

## 502 - PORTLAND CEMENT CONCRETE PAVEMENT

### 502.1 SUMMARY

This section includes the construction of Portland cement concrete pavement. This work shall be performed in accordance with Section 502 of the Standard Specifications except as otherwise modified herein.

### 502.2 MATERIALS

#### a. Concrete

Concrete shall conform to the specifications for Kansas City Metro Materials Board (KCMMB) 4K Concrete.

#### b. Entrained Air Content

Air entrainment shall be accomplished by addition of an approved air entraining agent.

Air content shall be determined on each day of production as early and as frequently as necessary until the air content is consistently acceptable. The intended content of finished concrete is 6.5% and the "target" air content in front of the paver shall be determined to account for air loss during consolidation of concrete during slip form paving. The difference between the before and after paver air contents for a given location shall be considered the "air loss".

On the first day of paving, the "air loss" and "target" air content shall be established. Samples shall be taken at the point of acceptance (behind the paver) by the Contractor. The air loss shall be determined at a minimum of two locations. The air loss from both locations shall be averaged and added to 6.5% to establish the target air content, rounded to the next higher 0.5%. After the air loss has been established, the air content before the paver shall be the target air content plus 1.5% or minus 1.5%.

Once the target air content and air loss has been established, the air content shall be tested before the paver and shall be the target air content plus 1.5% or minus 1.0%. The air loss shall be checked at intervals determined by the City Engineer. A new target air content shall be established if the average air loss from two consecutive tests deviates by more than 0.5% from the air loss.

All testing required to establish and maintain the target air content is the responsibility and at the expense of the Contractor. No separate payment will be made for any Contractor testing required.

#### c. Forms

All forms shall be in good condition, clean, and free from imperfections. Each form shall not vary more than 1/8 inch in horizontal and vertical alignment for each 10 feet of length.

##### (1) Material & Size

Forms shall be made of metal and shall have a height equal to or greater than the prescribed edge thickness of the pavement slab.

##### (2) Strength

Forms shall be of such cross-section and strength, and so secured as to resist the pressure of the concrete when struck off, vibrated, and finished, and the impact and vibration of any equipment that they may support.

#### d. Reinforcement

##### (1) Steel Bars

Steel bars for concrete reinforcement shall conform to Subsection 1601 of the Standard Specifications. Epoxy coated deformed steel bars for concrete reinforcement shall conform to Subsection 1602 of the Standard Specifications.

##### (2) Welded Steel Wire

Welded steel wire fabric shall conform to Subsection 1603 of the Standard Specifications.

##### (3) Supporting Elements

Representative samples of supporting elements shall be submitted and approved by the City Engineer prior to their use in the project. Supporting elements shall be epoxy coated.

**e. Expansion Joint Fillers**

Expansion joint fillers shall conform to ASTM D 1752-04a, Section 4.1. Expansion joint material shall be compatible with hot-poured joint sealing compounds.

**f. Joint Sealing Compounds**

Hot-poured joint sealing compounds shall conform to Subsection 1501 of the Standard Specifications.

**g. Curing Membrane**

All material to be used or employed in curing Portland cement concrete must be approved by the City Engineer prior to its use. It shall be of the liquid membrane type and shall conform to ASTM C 309, Type II, Class B.

**502.3 CONSTRUCTION REQUIREMENTS**

Portland cement concrete pavement shall be constructed to the configuration, and to the lines and grades shown on the plans.

**a. Grading and Subgrade Preparation**

All excavation or embankment shall be as defined in the specifications. If areas of the subgrade are below the lines and grades shown on the plans, they shall be brought to the proper line and grade by additional fill material placed in accordance with "Compaction of Earthwork". When forms are used, the top surface of the subgrade shall be checked with a template riding on the forms to assure full thickness of pavement.

**b. Forms**

(1) Installation

Forms shall be set true to line and grade, supported through their length and, joined neatly in such a manner that the joints are free from movement in any direction.

