SECTION 324 – REVISED 2-20-14

PORTLAND CEMENT CONCRETE PAVEMENT (PCCP)

324.1 DESCRIPTION:

This item shall consist of construction of a pavement composed of plain jointed portland cement concrete on a prepared subgrade. The Contractor shall furnish all labor, materials and equipment necessary for the construction of the pavement in accordance with these specifications and in reasonably close conformity to the lines, grades, thicknesses and details indicated by the plans or as established by the Engineer. All tests shall be performed by a laboratory approved by the Engineer.

324.2 MATERIALS:

324.2.1 Portland Cement Concrete: Portland cement concrete shall conform to the applicable requirements of MAG Standard Specifications Section 725 for Class AA (Table 725-1) and the additional requirements of this section.

~~Concrete shall develop a modulus of rupture of not less than 520 psi within 14 days after placement, and not less than 650 psi at 28 days' age as determined by tests of specimens fabricated in accordance with ASTM C 31 and tested in accordance with ASTM C 78 procedures. The Contractor shall submit data acceptable to the Engineer at least 30 days in advance of the start of concrete paving operations which demonstrate that concrete produced with materials and proportions as proposed for use in the construction will conform to the modulus of rupture requirements of these specifications. The data shall include results of compressive strength tests conducted at the same age as modulus of rupture tests to establish the correlation which can be expected between the flexural and compressive strength properties of the concrete. The Engineer may, at his option, use compressive strength tests of specimens fabricated in accordance with ASTM C 31 and tested in accordance with ASTM C 39 to verify conformance to the modulus of rupture requirements of these specifications.~~

The maximum concrete slump shall be as determined by the approved mix design in accordance with tolerances of Section 725.9,(A)1.

324.2.2 Concrete Materials: ~~Portland cement conforming to the requirements of ASTM C 150 for Type III, low-alkali, may be used at the Contractor's option. Aggregates shall be crushed rock or gravel conforming to the requirements of ASTM C 33. Coarse aggregate gradation shall conform to requirements for Size No. 57.~~ Fine aggregates shall have an average ~~s~~Sand ~~e~~Equivalent of not less than 75 when tested in accordance with the requirements of AASHTO T-176 or ASTM D-2419.

324.2.3 Reinforcement: Tie bars shall be deformed billet steel reinforcing bars conforming to the requirements of ASTM A-615, Grade 40.

Dowel bars shall be plain round bars conforming to the requirements of ASTM A-615, Grade 40. One-half the length of each dowel bar shall be ~~painted with one coat of tar paint~~.Find appropriate product and wording

Metal sleeves of an approved design shall be provided for use with dowel bars. Sleeves shall cover 2 inches, plus or minus 1/4 inch, of the dowel, shall have a closed end with a suitable stop to hold the end at least 1 inch from the end of the bar, and shall be designed to prevent collapse during construction. An approved basket support shall be used to hold bars parallel to pavement surface.

324.2.4 Curing Materials: Materials for curing concrete shall conform to the requirements of Section 726.

324.2.5 Joint Materials: Joint sealant shall be ~~a one component, hot~~ poured type, conforming to the requirements of ~~ASTM D 3406~~ Section 729.2 or as approved by the Engineer.

Back-up rod or tape and bond breakers provided to control the depth of sealant, achieve the desired shape factor, support sealant against indentation and sag, or to prevent bond of the sealant to the bottom concrete surface shall be compatible with the joint sealant material.

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~~Other pour-type joint sealants conforming to the requirements of Subsection 729.2 may be used if approved by the Engineer.~~

Preformed expansion joint filler shall conform to the requirements ~~of ASTM D 1751~~ Section 729.1 or as approved by the Engineer.

324.3 CONSTRUCTION METHODS:

324.3.1 General: Pavement shall be constructed with mechanical equipment utilizing stationary side forms or by the use of slipform paving equipment without stationary side forms. Manual methods of placing and finishing concrete with stationary side forms may be permitted by the Engineer for areas inaccessible for mechanical equipment.

