

Section 02751

CONCRETE PAVING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Portland cement concrete paving.

1.02 MEASUREMENT AND PAYMENT

- A. Unit Prices.

1. Payment for concrete paving is on square yard basis. Separate pay items are used for each different required thickness of pavement.
2. Payment for concrete paving, high early strength, is on square yard basis.
3. Payment for pavement repair or pavement replacement for utility projects is on a square yard basis and includes base materials in accordance with Section 02951 Pavement Repair and Restoration.
4. Refer to Section 01270 - Measurement and Payment for unit price procedures.
5. Refer to Paragraph 3.15, Unit Price Adjustment.

- B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for Work in this Section is included in total Stipulated Price.

1.03 REFERENCES

- A. ASTM A~~1064~~82 - Standard Specification for Carbon-Steel Wire and Welded Wire, Plain, for Concrete-Reinforcement, Plain and Deformed, for Concrete.
- ~~B. ASTM A185 - Standard Specifications for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement.~~
- ~~C. ASTM A497 - Standard Specification for Steel Welded Wire Reinforcement, Deformed, for Concrete.~~
- ~~D.B.~~ ASTM A615 - Standard Specification for Deformed and Plain Billet Carbon Steel Bars for Concrete Reinforcement.
- ~~E.C.~~ ASTM C 31 - Standard Practice for Making and Curing Concrete Test Specimens in the Field.

- ~~F.D.~~ ASTM C 33 - Standard Specifications for Concrete Aggregates.
- ~~G.E.~~ ASTM C 39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
- ~~H.F.~~ ASTM C 40 - Standard Test Method for Organic Impurities in Fine Aggregates for Concrete.
- ~~I.G.~~ ASTM C 42 - Standard Test Method of Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
- ~~J.H.~~ ASTM C 78 - Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Third Point Loading).
- ~~K.I.~~ ASTM C 94 - Standard Specification for Ready-Mixed Concrete.
- ~~L.J.~~ ASTM C 131 - Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
- ~~M.K.~~ ASTM C 136 - Standard Method for Sieve Analysis of Fine and Coarse Aggregates.
- ~~N.L.~~ ASTM C 138 - Standard Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete.
- ~~O.M.~~ ASTM C 143 - Standard Test Method for Slump of Hydraulic Cement Concrete.
- ~~P.N.~~ ASTM C 150 - Standard Specification for Portland Cement.
- ~~Q.O.~~ ASTM C 174 - Standard Test Method for Measuring Thickness of Concrete Elements Using Drilled Concrete Cores.
- ~~R.P.~~ ASTM C 231 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
- ~~S.Q.~~ ASTM C 260 - Standard Specification for Air-Entraining Admixtures for Concrete.
- ~~T.R.~~ ASTM C 494 - Standard Specification for Chemical Admixtures for Concrete.
- ~~U.S.~~ ASTM C 618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for use in as a Mineral Admixture in Portland Cement Concrete.
- ~~V.T.~~ TxDOT Tex-203-F - Sand Equivalent Test.
- ~~W.U.~~ TxDOT Tex-406-A - Material Finer than 75  $\mu\text{m}$  (No. 200) Sieve In Mineral Aggregates (Decantation Test for Cement Aggregates).

1.04 SUBMITTALS

- A. Conform to requirements of Section 01330 - Submittal Procedures.
- B. Submit proposed mix design and test data for each type and strength of concrete in Work. Include proportions and actual flexural strength obtained from design mixes at required test ages.
- C. Submit for approval manufacturer's description and characteristics for mixing equipment, and for traveling form paver, when proposed for use.
- D. Submit manufacturer's certificates giving properties of reinforcing steel. Include certificate of compliance with ASTM A 821064. Provide specimens for testing when required by Project Manager.

1.05 HANDLING AND STORAGE

- A. Do not mix different classes of aggregate without written permission of Project Manager.
- B. Class of aggregate being used may be changed before or during Work with written permission of Project Manager. Comply new class with specifications.
- C. Reject segregated aggregate. Before using aggregate whose particles are separated by size, mix them uniformly to grading requirements.
- D. Reject aggregates mixed with dirt, weeds, or foreign matter.
- E. Do not dump or store aggregate in roadbed.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Portland Cement:
  - 1. Sample and test cement to verify compliance with Standards of ASTM C 150, Type I or Type III.
  - 2. Bulk cement which meets referenced standards may be used when method of handling is approved by Project Manager. When using bulk cement, provide satisfactory weighing devices.
  - 3. Fly ash which meets standards of ASTM C 618 may be used as mineral fill when method of handling is approved by Project Manager.

- B. Water: Conform to requirements for water in ASTM C 94.
- C. Coarse Aggregate: Crushed stone, gravel, or combination thereof, which is clean, hard, and durable, conforms to requirements of ASTM C 33, and has abrasion loss not more than 45 percent by weight when subjected to Los Angeles Abrasion Test (ASTM C 131).

