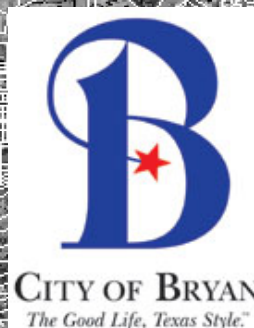




B/CS
Unified Technical
Specifications



Street
2012



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SECTION 31 23 00

EXCAVATION AND EMBANKMENT**PART 1 - GENERAL****1.1 DESCRIPTION**

- A. This Section includes providing all labor, materials, tools, and equipment necessary for excavation and embankment construction to the lines, grades and cross sections indicated in the Drawings or as directed by the ENGINEER.

1.2 MEASUREMENT AND PAYMENT

- A. This item will be measured by the cubic yard. Cubic yards will be measured by the difference between the surveyed original grades and the final grades. Measurements will include all authorized excavation below grade, which are not attributed to the Contractor's carelessness, in the opinion of the Engineer.
- B. The prices bid shall be full compensation for furnishing all materials, tools, equipment, pre- and post-grade surveys and incidentals necessary to complete the work. Payment will not be made for borrow material that is not suitable to use in embankments. Payment for unauthorized work will not be made.
- C. All work required for the disposal of waste, including haul, and for the salvage, utilization in the work and disposal of salvageable materials, will not be paid for directly but shall be considered a part of "Excavation and Embankment" and included in the unit price bid for this item. Payment will not be made for unauthorized work.

1.3 SUBMITTALS

- A. All material to be imported to the site shall be sampled at its original location and tested for acceptability. This testing shall be provided by the contractor at no expense to the owner.
- B. A list of all compaction equipment to be utilized shall be submitted for approval prior to equipment arriving on site.

PART 2 – PRODUCTS**2.1 MATERIALS****A. EXCAVATION**

- 1. All excavation shall be unclassified excavation, and shall consist of excavation and disposal of all materials, of whatever character, encountered in the WORK.

B. EMBANKMENT

- 1. Material shall consist of soil native to the work site, with or without stone or conglomerate, of a suitable quality to secure a well bonded course. Imported material shall consist of soil hauled to the work site for use in embankment operations.
- 2. Material for embankment shall be free of vegetation, wood, organic material, trash, bricks, broken concrete, piping, rubble, or other objectionable material. Material sources shall be selected to eliminate the introduction of hazardous materials into the work site.

C. SELECT MATERIAL

1. Material shall have a Plasticity Index between 4 and 20 and meet all other requirements of this specification.

2.2 TESTING REQUIREMENTS

- A. All embankment material placed shall be tested. Unless otherwise shown on the plans, material placed for the benefit of roadway construction shall be compacted as follows:
- B. Structural areas (roadways, slabs, sidewalks, detention pond berms, and all areas within 5 feet of any of these) shall be compacted to 95% of the maximum dry density as determined by the Standard Procter Density Test (ASTM D698) at a moisture content between optimum and +4% wet of optimum moisture content.
- C. Non-structural areas (as shown on plans) shall be compacted to 90% of the maximum dry density as computed by the Standard Procter Density Test (ASTM D698) at a moisture content between optimum and +4% wet of optimum moisture content.
- D. Tests shall be taken at a minimum of one test per every 4000 square feet of embankment per every 12” of depth. Additional tests shall be conducted at the engineer’s request. All tests meeting these requirements shall be paid for by the owner. The cost of all tests failing these requirements shall be deducted from payment for this item.

PART 3 – EXECUTION**3.1 EXCAVATION**

- A. All project excavation shall conform to the requirements of this specification. The completed roadway shall conform to the established alignment, grades and cross sections.
- B. Clearing and grubbing in excavation areas must be completed prior to beginning excavation operations.
- C. Topsoil shall be removed and stockpiled for reuse on the proposed surface. Topsoil in excess of what may be used on the finished surface shall be removed from the site by the contractor at no additional charge. Topsoil shall be assumed to be 6” deep, but shall be excavated deep enough to remove all roots and other organic material. Contractor shall first check with City to determine if the City would like to stockpile the topsoil.
- D. All suitable excavated materials shall be utilized, insofar as practicable, in constructing the required roadway sections or in uniformly widening embankments, flattening slopes, etc., as directed by the Engineer. Unsuitable roadway excavation and excavation in excess of that needed for construction shall be known as "Waste" and shall become the property of the Contractor to be disposed of at a location approved by the Engineer.
- E. If “Waste” material is to be placed on property owned by a third party, the City will need a letter from the third party stating acceptance of such fill. Fill will not be allowed in 100-year floodplain without approved permits.
- F. Waste areas shall be uniformly graded to drain, with the outer limits feathered to blend with the existing ground. Waste areas shall be seeded, capped with suitable material, or otherwise protected from long-term erosion.