Curbs, or combined curb and gutter, shall be constructed along the edges of all pavement where shown in the plans and shall be formed to the cross -section in accordance with the plans. Curbs may be constructed integrally with the pavement using a slipform or extrusion equipment or placed immediately after finishing operations by hand forming or using face forms. They may also be constructed as a separate operation after pavement construction using forms, slipform, or extrusion equipment. The edge of each gutter of the curb and gutter section built first may be used as a form in lieu of the setting of stationary side forms. Curbs, or curb and gutter, constructed as a separate operation shall otherwise conform to the requirements of Section 340. All curbs and gutters shall have the same thickness as the main roadway section. All joints shall be aligned with roadway joints.

324.3.2 Equipment: Design, capacity, and mechanical condition of equipment and tools necessary for handling materials and performing all parts of the work shall be approved by the Engineer. Equipment shall be at the jobsite sufficiently ahead of the start of concrete paving operations to permit thorough examination and approval by the Engineer prior to start of concrete paving.

Equipment used to place concrete may consist of one or more machines, shall be capable of uniformly distributing and consolidating the concrete as it is placed without segregation and shall be capable of producing concrete pavement which will conform to the required cross-section with a minimum of hand work. The number and capacity of machines furnished shall be adequate to perform the work required at a rate equal to the concrete delivery rate.

Vibrators shall be used to consolidate concrete; the rate of vibration shall be not less than 3,500 cycles per minute for surface vibrators and not less than 8,000 cycles per minute for internal vibrators. Power to vibrators mounted on mechanical equipment shall be so connected that vibration ceases when forward or backward motion of the machine is stopped. Contractor shall furnish a tachometer or other suitable device for measuring and indicating the frequency of vibration.

Slipform pavers shall be equipped with high frequency internal vibrators mounted with axes either parallel or normal to pavement alignment for the full paving width. Vibrators mounted with axes parallel with pavement alignment shall be spaced at intervals not to exceed 24 inches, measured center-to-center. Vibrators mounted with axes normal to pavement alignment shall be spaced so that lateral clearance between individual vibrating units does not exceed 6 inches.

Slipform paving equipment which will be wholly or partially supported on subgrade shall be equipped with traveling side forms of sufficient dimensions, shape and strength to support the concrete at free edges laterally for a sufficient length of time during placement to produce pavement of the required cross-section, and shall be equipped and operate with automatic sensing and control devices such that the machine automatically senses deviations from the established guideline and performs the necessary corrective maneuvers to overcome variations from correct grade and alignment.

When concrete will be placed adjacent to existing pavement or curb and gutter, that part of the equipment supported on the existing pavement or curb and gutter shall be equipped with protective pads on crawler tracks or rubber-tired wheels with bearing surfaces offset a sufficient distance from the edge of the pavement or curb and gutter to avoid

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edge damage, or the surface of the existing pavement or curb and gutter shall be otherwise protected against such damage in a manner approved by the Engineer.

324.3.3 Subgrade Preparation: Subgrade shall conform to the compaction and elevation tolerances specified for the material involved, shall be kept smooth and compacted, and shall be free of all loose and extraneous material when concrete is placed.

The surface of the subgrade shall be uniformly moist when concrete is placed. The surface of the subgrade shall be moistened immediately prior to placement of concrete if necessary to produce a uniformly moist condition. Any excess water standing in pools or flowing on the surface shall be removed prior to placing concrete.

~~Construction equipment shall not operate on the subgrade in the paving lane when conditions of the job will permit operation from outside the lane. When job conditions make it necessary to operate equipment on the subgrade in the paving lane, suitable runways or other precautions shall be taken to prevent rutting or displacement of subgrade material. The grade shall be checked and corrected immediately ahead of concrete placement and all disturbed grade shall be properly recompacted.~~ (moved to 3.5)

~~When concrete pavement will be placed with slipform paving equipment which will be supported and operate on the subgrade, the subgrade and slipform paver track area shall be brought to proper grade and cross section by means of a properly designed and operated machine.~~ (moved to 3/6(a))

324.3.4 Stationary Side Forms and Setting of Forms: Side form sections shall be straight, free from warps, bends, indentations or other defects. Side forms shall be of metal, have a base width of at least four inches and a minimum depth equal to the thickness of the pavement. No section shall show a variation from a true plane greater than 1/8 inch in ten feet on the top of the form or more than 1/4 inch in ten feet on the inside face. Flexible or curved forms of proper radius shall be used for curves of 100 feet radius or less. Suitable materials other than metal may be used to form end closures or at other locations where use of metal forms is not practical when approved by the Engineer. Forms shall be thoroughly cleaned and oiled each time they are used.