1. Maximum percentage by weight of deleterious substances shall not exceed following values:

<u>Item</u>	<u>Percent by Weight of Total Sample Maximum</u>
Clay lumps and friable particles	3.0
Material finer than 75- $\mu$ m (No. 200) sieve:	
Concrete subject to abrasion	3.0*
All Other concrete	5.0*
Coal and lignite:	
Where surface appearance of concrete is of importance	0.5
All other concrete	1.0

\* In case of manufactured sand, when material finer than 75- $\mu$ m (No. 200) sieve consists of dust of fracture, essentially free from clay or shale, these limits may be increased to 5 and 7 percent, respectively.

2. Conform coarse aggregate (size 1 1/2-inch to No. 4 sieve) to requirements of ASTM C33. Use gradation within following limits when graded in accordance with ASTM C 136:

<u>Sieve Designation (Square Openings)</u>	<u>Percentage by Weight</u>
Retained on 1 3/4" sieve	0
Retained on 1 1/2" sieve	0 to 5
Retained on 3/4" sieve	30 to 65
Retained on 3/8" sieve	70 to 90
Retained on No. 4 sieve	95 to 100
Loss by Decantation Test *Method Tex-406-A	1.0 maximum

\* In case of aggregates made primarily from crushing of stone, when material finer than 200 sieve is dust of fracture essentially free from clay or shale as established by Part III of TxDOT Tex-406-A, percent may be increased to 1.5.

- D. Fine Aggregate: Sand, manufactured sand, or combination thereof, composed of clean, hard, durable, uncoated grains, free from loams or other injurious foreign matter. Conform fine aggregate for concrete to requirements of ASTM C 33. Use gradation within following limits when graded in accordance with ASTM C 136:

Sieve Designation (Square Openings)	Percentage by Weight
Retained on 3/8" sieve	0
Retained on No. 4 sieve	0 to 5
Retained on No. 8 sieve	0 to 20
Retained on No. 16 sieve	15 to 50
Retained on No. 30 sieve	35 to 75
Retained on No. 50 sieve	65 to 90
Retained on No. 100 sieve	90 to 100
Retained on No. 200 sieve	97 to 100

1. When subjected to color test for organic impurities (ASTM C 40), fine aggregate shall not show color darker than standard color. Fine aggregate shall be subjected to Sand Equivalent Test (Tex-203-F). Sand equivalent value shall not be less than 80, unless higher value is shown on Drawings.
- E. Mineral Filler: Type “C” or Type “F” fly ash of acceptable quality and meeting requirements of ASTM C 618 may be used as mineral admixture in concrete mixture. When fly ash mineral filler is used, store and inspect in accordance with ASTM C 618. Do not use fly ash in amounts to exceed 25 percent by weight of cementitious material in mix design. Cement content may be reduced when strength requirements can be met. Note: When fly ash is used, term "cement" is defined as cement plus fly ash.
- F. Air Entraining Agent: Furnish air entraining agent conforming to requirements of ASTM C 260.
- G. Water Reducer: Water reducing admixture conforming to requirements of ASTM C 494 may be used when required to improve workability of concrete. Amount and type of admixture is subject to approval by Project Manager.
- H. Reinforcing Steel:
1. Provide new billet steel manufactured by open hearth process and conforming to ASTM A 615, Grade 60. Store steel to protect it from mechanical injury and rust. At time of placement, steel shall be free from dirt, scale, rust, paint, oil, or other injurious materials.
  2. Cold bend reinforcing steel to shapes shown. Once steel has been bent, it may not be rebent.
  3. Provide wire fabric conforming to ASTM A ~~821064~~. Use fabric in which longitudinal and transverse wires have been electrically welded at points of intersection. Welds shall have sufficient strength not to be broken during handling or placing. Conform welding and fabrication of fabric sheets to ASTM A ~~4851064~~.

2.02 EQUIPMENT

- A. Conform Equipment to requirements of ASTM C94.