(2) Preparation

Forms shall be cleaned and lubricated prior to each use and shall be so designed to permit their removal without damage to the new concrete.

**c. Joints**

Joints shall be formed at right angles to the true alignment of the pavement and to the depths and configuration specified by the appropriate standard or as modified by the plans and specifications. The required material shall be furnished and placed by the Contractor. Sufficient fastenings shall be used to insure joint assemblies and materials remaining in position during the entire period of concrete placing, striking off, vibrating and finishing.

(1) Expansion joints

Expansion joints shall be placed at all locations where shown on the plans and standards or as directed by the City Engineer.

Expansion joints shall extend the entire width of the pavement and extend from the subgrade. The material will have a suitable tear strip or removable expansion board cap provided to allow for the application of the joint sealer.

Under no circumstances shall any concrete be left across the expansion joint at any point.

(a) Material

Expansion joints shall be formed by a one piece, 1 inch thick preformed joint filler cut to the configuration of the correct pavement section.

(b) Stability

Expansion joints shall be secured in such a manner that they will not be disturbed during the placement, consolidation and finishing of the concrete.

(c) Dowels

Expansion joints that are specified to be equipped with dowels shall have dowels of the size and type specified, and shall be firmly supported in place, by means of a dowel basket that shall remain in place. One half of each dowel shall be lightly painted or lubricated with a product approved by the City

Engineer. All dowels shall be epoxy coated meeting the requirements of ASTM A934. Epoxy coating shall have a minimum 10 mil thickness.

(2) Contraction joints

Contraction joints shall be placed where indicated and to the depth indicated by the plans, specifications and standards.

(a) Method

Longitudinal and transverse contraction joints shall be sawed. When sawing joints, the contractor shall begin as soon as the concrete hardens sufficiently to prevent excessive raveling along the saw cut and shall finish before conditions induce uncontrolled cracks, regardless of the time or weather. The cut shall be approximately 1/4 inch wide, and the depth shall be one-third the thickness of the slab (minimum) or as shown in the plans.

(b) Dowels

Dowels for contraction joints shall be of the size and type specified and shall be firmly supported in place and accurately aligned parallel to the pavement line and grade with an allowable tolerance of 1/8 inch. All dowels shall be epoxy coated meeting the requirements of ASTM A934 with a minimum of 10 mil thickness.

(3) Longitudinal and Construction joints

Longitudinal joints or construction joints shall be placed as shown on the plans or where the Contractor's construction procedure may require them to be placed. Longitudinal construction joints (joints between construction lanes) shall be tied joints of the dimensions shown on the plans or standards.

Keyways shall not be allowed.

All construction joint tie bars shall be drilled and epoxy coated.

(4) Center joints

Longitudinal center joints shall be constructed using the methods specified in "Contraction joints."

(5) Transverse Construction joints

Transverse construction joints of the type shown on the plans or standards shall be placed wherever concrete placement is suspended for more than 30 minutes. The joint shall be placed in a location consistent with a planned contraction or expansion joint.

(6) Tie bars

Tie bars shall be of epoxy coated deformed steel of the dimensions specified by the plans or standards. Tie bars shall be installed at the specified spacing and secured firmly so as not to be disturbed by the construction procedure.

Tie bars shall be evenly spaced along the length of the slab and no tie bar shall be within 2 feet of a contraction joint. Tie bars shall be supported in the proper position by chairs driven into the subgrade, or may be placed by approved mechanical methods into the plastic concrete within the limits of the finishing screed. Tie bars shall NOT be inserted by driving (or "poking") them into the finished consolidated concrete.

(7) Plastic Filler

After the pavement has been properly cured all open joints including expansion joints, construction joints, and the joints between the pavement and other structures, if any, shall be cleaned and poured full of a hot-poured joint sealing compound. The joint sealing compound shall be heated in a heater specifically manufactured for this purpose. The heat shall be controlled to within 20° F of the manufacturers recommended application temperature by a thermostat and the compound shall not be permitted to come in contact with the open flame which shall be contained in an oil bath. The compound shall be agitated to prevent segregation. The melted compound shall be poured so that the joint is filled to the level of the adjacent concrete pavement surface.

