

ITEM 360

CONCRETE PAVEMENT

360.1 Description. This item shall consist of a pavement of Portland cement concrete with reinforcement. The pavement shall be as shown on the drawings, and may or may not include monolithic curbs. The pavement includes driveways.

The pavement shall be constructed as herein specified on the prepared subgrade or other base course in conformity with the thickness and typical cross sections shown on the drawings, and to the lines and grades established by the Engineer. All materials shall be provided from an approved Texas Department of Transportation (TxDOT) supplier and it shall be the responsibility of the Contractor to provide certification that such approval has been met. In addition, other tests or approvals may be required at the discretion of the Engineer.

360.2 Materials. Harris County's standard mix design shall contain minimum five and one-half (5 ½) sacks (94 pounds per sack) of cementitious material per cubic yard and achieve a minimum compressive strength of 3,000 psi at 28 days, with the addition of fly ash, as necessary.

1) High Early Strength Concrete shall contain seven (7) sacks of Portland cement per cubic yard and may be produced from either Type I, Type II, or Type III Portland cement with other chemical admixtures.

2) Rapid Setting High Early Strength Concrete Mix also contains 7 sacks of Portland cement per cubic yard, with other chemical admixtures and it's applications are designed for early opening of the concrete road pavement to traffic within less than 24 hours after completing the pour and finish, and shall meet the approval of the Design Engineer.

An accelerating agent (Type C), conforming to ASTM C494, "Specification for Chemical Admixtures for Concrete" may be used. All chemical admixtures shall be used in accordance with the manufacturer's recommendations.

The use of fly ash is acceptable and when used, the mix design shall contain five and one-half (5½) sacks of cementitious material per cubic yard with a fly ash content of not more than 25% by weight, and will achieve a minimum compressive strength of 3,000 psi at 28 days. It is recommended that the percent of fly ash by weight be reduced to a maximum of 20% during cold weather concreting (average ambient temperature, over a 24-hour period after placement, less than 50°F). Fly ash shall be Class C or Class F, conforming to the requirements of ASTM C618, "Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete". Fly ash shall have a minimum combined Oxide content of 50% or 70% for Class C or Class F respectively. Do not use Class C fly ash in sulfate-resistant (Type II cement) concrete.

Concrete shall be composed of Portland cement, water, chemical admixtures and coarse and fine aggregates, as outlined below:

- A. Portland cement shall meet the requirements of ASTM C150, "Specification for Portland Cement". Unless otherwise permitted or required, cement shall be Type I, Type II, or Type III.
- B. Mixing water for concrete shall conform to the requirements of ASTM C94, "Specification for Ready-Mixed Concrete".
- C. Chemical admixtures shall conform to the following specifications:
  - 1. Air-entraining admixtures shall conform to the requirements of ASTM C260, "Specification for Air-Entraining Admixtures for Concrete".
  - 2. Chemical admixtures shall conform to the requirements of ASTM C494, "Specification for Chemical Admixtures for Concrete".
- D. Aggregates shall conform to ASTM C33, "Standard Specifications for Concrete Aggregates".

Coarse aggregate shall consist of durable particles of gravel, crushed stone, or combinations thereof, free from frozen material or injurious amounts of salt, alkali, vegetable matter, or other objectionable material either free or as an adherent coating, and its quality shall be reasonably uniform throughout. It shall contain not more than 0.25 percent by weight of clay lumps and not more than 1.0 percent by weight of laminated and/or friable particles. When tested by ASTM C136, "Sieve Analysis of Fine and Coarse Aggregates" and C117, "Mineral Aggregates by Washing", it shall meet the following grading requirements:

TABLE I  
COARSE AGGREGATE GRADATION

	% Retained by Wt.		
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%

The loss by decantation shall be a maximum of one percent (1%).

- E. Fine aggregate shall consist of clean, hard, durable and uncoated particles of natural or manufactured sand or a combination thereof, with or without mineral filler. It shall be free from frozen material, or injurious amounts of salt, alkali, vegetable matter or other objectionable material and it shall contain not more than 0.5

percent, by weight, of clay lumps. When subjected to the color test for organic impurities, ASTM C40 "Standard Test Method for Organic Impurities in Fine Aggregates for Concrete", the fine aggregate shall not show a color darker than the standard.

Unless otherwise specified, fine aggregate shall meet the following grading requirements:

TABLE II  
FINE AGGREGATE GRADATION

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%

Fine aggregate shall be subjected to ASTM D2419, "Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate". The sand equivalent shall be not less than 80.

Mineral filler shall consist of stone dust, clean crushed sand or other approved inert material.