Forms shall be of such cross -section and strength and so secured and supported on the subgrade as to resist the pressure of the concrete when placed and the impact and vibration of any equipment they are to support without springing or settlement. The method of connection between sections shall be such that the joints shall not move in any direction.

Subgrade under forms shall be compacted and cut to grade so that the form when set will be uniformly supported for its entire length at the specified elevation. Forms shall be so supported and secured during the entire operation of placing and finishing that they will not deviate vertically at any point more than 1/8 inch from the proper elevation. Forms shall be set to the required lines and grades well in advance and for a distance sufficient to prevent delay in placing concrete, and shall be approved by the Engineer prior to placing concrete. When any form has been disturbed or any grade has become unstable, the form shall be reset and rechecked.

Side forms shall remain in place until the day after placing concrete, and in all cases until the edge of the pavement no longer requires the protection of the forms. Forms shall be carefully removed in such a manner as to avoid damage to the pavement. Use of pry bars between the pavement and the forms will not be permitted.

324.3.5 Placing, Spreading and Compacting: Construction equipment shall not operate on the subgrade in the paving lane when conditions of the job will permit operation from outside the lane. When job conditions make it necessary to operate equipment on the subgrade in the paving lane, suitable runways or other precautions shall be taken to prevent rutting or displacement of subgrade material. The grade shall be checked and corrected immediately ahead of concrete placement and all disturbed grade shall be properly recompacted. Except when otherwise approved by the Engineer, concrete shall be deposited on the subgrade and spread full width using mechanical methods that result in minimal ~~a minimum of~~ handling and segregation. Necessary hand spreading shall be done with shovels, not rakes. Placement shall be continuous between transverse joints without the use of intermediate bulkheads.

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The Contractor shall make adequate advance arrangements for preventing delay in delivery and placing of concrete. An interval of more than 15 minutes between placing of any two consecutive batches shall constitute cause for stopping operations, and Contractor shall install a construction joint in the concrete already placed at the location and of the type directed by the Engineer.

Concrete shall be deposited as near to expansion and construction joints as possible without disturbing them but shall not be dumped onto a joint assembly. Concrete shall be thoroughly consolidated against and along the faces of all forms, adjacent pavement or curb and gutter, and on both sides of all joint assemblies. Vibrators shall not be permitted to come in contact with joint assemblies, the grade, or side forms, and shall not be operated longer than 15 seconds in any one location.

Manual methods of placing, spreading, and compacting may be used in the construction of pavement lanes of irregular width or widths less than 10 feet, and sections of intersections or other locations with complex variable surface configurations when permitted by the Engineer. Workmen shall not be allowed to walk in the freshly placed concrete with boots or shoes coated with earth or other foreign substances.

324.3.6 Shaping and Initial Finishing: Concrete shall be struck off, consolidated, and float-finished with a slipform paver, mechanical finishing machine, vibrating screed, or by hand finishing methods when approved by the Engineer so that the complete pavement will conform to the thickness and cross -section requirements of the plans and specifications. When the pavement being constructed is contiguous to existing parallel concrete pavement or curb and gutter, the elevation of the new pavement surface shall conform as closely as possible to the elevation of the existing pavement or gutter surface and in a manner which will prevent ponding.

Water shall not be applied to the pavement surface during screeding and finishing operations in excess of the amount lost by evaporation. Adding water to the surface of the concrete to assist in finishing operations shall not be permitted. When applications of water to the surface are required to prevent rapid evaporation of water from the surface during finishing operations, it shall be applied as a fog spray and with approved spray equipment.

324.3.6 (a) Slipform Supported on Subgrade Method: When concrete pavement will be placed with slipform paving equipment which will be supported and operate on the subgrade, the subgrade and slipform paver track area shall be brought to proper grade and cross section by means of a properly designed and operated machine. The equipment shall spread, consolidate, screed and float-finish the concrete in one complete pass of the machine. The machine shall be operated with as nearly a continuous forward movement as possible and all paving operations shall be so coordinated as to provide uniform progress with stopping and starting of the paver held to a minimum. Sliding side forms shall be rigidly held together to prevent spreading. Any edge slump of the pavement, exclusive of edge rounding, in excess of 1/4 inch shall be corrected.