- G. During construction, the roadbed and ditches shall be maintained in a condition to insure proper drainage at all times. Ditches and channels shall be constructed and maintained to avoid damage to the roadway section.
- H. Gravel or base material on all existing streets shall be salvaged and used to tie-in new construction with existing unpaved streets and gravel and flexible pavement driveways. Driveways will be adjusted to provide smooth connections to new construction and shall be restored to a condition equal to or better than that existing before work began. All salvageable asphalt, gravel or rock base material not used in the work shall remain the property of the city. Such unused materials, as designated by the Engineer, shall be hauled to the city stockpile or to other stockpile locations designated by the Engineer and closer to the project than the site above.

3.2 EMBANKMENT

- A. Prior to placing any embankment, all Clearing and Grubbing operations shall have been completed on the excavation sources and areas over which embankment is to be placed.
- B. Stump holes or other small excavations in the limits of the embankments shall be backfilled with suitable material and thoroughly compacted by approved methods before commencing embankment construction. The surface of the ground, including plowed loosened ground, or surface roughened by erosion or otherwise, shall be restored to approximately its original grade by blading or other methods. Where indicated on Plans or required by the Engineer, the ground surface thus prepared shall be compacted by sprinkling and rolling.
- C. Unless otherwise indicated on the Plans the surface of all unpaved areas, other than rock, which are to receive embankment shall be loosened by scarifying or plowing to a depth of not less than four (4) inches. The loosened material shall be re-compacted with the new embankment as hereinafter specified.
- D. Where indicated on Plans or directed by the Engineer, the surface of hillsides to receive embankment shall be loosened by scarifying or plowing to a depth of not less than four (4) inches, or cut into steps before embankment materials are placed. The embankment shall then be placed in layers, as hereinafter specified, beginning at the low side in part width layers and increasing the widths as the embankment is raised. The material which has been loosened shall be re-compacted simultaneously with the embankment material placed at the same elevation.
- E. Layers of embankment may be formed by utilizing equipment which will spread the material as it is dumped, or they may be formed by being spread by blading from piles or windrows dumped from excavating or hauling equipment in such amounts that material is evenly distributed.
- F. No material placed in the embankment by dumping in a pile or windrow shall be incorporated in a layer in that position. All such piles or windrows shall be moved by blading or similar methods. Clods or lumps of material shall be broken and the embankment material mixed by blading, harrowing, disking, or similar methods.
- G. Water required for sprinkling to bring the material to the moisture content necessary for maximum compaction shall be evenly applied. It shall be the responsibility of the Contractor to secure uniform moisture content throughout the layer by such methods as may be necessary. When water is required to achieve the required moisture content, the water must be from a source which does not contain any hazardous materials. Water removed from natural sources (ponds, lakes, rivers...) shall not impact any endangered species. Potable water sources shall be metered and paid by the contractor.

- H. Where embankments are to be placed adjacent to or over existing roadbeds, the roadbed slopes shall be plowed or scarified to a depth of not less than six (6) inches and the embankment built up in successive layers, as hereinafter specified, to the level of the old roadbed before its height is increased. Then, if directed, the top of the old roadbed shall be scarified and re-compacted with the next layers of the new embankment. The total depth of the scarified and added material shall not exceed the permissible depth of layer.
- I. Trees, stumps, roots, vegetation, or other unsuitable materials shall not be placed in embankment.
- J. Except as otherwise required by the Plans, all embankment shall be constructed in layers approximately parallel to the finished grade of the roadbed, unless otherwise specified, each layer shall be so constructed as to provide a uniform slope of 1/4 inch per foot from the center line of the roadbed to the outside. Super elevated curves will require that each layer shall be constructed to conform to the super elevation required by the governing standard.
- K. Embankments shall be constructed to the grade established by the Engineer and completed embankments shall correspond to the general shape of the typical sections shown on the Plans. Each section of the embankment shall correspond to the detailed section or slopes established by the Engineer. After completion of the roadway, it shall be continuously maintained to its finished section and grade until the project is accepted.