2.03 MIXING

- A. Flexural strength shall be as specified using test specimens prepared in accordance with ASTM C 31 and tested in accordance with ASTM C78 (using simple beam with third-point loading). Compressive strength shall be as specified using test specimens prepared in accordance with ASTM C 31 and tested in accordance with ASTM C 39. Determine and measure batch quantity of each ingredient, including water for batch designs and all concrete produced for Work. Mix shall conform to these specifications and other requirements indicated on Drawings.
- B. Mix design to produce concrete which will have flexural strength of 500 psi at 7 days and 600 psi at 28 days. Minimum compressive strength shall be 3,000 pounds per square inches for 7 days and ~~3500-4,000~~ pounds per square inches at 28 days when tested in accordance with ASTM C39. Slump of concrete shall be at least 2--inches but no more than 5--inches, when tested in accordance with ASTM C143.
1. Concrete pavement, including curb, curb and gutter, and saw-tooth curb, shall contain at least 5 1/2 sacks (94 pounds per sack) of cement per cubic yard, with not more than 6.5 gallons of water, net, per sack of cement (water-cement ratio maximum 0.57). Determine cement content in accordance with ASTM C 138. Addition of mineral filler may be used to improve workability or plasticity of concrete to limits specified.
  2. Coarse dry aggregate shall not exceed 85 percent of loose volume of concrete.
  3. Add air-entraining admixture to ensure uniform distribution of agent throughout batch. Base air content of freshly mixed air-entrained concrete upon trial mixes with materials to be used in Work, adjusted to produce concrete of required plasticity and workability. Percentage of air entrainment in mix shall be 4 1/2 percent plus or minus 1 1/2 percent. Determine air content by testing in accordance with ASTM C 231.
  4. Use retardant when temperature exceeds 90 degrees F. Proportion as recommended by manufacturer. Use same brand as used for air-entraining agent. Add and batch material using same methods as used for air-entraining agent.
- C. Use high early strength concrete pavement to limits shown on Drawings. Design to meet following:
1. Concrete Mix: Flexural strength greater than or equal to 500 psi at 72 hours.
  2. Cement: Minimum of 7 sacks of cement per cubic yard of concrete.

3. Water-Cement Ratio maximum of 0.45. Slump of concrete shall a maximum of 5-inches, when tested in accordance with ASTM C 143.
4. Other requirements for proportioning, mixing, execution, testing, etc., shall be in accordance with this Section 02751 - Concrete Paving.

### PART 3 EXECUTION

#### 3.01 EXAMINATION

- A. Verify compacted base is ready to support imposed loads and meets compaction requirements.
- B. Verify lines and grades are correct.

#### 3.02 PREPARATION

- A. Properly prepare, shape and compact each section of subgrade before placing forms, reinforcing steel or concrete. After forms have been set to proper grade and alignment, use subgrade planer to shape subgrade to its final cross section. Check contour of subgrade with template.
- B. Remove subgrade that will not support loaded form. Replace and compact subgrade to required density.

#### 3.03 EQUIPMENT

- A. Alternate equipment and methods, other than those required by this Section, may be used provided equal or better results will be obtained. Maintain equipment for preparing subgrade and for finishing and compacting concrete in good working order.
- B. Subgrade Planer and Template:
  1. Use subgrade planer with adjustable cutting blades to trim subgrade to exact section shown on Drawings. Select planer mounted on visible rollers which ride on forms. Planer frame must have sufficient weight so that it will remain on form, and have strength and rigidity that, under tests made by changing support from wheels to center, planer will not develop deflection of more than 1/8-inch. Tractors used to pull planer shall not produce ruts or indentations in subgrade. When slip form method of paving is used, operate subgrade planer on prepared track grade or have it controlled by electronic sensor system operated from string line to establish horizontal alignment and elevation of subbase.
  2. Provide template for checking contour of subgrade. Template shall be long enough to rest upon side forms and have strength and rigidity that, when supported at center, maximum deflection shall not exceed 1/8-inch. Fit template with accurately adjustable rods projecting downward at 1-foot intervals. Adjust



these rods to gauge cross sections of slab bottom when template is resting on side forms.

- C. Machine Finisher: Provide power-driven, transverse finishing machine designed and operated to strike off and consolidate concrete. Machine shall have two screeds accurately adjusted to crown of pavement and with frame equipped to ride on forms. Use finishing machine with rubber tires when it operates on concrete pavement.
- D. Hand Finishing:
  - 1. Provide mechanical strike and tamping template 2-feet longer than width of pavement to be finished. Shape template to pavement section.
  - 2. Provide two bridges to ride on forms and span pavement for finishing expansion and dummy joints. Provide floats and necessary edging and finishing tools.
- E. Burlap Drag or transverse broom for Finishing Slab: Furnish four plies of 10-ounce burlap material fastened to bridge to form continuous strip of burlap full width of pavement. Maintain contact 3-foot width of burlap material with pavement surface. Keep burlap drags clean and free of encrusted mortar.
- F. Vibrators: Furnish mechanically-operated, synchronized vibrators mounted on tamping bar which rides on forms and hand-manipulated mechanical vibrators. Furnish vibrators with frequency of vibration to provide maximum consolidation of concrete without segregation.
- G. Traveling Form Paver: Approved traveling form paver may be used in lieu of construction methods employing forms, consolidating, finishing and floating equipment. Meet requirements of this specification for subgrade, pavement tolerances, pavement depth, alignments, consolidation, finishing and workmanship. When traveling form paver does not provide concrete paving that meets compaction, finish, and tolerance requirements of this Specification, immediately discontinue its use and use conventional methods.
  - 1. Equip traveling paver with longitudinal transangular finishing float adjustable to crown and grade. Use float long enough to extend across pavement to side forms or edge of slab.
  - 2. Ensure that continuous deposit of concrete can be made at paver to minimize starting and stopping. Use conventional means of paving locations inaccessible to traveling paver, or having horizontal or vertical curvature that traveling paver cannot negotiate.