No abrupt changes in longitudinal alignment of the pavement will be permitted. The horizontal deviation shall not exceed 1 inch from the alignment established by the Engineer.

While concrete is being spread, compacted and shaped, vibrating units shall be operated within fresh concrete so that the longitudinal axis, at the center of each unit, is not more than 6 inches above the top of the subgrade. Amplitude of vibration shall be sufficient to be perceptible on the surface of concrete along the entire length of vibrating units and for a distance of at least one foot ~~there from~~.

324.3.6 (b) Mechanical Equipment Supported on Fixed Form Method: When concrete is spread without the use of internal vibration, the finishing machine shall be equipped with vibrating equipment that will internally vibrate the concrete for the full paving width and with not less than two oscillating or reciprocating screeds. Concrete shall be struck off and consolidated so that the surface will conform to the finished grade and cross -section shown on the project plans and with sufficient material on the surface for floating operations.

After the concrete has been struck off and consolidated, it shall be floated with a longitudinal float of a type approved by the Engineer.

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A slipform paver or a single machine which will effectively spread, consolidate, screed, and float in one operation may be used in lieu of separate finishing and floating equipment.

324.3.6 (C) Manual Methods with Fixed Forms: Concrete shall be deposited, spread and struck off to such an elevation that, when properly consolidated, the surface will conform to the required lines and grades. Concrete shall be consolidated by internal vibration as it is struck off with a screed. A slight excess of concrete shall be kept in front of the screed at all times during the strike-off operation.

After consolidation and screeding, concrete shall be tamped to the proper surface elevation and cross -section using either a heavy plank with a length in excess of the width of pavement being placed by one foot or more, or with a mechanical vibrating unit spanning the full width between forms. The tamping plank, if used, shall be stiffened as necessary to prevent sag and shall have the lower tamping edge shod with metal. The tamping plank shall be moved forward with a combined vertical tamping and longitudinal screeding motion so that the concrete will be thoroughly consolidated and the surface screeded to the required elevation. A small surplus of concrete shall be kept in front of the tamper or vibrating unit. Tamping or vibrating shall continue until the specified cross- section is obtained and the mortar flushed slightly to the surface. On grades in excess of 5 percent a second strike board shall follow from 25 to 50 feet behind the tamper or vibrating unit and shall be used in the same manner to remove waves caused by the flow of concrete behind the first strike board.

~~Other~~ M~~m~~ethods other than the tamping plank may be utilized for screeding when approved by the Engineer.

Pavement shall be finished smooth and true to grade with suitable manually operated floats or powered finishing equipment.

324.3.7 Final Finishing: After the pavement has been float–finished, it shall be scraped with a 10-foot long straightedge equipped with a handle to permit operations from the edge of the pavement, and excess water and laitance shall be removed from the surface. The straightedge shall be operated parallel to the centerline of the pavement and shall be moved forward one-half length after each pass. Irregularities shall be corrected by adding or removing concrete, and disturbed places shall be again straight-edged.

Long-handled ~~wood~~ floats shall be used only in areas not accessible to finishing equipment and in emergencies, and use of such floats shall be confined to a minimum.

The addition of water to the surface of the concrete to assist in finishing operations shall not be permitted unless approved by the Engineer. When the evaporation rate on the concrete surface exceeds the rate of bleeding of the concrete, measures shall be taken ~~When addition of water to the surface is permitted~~ to prevent the rapid evaporation of water from the surface during finishing operations.~~,~~ When allowed by the Engineer, the addition of water to the surface may be permitted when applied as a fog spray with approved spray equipment immediately after screeding and/or between finishing operations. A commercial evaporation reducer that forms a monomolecular film may also be sprayed onto the concrete surface in accordance with the Manufacturer's recommendations. When either of these methods is approved and used it does not take the place of proper curing methods per Section 3.8.

Pavement edges and joints shall be edged in accordance with details shown on the project plans or as directed by the Engineer.