3.3 EARTH EMBANKMENTS

- A. Earth embankments shall be defined as those composed principally of material other than rock, and shall be constructed of accepted material from approved sources.
- B. Except as otherwise specified, earth embankments shall be constructed in successive layers for the full width of the individual roadway cross section and in such lengths as are best suited to the sprinkling and compaction methods utilized.
- C. Layers of embankment may be formed by utilizing equipment which will spread the material as it is dumped, or they may be formed by being spread by blading from piles or windrows dumped from excavating or hauling equipment in such amounts that material is evenly distributed.
- D. No material placed in the embankment by dumping in a pile or windrow shall be incorporated in a layer in that position. All such piles or windrows shall be moved by blading or similar methods. Clods or lumps of material shall be broken and the embankment material mixed by blading, harrowing, disking, or similar methods.
- E. Water required for sprinkling to bring the material to the moisture content necessary for maximum compaction shall be evenly applied. It shall be the responsibility of the Contractor to secure a uniform moisture content throughout the layer by such methods as may be necessary.
- F. All earth cuts, full or part width cuts in side hill which are not required to be excavated below sub-grade elevation for base and backfill, shall be scarified to a uniform depth of at least six (6) inches below grade. The material shall be mixed and reshaped by blading and then sprinkled and rolled in accordance with the requirements outlined above for earth embankments and to the same density as required for the adjacent embankment.

3.4 COMPACTION

- A. Each layer shall be compacted to the required density by suitable equipment.

- B. The depth of each layer, prior to compaction, shall not exceed that depth which will produce six (6) inch compacted thickness. Prior to and in connection with, the compaction operation each layer shall be brought to the moisture content necessary to obtain the required density and shall be kept leveled with suitable equipment to insure uniform compaction of the entire layer.
- C. For each layer of earth embankment and select material, it is the intent of this Specification to provide the density as required herein, unless otherwise shown on the Plans. Embankment soils shall be sprinkled as required and compacted to the extent necessary to provide not less than ninety-five (95) percent of the density as determined in accordance with Texas Highway Department Test Method Tex-113-E. Field density determinations will be made in accordance with approved methods.
- D. When the Contractor states that each layer of earth embankment or select material is complete and ready for the next layer, tests as necessary will be made by the Engineer. If the material fails to meet the density specified, the course shall be reworked as necessary to obtain the specified compaction, and the compaction method shall be altered on subsequent work to obtain specified density. Such procedure shall be determined by, and subject to, the approval of the Engineer.
- E. Should the sub-grade, due to any reason or cause, lose the required stability, density, or finish before the pavement structure is placed, it shall be re-compacted and refinished at the sole expense of the Contractor. Excessive loss of moisture in the sub-grade shall be prevented by sprinkling, sealing or covering with a subsequent layer of granular material. Excessive loss of moisture shall be construed to exist when the sub-grade soil moisture content is more than four (4) percent below the optimum for the density specified.
- F. In addition to the requirements in the Roadway Excavation item of the Specifications covering the general selection and utilization of materials to improve the roadbed, embankments shall be constructed in proper sequence to receive the select material layers shown on Plans, with such modifications as may be directed by the Engineer. The layer of embankment immediately preceding the upper layer of select material shall be constructed to the proper section and grade within a tolerance of not more than 0.10 foot from the established section and grade when properly compacted and finished to receive the select material layer.

3.5 PROOF ROLLING

- A. Prior to the placement of any material on native earth, the area shall be proof rolled. The native soil shall be rolled with sufficient intensity to bring out weak spots in the sub-grade which would otherwise fail during the construction process. The proof rolling shall be completed with equipment weighing at least 20 tons with tire pressures at least 50 and no more than 150 psi. A minimum of two coverage's of the proof roller will be required each succeeding trip of the proof roller shall be offset by not greater than one tire width. Rollers shall be operated at speed between 2 and 6 miles per hour. Areas failing this test shall be excavated to a depth not to exceed two feet and horizontally ten feet beyond the failed area in all directions. Earth removed from this area may be replaced, stabilized, or "dried out" at the discretion of the engineer. No additional payment will be made for proof rolling prior to placement of embankment.