3. Where Drawings require tie bars for adjacent paving, securely tie and support bars to prevent displacement. Tie bars may be installed with approved mechanical bar inserter mounted on traveling-form paver. Replace pavement in which tie bars assume final position other than that shown on Drawings.

### 3.04 FORMS

- A. Side Forms: Use metal forms of approved shape and section. Preferred depth of form is equal to required edge thickness of pavement. Forms with depths greater or less than required edge thickness of pavement will be permitted, provided difference between form depth and edge thickness when not greater than 1-inch, and further provided that forms of depth less than pavement edge are brought to required edge thickness by securely attaching wood or metal strips to bottom of form, or by grouting under form. Bottom flange of form shall be same size as thickness of pavement. Aluminum forms are not allowed. Forms shall be approved by Project Manager. Length of form sections shall be not less than 10-feet and each section shall provide for staking in position with not less than 3 pins. Flexible or curved forms of wood or metal of proper radius shall be used for curves of 200-foot radius or less. Forms shall have ample strength and shall be provided with adequate devices for secure setting so that when in-place they will withstand, without visible springing or settlement, impact and vibration of finishing machine. In no case shall base width be less than 8-inches for form 8-inches or more in height. Forms shall be free from warp, bends or kinks and shall be sufficiently true to provide straight edge on concrete. Top of each form section, when tested with straight edge, shall conform to requirements specified for surface of completed pavement. Provide sufficient forms for satisfactory placement of concrete. For short radius curves, forms less than 10-feet in length or curved forms may be used. For curb returns at street intersections and driveways, wood forms of good grade and quality may be used.
- B. Form Setting:
  1. Rest forms directly on subgrade. Do not shim with pebbles or dirt. Accurately set forms to required grade and alignment and, during entire operation of placing, compacting and finishing of concrete, do not deviate from this grade and alignment more than 1/8-inch in 10-feet of length. Do not remove forms for at least 8 hours after completion of finishing operations. Provide supply of forms that will be adequate for orderly and continuous placing of concrete. Set forms and check grade for at least 300-feet ahead of mixer or as approved by Project Manager.
  2. Adjacent slabs may be used instead of forms, provided that concrete is well protected from possible damage by finishing equipment. Do not use adjacent slabs for forms until concrete has aged at least 7 days.

3. Prior to form setting, grade subgrade appropriately so that when the forms are set, and the concrete is poured, finished, and cured, there is positive drainage, free of sitting water / ponding in the gutter (“gutter ponds”) or on the pavement area of new panels. This requirement may not be capable of being met at the construction joint between an existing pavement panel and a new individual pavement panel that is properly installed to match the existing panel. However, this requirement shall be met between two new panels and within the area of new panels.

### 3.05 REINFORCING STEEL AND JOINT ASSEMBLIES

- A. Place reinforcing steel and joint assemblies and position securely as indicated on Drawings. Wire reinforcing bars securely together at intersections and splices. Bars and coatings shall be free of rust, dirt or other foreign matter when concrete is placed. Secure reinforcing steel to chairs.
- B. Position pavement joint assemblies at required locations and elevations, and rigidly secure in position. Install dowel bars in joint assemblies, each parallel to pavement surface and to center line of pavement, as shown.
- C. Cut header boards, joint filler, and other material used for forming joints to receive each dowel bar.
- D. Secure in required position to prevent displacement during placing and finishing of concrete.
- E. Drill dowels into existing pavement, secure with epoxy, and provide paving headers as required to provide rigid pavement sections.
- F. Use sufficient number of chairs for steel reinforcement bars to maintain position of bars within allowable tolerances. Place reinforcement as shown on Drawings. In plane of steel parallel to nearest surface of concrete, bars shall not vary from plan placement by more than 1/12 of spacing between bars. In plane of steel perpendicular to nearest surface of concrete, bars shall not vary from plan placement by more than 1/4-inch.

### 3.06 FIBROUS REINFORCING

- A. Do not use fibrous reinforcing to replace structural, load-bearing, or moment-reinforcing steel.

### 3.07 PLACEMENT

- A. Place concrete when air temperature taken in shade and away from artificial heat is above 35 degrees F and rising. Do not place concrete when temperature is below 40 degrees F and falling.