In advance of curing operations, pavement shall be given a texturing. Texturing shall be performed with an artificial turf drag with a board added to assure the weight needed to obtain an approved surface. Artificial turf shall be a molded composite structure with polyethylene face, nylon and polyester backing, a pile height of 0.85 inches, and total weight of 75 oz./sq. yd. The approved surface will be made by the Engineer on the initial construction and shall not be changed without approval. Each time the construction is stopped or causes the texturing to stop, the artificial turf must be shaken clean before continuing.

324.3.8 Curing: Curing shall begin immediately following surface texturing and edging. Before concrete placement begins, Contractor shall have at hand and ready to install ~~before concrete placement begins~~ the materials and equipment needed for adequate curing.

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After finishing operations have been completed, the newly placed concrete shall be cured by moist curing methods, by application of a white liquid membrane compound, or by a combination of these methods. All surfaces not covered by reasonably waterproof forms shall be kept damp by applying water with a nozzle that so atomizes the flow of water that a fog mist and not a spray is formed until the surface is covered with liquid membrane compound, the surface has hardened sufficiently to permit sprinkling of the surface, or moist curing by covering with wet burlap or other approved materials can be initiated. Moisture from the nozzle shall not be applied under pressure directly upon the concrete and shall not be allowed to accumulate on the concrete in a quantity sufficient to cause a flow and erode the surface. Moist curing shall be continued until liquid membrane curing compound or other type of curing membrane is applied.

Membrane curing compound shall be applied to all pavement by automatic mechanical method from a construction bridge.

The edges of concrete slabs exposed by the removal of forms shall be protected immediately to provide these exposed surfaces with continuous curing treatment equal to the method selected for curing the pavement surface.

The membrane method of curing may be applied behind the final finishing operation after all free water has disappeared from the surface. Complete and uniform coverage at the rate of one gallon per 100 square feet, or as otherwise recommended by the manufacturer, shall be required. Compound shall be kept agitated to prevent pigment from settling.

324.3.9 Joints:

324.3.9.1 General: Joints shall be provided in the pavement of the type, dimensions and at the locations as indicated in the plans or as specified herein.

Joints in concrete pavement will be designated as transverse expansion joints, longitudinal or transverse construction joints, longitudinal or transverse weakened plane joints, or isolation joints. The faces of all joints shall be perpendicular to the pavement surface. Joints shall be constructed in accordance with the details shown in the plans and in accordance with the following provisions.

At all times prior to acceptance of the construction, joints shall be maintained clean and free of all soil, gravel, and other foreign material except approved types of joint filler materials.

324.3.9.2 Longitudinal Joints: Longitudinal joints shall be weakened plane or construction joints. Longitudinal weakened plane joints shall be constructed by sawing or by insertion of a parting strip in the plastic concrete to be left in place. Longitudinal construction joints shall be constructed with tie bars or keyways as indicated in the plans.

324.3.9.3 Transverse Joints: Transverse joints shall be weakened plane, construction or expansion joints. All transverse weakened plane joints will be constructed by sawing and in accordance with the details shown in the project plans. Transverse construction joints shall be constructed with dowels or with sawed keyways and in accordance with the details shown in the project plans. Transverse expansion joints shall be constructed as butt joints with vertical expansion joint filler and with or without dowel bars in accordance with the details shown in the project plans. Dowel bars shall be supported on a basket-type system with a base plate on subgrade and up the side form to prevent material from entering dowel openings.

324.3.9.4 Joint Location: Longitudinal joints shall be constructed between traffic lanes and at other locations as indicated in the project plans.

Transverse construction joints shall be constructed at the end of a day's production or when placing of concrete is discontinued for more than 45 minutes. Transverse construction joints will not be allowed within 500 feet of a structure unless otherwise approved by the Engineer.

Transverse weakened plane joints in concrete placed in lanes adjacent to previously placed concrete shall be located to align with weakened plane joints in the adjacent lanes. No transverse weakened plane joint shall be constructed within 6 feet of another transverse joint. When the planned spacing of transverse weakened plane joints results in

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location of a weakened plane joint within 6 feet of another transverse joint, the transverse weakened plane joint shall be relocated so it is not within 6 feet of said transverse joint.