Joints shall be clean and dry before seal is poured.

**d. Placing, Finishing, Curing, and Protection**

Concrete shall be furnished in quantities required for immediate use and shall be placed in accordance with the requirements of the Standard Specifications. Prior to commencing construction, the

contractor shall furnish a concrete delivery plan which includes at a minimum the number of trucks which will be dedicated to the project, the location of the concrete plant, the route and distance from the plant to the job site, and the anticipated rate of concrete usage. It is essential that concrete be delivered in sufficient quantities to prevent stoppage of the paving operation.

The concrete supplier shall have a representative on-site at all times for concrete placement operations over 200 cubic yards.

(1) Concrete Placement

The concrete shall be deposited on the subgrade to the required depth and width of the construction lane in successive batches and in a continuous operation without the use of intermediate forms or bulkheads. The subgrade shall be moistened prior to the placement of concrete. The concrete shall be placed as uniformly as possible in order to minimize the amount of additional spreading necessary. While being placed, the concrete shall be vibrated and compacted with suitable tools so that the formation of voids or honeycomb pockets is prevented.

When it is necessary to drop concrete a distance of more than three feet, troughs, pipes, or chutes shall be used as aids in placing concrete and shall be arranged and used in such a manner that ingredients of the concrete shall not be separated. Where steep slopes are required, the chutes shall be equipped with baffle boards or short lengths that reverse the direction of movement. All chutes, troughs and pipes and reinforcing steel shall be kept clean and free from coatings of hardened concrete. All troughs and chutes shall be either metal or metal lined and shall extend as nearly as possible to the point of deposit. Depositing in a large quantity at any point and running or working it along the forms in a manner which will cause segregation or separation will not be permitted. At no time shall concrete be dropped freely a distance of more than three feet.

The concrete shall be well vibrated and tamped against the forms and along all joints. Care shall be taken in the distribution of the concrete to deposit a sufficient volume along the outside form lines so that the curb section can be consolidated and finished simultaneously with the slab.

No concrete shall be placed around manholes or other structures until they have been brought to the required grade, alignment, and cross slope.

Concrete shall not be allowed to extrude below the forms.

(2) Concrete Finishing Methods

The pavement shall be struck off and consolidated with a mechanical finishing machine. Hand finishing methods may be used for small or irregular areas. Furnish paving and finishing equipment applicable to the type of construction as follows:

(a) Slip-form Machines

A self propelled slip form paving machine shall be used for all mainline Portland Cement Concrete Paving operations where the design speed is 40 mph or above. The slip form paver shall meet the requirements set forth in Section 154.5 of the Standard Specifications and be capable of paving at least a 24 feet wide section in a single pass.

(b) Self-Propelled Form-Riding Machines

Shall not be used without approval of the City Engineer.

(c) Manual Fixed-Form Paving Machines

Shall not be used without approval of the City Engineer.

(d) Hand Methods

If hand operated equipment is used, the concrete pavement shall be struck off with a roller screed weighing not less than fifteen pounds per linear foot. The screed shall rest on the side forms. A depth of at least two inches of concrete shall be carried in front of the screed for the full width of the slab, whenever the screed is being drawn forward. In hand finishing, the vibrating shall be so executed that all voids in a body of the concrete are closed and porous places on the surface of the concrete eliminated. Additional concrete shall be added to the remaining low places and porous spots, and the concrete restocked and revibrated. The striking and compacting shall continue until the entire pavement has a uniform, even surface that is free from porous or rough spots, waves or depressions, has the required crown, and is at the specified grade.

The system and methods of vibrating shall be subject to approval of the City Engineer. Vibrating equipment shall, under no circumstances, be used as a tool for moving concrete laterally on the grade.