- B. Place concrete within 90 minutes after initial water had been added. Remove and dispose of concrete not placed within this period.
- C. Concrete slump during placement shall be 1 to 5-inches, except when using traveling-form paver, slump shall be maximum of 2-inches.
- D. Deposit concrete continuously in successive batches. Distribute concrete in manner that will require as little rehandling as possible. Where hand spreading is necessary, distribute concrete with shovels or by other approved methods. Use only concrete rakes in handling concrete. At placement interruption of more than 30 minutes, place transverse construction joint at stopping point. Remove and replace sections less than 10-feet long.
- E. Take special care in placing and spading concrete against forms and at longitudinal and transverse joints to prevent honeycombing. Voids in edge of finished pavement will be cause for rejection.

### 3.08 COMPACTION

- A. Consolidate concrete using mechanical vibrators as specified herein. Extend vibratory unit across pavement, not quite touching side forms. Space individual vibrators at close enough intervals to vibrate and consolidate entire width of pavement uniformly. Mount mechanical vibrators to avoid contact with forms, reinforcement, transverse or longitudinal joints.
- B. Furnish enough hand-manipulated mechanical vibrators for proper consolidation of concrete along forms, at joints and in areas not covered by mechanically controlled vibrators.

### 3.09 FINISHING

- A. Finish concrete pavement with power-driven transverse finishing machines or by hand finishing methods.
  - 1. Hand finish with mechanical strike and tamping template in same width as pavement to be finished. Shape template to pavement section shown on Drawings. Move strike template forward in direction of placement, maintaining slight excess of material in front of cutting edge. Make minimum of two trips over each area. Screed pavement surface to required section. Work screed with combined transverse and longitudinal motion in direction work is progressing. Maintain screed in contact with forms. Use longitudinal float to level surface.
- B. On narrow strips and transitions, finish concrete pavement by hand. Thoroughly work concrete around reinforcement and embedded fixtures. Strike off concrete with strike-off screed. Move strike-off screed forward with combined transverse and longitudinal motion in direction work is progressing, maintaining screed in contact with forms, and maintaining slight excess of materials in front of cutting edge. Tamp concrete with tamping template. Use longitudinal float to level surface.

- C. After completion of straightedge operation, make first pass of burlap drag or transverse broom as soon as construction operations permit and before water sheen has disappeared from surface. Follow with as many passes as required to produce desired texture depth. Permit no unnecessary delays between passes. Keep drag wet, clean and free from encrusted mortar during use.

### 3.10 JOINTS AND JOINT SEALING

- A. Conform to requirements of Section 02752 - Concrete Pavement Joints.

### 3.11 CONCRETE CURING

- A. Conform to requirements of Section 02753 - Concrete Pavement Curing.

### 3.12 TOLERANCES

- A. Test entire surface before initial set and correct irregularities or undulations. Bring surface within requirements of following test and then finish. Place 10-foot straightedge parallel to center of roadway to bridge depressions and touch high spots. Do not permit ordinates measured from face of straight edge to surface of pavement to exceed 1/16-inch per foot from nearest point of contact. Maximum ordinate with 10-foot straightedge shall not exceed 1/8-inch. Grind spots in excess of required tolerances to meet surface test requirements. Restore texture by grooving concrete to meet surface finishing specifications.

### 3.13 FIELD QUALITY CONTROL

- A. Perform testing under provisions of Section 01454 - Testing Laboratory Services.
- B. Compressive Strength Test Specimens: Make four test specimens for compressive strength test in accordance with ASTM C 31 for each 150 cubic yards or less of pavement that is placed in one day. Test two specimens at 7 days or at number of hours as directed by the Project Manager for high early strength concrete. Test remaining two specimens at 28 days. Test specimens in accordance with ASTM C 39. Minimum compressive strength shall be 3000 pounds per square inch for first two specimens and 3500 pounds per square inch at 28 days.
- C. When compressive test indicates failure, make yield test in accordance with ASTM C 138 for cement content per cubic yard of concrete. When cement content is found to be less than that specified per cubic yard, increase batch weights until amount of cement per cubic yard of concrete conforms to requirements.
- D. Minimum of one 4-inch core will be taken at random locations per 375-feet per 12-foot lane or 500 square yards of pavement to measure in-place depth. Measure depth in accordance with ASTM C 174. Each core may be tested for 28 day compressive strength according to methods of ASTM C 42. 28 day compressive strength of each core tested shall be a minimum of 3000 pounds per square inch.

- E. Request, at option, three additional cores in vicinity of cores indicating nonconforming in- place depths at no cost to City. In-place depth at these locations shall be average depth of four cores.
- F. Fill cores and density test sections with new concrete paving or non-shrink grout.

