SECTION 02805
CONCRETE PAVING

PART I: GENERAL

1.1 GENERAL REQUIREMENTS
- A. Portland cement concrete paving.

1.2 MEASUREMENT AND PAYMENT
- A. Unit Prices:
  1. Payment for concrete paving is on a 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 a square yard basis.
  3. Measurement for utility projects: Match actual pavement replaced but no greater than a maximum pavement replacement limits shown on the Drawings.
  4. Refer to Section 01270 – Measurement and Payment for unit price procedures.
- B. Stipulated Price (Lump Sum):
  1. If Contract is Stipulated Price Contract, payment for Work in this Section is included in Total Stipulated Price.

1.3 REFERENCES
- A. ASTM – American Standards for Testing and Materials.
  1. ASTM A82 – Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
  2. ASTM A185 – Standard Specifications for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement.
  3. ASTM A615 – Standard Specification for Deformed and Plain Billet – Steel Bars for Concrete Reinforcement.
  4. ASTM C31 – Standard Practice for Making and Curing Concrete Test Specimens in the Field.
  5. ASTM C33 – Standard Specifications for Concrete Aggregates.
  6. ASTM C39 – Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
  7. ASTM C40 – Standard Test Method for Organic Impurities in Fine Aggregates for Concrete.
  8. ASTM C42 – Standard Test Method of Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
  9. ASTM C94 – Standard Specification for Ready-Mixed Concrete.
  10. ASTM C131 – Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.

11. ASTM C136 – Standard Method for Sieve Analysis of Fine and Coarse Aggregates.
12. ASTM C138 – Standard Test Method for Unit Weight, Yield and Air Content (Gravimetric) of Concrete.
13. ASTM C143 – Standard Test Method for Slump of Hydraulic Cement Concrete.
14. ASTM C150 – Standard Specification for Portland Cement.
15. ASTM C174 – Standard Test Method for Measuring Thickness of Concrete Elements Using Drilled Concrete Cores.
16. ASTM C231 – Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
17. ASTM C260 – Standard Specification for Air-Entraining Admixtures for Concrete.
18. ASTM C494 – Standard Specification for Chemical Admixtures for Concrete.
19. ASTM C618 – Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for use as a Mineral Admixture in Portland Cement Concrete.

B. CFTS – City of Friendswood Technical Specifications.

C. TxDOT – Texas Department of Transportation.
   1. TxDOT Tex-203-F – Sand Equivalent Test.
   2. TxDOT Tex-406-A – Material Finer than 75 Fm (No. 200) Sieve In Mineral Aggregates (Decantation Test for Cement Aggregates).

1.4 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 the 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 A82. Provide specimens for testing when required by the Project Manager.

1.5 HANDLING AND STORAGE
A. Do not mix different classes of aggregate without written permission of the Project Manager.
B. Class of aggregate being used may be changed before or during the Work with written permission of The Project Manager. When new class of aggregate is being used, it shall comply with this Technical Specification and shall be verified by the Project Manager.
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.

1.6 DEFINITIONS

A. Batch – materials proportioned for concrete according to the APPROVED mix design and adjusted for moisture in aggregates. Batch targets shall be based on mixed design parameters, adjusted for moisture and stay within tolerance the Specifications for proportioning in accordance with ASTM C685.

B. Cracks – any split, rip or tear that penetrates the surface of the finished concrete. Crazing or "spider cracks" shall not be considered under this Section. The following are types of cracking with clear definitions and remedies which shall be followed:

