curing period, the damaged portions shall be repaired immediately with additional compound.

c. Upon removal of side forms, the sides of the slabs exposed shall be protected immediately by applying curing treatment equal to that provided for the surface.

4. White Polyethylene Sheeting: The top surface and sides of the pavement shall be entirely covered with polyethylene sheeting. The units used shall be lapped at least 18 inches. The sheeting shall be so placed and weighted down as to cause it to remain in intimate contact with the surface covered. The sheeting as prepared for use shall have such dimension that each unit as laid will extend beyond the edges of the slab at least twice the thickness of the pavement. The surface of the pavement shall be thoroughly wetted prior to placing the sheeting. Unless otherwise specified, the covering shall be maintained in place for 72 hours after the concrete has been placed.

5. Curing in Cold Weather

a. Concrete pavement that is placed during cold weather, when the air temperature in the shade, away from artificial heat, is or may be expected to drop below 35^{o} F, shall be protected by suitable blanket material placed over the surface and sides of the slab to sufficient depth to prevent freezing of the concrete. Care shall be taken during application of the blanket material not to mar the surface of the concrete. The period of time such protection shall be maintained shall be not less than 5 days.

b. The Contractor shall be responsible for the quality and strength of concrete laid during cold weather, and any concrete injured by freezing action shall be removed and replaced at this expense.

3.12 REMOVING FORMS

A. Forms may be removed at any time that removal does not cause damage to the slab edges. The forms shall be removed carefully so as to avoid damage to the pavement. After the forms have been removed, the sides of the slab shall be cured as outlined in one of the methods indicated above. Major honeycombed areas will be considered as defective work, and all unsound material shall be removed and replaced with satisfactory material at the Contractor's expense.

3.13 SEALING JOINTS

A. Joints shall be sealed with one of the joint sealing materials specified in Specification Section 02750 Paragraph 2.01 F before the pavement is opened to traffic and as soon after completion of

the curing period as is feasible. The pavement temperature shall be that recommended by the manufacturer of the sealant. Just prior to sealing, each join shall be thoroughly cleaned of all foreign material, including membrane curing compound, by sandblasting. The joint faces shall be clean and dry when the seal is applied. The sealant shall be applied to the joint immediately after cleaning.

B. The sealing material shall be applied to each joint opening to conform to the details shown on the Plans or as directed by the Owner. The sealing shall be done in such manner that material will not be spilled on the exposed surface of the concrete. Any excess material on the surface of the concrete pavement shall be removed immediately and the pavement surface cleaned.

C. Sealing material that does not bond to the concrete shall be removed, and the joint recleaned and resealed to the Contractor's expense.

D. All random cracks shall be reamed with a suitable tool and filled with an approved liquid joint sealant.

3.14 PROTECTION OF PAVEMENT

A. The Contractor shall protect the pavement and its appurtenances against both public traffic and traffic caused by his own employees and agents. This shall include watchmen to direct traffic and the erection and maintenance of warning signs, barricades, lights, pavement bridges or crossovers.

B. Any damage to the pavement occurring prior to final acceptance shall be repaired or the pavement replaced at the Contractor's expense.

3.15 OPENING TO TRAFFIC

The Owner will determine when the pavement will be opened to traffic. The pavement will not be opened to traffic until test specimens have attained the strength specified in Specification Section 03050. If such tests are not conducted, the pavement shall not be opened to traffic until 14 days after the concrete is placed. Prior to opening to traffic, the pavement shall be cleaned and all joints shall be sealed.

3.16 MANHOLE ADJUSTMENTS

Drainage and sanitary sewer manholes owned by the City shall be adjusted and set at final grade by the Contractor as necessary for compliance with the Plans. Adjustments of City owned manholes shall be a specified in Specification Section 02530 or 02630 as appropriate. Manholes, valve boxes, and other utility structures not owned by the City but within the right-of–way of the project shall be adjusted as necessary by the owner of such facilities. The Contractor shall be responsible for notifying other owners of any required adjustments and for the accomplishment of that work by the owner of such facilities according to the project schedule.

3.17 TOLERANCE IN PAVEMENT THICKNESS

Deficiencies in pavement thickness will be determined and payment made in accordance with the provisions of Specification Section 02710.3 Paragraph 3.06, "Tolerance in Base Thickness".

PART 4 – MEASUREMENT

4.01 PORTLAND CEMENT CONCRETE PAVEMENT

Concrete pavement will be measured by the square yard, in place at specified thickness.

4.02 GENERAL

A. Dowel bars and assembly devices, reinforcing fabric, tie bars, curing materials, joint fillers, preparing and sealing joints, and any chemical additives used will not be measured for payment, as these items are considered incidental to the work.

B. Manhole adjustments will be measured and paid for in accordance with Pay Item 02530-01 or 02630-01.

PART 5 – PAYMENT

5.01 PORTLAND CEMENT CONCRETE PAVEMENT

Cement concrete pavement will be paid for at the contract unit price per square yard, which price will be full compensation for preparing the subgrade, forming, furnishing, consolidating, curing the concrete, provision of all items identified in Specification Section 02750 Paragraph 4.02, and maintaining the pavement until final acceptance, complete in place.

5.02 PAYMENT WILL BE MADE UNDER:

Item No.	Pay Item	Pay Unit
02750-01	Portland Cement Concrete Pavement	Square Yard
02750-01.____	_____ " Thickness	Square Yard

END OF SECTION 02750