Unless otherwise designated on the drawings, or herein, all bar reinforcement shall be deformed and shall conform to ASTM A615, "Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement", Grade 60, open hearth, basic oxygen or electric furnace new billet steel. The use of Grade 40 is permissible for bars that must be bent. The use of prefabricated deformed steel bar mats, conforming to ASTM A184, "Standard Specification for Fabricated Deformed Steel Bar Mats for Concrete Reinforcement", is not permitted.

Boards for expansion joint filler shall be 3/4-inch finished thickness. The material for the boards shall consist of Class A redwood or composite material as approved by the Engineer. The joint filler shall meet the requirements of ASTM D545, "Standard Test Methods for Preformed Expansion Joint Fillers for Concrete Construction (Non-Extruding and Resilient Types)" and ASTM D1751, "Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non-Extruding and Resilient Bituminous Types)." Joint sealant shall be Type II or III and shall meet the requirements of ASTM D6690, "Standard Specifications for Joint and Crack Sealants, Hot-Applied for Concrete and Asphalt Pavements." Joint sealant for expansion joints shall be installed one-quarter inch (1/4") below the top of pavement elevation. Prefabricated expansion joints may be used with approval by the Engineer.

Load transmission devices shall consist of an eighteen-inch (18") smooth dowel placed equidistance through the center of the expansion joint and a

locking device to hold the dowel parallel to the pavement grade and parallel to the longitudinal direction of the pavement.

The dowels shall be three-fourths inch (3/4") in diameter for a pavement thickness of six inches (6"). The dowels shall be one inch (1") in diameter for pavement thickness of seven inches (7") or eight inches (8"). The dowels shall be one and one-quarter inch (1 1/4") in diameter for pavement thickness of nine inches (9") or more. All dowels shall be smooth and may be sheared or saw cut to the desired length.

The locking device shall be steel plate type (flat or wing), or a synthetic type of sleeve with the locking device being an integral part of the sleeve. If a metal plate-locking device is used on the dowel, a plastic sleeve with a complete closed end must be placed over the dowel on one side of the expansion joint. The synthetic type of sleeve with locking device satisfies this requirement.

Tie bars are to be of the same diameter and spacing as the reinforcing steel being used in the pavement, and shall be thirty inches (30") minimum in length. Type III - adhesives meeting the requirements of TxDOT specification DMS-6100 "Epoxy and Adhesives" shall be used for installing drilled-in reinforcing steel and dowels, into the existing concrete pavements.

360.3 Storage of Materials. Cement shall be stored in well ventilated weathertight buildings, bins, or silos which shall exclude moisture and contaminants.

Aggregate stockpiles shall be arranged and used in such a manner as to avoid contamination, with other materials or with other sizes of like aggregates. To ensure that this condition is met, any test for determining conformance to requirements for cleanliness and grading shall be performed on samples secured in accordance with ASTM D75, "Practice for Sampling Aggregates". Frozen or partially frozen aggregates shall not be used. Unless otherwise authorized by the Engineer, all aggregate shall be stockpiled at least 24-hours prior to use, to reduce free moisture content.

Chemical admixtures shall be stored in such a manner as to avoid contamination, evaporation, or damage. For those used in the form of suspensions or non-stable solutions, agitating equipment shall be provided to assure thorough distribution of the ingredients. Liquid admixtures shall be protected from freezing and from temperature changes which would adversely affect their characteristics.

360.4 Proportioning of Concrete. Concrete for all parts of the work shall be of the specified quality, capable of being placed without excessive segregation and, when hardened, of developing all characteristics required by this item and the contract documents.

The specified compressive strength of the concrete, for each portion of the structure, shall be as designated in the contract documents. Strength requirements shall be based on the 28-day and 7-day compressive strength, respectively.

360.5 Concrete Classification. Concrete shall be classified as shown by Table No. 3.

TABLE 3 - Concrete Classification

Class	Nominal Coarse Aggregate	Cement Sacks Per C.Y.	Minimum 28-day Compressive Strength(f'c) (psi)	Minimum 7-day Compressive Strength(f'c) (psi)	Water – Cement Ratio, by Weight	
					Non-Air Conc. Max	Entr. Min. – Air Entr. Conc. Min. – Max
A <sub>1</sub>	1-1/2"	7	4,000	2,800	0.42 - 0.48	0.38 - 0.40
*A <sub>2</sub>	3/4"	7	4,000	2,800	0.48 - 0.55	0.43 – 0.49
B <sub>1</sub>	1-1/2"	6	3,500	2,400	0.49 - 0.56	0.44 – 0.52
*B <sub>2</sub>	3/4"	6	3,500	2,400	0.56 - 0.64	0.50 – 0.58
C <sub>1</sub>	1-1/2"	5.5	3,000	2,100	0.53 - 0.61	0.48 – 0.56
*C <sub>2</sub>	3/4"	5.5	3,000	2,100	0.61 - 0.70	0.54 - 0.63
D <sub>1</sub>	1-1/2"	5	2,500	1,750	0.59 - 0.67	0.53 – 0.62
*D <sub>2</sub>	3/4"	5	2,500	1,750	0.67 - 0.77	0.60 – 0.69