Transverse expansion joints shall be located at the junction of the normal roadway pavement slab with bridge approach slabs and at other locations as shown on the plans.

Isolation joints shall be provided around manholes, catch basins, or other elements which extend into or project through the pavement and act as point of restraint to horizontal or vertical movement of the pavement.

324.3.9.5 Construction of Joints:

324.3.9.5.1 Sawed Joints: Sawed joints shall be constructed by cutting a groove in the pavement using a single or multiple-blade power saw. The groove shall be cut to the dimensions shown on the project plans. Suitable guidelines or devices shall be used to ~~assure~~ensure joints are cut true to the lines as shown on the project plans.

If joints are sawed in stages, the initial saw cut shall be of the minimum width specified and sawed to the required depth shown on the project plans. The depth of the initial saw cut in the construction of weakened plane joints shall be a minimum of 1/4 of slab thickness.

Sawing of weakened plane joints shall be done before uncontrolled cracking takes place, and after the concrete has hardened to the extent that tearing or raveling of the edges of the saw cut is not excessive. The exact time for all sawing shall be determined by the Contractor when not otherwise specified herein.

Any procedure for sawing joints that result~~s~~ in premature, uncontrolled cracking shall be revised immediately. The Contractor shall be responsible for replacing or repairing areas containing uncontrolled cracking and for repairing spalled or chipped concrete along the edges of sawed joints as directed and to the satisfaction of the Engineer.

After saw cutting of the joint and just prior to sealing the joint, the internal joint surfaces shall be cleaned of all dirt, curing and compound residue, laitance and other foreign materials. The internal joint surface shall be defined as the sawed portion of the joint and the resultant crack for the full depth of the pavement.

324.3.9.5.2 Construction Joints: Longitudinal and transverse construction joints shall be of the type and formed in accordance with the details shown on Detail 224 or as directed by the Engineer.

324.3.9.5.3 Expansion and Isolation Joints: Transverse expansion and isolation joints shall be formed in accordance with the details shown on Detail 224 or as directed by the Engineer.

324.3.9.5.4 Sealing of Joints: Sealing of sawed joints where required shall be completed prior to the opening of the pavement to traffic unless otherwise approved by the Engineer. When delayed sealing of sawed joints is permitted, saw cuts and formed recess to be filled with sealant shall be protected to ensure thorough curing of the concrete along the edges of the joint recesses and to prevent entry of foreign materials into the joint. At the Contractor's option, inert compressible joint filler material such as plastic backer rod or upholstery cord may be inserted into joints immediately after sawing or forming of the joint recess to provide curing protection and prevent entry of foreign material. If absorptive filler material is used, it shall be thoroughly moistened either before or immediately after installation in the sawed groove. When filler material is rope, or similar material which does not fill the entire depth of sawed groove, it shall be depressed not less than ½ inch below the pavement surface before the pavement is opened to traffic.

Sealant shall be applied in accordance with the sealant manufacturer's recommendations. A primer shall be furnished and applied after the joint has been cleaned and prepared to receive sealant if so indicated in the manufacturer's recommendations.

Prior to the application of the sealant, an approved type of inert, compressible joint filler material such as plastic backer rod or upholstery cord, or an approved type of bond breaker, shall be inserted along the joint in accordance with the details shown on the project plans. The joint shall then be filled with sealant to a level not less than 1/8 inch or more than 1/4 inch below the elevation of the pavement surface adjacent to the joint edge.

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The equipment used to apply sealant shall be as recommended by the sealant manufacturer. Sealant shall not be spilled on the surface of the concrete pavement, and Contractor shall remove any sealant inadvertently spilled on the pavement surface.

324.3.9.5.5 Repair of Cracks, Spalls, Raveling and Tearing: Contractor shall be responsible for replacing or repairing all areas of pavement containing uncontrolled cracking, surface spalls, or other types of surface defects as directed by the Engineer. Repairs shall be made by methods acceptable to the Engineer and the repair shall be completed to the satisfaction of the Engineer.