The concrete pavement shall be uniform in appearance, composition, density and strength.

(3) Concrete Finishing

(a) Floating

All surfaces shall be consolidated and floated within 15 minutes of initial concrete placement and prior to final surface finish.

(b) Straight edging

Straight edging in conformance with the specifications shall be used when the optional smoothness section is not used.

(c) Surface Tolerance

After the longitudinal floating has been completed and the excess water has been removed, and while the concrete is still plastic, the slab shall be tested for trueness with a highway straightedge. The highway straightedge shall be held in successive positions parallel to the road centerline in contact with the surface and the whole area worked from one side of the slab to the other as necessary. Advancement along the pavement shall be in successive stages of not more than one half the length of the highway straightedge. Any depressions found shall be immediately filled with freshly mixed concrete, struck off, consolidated, and refinished. The surface shall be checked longitudinally while concrete is still plastic; correcting any surface deviations greater than 1/8 inch in 10 feet.

(d) Edging

Before final finishing is completed and before the concrete has taken its initial set, the edges of the slab and curb shall be finished to 1/8 inch radius, or that shown on the plans or standards by the paving equipment, or with hand edging tools.

(e) Final Surface Finish

(f) Dragged Surface Treatment

Burlap shall be dragged longitudinally over the finished surface to produce a tight, uniform, textured surface, and the edges shall be rounded in a workmanlike manner for roadways with a design speed of 45 MPH or to be posted 45 MPH or less. The texture achieved by the burlap drag shall be tested by the Contractor in accordance with ASTM E 965, "Test Method for Measuring Surface Macrottexture Depth Using a Sand Volumetric Technique", to ensure the texture is adequate for skid resistance when this surface treatment is used for roadways to be posted 50 MPH or more. The City Engineer will determine test locations. The results of ASTM E 965 shall show an average texture depth of any lot, as defined below, shall have a minimum value of 0.032 inch. Any lot showing an average of less than 0.032 inch but equal to or greater than 0.024 inch will be accepted as substantial compliance but the contractor shall amend their operation to achieve the required 0.032 inch minimum depth. (It is not the intention of this tolerance to allow the contractor to continuously pave with an average texture depth of less than 0.032 inch). Any lot showing an average texture depth of less than 0.024 inch shall require diamond grinding of the pavement represented by this lot to attain the necessary texture. Any individual test showing a texture depth of less than 0.020 inch shall require diamond grinding of the pavement represented by this lot to attain the necessary texture. Limits of any failing individual test shall be determined by running additional tests at 100 foot intervals before and after the failing test location. All testing of the surface texture shall be completed no later than the day following pavement placement.

(g) Curing

As soon as practical after the concrete is finished it shall be cured with liquid curing membrane applied in accordance with the manufacturer's directions.

(h) Method of Applying Curing Membrane

A nozzle producing a uniform fan pattern will be used on all spray equipment when applying the liquid curing membrane. The curing compound should be applied after final finishing operations have been completed, and immediately after the free water has left the surface of the concrete. Two smooth coats shall be used to ensure complete coverage and effective protection, with each coat applied at an application rate not less than 300 square feet per gallon.

(i) Curing Formed Surfaces

If the forms are removed from finished concrete pavement within a period of 72 hours or if a slip form paving machine has been used, these surfaces shall also be cured. The Contractor shall repair curing membrane damaged by joint sawing operations as directed by the City Engineer.

(4) Protection

The Contractor shall, at his own expense, protect the concrete work against damage or defacement of any kind until the City Engineer has accepted it.

All vehicular traffic shall be prohibited from using the new concrete pavement until it has attained strength in accordance with Section 502 of the Standard Specifications with the following revision:

Delete Section 502.3.i.(3).(a) and replace with:

(a) Construction Traffic Only

The compressive strength of the pavement shall meet or exceed 2800 psi. Compressive strength shall be determined by testing in accordance with ASTM C39, or by the use of calibrated maturity meters. If testing is not done, a four (4) day curing period shall be observed before motorized traffic is allowed on the pavement. All costs associated with calibration of the maturity meter testing required for opening pavement to traffic shall be subsidiary to other bid items.