\*Other nominal maximum aggregate sizes will be allowed, based on the thickness of section or spacing of reinforcing bar, or other criteria, as approved by the Design Engineer.

360.6 Selection of Proportions. Proportions of materials for concrete shall be established to provide:

- A. Workability and consistency to permit concrete to be worked readily into forms and around reinforcement under conditions of placement to be employed without segregation or excessive bleeding.
- B. Strength requirements in accordance with Table 3.
- C. Resistance to special exposure as required by the Engineer and as specified in the contract documents or in Special Provisions.

Unless otherwise permitted, the concrete mix design shall be proportioned to provide a slump between 1 and 6 inches. A slump range of 1" to 3½" shall be used for concrete laid with a slip form paver, while vibrated concrete shall have a slump range of 2½" to 6", when tested in accordance with ASTM C143, "Standard Test Method for Slump of Hydraulic Cement Concrete". A slump test will be made for each sample of concrete obtained, or when slumps appear to be outside specification requirements. The Engineer may reject any concrete shown to be outside of these requirements.

The allowable air-content for moderate exposures is:

1-1/2" aggregate (No. 2) - 2.5 - 4.5 percent  
3/4" aggregate (No. 5) - 3.5 - 5.0 percent

All concrete pavement shall have a minimum design compressive strength of 3,000 psi at twenty-eight (28) days. A minimum of four (4) test cylinders shall be made for each one hundred and fifty (150) cubic yards, or portion thereof, placed each day. Samples shall be taken in accordance with ASTM C172, "Standard Practice for Sampling Freshly Mixed Concrete" and molded and cured in accordance with ASTM C31, "Standard Practice for Making and Curing Concrete Test Specimens in the Field".

All test specimens shall be prepared in accordance with ASTM C617, "Standard Practice for Capping Cylindrical Concrete Specimens" and tested in accordance with ASTM C39, "Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens". Two (2) specimens shall be tested at seven (7) days and two (2) specimens shall be tested at twenty-eight (28) days. The acceptance test results shall be the average of the two specimens tested for each age interval. If one specimen in a test age indicates evidence of improper sampling, handling, molding or testing, it shall be discarded and the strength of the remaining specimen shall be considered the test result. Should both specimens in a test interval show any of the aforementioned defects, the Engineer may request that cores be taken in the affected area.

Additional test specimens may be required due to concrete placing conditions and due to use of high strength concrete. No extra compensation shall be allowed for materials and work involved in fulfilling these requirements.

360.7 Equipment. All equipment necessary for the construction of concrete pavement shall be on the job and shall have been approved by the Engineer as to condition, before the Contractor will be permitted to begin construction operations on which the equipment is to be used.

A template or other approved method, for checking the contour of the subgrade shall be provided and operated by the Contractor. The template shall rest upon the side forms and shall be of such strength and rigidity that under a test made by changing the support to the center, it shall not show a deflection of more than one-half inch (1/2"). It shall be provided with accurately adjustable rods projecting downward to the subgrade at 1-foot intervals and these rods shall be adjusted to the required cross-section of the bottom of the slab, when the template is resting upon the side forms.

Side forms shall be of metal of approved cross section. The preferred depth of the form shall be equal to the required edge thickness of the pavement. Forms with depths greater or less than the required edge thickness of the pavement will be permitted, provided the difference between the form depth and the edge thickness is not greater than 1-inch, and further provided that forms of a depth, less than the pavement edge

are brought to the required edge thickness by securely attaching wood or metal strips, of approved section, to the bottom of the form, or by grouting under the form.

The length of form sections shall be not less than ten feet (10') 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 100-foot radius or less. Forms shall be of 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, the impact and vibration of the finishing machine. The forms shall be free from warp, bends or kinks and shall be sufficiently true to provide a reasonable straight edge on the concrete and the top of each form section, when tested with a straight edge, shall conform to the requirements specified for the surface of the completed pavement. Sufficient forms shall be provided for satisfactory prosecution of the work.