END OF SECTION

SECTION 31 23 23
SELECTED BORROW

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This item shall consist of furnishing, hauling, spreading and compacting selected borrow on the roadway to bring the roadbed up to proper grade.

1.2 MEASUREMENT AND PAYMENT

- A. Work and accepted material as prescribed for this item will be measured by the cubic yard of material in vehicles as delivered on the road.
- B. Payment for selected borrow will be made by the cubic yard, as measured under measurement. Payment shall be for full compensation of securing, hauling, spreading, mixing and compacting

1.3 SUBMITTALS

- A. Atterberg Limits
- B. Sieve Analysis

PART 2 – PRODUCTS

2.1 MATERIALS

- A. The material shall consist of soil, with or without stone or conglomerate, and of a suitable quality to secure a well bonded course. It shall be free of vegetation or other objectionable material and shall have a maximum Plasticity Index of 20 as determined by Texas Highway Department Test Method Tex-106-E.

2.2 TESTING REQUIREMENTS

- A. When necessary or as directed by the City Engineer samples of the borrow material shall be collected and tested for Atterberg Limits. In addition a Sieve Analysis shall be performed.

PART 3 – EXECUTION

3.1 GENERAL

- A. The material shall be delivered in approved vehicles of uniform capacity, and it shall be the responsibility of the Contractor to deliver the material at the proper location. The material shall be spread by the use of blades, drags, or other suitable equipment.
- B. If the material is not well mixed or contains oversized material, it shall be thoroughly mixed. After spreading, all oversized material shall be broken by raking, blading, disking, harrowing, scarifying, or other approved methods.

- C. Borrow placed in the roadbed for the purpose of bringing the roadbed to proper grade subsequent to lime stabilization, will be mixed with the existing material to form a subgrade of uniform material at proper grade.
- D. Borrow used for constructing or widening embankment will be sprinkled if necessary and compacted according to SECTION 31 23 00 – EXCAVATION AND EMBANKMENT.

END OF SECTION

SECTION 32 01 13.61

**SLURRY SEAL
(Latex Modified-MicroSurfacing)****PART 1 - GENERAL****1.1 DESCRIPTION**

- A. This item shall consist of a micro-surfacing system which shall be a mixture of cationic modified asphalt emulsion, mineral aggregate, mineral filler, water and other additives mixed and spread on the paved surface in accordance with these specifications and to the dimensions as shown on the plans.

1.2 MEASUREMENT AND PAYMENT

- A. Slurry Seal (Latex Modified) will be measured by the ton of 2,000 pounds of the composite "Slurry Seal (Latex Modified)" of the grade actually used in the completed and accepted work in accordance with the plans and specifications for the project. The composite Slurry Seal (Latex Modified) mixture is hereby defined as the asphalt, aggregate and additives.
- B. All material shall be weighed on certified public scales or the contractor shall place a set of standard platform truck scales at a location approved by the Engineer. Scales shall conform to the requirements of the Item, "Weighing and Measurement Equipment."
- C. The work performed and materials furnished as prescribed by this item and measured as provided under "Measurement" will be paid for at the unit price bid for "Slurry Seal (Latex Modified)," of the grade specified, which price shall be full compensation for furnishing all materials and performing all operations necessary to complete the work.

1.3 WEATHER LIMITATIONS

- A. The material shall be spread only when the atmospheric temperature is at least fifty (50) degrees Fahrenheit and rising and the weather is not foggy or rainy.

1.4 STOCKPILING AND STORAGE

- A. AGGREGATE STORAGE: If the mineral aggregates are stored or stockpiled, they shall be handled in such a manner as to prevent segregation, mixing of the various materials or sizes, and contamination with foreign materials. The grading of aggregates proposed for use and as supplied to the mixing plant shall be uniform. Suitable equipment of acceptable size shall be furnished by the contractor to work the stockpiles and prevent segregation of the aggregates.
- B. STORAGE AND HEATING OF ASPHALTIC MATERIALS: The asphaltic material storage shall be ample to meet the requirements of the plant. CSS-1P asphalt emulsion shall not be heated to a temperature in excess of that specified for Grade CSS-H. All equipment used in the storage and handling of asphaltic material shall be kept in a clean condition at all times and shall be operated in such manner that there will be no contamination with foreign matter.