3.14 NONCONFORMING PAVEMENT

- A. Remove and replace areas of pavement found deficient in thickness by more than 10 percent, or that fail compressive strength tests, with concrete of thickness shown on Drawings.
- B. When measurement of any core is less than specified thickness by more than 10 percent, actual thickness of pavement in this area will be determined by taking additional cores at 10-foot intervals parallel to centerline in each direction from deficient core until, in each direction, core is taken which is not deficient by more than 10 percent. Exploratory cores for deficient thickness will not be used in averages for adjusted unit price. Exploratory cores are to be used only to determine length of pavement in unit that is to be removed and replaced. Replace nonconforming pavement sections at no additional cost to City.
- C. Remove and replace new pavement panels that do not have positive drainage and are not free of sitting water / ponding in the gutter (“gutter ponds”) or on the pavement area of new panels. This requirement does not apply at the construction joint between existing pavement and a new individual panel that is properly installed to match the existing panel. However, this requirement applies between two new panels and within the area of new panels.

3.15 UNIT PRICE ADJUSTMENT

- A. Unit price adjustments shall be made for in-place depth determined by cores as follows:
  - 1. Adjusted Unit Price shall be ratio of average thickness as determined by cores to thickness bid upon, times unit price.
  - 2. Apply adjustment to lower limit of 90 percent and upper limit of 100 percent of unit price.
  - 3. Average depth below 90 percent but greater than 80 percent may be accepted by Project Manager at adjusted Unit Price of:
    - a. Unit Price Bid - [2 x (1-ratio) x Unit Price Bid]
    - b. Ratio equals average core thickness divided by thickness bid upon
    - c. 0.9 ratio pays 80 percent of unit price and 0.8 ratio pays 60 percent of unit price.

4. Average depth below 80 percent will be rejected by Project Manager.

3.16 PAVEMENT MARKINGS

- A. Restore pavement markings to match those existing in accordance with City of Houston standard specifications and details and Project Manager's requirements.

3.17 PROTECTION

- A. Barricade pavement section to prevent use until concrete has attained minimum design strength. Cure barricade pavement section for minimum 72 hours before use. Do not open pavement to traffic until concrete is at least 10 days old. Pavement may be open to traffic earlier provided Contractor pays for testing and additional specimen once 7 day specified strength is obtained. Pavement may be opened when high early strength concrete is used meeting specified 72 hour strength.
- B. High early strength concrete may be used to provide access at driveways, street intersections, esplanades and other locations approved by Project Manager.
- C. On those sections of pavement to be opened to traffic, seal joints, clean pavement, and place earth against pavement edges before permitting use by traffic. Opening of pavement to traffic shall not relieve responsibility for Work.
- D. Maintain concrete paving in good condition until completion of Work.
- E. Repair defects by replacing concrete to full depth.

END OF SECTION

Section 02752

CONCRETE PAVEMENT JOINTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Joints for concrete paving; concrete sidewalks, concrete driveways, curbs, and curb and gutters.
- B. Saw-cutting existing concrete or asphalt pavements for new joints.

1.02 MEASUREMENT AND PAYMENT

A. Unit Prices.

- 1. Payment for street pavement expansion joints, with or without load transfer, is on linear foot basis.
- 2. Payment for horizontal dowels is on a unit price basis for each horizontal dowel.
- 3. No separate payment will be made for formed or sawed street pavement contraction joints and longitudinal weakened plane joints. Include payment in unit price for Concrete Paving.
- 4. No separate payment will be made for joints for Curb, Curb and Gutter, Saw-tooth Curb, Concrete Sidewalks, and Concrete Driveways. Include payment in unit price for Curb and Gutter, Concrete Sidewalks, and Concrete Driveways.
- 5. Payment will be made for Preformed Expansion Joints on a linear foot basis only when field conditions require that sidewalk be moved adjacent to existing concrete structure (i.e., street, back of curb, etc.).
- 6. Refer to Section 01270 - Measurement and Payment for unit price procedures.

- B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.03 REFERENCES

- A. ASTM A 615 - Standard Specification for Deformed and Plain ~~Carbon-Billet~~ Steel Bars for Concrete Reinforcement.



- B. ASTM D 994 - Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type).
- C. ASTM D 1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
- D. ASTM D ~~3405-6690~~ - Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements.
- E. TxDOT Tex-525-C - Tests for Asphalt and Concrete Joint Sealers

#### 1.04 SUBMITTALS

- A. Conform to requirements of Section 01330 - Submittal Procedures.
- B. Submit product data for joint sealing compound and proposed sealing equipment for approval.
- C. Submit samples of dowel cup, metal supports, and deformed metal strip for approval. Submit manufacturer's recommendation for placing sealant(s).

### PART 2 PRODUCTS

#### 2.01 BOARD EXPANSION JOINT MATERIAL

- A. Filler board of selected stock. Use wood of density and type as follows:
  - 1. ~~Clear, all heart~~Construction heart cypress weighing no more than 40 pounds per cubic foot, after being oven dried to constant weight.
  - 2. ~~Clear, all heart~~Construction heart redwood weighing no more than 30 pounds per cubic foot, after being oven dried to constant weight.