A minimum of two hand vibrators is required at the jobsite when placing concrete. A hand vibrator shall be used around all load transfer devices and intersections where screeds or slip form pavers cannot be operated.

Pavement shall be finished by machine, except as hereinafter provided. Placement shall be the Contractor's responsibility and shall be based upon equipment sequences utilized in accordance with the recommendations and practices of ACI 304R, "Guide for Measuring, Mixing, Transporting, and Placing Concrete", and with the approval of the Engineer.

The Contractor shall furnish and maintain at least two standard 10-foot steel or aluminum straight edges.

Where applicable, the Contractor shall furnish a sufficient number of bridges equipped to ride on the forms and span the pavement for finishing operations and for the installation and finishing of joints and center strips. All necessary finishing and edging tools shall be furnished as may be required to complete the pavement in accordance with the drawings.

- 360.8 Slip Form Paver. Slip form pavers are allowed by Harris County.
- 360.9 Subgrade and Forms. The subgrade shall be excavated as required, all unstable or otherwise objectionable material removed, and all holes, ruts, and depressions filled with approved material, as per Item 205 "Subgrade". Rolling and sprinkling shall be performed when, and to the extent directed, and the roadbed shall be completed to or above the drawings of the typical sections shown on plans and the lines and grades established by the Engineer. Material excavated in the preparation of the subgrade shall be utilized in the construction of adjacent shoulders and slopes, and any additional material required for the completion of the sections shall be secured from sources indicated on plans or designated by the Engineer. Drainage of the roadbed shall be maintained at all times.

The subgrade shall be finished to the exact section of the bottom of the pavement as shown on plans, and tested with the approved template operated and maintained by the Contractor. The subgrade shall be maintained in a smooth, compacted condition, in conformity with the required section and established grade until the pavement is placed, and shall be kept thoroughly wetted down sufficiently in advance of placing any pavement to insure its being in a firm and moist condition for at least 2 inches below the prepared surface. Sufficient subgrade shall always be prepared in advance to insure satisfactory prosecution of the work. No equipment or hauling shall be permitted on the prepared subgrade, except on special permission of the Engineer, which will be granted only in exceptional cases and only where a suitable protection in the form of two-ply timber mats or other approved material is provided.

The subgrade under the forms shall be firm and cut true to grade so that each form section when placed will be firmly in contact for its whole length and base width, and exactly at the established grade. Any subgrade under the forms below established grade shall be corrected, using suitable material, placed, sprinkled and rolled as directed. Forms shall be staked with at least three pins for each ten-foot section. A pin shall be placed at each side of every joint. Form sections shall be tightly joined and keyed to prevent relative displacement. Forms shall be cleaned and oiled each time they are used.

Forms shall be set for a sufficient distance in advance of the point where concrete is being placed to permit a finished and approved subgrade length of not less than 300 feet ahead of concrete placement, or as approved by the Engineer. Conformity of the grade and alignment of forms shall be checked immediately prior to placing concrete and all necessary corrections made by the Contractor. Where any form has been disturbed or any subgrade becomes unstable, the form shall be reset and rechecked. In exceptional cases, the Engineer may require suitable stakes driven to the grade of the bottom of the forms to afford additional support. Sufficient stability of forms to support the equipment operated thereon and to withstand its vibration without springing or settlement shall be required. If forms settle over one-eighth inch (1/8") under finishing operation, paving operations shall be stopped and the forms shall be reset to line and grade.

Forms shall remain in place for not less than 8 hours after the concrete has been placed. They shall be carefully removed in such a manner that little or no damage will be done to the edge of the pavement. Any damage resulting from this operation shall be immediately repaired. After the forms have been removed, the ends of all joints shall be cleaned, and any honeycombed areas pointed up with an approved mortar.

Immediately after pointing is complete, the form trench shall be filled with earth from the shoulders in such manner as to shed water from rainfall or curing away from the edge of the pavement. On completion of the required curing, the subgrade or shoulders adjacent to the pavement shall be placed in condition to maintain drainage.



360.10 Reinforcing Steel and Joint Assemblies. All reinforcing steel, tie bars and load transmission units used in accordance with plan provisions meeting the requirements of Item 440, "Reinforcing Steel", shall be accurately placed and secured in position in accordance with the details shown on drawings.

Reinforcing bars shall be secured on alternating intersections and splices. The tie bars shall be installed in required position by the method and device shown on drawings, or by approved method and device equivalent thereto. Bar coatings required by plans, and of material specified, shall be completed and the bars and coating shall be free of rust, dirt or other foreign matter at the time of installation in the concrete. Reinforcing bars shall be supported on bar chairs or other approved devices placed on maximum thirty-six inches (36") center each way, and placed so that the reinforcing bar is located at the centerline of the concrete.