PART 2 – PRODUCTS

2.1 ASPHALTIC MATERIALS

- A. The asphalt emulsion used shall be a cationic slow setting type, designated as CSS-1P. The emulsion shall be modified with an approved polymer. The distillation residue of the modified emulsion shall contain a minimum of 2.0 percent rubber solids by weight, as determined by an analytical method approved by the weight, as determined by an analytical method approved by the Department. The emulsion supplier shall furnish the Department samples of the base asphalt and polymer used in the finished emulsion.
- B. The modified emulsified asphalt shall be so formulated that when the paving mixture is applied with the relative humidity at not more than 50% and ambient air temperature of at least 75°F, it will cure sufficiently that rolling traffic can be allowed in one hour with no damage to the surface.

In addition, the emulsion shall comply with the following requirements:

	<u>MIN.</u>	<u>MAX.</u>
Viscosity, Saybolt Furol at 77 F. Sec.	20	10
Storage Stability test, one day, percent	-	1
Particle charge test	Positive	
Sieve test, percent	-	0.1
*Distillation:		
Oil distillate, by volume of emulsion, percent	-	1/2
Residue, percent	60	-
Tests on Residue from Distillation:		
Penetration, 77 F., 100 g, 5 seconds	55	90
Ductility, 77 F., 5 cm/min, cm	70	-
Solubility in trichlorethylene, percent	97	-

*The standard distillation procedure shall be modified as follows:

- C. The temperature on the lower thermometer shall be brought slowly to 350°F, plus or minus 10°F, and maintained at this point for 20 minutes. Complete the total distillation in 60 minutes, plus or minus 5 minutes, from the first application of heat.

2.2 MINERAL AGGREGATE

- A. DESCRIPTION: The mineral aggregate used shall be of the type and grade specified for micro-surfacing. The aggregate shall be manufactured crushed stone such as granite, slag, limestone, chat or other high quality aggregate or combination thereof. A sand equivalent of 65 or higher is required. The aggregate shall have a weighted loss of not more than 25% when subjected to the four-cycle soundness test using magnesium sulfate in accordance with ASTM C88.

The aggregate shall have a resistance to abrasion resulting in a maximum loss of 35% when tested to ASTM C131.

- B. **GRADES:** When tested by Test Method Tex-200-F, Part I, the gradation requirements shall be as follows:

GRADE 2 (Coarse Graded Surface Course)	Percentage Aggregate By Weight
Passing 1/2" sieve	100
Passing 3/8" sieve	99-100
Passing No. 4 sieve	86-94
Passing No. 8 sieve	45-65
Passing No. 16 sieve	25-46
Passing No. 30 sieve	15-35
Passing No. 50 sieve	10-25
Passing No. 200 sieve	05-15

- C. **MINERAL FILLER:** Mineral filler shall be non-air-entrained Portland cement which is free of lumps or foreign matter.

2.3 WATER

The water shall be potable and shall be free of harmful soluble salts.

2.4 OTHER ADDITIVES

Additives supplied by the emulsion manufacturer may be added to the emulsion mix or to any of the component materials to provide control of the set time in the field.

2.5 PAVING MIXTURE

- A. **MIX DESIGN:** Before work commences, the Contractor shall submit a signed mix design covering the specific materials to be used on the project. This design shall be performed by a qualified laboratory. Once the materials are approved, no substitution will be permitted, unless first tested and approved by the laboratory preparing the mix design.

The qualified laboratory shall develop the job mix design and present certified test results for the Engineer's approval. Compatibility of the aggregate and modified CSS-1H shall be verified by the mix design. The job mix formula shall provide a minimum Marshall stability of 1,800 pounds and a flow of 6 to 16 units when tested according to the modified ASTM 1559 or AASHTO 2450 procedure. All component materials used in the mix design shall be representative of the material proposed by the Contractor for use on the project.

- B. **COMPOSITION OF MIXTURE:** The Engineer shall approve the design mix and all micro-surfacing materials and methods prior to use and shall designate the proportions to be used within the following limits.

- Residual Asphalt - 6 to 9 percent by weight of dry aggregate or 13.5 to 23 percent by volume of the aggregate
- Mineral Filler - 1.5% to 3.0% by dry weight of aggregate
- Modifier - As required to provide the specified properties (Minimum of 2.0% solids based on bitumen weight content)
- Water - As required to provide proper consistency

C. **TYPE** : The paving mixture shall consist of a uniform mixture of coarse aggregate, fine aggregate and asphaltic material. Mineral filler, and/or additives may also be required.