#### 2.02 PREFORMED EXPANSION JOINT MATERIAL

- A. Bituminous fiber and bituminous mastic composition material conforming to ASTM D 994 and ASTM D 1751.

#### 2.03 JOINT SEALING COMPOUND

- A. Conform joint sealants to one of sealant classes described in this section.
- B. Conform hot-poured rubber-asphalt compound to ASTM D ~~34056690~~.
- C. Two-component Synthetic Polymer.

1. Curing is to be by polymerization and not by evaporation of solvent or fluxing of harder particles.
2. Cure sufficiently at average temperature of  $25 \pm 1$  C ( $77 \pm 2$  F) so as not to pick up under wheels of traffic in maximum three hours.
3. Performance requirements, when tested in accordance with TxDOT Tex-525-C, shall meet above curing times and requirements as follows:

<b>Cold-Extruded and Cold-Pourable (Self-Leveling) Specifications</b>	
<b>Property</b>	<b>Requirement</b>
Penetration, 25 C (77 F) 150 g Cone, 5 s, 0.1 mm (in.), maximum	130
Bond and Extension 50%, -29 C (-20 F), 3 cycles: *Dry Concrete Block *Steel blocks (Primed, if recommended by manufacturer) *Steel blocks shall be used when armor joints are specified	Pass Pass
Flow at 70 C (158 F)	None
Water content % by mass, maximum	5.0
Resilience: * Original sample, % min. (cured) * Oven-aged at 70 C (158 F), % min.	50 50
Cold-extruded material only - Cold Flow (10 minutes)	None

After bond and extension test, there shall be no evidence of cracking, separation or other opening that is over 3 millimeters (1/8-inch) deep in sealer or between sealer and test blocks.

4. Provide cold-extruded type for vertical or sloping joints.
  5. Provide self-leveling type for horizontal joints.
- D. Self-Leveling, Low Modulus Silicone or Polyurethane Sealant for Asphaltic Concrete and Portland Cement Concrete Joints. This shall be a single component self-leveling silicone or polyurethane material that is compatible with both asphalt and concrete pavements. The sealer shall not require a primer for bond; a backer rod shall be required which is compatible with the sealant; no reaction shall occur between rod and sealant.

When tested in accordance with TxDOT Tex-525-C, self-leveling sealant shall meet following requirements:

<b>Self-Leveling, Low Modulus Silicone or Polyurethane Sealant</b>	
<b>Property</b>	<b>Requirements</b>
Tack Free Time, 25 ± 1 C (77 ± 2 F), minutes	120 maximum
Nonvolatile content, % by mass	93 minimum
Tensile Strength and 24 Hour Extension Test: * Initial, 10-day cure, 25 ± 1 C (77 ± 2 F), kPa (psi) * After Water Immersion, kPa (psi) * After Heat Aging, kPa (psi) * After Cycling, -29 C (-20 F), 50%, 3 cycles, kPa (psi) * 24 Hour Extension	* 21 to 69 (3 to 10) * 21 to 69 (3 to 10) * 21 to 69 (3 to 10) * 21 to 69 (3 to 10) * Pass (All Specimens) After 24 hours, there shall be no evidence of cracking, separation or other opening that is over 3 mm (1/8 in.) deep at any point in the sealer or between the sealer and test blocks.

2.04 LOAD TRANSMISSION DEVICES

- A. Smooth, steel dowel bars conforming to ASTM A 615, Grade 60. When indicated on Drawings, encase one end of dowel bar in approved cap having inside diameter 1/16-inch greater than diameter of dowel bar.
- B. Deformed steel tie bars conforming to ASTM A 615, Grade 60.

2.05 SUPPORTS FOR REINFORCING STEEL AND JOINT ASSEMBLY

- A. Employ supports of approved shape and size that will secure reinforcing steel and joint assembly in correct position during placing and finishing of concrete. Space supports as directed by Project Manager.

PART 3 EXECUTION

3.01 PLACEMENT

- A. When new Work is adjacent to existing concrete, place joints at same location as existing joints in adjacent pavement.
- B. If limit of removal of existing concrete or asphalt pavement does not fall on existing joint, saw cut existing pavement minimum of 2-inches deep to provide straight, smooth joint surface without chipping, spalling or cracks.

3.02 CONSTRUCTION JOINTS

- A. Place transverse construction joint wherever concrete placement must be stopped for more than 30 minutes. Place longitudinal construction joints at interior edges of pavement lanes using No. 6 deformed tie bars, 30-inches long and spaced 18-inches on centers.