Where plans require an assembly of parts at pavement joints, the assembly shall be completed, placed at required location and elevation, and all parts rigidly secured in required position by the method and devices shown on plans, or by approved method and devices equivalent thereto. Dowel bars shall be accurately installed in joint assemblies in accordance with drawings, each parallel to the pavement, and shall be rigidly secured in required position by such means (as shown on plans, or approved equivalent thereto) that will prevent their displacement during placing and finishing of the concrete. The assembled units comprising the load transmission devices shall be accurately installed in joint assemblies in accordance with plans, each unit vertical with its length perpendicular to the centerline of the pavement, and all units shall be rigidly secured in required position by such means (as shown on drawings, or approved equivalent thereof) that will prevent their displacement during placing and finishing of the concrete. Leader boards, joint filler and other material used for forming joints shall be accurately notched to receive each load transmission unit. All load transmission units shall be free of rust and clean when installed in the concrete.

360.11 Concrete Placing. Except by specific written authorization of the Engineer, concrete shall not be placed when the ambient temperature is below 40°F and falling. Concrete may be placed when the ambient temperature is above 35°F and rising, the ambient temperature being taken in the shade and away from artificial heat.

The Contractor shall have available a sufficient supply of approved cotton mats, polyethylene sheeting or other approved covering materials to immediately protect concrete if the air temperature falls to 32°F, or below, before concrete has been in place for less than four (4) hours. Such protection shall remain in place during the period the temperature continues below 32°F, or for a period of not more than five (5) days. Neither salt nor other chemical admixtures shall be added to the concrete to prevent freezing. The Contractor shall be responsible for the quality and strength of concrete under cold weather conditions and any concrete damaged by freezing shall be removed and replaced at the Contractor's expense.

The temperature of the concrete shall at no time exceed 100°F.

When the concrete reaches a temperature of 85°F, retarders shall be introduced into the mixture and shall continue to be used until the concrete reaches a temperature of 95°F.

After 95°F and through 100°F, a plasticizer shall be introduced into the mixture. After 95°F, ice may be used to control temperature, in lieu of a plasticizer.

For concrete between temperatures of 85°F through 95°F, the slump shall be as specified in Item 360. For concrete with temperatures greater than 95° F, slumps shall be as specified by the Engineer.

The amount of retarder or plasticizer, introduced into a mixture, shall be in accordance with the manufacturer's recommendations. See section 360.2, Materials, for requirements of admixtures.

No concrete shall be used if the concrete has developed initial set, or which is not in place within 1-1/2 hours after the initial water has been added.

Pouring concrete during inclement weather, which would adversely affect the quality and/or finish of the concrete pavement does not relieve the contractor from his responsibility to provide a pavement that complies with the specification.

360.12

Joints. All transverse and longitudinal joints in the pavement shall be of the type or the alternate type shown on the drawings, shall be constructed at required locations, on required alignment in the required relationship to tie bars and joint assemblies and in accordance with the details shown on the drawings.

Normally, the stoppage of the placement of concrete shall be scheduled to occur at proposed expansion joints, or at proposed longitudinal joints located between traffic lanes. If it becomes necessary to stop the placement of concrete at an unscheduled location due to unforeseen circumstances, the stoppage may occur at a proposed contraction joint, or at other locations with the approval of the Engineer. The following provisions shall govern for each type of joint at which the placing of concrete is stopped:

When the placing of concrete is stopped at any expansion joint, the complete jointed assembly shall be installed and rigidly secured in required position as shown on plans. A bulkhead of sufficient cross sectional areas to prevent deflection, to receive the load transmission units or dowels, as the case may be, and shaped accurately to the cross section of the pavement shall be provided and installed as a back-up for the joint filler and rigidly secured in required position to permit accurate finishing of the concrete up to the joint. After the concrete has been finished to the joint, formation of the joint seal space and finishing of the joint shall be executed as specified herein and in accordance with plan requirements. The back-up bulkhead shall remain in place until

immediately prior to the time when concrete placing is resumed, when it shall then carefully be removed in such manner that no element of the joint assembly will be disturbed. The exposed portions of the joint assembly shall be free of adherent concrete, dirt or other material at the time placing of concrete is resumed.