The mixture shall be designed so that the mineral aggregate will produce a gradation which conforms to the limitations for the master grading for the type specified herein. The gradation will be determined in accordance with ASTM C136 (Dry Sieve Analysis) and shall be based upon aggregate only. The amount of asphaltic material shall conform to the limitation for the type specified.

D. **TOLERANCE**: The aggregate portion of the paving mixture produced shall not vary from the design gradation by more than the tolerances which follow. The material passing the No. 200 sieve is further restricted to conform to the limitations for the master grading for the type specified. The asphaltic material portion of the paving mixture shall not vary from the design amount by more than the allowed tolerance and is also restricted to conform to the master limits.

	Percent by Weight or Volume as Applicable
Passing 3/8" sieve, retained on No. 4 sieve	Plus or minus 5
Passing No. 4 sieve, retained on No. 8 sieve	Plus or minus 5
Total retained on No. 8 sieve	Plus or minus 5
Passing No. 8 sieve, retained on No. 16 sieve	Plus or minus 3
Passing No. 16 sieve, retained on No. 30 sieve	Plus or minus 3
Passing No. 30 sieve, retained on No. 50 sieve	Plus or minus 3
Passing No. 50 sieve, retained on No. 200 sieve	Plus or minus 3
Passing No. 200 sieve	Plus or minus 2
Asphaltic Material	Plus or minus 0.5 by wt. or 1.2 by vol.

2.6 EQUIPMENT

A. All equipment for the handling of all materials and mixing and placing of the mixture shall be maintained in good repair and operating condition and subject to the approval of the Engineer. Any equipment found to be defective and potentially affecting the quality of the paving mixture will be replaced.

- B. The material shall be mixed by a self-propelled micro-surfacing mixing machine which shall be a continuous flow mixing unit able to accurately deliver and proportion the aggregate, emulsified asphalt, mineral filler and water to a revolving multi-blade mixer and discharge the mixed product on a continuous flow basis. The machine shall have sufficient storage capacity for aggregate, emulsified asphalt, mineral filler and water to maintain an adequate supply to the proportioning controls. Self-loading devices which provide for the loading of all materials while continuing to lay micro-surfacing, thereby minimizing construction joints, may be used. Other methods may also be used by the Contractor if requested in writing and approved by the Engineer.
- C. Individual volume or weight controls for proportioning each material to be added to the mix shall be provided. Each material control device shall be calibrated and properly marked.
- D. The aggregate feed to the mixer shall be equipped with a revolution counter or similar device so the amount of aggregate used may be determined at any time.
- E. The emulsion pump shall be a positive displacement type and shall be equipped with a revolution counter or similar device so that the amount of emulsion used may be determined at any time.
- F. The mixing machine shall be equipped with a water pressure system and nozzle type spray bar to provide a water spray immediately ahead of and outside the spreader box. Other methods for accomplishing this task will be considered if requested in writing to the Engineer.
- G. The mixing machine shall be equipped with an approved fines feeder that shall provide a uniform, positive, accurately metered, predetermined amount of the specified mineral filler.

PART 3 – EXECUTION

3.1 CONSTRUCTION:

- A. **GENERAL:** It shall be the responsibility of the Contractor to produce, transport, and place the specified paving mixture in accordance with these specifications and as approved by the Engineer.
- B. **SURFACE PREPARATION:** The area to be sealed shall be thoroughly cleaned of all vegetation, loose aggregate and soil. Water used in pre-wetting the surface ahead of and outside the spreader box shall be applied at a rate to dampen the entire surface without any free flowing water ahead of the spreader box.
- C. **SPREADING EQUIPMENT:** The paving mixture shall be spread uniformly by means of a mechanical type squeegee box attached to the mixer, equipped with paddles to agitate and spread the materials throughout the box. A front seal shall be provided to ensure no loss of the mixture at the road contact surface. The rear seal shall act as a final strike-off and shall be adjustable. The mixture shall be spread to fill cracks and minor surface irregularities and leave a uniform skid resistant application of aggregate and asphalt on the surface. The spreader box and rear strike-off shall be so designed and operated that a uniform consistency is achieved to produce a free flow of material to the rear strike-off. The seam where two spreads join shall be neat appearing and uniform.