3.03 EXPANSION JOINTS

- A. Place 3/4-inch expansion joints at radius points of curb returns for cross street intersections, or as located in adjacent pavement but no further than 80 feet apart. Use no boards shorter than 6 feet. When pavement is 24 feet or narrower, use not more than 2 lengths of board. Secure pieces to form straight joint. Shape board filler accurately to cross section of concrete slab. Use load transmission devices of type and size shown on Drawings unless otherwise specified or shown as "No Load Transfer Device." Seal with joint sealing compound.

3.04 CONTRACTION JOINTS

- A. Place contraction joints at same locations as in adjacent pavement or at spaces indicated on Drawings. Place smoothed, painted and oiled dowels accurately and normal to joint. Seal groove with joint sealing compound.

3.05 LONGITUDINAL WEAKENED PLANE JOINTS

- A. Place longitudinal weakened plane joints at spaces indicated on Drawings. If more than 15 feet in width is poured, longitudinal joint must be saw cut. Seal groove with joint sealing compound.

3.06 SAWED JOINTS

- A. Use sawed joints as alternate to contraction and weakened plane joints. Use circular cutter capable of cutting straight line groove minimum of 1/4-inch wide. Maintain depth of one quarter of pavement thickness. Commence sawing as soon as concrete has hardened sufficiently to permit cutting without chipping, spalling or tearing and prior to initiation of cracks. Once sawing has commenced, continue until completed. Make saw cut with one pass. Complete sawing within 24 hours of concrete placement. Saw joints at required spacing consecutively in sequence of concrete placement.
- B. Concrete Saw: Provide sawing equipment adequate in power to complete sawing to required dimensions and within required time. Maintain ample supply of saw blades at work site during sawing operations. Maintain sawing equipment on job during concrete placement.

3.07 TRANSVERSE WEAKENED PLANE JOINTS

- A. Saw cut transverse contraction joints every 20-feet (nominally) in the pavement, but no greater than 20-feet between saw cuts. The spacing of the saw cuts shall be at regular

intervals between expansion joints. The width of the saw cuts shall be a minimum of 1/4-inch wide, and the depth of the saw cuts shall be one-quarter of the pavement thickness. Commence saw cutting as soon as concrete has hardened sufficiently to allow saw cutting without damage to the pavement (affecting finish, chipping, spalling, tearing, etc.) and within 24 hours after concrete placement, but prior to initiation of cracks. Once sawing has commenced on a cut, continue until the cut is completed. Make each saw cut with one pass. Make saw cuts at required spacing consecutively in sequence of concrete placement. Seal the saw cuts (grooves) with joint sealing compound. The goal of the transverse saw cutting is to create weakened joints that will prevent random, non-linear, surface contraction cracking.

B. The dimension D/3 (but no less than 3-inches) on City of Houston Standard Drawing Number 02751-01 is measured from the bottom of the concrete slab.

C. Equipment requirements shall be in accordance with paragraph 3.06.B.

### 3.073.08 JOINTS FOR CURB, CURB AND GUTTER

- A. Place 3/4-inch preformed expansion joints through curb and gutters at locations of expansion and contraction joints in pavement, at end of radius returns at street intersections and driveways, and at curb inlets. Maximum spacing shall be 120-foot centers.

### 3.083.09 JOINTS FOR CONCRETE SIDEWALKS

- A. Provide 3/4-inch expansion joints conforming to ASTM A 1751 along and across sidewalk at back of curbs, at intersections with driveways, steps, and walls; and across walk at intervals not to exceed 36 feet. Provide expansion joint material conforming to ASTM D 994 for small radius curves and around fire hydrants and utility poles. Extend expansion joint material full depth of slab.

### 3.09 JOINTS FOR CONCRETE DRIVEWAYS

- A. Provide 3/4-inch expansion joints conforming to ASTM D 1751 across driveway in line with street face of sidewalks, at existing concrete driveways, and along intersections with sidewalks and other structures. Extend expansion joint material full depth of slab.

### 3.10 JOINT SEALING

- A. Seal joints only when surface and joints are dry, ambient temperature is above 50 degrees F and less than 85 degrees F and weather is not foggy or rainy.
- B. Use joint sealing equipment in like new working condition throughout joint sealing operation, and be approved by Project Manager. Use concrete grooving machine or power-operated wire brush and other equipment such as plow, brooms, brushes, blowers or hydro or abrasive cleaning as required to produce satisfactory joints.

- C. Clean joints of loose scale, dirt, dust and curing compound. The term joint includes wide joint spaces, expansion joints, dummy groove joints or cracks, either preformed or natural. Remove loose material from concrete surfaces adjacent to joints.
- D. Fill joints neatly with joint sealer to depth shown. Pour sufficient joint sealer into joints so that, upon completion, surface of sealer within joint will be 1/4-inch above level of adjacent surface or at elevation as directed.

### 3.11 PROTECTION

- A. Maintain joints in good condition until completion of Work.
- B. Replace damaged joints material with new material as required by this Section.

END OF SECTION