All contraction and longitudinal joints that are not at the edge or end of a pour shall be saw cut. Metal or fiber strips placed in the uncured concrete will not be permitted. Where sawed joints are permitted by the Engineer, they shall be sawed as soon as sawing can be accomplished, without damage to the pavement, and as directed by the Engineer. Once sawing has commenced, it shall be continued until completed. The saw cut shall be made with one pass of the concrete saw. Sawing must be accomplished even in rain or cold weather. All sawing must be completed within twenty-four hours of the concrete pavement placement. Should the sawing for any day's placement fail to be completed within forty-eight hours; the following concrete placement shall be limited to the amount that was sawed on time. The limitation shall continue until the sawing crew demonstrates it can handle a larger volume of sawing.

The sawed cut shall be a minimum of 1/4-inch width and have a depth of one-fourth the thickness of the pavement. After sawcutting, the joint shall be sealed with joint sealer, in accordance with the instructions supplied by the manufacturer of the joint sealant.

Unless otherwise specified, transverse sawed control joints shall be constructed at twenty-foot (20') intervals measured along the longitudinal axis of the roadway, or as directed by the Engineer.

When placing of concrete is stopped at a longitudinal joint, all applicable provisions of Section 360.7 shall apply in addition to the following requirements:

The face of the bulkhead at the joint shall be grooved or recessed as necessary to provide the required spaces for the top and bottom breaker strips as shown on plans. The bulkhead shall be either drilled or notched to receive the tie bars. Tie bars shall be secured in required position by use of adequate transverse bracing and vertical supports meeting the approval of the Engineer.

When placing of concrete is stopped at a contraction joint, all applicable provisions of Section 360.7 shall apply, in addition to the following requirements:

The face of the bulkhead adjoining the slab end shall be notched and grooved to fit the exposed half-screen of the joint assembly and shall be shaped to form the slab end at the center of joint as shown on plans. The half-width of joint seal-space may be formed by a strip of required section placed and removed in accordance with drawing requirements for construction of transverse contraction joints. The Contractor shall have available a bulkhead shaped to the section of the pavement, and of a

section to form a key not less than 1 inch in depth and 2 inches in height at the center of depth of the pavement. This bulkhead must be drilled to permit the continuation of all longitudinal reinforcing steel through the construction joint, and shall be of sufficient section and strength to prevent deflection.

Concrete shall be placed and finished to this bulkhead. Any concrete remaining on the subgrade ahead shall be removed and disposed of as directed. When placing of concrete is resumed before the concrete has set to the extent that the concrete will stand on removal of the bulkhead, the new concrete shall be rodded, and the key in the first concrete must be carefully preserved. An edge created by a construction joint of this type shall have a joint seal space and shall be sealed as required for construction joints.

Transverse expansion joints shall be formed perpendicular to the centerline and surface of the pavement, and shall be constructed in accordance with the sequence of operations shown on drawings. After the transverse finishing machine and before the longitudinal finishing machine has passed over the joint, the contractor shall test the joint filler for correctness of position and make any required adjustment in position of the filler, and shall install the joint seal space form in accordance with plans. After removal at the joint seal form as required by plans, the joint seal space above the joint filler shall be thoroughly cleaned and the concrete faces of the joint seal space shall be left true to line and section throughout the entire length of the joint. On completion of curing of the pavement, the joint sealing filler of the type specified shall be placed in accordance with drawings. The faces of the joint seal space shall be clean and surface dry at the time joint sealing filler is placed. On completion of the joint seal, the pavement adjacent to the joint shall be left free of joint sealing material.

- 360.13 Finishing. All finishing shall be in accordance with ACI 325.6R, "Texturing Concrete Pavements".

The Engineer shall approve the straight edge. The surface shall not vary from the straight edge by more than one-sixteenth inch (1/16") per foot from the nearest point of contact, and in no case shall the maximum ordinate from a ten-foot straight-edge to the pavement be greater than one-eighth inch (1/8"). Any high spots causing a departure from the straight edge in excess of that specified shall be ground down by the Contractor to meet the surface test requirements, when required by the Engineer.

- 360.14 Curing. The Contractor shall prevent surface drying of the pavement before application of curing system by means that may include water fogging, use of wind screens or the use of evaporation retardants. He shall provide for protection of freshly laid concrete against pitting and washing from rain, by having on the job at the time and place of pouring, sufficient canvas and/or waterproof covering material to protect all placed concrete.

- A. Liquid Membrane. Liquid membrane curing shall be used as per Item 526, "Membrane Curing".
- B. Additional Curing Methods. Other methods meeting the requirements of ACI 308R, "Standard Practice for Curing Concrete" must be submitted by the Contractor in writing prior to concrete placement and approved by the Engineer.