1. Longitudinal Crack – cracks that mostly follow the centerline of the roadway. In a case where the line runs diagonal to the centerline, it shall be determined by using the rise/run method whether or not the crack is parallel to the centerline of the road way. Any crack that has a run greater than the rise (perpendicular to the centerline) shall be considered a longitudinal crack. If said crack proceeds beyond a construction or expansion joint, this shall be considered the same crack. All concrete that has longitudinal cracks shall be replaced with no exceptions, and new maintenance bond given to cover one year (1 Yr) from date of replacement of concrete.
2. Shrinkage Crack – cracks that are less than six hundredths inch (0.06 In) in width and no more than one-half inch (1/2 In) in depth shall be considered shrinkage cracks. No corrective action shall be required, but the length, width (at widest point) and depth (at widest point) shall be documented. At the one year (1 Yr) maintenance walkthrough, if any of these three (3) measurements have increased by ten percent (10%) or new shrinkage cracks have appeared in the same paving panel, corrective action shall be taken as approved by the Director of Engineering. An extended maintenance bond may be required.
3. Stress Crack – cracks that are more than six hundredths inch (0.06 In) but less than one-tenth inch (0.1 In) in width and of varying depths shall be considered stress cracks. These types of cracks are caused by tensile stress on concrete. Length, width and depth stress cracks shall be documented as described in 1.7.B.2 in this Section. Corrective action shall be taken as approved by the Director of Engineering. An extended maintenance bond may be required.
4. Structural Crack – cracks greater than one-tenth inch (0.1 In) in width, no matter what depth shall be considered structural cracks. These types of cracks are caused by severe tensile

stress on concrete and concrete failure. All concrete with structural cracks shall be replaced with no exceptions, and new maintenance bond given to cover one (1 Yr) year from date of replacement of concrete.

C. Joints:
   1. Control joint – shall either be a tooled or saw cut joint that shall control cracking of concrete paving. Control joints shall be spaced not greater than fifteen foot (15 Ft) intervals between expansion joints unless approved by the Project Manager.
   2. Construction joint – shall end a placement of concrete at the end of or at the centerline of a paving section. All construction joints shall use keyways to facilitate tie in to adjacent concrete placement.
   3. Expansion joint – shall end a paving panel or connect to existing pavement. Expansion joint shall use cedar wood material with a one inch (1 In) zip strip to allow for installation of sealant material. Dowels shall be imbedded as specified in the City of Friendswood Standard Detail Sheets. Expansion joints shall be placed not more than sixty feet (60 Ft) apart unless otherwise approved by the Project Manager.

D. Paving Panel – defined as concrete paving from one (1) expansion/construction joint to the next expansion/construction joint in length and edge of paving/construction joint to the next edge of paving/construction joint. There shall be no full width monolithic paving or paving from edge of pavement to edge of pavement, if the placement width exceeds fifteen feet (15 Ft), allowed at anytime.

PART II: PRODUCTS

2.1 MATERIALS

A. Portland Cement:
   1. Sample and test cement to verify compliance with Standards of ASTM C150, Type I or Type III.
   2. Bulk cement which meets referenced standards may be used when method of handling is approved by the Project Manager. When using bulk cement, provide satisfactory weighing devices.
   3. Fly ash which meets standards of ASTM C618 may be used as mineral fill when method of handling is approved by the Project Manager.

B. Water: Conform to requirements for water in ASTM C94.

C. Coarse Aggregate: Crushed stone, gravel or combination thereof, which is clean, hard and durable, conforms to requirements of ASTM C33 and has abrasion loss not more than forty-five percent (45%) by weight when subjected to Los Angeles Abrasion Test (ASTM C131).
   1. Maximum percentage by weight of deleterious substances shall not exceed values specified in TABLE 4.1 – DELETERIOUS

SUBSTANCES in this Section.

2. Conform coarse aggregate (size 1-1/2 inch to No. 4 sieve) to requirements of ASTM C33. Use gradation within limits specified in TABLE 4.2 – COARSE AGGREGATE SIEVE ANLAYSIS REQUIREMENTS when graded in accordance with ASTM C136.

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 C33. Use gradation within TABLE 4.3 – FINE AGGREGATE SIEVE ANALYSIS REQUIREMENTS in this Section, limits when graded in accordance with ASTM C136.