324.4 Tests of Finished Pavement:

324.4.1 Smoothness: The pavement Surface Profile Index shall not exceed seven inches per mile in any 0.1 of a mile section or any remaining portion thereof as measured along any line parallel to the edge of the pavement except at and through intersections, and at and through railroad crossings. The surface profiles will be evaluated in accordance with the requirements of Arizona Department of Transportation Test Method 801.

After completion of all paving, the Contractor shall clean the pavement by brooming or any other method to allow the Engineer to obtain accurate profilograph readings. Profilograph readings will be taken one time in each wheel path of each lane.

Grinding will be required if necessary to produce a surface smoothness conforming to the requirements of this section. In addition, all high areas having deviations in excess of 0.3 of an inch shall be ground. After grinding, the finished surface of the ground area shall be provided with a uniform texture acceptable to the Engineer. The method of texturing shall be approved by the Engineer.

In addition to the Surface Profile Index requirement, the pavement surface including pavement in intersections will be tested with a ten-foot straight-edge placed parallel to the centerline of the pavement in each lane. Ordinates measured from the face of the straight-edge to pavement surface shall at no place exceed one-quarter inch. Areas that do not meet the required surface accuracy as determined by straight-edge testing shall be marked, and Contractor shall at his own expense and as required by the Engineer either:

(1) Grind down areas higher than 1/4 inch but not more than 1/2~~½~~ inch above the correct surface.

(2) Correct areas lower than 1/4 inch but not lower than 1/2 ~~½~~ inch below the correct surface by grinding down the adjacent areas.

(3) Break out and replace pavement when the deviation exceeds 1/2 ~~½~~ inch from the correct surface. Area replaced shall be of a length, width and depth as required to allow formation of a new slab of the required quality.

324.4.2 Pavement Thickness: Concrete pavement shall be constructed in accordance with the thickness requirements of the plans and specifications. Tolerances for base and subgrade construction and other provisions of these specifications which may affect thickness shall not be construed to modify such thickness requirements.

For the purpose of determining acceptability for thickness, cores shall be drilled by the Contractor at the locations specified by the Engineer. Cores shall have a minimum diameter of four inches. Length of cores will be determined in accordance with the requirements of AASHTO T-148 by measurements read to the nearest thousandth of an inch. The average of the measurements will be reported to the nearest hundredth of an inch.

In calculating average length, cores which have a length in excess of the thickness specified by more than 0.25 of an inch will be deemed to have a length of the specified thickness plus 0.25 of an inch. Field length measurements will be acceptable in lieu of average length measurement in accordance with the requirements of AASHTO T-148, provided the original core in any secondary unit meets or exceeds the specified thickness. Measurements in accordance with the requirements of AASHTO T-148 will be required on any questionable thickness measurements and on the three cores used to determine the average length for payment, regardless of length.

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A primary unit of pavement shall be the area of pavement placed in each day's paving operation. Each intersection or special section shall be considered as a primary unit.

A secondary unit of pavement shall consist of 1,000 linear feet, or fraction thereof, of each traffic lane. Each 1,300 square yards of pavement in intersections, etc., shall be considered a secondary unit regardless of when the concrete was placed.

One core shall be drilled in each secondary unit. If the length of that core is not deficient by more than 0.25 of an inch, that secondary unit will be measured for payment at 100 percent. If the length of that core is deficient by more than 0.25 of an inch but less than 1.0 inch, two additional cores shall be drilled within that secondary unit and the length of the three cores averaged. If the average length is not deficient by more than 0.25 of an inch, that secondary unit will be measured for payment at 100 percent. If the average length of the three cores is deficient by more than 0.25 of an inch, that secondary unit will be measured for payment in accordance with the requirements of Table 324-1.

If the core in the secondary unit is deficient by more than 1.00 inch, that core will not be used in determining the average thickness of that secondary unit. Additional cores shall be drilled at intervals not to exceed ten feet in each direction from the deficient core, parallel to the main-line centerline, until one core is obtained in each direction which is not deficient by more than 1.00 inch. The pavement between these two cores will be evaluated separately from the balance of the pavement in that secondary unit. The limits for evaluation shall be between the longitudinal weakened plane or construction joint on each side of the core and between the next transverse weakened plane, construction, or expansion joint beyond each of the last two cores. Unless the Engineer allows the pavement to remain, it shall be removed and replaced with pavement of the specified thickness and no payment will be made for the removed~~al~~ pavement. One additional core shall be drilled in the secondary unit to represent the quality of the concrete in that unit after deducting the limits of the deficient area if that pavement represented by the deficient area is allowed to remain. The core shall be measured for payment as hereinbefore specified.