360.15

Protection of Pavement. The Contractor shall erect and maintain the barricades required by the plans, and such other barricades and approved devices as will exclude public traffic and traffic of his employees and agents from the newly placed pavement for the periods of time hereinafter prescribed. Portions of the roadway, or crossings of the roadbed required to be maintained open for use by traffic, shall not be obstructed by the above-required barricades. Crossings of the pavement required by plans, or by construction sequence, during the period prior to opening to traffic as herein specified, shall be provided with an adequate and substantial bridge, approved by the Engineer.

Cracked pavement shall be cored by Harris County any time after the 28-day cure time is complete. The location of these cores shall be selected by the Engineer. Pavement that has developed full depth cracks (greater than  $t/4$  inch depth, where  $t$  = thickness of pavement) may, at the County's option, be left in place and repaired by the epoxy injection method. Otherwise the cracked pavement shall be removed and replaced. There shall be no additional payment for repairs or replacement. Basis of removal for cracked pavement shall be determined by the engineer and the extent of this pavement removal shall be based on the crack pattern and number of cracks in each panel. If the cracks are wide spread (vertically or horizontally) or close to expansion joint or control joint, and over a large area of 12' wide panel, then entire panel shall be removed and replaced as determined by the Engineer.

Surface cracks  $t/4$  inches and less in depth may be repaired by the epoxy injection method at no cost to the County.

Prior to epoxy injection, the Contractor shall submit to the County for approval, the injection method to be used. The Contractor shall furnish a minimum of two-year warranty when utilizing the epoxy injection method.

New pavement sections shall be closed to all traffic, both PUBLIC and CONSTRUCTION, until the concrete has attained a compressive strength of twenty-seven hundred (2700) psi. If the Contractor or the County desires to open the new pavement section to traffic early, an additional set of test cylinders must be requested for an early test. If the early test indicates that the minimum compressive strength requirement has been met, and if all other requirements of this specification have been met, the pavement section can be opened to traffic. If the Contractor requests the early test, the Contractor will pay the cost. If the County requests the early test, the County will pay the cost. Such opening of a new pavement section, to PUBLIC or CONSTRUCTION traffic, shall in no manner relieve the Contractor from his responsibility of the work.

On those sections of pavement to be opened to PUBLIC traffic, the pavement shall be thoroughly cleaned, stable material shall be placed, graded, and compacted against the pavement edge or curb unless specified otherwise, joints shall be sealed and cured, and all required traffic control work shall be performed for the safety of the traffic.

The Engineer may require the opening of pavement to traffic prior to the minimum strength specified above under conditions of emergency, which in his opinion, require such action in the interest of the public. In no case shall the Engineer order opening of the pavement to traffic within less than 72 hours after the last concrete in the sections is placed unless an approved high strength concrete was used. The Contractor shall remove any curing mats, place earth against the pavement edges, and perform other work involved in providing for the safety of traffic as required by the Engineer in ordering emergency opening. Orders for emergency opening of the pavement to traffic will be issued by the Engineer in writing.

360.16 Backfilling behind curbs and in esplanades. The Contractor is required to backfill behind all curbs and within the esplanade, after completion of the paving operation. The backfill material shall be on-site material having the prior approval of the Engineer. No separate payment shall be made for backfilling behind curbs and in esplanades, but it shall be considered incidental to this item.

360.17 Deficient Pavement Thickness. It is the intent of this specification that the pavement be constructed in strict conformity with the thickness and typical sections shown on plans. Where any pavement is found not so constructed, the following rules relative to adjustment of payment for acceptable pavement and to replacement of faulty pavement shall govern.

The Engineer will check the thickness in accordance with the dimensions shown on the plans. The Engineer will perform 1 thickness test consisting of 1 reading at approximately the center of each alternate lane every 500 feet or fraction thereof. Core where directed in accordance with ASTM C-174, "Standard Test Method for Measuring Thickness of Concrete Elements Using Drilled Concrete Cores." Verify deficiencies of more than 0.2 inch from plan thickness and to determine the limits of deficiencies of more than 0.75 inch from plan thickness. Fill core holes using a concrete mixture and method approved by the Engineer.

**Thickness Deficiencies Greater than 0.2 inch.** When any depth test measured in accordance with ASTM C-174, is deficient by more than 0.2 inch from the plan thickness take an additional coring at that location to verify the measurement.

If the core is deficient by more than 0.2 inch but not more than 0.75 inch from the plan thickness, take 2 additional cores from the unit (500 foot length) at intervals of at least 150 feet and at locations selected by the Engineer, and determine the thickness of the unit for payment purposes by averaging the thickness of the 3 cores. (See Table for "Deficient Pavement Thickness price Adjustment Factor").