1. When subjected to color test for organic impurities (ASTM C40), 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 eighty (80), unless higher value is shown on the Drawings.

E. Mineral Filler: **FLY ASH CAN ONLY BE USED WHEN DESIGN MIX HAS BEEN SUBMITTED AND APPROVED BY THE DIRECTOR OF ENGINEERING.** Type “C” or Type “F” fly ash of acceptable quality and meeting requirements of ASTM C618 may be used as mineral admixture in concrete mixture. When fly ash mineral filler is used, store and inspect in accordance with ASTM C618. Do not use fly ash in amounts ion excess of twenty-five percent (25%) by weight of cementatious material in mix design. Cement content may be reduced when strength requirements can be met. Note: When fly ash is used, the term "cement" is defined as cement plus fly ash.

F. Air Entraining Agent: Furnish air entraining agent conforming to requirements of ASTM C260.

G. Water Reducer: Water reducing admixture conforming to requirements of ASTM C494 may be used when required to improve workability of concrete. Amount and type of admixture is subject to approval by the Project Manager.

H. Reinforcing Steel:

1. Provide new billet steel manufactured by open hearth process and conforming to ASTM A615, Grade 60. Store reinforcing 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 A82. Use fabric in which longitudinal and transverse wires have been electrically welded at points of intersection. Welds shall have sufficient strength to not be broken during handling or placing. Conform welding and fabrication of fabric sheets to ASTM A185.

4. Reinforcing Steel shall conform with Section 03200 – Reinforcing Steel.

2.2 EQUIPMENT

A. Conform Equipment to requirements of ASTM C94.

2.3 MIXING

A. Compressive strength shall be as specified using test specimens prepared in accordance with ASTM C31 and tested in accordance with ASTM C39. Determine and measure batch quantity of each ingredient, including water for batch designs and all concrete produced for the Work. Mix shall conform to these Technical Specifications and other requirements indicated on the Drawings.

B. Mix design to produce concrete which shall have compressive strength of two thousand seven hundred pounds per square inch (2700 psi) at seven days (7 D) and three thousand pounds per square inch (3000 psi) at twenty-eight days (28 D). Slump of concrete shall be at least three inches (3 In) but no more than five inches (5 In), when tested in accordance with ASTM C143.

1. Concrete pavement, including curb, curb and gutter and saw-tooth curb, shall contain at least five (5) sacks [ninety-four pounds (94 Lbs) per sack] of cement per cubic yard, with not more than six and one-half gallons (6-1/2 Gals) of water, net, per sack of cement (water-cement ratio maximum 0.57). Determine cement content in accordance with ASTM C138. Addition of mineral filler may be used to improve workability or plasticity of concrete to limits specified.
2. Coarse dry aggregate shall not exceed eighty-five percent (85%) 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 the Work, adjusted to produce concrete of required plasticity and workability. Percentage of air entrainment in mix shall be four percent (4%) plus or minus one and one-half percent (± 1-1/2%). Determine air content by testing in accordance with ASTM C231.
4. Use retardant when temperature exceeds ninety degrees Fahrenheit (90° 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 the Drawings. Design to meet following:

1. Concrete Mix: Compressive strength greater than or equal to three thousand pounds per square inch (3000 psi) at seventy-two hours (72 Hrs).

2. Cement: Minimum of seven (7) sacks of cement per cubic yard of concrete.
3. Water-Cement Ratio maximum of 0.45. Slump of concrete shall a maximum of five inches (5 In), when tested in accordance with ASTM C143.
4. Other requirements for proportioning, mixing, execution, testing, etc., shall be in accordance with this Section.

PART III: EXECUTION

3.1 EXAMINATION

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

3.2 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 shall not support loaded form. Replace and compact subgrade to required density.
C. After one inch (1 In) or more of consecutive rain, retest subgrade for compaction and moisture. Replace or, scarify and compact, to achieve required density.