The Contractor shall submit a maturity testing proposal to the City Engineer and receive approval at least 30 days prior to any concrete paving. Maturity meter readings shall be taken with the Owner's representative present.

The compressive strength of the pavement shall meet or exceed 4000 psi at 28 days of cure. The compressive strength shall be determined by testing in accordance with ASTM C39.

Provide protection to keep foreign material out of the unsealed joints by an approved method.

Concrete pavement that is not acceptable to the City Engineer because of damage or defacement, shall be removed and replaced, or repaired to the satisfaction of the City Engineer, at the expense of the Contractor.

(5) Diamond Grinding

Grind the riding surface to reduce or eliminate the irregularities.

Use a self-propelled grinding machine with diamond blades mounted on a multi-blade arbor. Avoid using equipment that causes excessive ravels, aggregate fractures, or spalls. Provide uniform texture the full width of the lane. Transverse grooving will not be required.

Use vacuum equipment or other continuous methods to remove grinding slurry and residue. Prevent the grinding slurry from flowing across lanes being used by traffic.

After corrections have been made to the riding surface, test the pavement for smoothness using the same technique used to determine smoothness originally. Furnish and operate the smoothness measurement equipment, and evaluate the results as specified.

Where smoothness is determined through the use of a profilograph, run two traces in each lane that has been corrected. Run one trace three feet from the longitudinal joint between the lanes, and another trace three feet from the shoulder or curb edge of the lane. Assure that a trained and certified operator performs the profilograph testing and evaluation. Within two days after the corrections to the riding surface are made, furnish the City Engineer with the profilogram and its evaluation.

Evaluate the profilogram of the corrected riding surface in 250 foot sections per lane. The required profile index per trace is 30 inches per mile or less for speeds greater than or equal to 45MPH and 40 inches per mile or less for speeds less than 45MPH

Perform additional grinding as required to attain the required profile index. Correct all deviations (in excess of 1/2 inch in a length of 25 feet) within each section regardless of the profile index value.

(6) Temperature Limitation

Concrete work shall be in accordance with the requirements of Concrete Construction specification.

**e. Backfill**

A minimum of 24 hours shall elapse before forms are removed and 5 days shall elapse, or the concrete must have attained 75% of its 28-day compressive strength, before pavement is backfilled unless otherwise approved by the City Engineer. Backfill shall be accomplished in accordance with the specifications.

The Contractor shall be responsible for the repair of any existing street pavement damaged by the construction to the satisfaction of the City Engineer.

**f. Joint Sealing and Cleanup**

All joints shall be sealed with an approved joint sealer meeting the requirements of the Standard Specifications applied in accordance with the manufacturer's directions within 7 days of the placement of the concrete and prior to the opening of the pavement to traffic.

The Contractor shall be responsible for the removal of excess dirt, rock, broken concrete, concrete splatters, and over spray from the area of the construction.

**g. Pavement Smoothness and Surface Defects**

Concrete pavement smoothness shall be in conformance with Section 503 of the Standard Specifications except as modified herein.

Average profile index shall be 45in./mi. or less per trace.

**No price adjustments will be made based on profilograph results.**

**h. Repairing Defects**

Contractor shall develop and submit a plan to the City Engineer for approval of repair methods prior to beginning any corrective work. The repair methods should at a minimum meet the requirements of 502.3.k.

**502.4 MEASUREMENT AND PAYMENT**

The Engineer will measure portland cement concrete pavement by square yard or tenth part thereof for the specified depth.

Payment for portland cement "Concrete Pavement" of the specified thickness and type at the unit price bid is full compensation for the specified work. No additional payment will be made for concrete pavement smoothness, this shall be subsidiary to "Concrete Pavement".