If the pavement in the deficient area is removed, either by the order of the Engineer or at the option of the Contractor, it shall be removed between the limits of the evaluation. After the pavement has been replaced, one core shall be drilled at random in that secondary unit after deducting the area of the replaced pavement and one core shall be drilled in the new pavement. Pavement represented by the core drilled in the secondary unit, less the replaced pavement, will be measured for payment as hereinbefore specified. The core drilled in the replaced pavement shall be not less than the specified thickness~~,~~; otherwise that pavement will not be measured or paid for.

At all locations where cores have been drilled, the resulting holes shall be filled with concrete in a manner satisfactory to the Engineer.

324.5 PROTECTION OF PAVEMENT:

The Contractor shall be responsible for taking adequate steps to protect concrete placed during rain, or hot or cold weather as defined in ACI Standards. Any concrete damaged by rain or extreme temperatures shall be removed and replaced at the Contractor's expense.

When ordered by the Engineer, pavement crossings shall be constructed for the convenience of public traffic. Where motor vehicles are encountered, a temporary bridge to span the newly placed concrete will be provided.

No traffic or Contractor's equipment, except as hereinafter provided, will be permitted on the pavement until the concrete has developed a compressive strength of 3500 psi.

Equipment for sawing joints will be permitted on the pavement when, in the Contractor's judgment, the concrete has developed sufficient strength to support the equipment without damage to the concrete. In case of visible cracking or other damage to the pavement, operation of the equipment on the pavement shall be immediately discontinued.

Any damage to the pavement resulting from early use of pavement by the Contractor's equipment shall be repaired by the Contractor at his expense.

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324.6 METHOD OF MEASUREMENT:

Portland Cement Concrete pavement will be measured by the square yard. Any opening in excess of one square yard will not be measured for payment.

324.7 BASIS OF PAYMENT:

The accepted quantities of Portland Cement Concrete pavement, measured as provided for herein, will be paid for at the contract unit price complete in place, except that where the average length of cores indicates pavement deficient in thickness by more than 0.25 of an inch but not more than 1.00 inch, payment will be made as specified in Table 324-1. Payment will be made to the nearest cent.

No additional payment will be allowed for pavement constructed in excess of the thickness specified on the project plans.

TABLE 324-1	
PAVEMENT THICKNESS PAYMENT REDUCTION (AC)	
Core Thickness, Less Than Specified Thickness, Inches	Percent of Contract Unit Price Allowed
0.00 to 0.25	100
0.26 to 0.35	93
0.36 to 0.45	85
0.46 to 0.55	75
0.56 to 0.75	63
0.76 to 1.00	50

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ACPA

Description

This web applet, based on various established correlation equations, allows you to quickly convert between compressive strength, flexural strength, split tensile strength, and modulus of elasticity of concrete.

Terms of Use

The user accepts ALL responsibility for decisions made as a result of the use of this design tool. American Concrete Pavement Association, its Officers, Board of Directors and Staff are absolved of any responsibility for any decisions made as a result of your use. Use of this design tool implies acceptance of the terms of use.

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CONTACT

Strength Converter

◉ English (psi) ○ Metric (MPa)

Convert 520 Flexural Strength

to Compressive Strength

Calculate

English (psi)	Source
2,996	MEPDG
3,399	Mindess, Young, and Darwin; Raphael
4,807	ACI 318
3,399	ACI 330*
2,704 to 4,225	Yoder and Witczak; Huang

* ACPA recommeded conversion.

Show/Hide References

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CONTACT

Strength Converter

(•) English (psi) ( ) Metric (MPa)

Convert 650 Flexural Strength

to Compressive Strength

Calculate

English (psi)	Source
4,681	MEPDG
4,751	Mindess, Young, and Darwin; Raphael
7,511	ACI 318
4,751	ACI 330*
4,225 to 6,602	Yoder and Witczak; Huang

* ACPA recommeded conversion.

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