3.3 EQUIPMENT

A. Alternate equipment and methods, other than those required by this Section, may be used provided equal or better results shall 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 the Drawings. Select planer mounted on visible rollers which ride on forms. Planer frame must have sufficient weight so that it shall remain on form and have strength and rigidity that, under tests made by changing support from wheels to center, planer shall not develop deflection of more than one-eighth inch (1/8 In). 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 one-eighth inch (1/8 In). Fit template with accurately adjustable rods projecting downward at one foot (1 Ft) 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 (2) 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 two feet (2 Ft) longer than width of pavement to be finished. Shape template to pavement section.
   2. Provide two (2) bridges to ride on forms and span pavement for finishing expansion and control joints. Provide floats and necessary edging and finishing tools.

E. Burlap Drag or transverse broom for Finishing Slab: Furnish four (4) plies of ten ounce (10 Oz) burlap material fastened to bridge to form continuous strip of burlap full width of pavement. Maintain contact of three foot (3 Ft) 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 Technical 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 the 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 the Drawings.

3.4 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 shall be permitted, provided difference between form depth and edge thickness is not greater than one inch (1 In), 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 the Project Manager. Length of form sections shall be not less than ten feet (10 Ft) and each section shall provide for staking in position with not less than three (3) pins. Flexible or curved forms of wood or metal of proper radius shall be used for curves of two hundred foot (200 Ft) radius or less. Forms shall have ample strength and shall be provided with adequate devices for secure setting so that when in-place they shall withstand, without visible springing or settlement, impact and vibration of finishing machine. In no case shall base width be less than eight inches (8 In) for form eight inches (8 In) 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 ten feet (10 Ft) 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 one-eighth inch (1/8 In) in ten feet (10 Ft) of length. Do not remove forms for at least eight hours (8 Hrs) after completion of finishing operations. Provide supply of forms that shall 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 the 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 seven days (7 D).

3.5 REINFORCING STEEL AND JOINT ASSEMBLIES

A. Place reinforcing steel and joint assemblies and position securely as indicated on the Drawings. Wire reinforcing bars securely together at ends and splices, remaining mat shall be fifty percent (50%) tied at intersections. 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 approved 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 the Drawings. In plane of steel parallel to nearest surface of concrete, bars shall not vary from plan placement by more than one-twelfth (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 one-quarter inch (1/4 In).

3.6 FIBROUS REINFORCING

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

3.7 PLACEMENT

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

B. Place concrete within ninety minutes (90 Min) after initial water had been added. Remove and dispose of concrete not placed within this period.

C. Concrete slump during placement shall be three inches (3 In) to five inches (5 In), except when using traveling-form paver which require slump shall be a maximum of three inches (3 In).

D. Deposit concrete continuously in successive batches. Distribute concrete in manner that shall 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 thirty minutes (30 Min), place transverse construction joint at stopping point. Remove and replace sections less than ten feet (10 Ft) 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 shall be cause for rejection of pavement sections.

3.8 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.

3.9 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 the Drawings. Move strike template forward in direction of placement, maintaining slight excess of material in front of cutting edge. Make a minimum of two (2) 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 (1st) 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 02840 – Concrete Pavement Joints.

3.11 CONCRETE CURING

A. Conform to requirements of Section 02835 – 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 ten foot (10 Ft) straightedge parallel to center of roadway to bridge depressions and touch high spots. Do not permit deviation measured from face of straight edge to surface of pavement to exceed one-sixteenth inch (1/16 In) per one foot (1 Ft) from nearest point of contact. Maximum deviation with ten foot (10 Ft) straightedge shall not exceed one-eighth inch (1/8 In). 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 Sections 01470 – Testing Laboratory Services and 01475 – Quality Control Testing Procedures

B. Compressive Strength Test Specimens: Make four (4) test specimens for compressive strength test in accordance with ASTM C31 for each one hundred cubic yards (100 Cy)or less of pavement that is placed in one (1) day. Test two (2) specimens at seven days (7 D), or at number of hours as directed by the Project Manager for high early strength concrete. Test remaining two (2) specimens at twenty-eight days (28 D). Test specimens in accordance with ASTM C39. Minimum compressive strength shall be at least two thousand seven hundred pounds per square inch (2700 psi) for first two (2) specimens tested at seven days (7 D) and three thousand pounds per square inch (3000 psi) for the second two (2) specimens tested at twenty-eight days (28 D).