**Thickness Deficiencies Greater than 0.75 inch.** If a core is deficient by more than 0.75 inch, take additional cores at 10 foot intervals in each direction parallel to the boundary of the deficient area. The Engineer will evaluate any area of pavement found deficient in thickness by more than 0.75 inch. As directed, the Contractor shall remove and replace the deficient areas with concrete pavement of thickness shown on the plans, without additional compensation.

**Pavement Units for Payment Adjustment.** Limits for applying a payment adjustment for deficient pavement thickness from 0.20 inch to not more than 0.75 inch are 500 feet of pavement in each lane. Lane width will be shown on typical sections and pavement design standards.

For greater than 0.75 inch deficient thickness, the limits for requiring removal will be defined by coring as determined by the Engineer. The remaining portion of the unit determined to be less than 0.75 inch deficient will be subject to the payment adjustment based on the average core thickness at each end of the 10 foot interval investigation as determined by the Engineer.

Shoulders will be measured for thickness unless otherwise shown on the plans. Shoulders 6 feet wide or wider will be considered as lanes. Shoulders less than 6 feet wide will be considered part of the adjacent lane.

Limits for applying payment adjustment for deficient pavement thickness for ramps, widenings, acceleration and deceleration lanes, and other miscellaneous areas are 500 feet in length. Areas less than 500 feet in length will be individually evaluated for payment adjustment based on the plan area.

See Table for Deficient Pavement Thickness Price Adjustment Factor.

<b>Deficient Pavement Thickness Deficiency in Thickness Determined by Cores in Inches</b>	<b>Price Adjustment Factor Proportional Part Contract Price Allowed</b>
0.00 to 0.20	100 Percent
0.21 to 0.30	80 Percent
0.31 to 0.40	72 Percent
0.41 to 0.50	68 Percent
0.51 to 0.75	57 Percent
Over 0.75	Remove and Replace

Any area found deficient in thickness by more than 0.75 inch shall be removed and replaced, at the Contractor's entire expense, with concrete of the thickness shown on drawings.

No additional payment over the contract unit price will be made for any pavements of a thickness exceeding that required on drawings and planing of concrete pavement shall not be allowed.

- 360.18 Non-Conforming Concrete. Any concrete deemed non-conforming, which in the opinion of the Engineer is unsatisfactory, shall be removed and replaced at the expense of the Contractor.
- 360.19 Quality Assurance. The Testing Laboratory's representative will sample concrete delivered to the site in accordance with ASTM C172 and will mold four specimens for each 150 cubic yards. Each time a set of specimens is molded, the slump will be determined in accordance with ASTM C143 and the air content in accordance with ASTM C173, "Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method" or C231 "Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method". Concrete cores, if required, shall be tested in accordance with ASTM C174 (9 point procedure) and ASTM C39.
- 360.20 Measurement. Concrete pavement shall be measured by the square yard of the specified mix design and thickness of completed and accepted pavement. Rapid Setting High Early Strength Concrete shall be measured by the cubic yard, as approved by the engineer. Dowels, when required, shall be measured by each, as provided in the bid schedule.
- 360.21 Payment. The work performed and the materials furnished as prescribed by this item and measured as provided under "Measurement" shall be paid for at the unit price bid for "Concrete Pavement", or "Concrete Pavement, High Early Strength", as required, or the adjusted unit price for pavement of deficient thickness as provided under "Penalty for Deficient Pavement Thickness", which price shall be full compensation for shaping and fine grading the roadbed, including furnishing and applying all water required; for furnishing, loading and unloading, storing, handling all concrete ingredients, including all freight and royalty involved; for mixing, placing, finishing and curing all concrete; for furnishing all materials for and placing longitudinal, warping, expansion, sawed control and contraction joints, and load transmission units, and joint filler material in proper position; for coating steel bars where required by plans, for furnishing and placing all reinforcing steel; and for all manipulations, labor, equipment, appliances, tools, traffic provisions and incidentals necessary to complete the work.

Doweling into the existing concrete pavement shall be paid for at the unit price bid per each of the specified size, which price shall be full compensation for drilling holes in the existing concrete pavement, providing and installing dowels and epoxy grouting them where required by the plans.

There are line code(s), description(s) and unit(s) for this item.



NOTE: This Specification Requires other Standard Specifications

Item 205, Subgrade  
Item 440, Reinforcing Steel  
Item 526, Membrane Curing

END OF ITEM 360