C. When compressive test indicates failure, make yield test in accordance with ASTM C138 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 (1) – four inch (4 In) core shall be taken at random locations per one thousand square yards (1000 Sy) of pavement to measure in-place depth. Measure depth in accordance with ASTM C174. Each core may be tested for twenty-eight day (28 D)compressive strength according to methods of ASTM C42. Twenty-eight (28) day compressive strength of each core tested shall be a minimum of three thousand pounds per square inch (3000 psi).

E. Request, at option of the Project Manager, three (3) additional cores in vicinity of cores indicating the nonconforming in-place depths at no cost to the City. In-place depth at these locations shall be average depth of four (4) cores.

F. Fill cores and density test sections with new concrete paving or non shrink grout.

G. Alternative testing for depth may be performed using string line and

random testing of locations for depth before concrete is placed.

3.14 NONCONFORMING PAVEMENT

A. Remove and replace areas of pavement found deficient in thickness by more than ten percent (10%) or that fail compressive strength tests, with concrete of thickness and strength shown on the Drawings.

B. When measurement of any core is less than specified thickness by more than ten percent (10%), actual thickness of pavement in this area shall be determined by taking additional cores at ten foot (10 Ft) intervals parallel to centerline in each direction from deficient core until, in each direction, core is taken which is not deficient by more than ten percent (10%). Exploratory cores for deficient thickness shall 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 the City.

3.15 PAVEMENT MARKINGS

A. Restore pavement markings to match those existing in accordance with the City of Friendswood Technical Specifications and Standard Details and the Project Manager's requirements.

3.16 PROTECTION

A. Barricade pavement section to prevent use until concrete has attained a minimum design strength. Cure barricade pavement section for a minimum of seventy-two hours (72 Hrs) before use. Do not open pavement to light construction traffic until concrete is at least ten days (10 D) old. No heavy loads shall be placed on concrete before twenty-eight day (28 D) breaks have passed. Pavement may be open to traffic earlier provided the Contractor pays for testing and additional specimens once the seven day (7 D) specified strength is obtained. Pavement may be opened when high early strength concrete is used and meets the specified seventy-two hour (72 Hr) strength.

B. High early strength concrete may be used to provide access at driveways, street intersections, esplanades and other locations approved by the 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 the Work.

D. Maintain concrete paving in good condition until completion of the Work.

E. Repair defects by replacing concrete to full depth.

PART IV: TABLES

4.1 DELETERIOUS SUBSTANCES

ITEM	PERCENT BY WEIGHT OF TOTAL SAMPLE MAXIMUM
Clay lumps and friable particles	3.0
Material finer than 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 No. 200 sieve consists of dust of fracture, essentially free of clay or shale, then these limits may be increased to five percent (5%) and seven percent (7%) respectively.

4.2 COARSE AGGREGATE SIEVE ANLAYSIS REQUIREMENTS

SIEVE DESIGNATION (SQUARE OPENINGS)	PERCENTAGE BY WEIGHT
Retained on 1 ¾" sieve	0%
Retained on 1 ½" 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 No. 200 sieve is dust fracture essentially free from clay or shale as established by Part III of TxDOT Tex-406-A, percent may be increased to one and one-half percent (1.5%).

4.3 FINE AGGREGATE SIEVE ANLAYSIS REQUIREMENTS

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%

END OF SECTION