- D. WORKMANSHIP: No excessive buildup, uncovered areas or unsightly appearance will be permitted on longitudinal or transverse joints.
1. Longitudinal joints shall be placed on lane lines. Excessive overlap will not be permitted. Care shall be taken to ensure straight lines along the roadway centerline, lane lines, and shoulder or curb lines. Lines at intersections will be kept straight to provide a good appearance.
 2. Care shall be exercised in areas that require handwork so that the finished surface is uniform in texture, dense and of overall good appearance comparable to that produced by the spreader box.
- E. RATE OF APPLICATION: The Slurry Seal (Latex Modified) mixture shall be applied at an application rate to achieve a coverage of 20 to 25 lbs. per square yard base on dry aggregate weight.

END OF SECTION

SECTION 32 01 13.63

SINGLE COURSE BITUMINOUS SLURRY

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The work covered by this specification includes the design, testing, construction, and quality control required for the proper application of an emulsified asphalt slurry seal surface (slurry seal).
- B. The slurry seal shall consist of a mixture of an approved emulsified asphalt, mineral aggregate, water and specified additives, proportioned, mixed and uniformly spread over a properly prepared surface as directed by the Owner. The completed slurry seal shall leave a homogeneous mat, adhere firmly to the prepared surface, and have a skid resistant surface texture.

1.2 MEASUREMENT AND PAYMENT

- A. The slurry seal will be measured and paid for at the contract unit price per square yard, complete in place.

1.3 LIMITATIONS

- A. WEATHER: The slurry seal shall not be applied if either the pavement or air temperature is below 55 degrees F (15 degrees C) and falling, but may be applied when both pavement and air temperature are above 45 degrees F (7 degrees C) and rising. No slurry seal shall be applied when there is danger the finished product will freeze before 24 hours. The mixture shall not be applied when weather conditions prolong opening to traffic beyond a reasonable time.
- B. OTHER: No slurry seal shall be applied before 8 A.M., and must be able to support traffic by 5 P.M. Weekend work is discouraged unless conditions warrant and is approved by the Engineer.

PART 2 – PRODUCTS

2.1 GENERAL

- A. The following specifications and test methods form a part of this specification.

AASHTO - American Association of State Highway and Transportation Officials.
 ASTM - American Society for Testing and Materials
 ISSA - International Slurry Seal Association

2.2 AGGREGATE AND MINERAL FILLER

AASHTO T2	ASTM D75	-	Sampling Mineral Aggregates
AASHTO T2	ASTM C136	-	Sieve Analysis of Aggregates
AASHTO T11	ASTM C117	-	Materials Finer than No. 200 in Mineral Aggregate

AASHTO T176	ASTM D2419 -	Sand Equivalent Value of Soils and Fine Aggregate
AASHTO T84	ASTM C128 -	Specific Gravity and Absorption of Fine Aggregate
AASHTO T19	ASTM C29 -	Unit Weight of Aggregate
AASHTO T96	ASTM C131 -	Resistance of Abrasion of Small Size Coarse Aggregate by use of the Los Angeles Machine
AASHTO T127	ASTM C183 -	Sampling Hydraulic Cement
AASHTO T37	ASTM D546 -	Sieve Analysis of Mineral Filler
AASHTO T104	ASTM C88 -	Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulphate
	ASTM D242 -	Mineral Filler for Bituminous Paving Mixtures

2.3 EMULSIFIED ASPHALT

AASHTO T40	ASTM D140 -	Sampling Bituminous Materials
AASHTO M140	ASTM D977 -	Specification for Emulsified Asphalt
AASHTO M208	ASTM D2397 -	Specification for Cationic Emulsified Asphalt
	ISSA T102 -	Mixing, Setting and Water Resistance Test to Identify "Quick-Set" Emulsified Asphalts

2.4 SLURRY SEAL

ISSA T101	-	Guide to Sampling Slurry Mix for Extraction Test
ISSA T106	-	Measurement of Slurry Seal Consistency
ISSA T111	-	Outline Guide Design Procedure for Slurry Seal
ISSA T114	-	Wet Stripping Test for Cured Slurry Seal Mixes
ISSA T115	-	Determination of Slurry Seal Compatibility
ASTM D3910	-	Design, Testing and Construction of Slurry Seal
ASTM D2172	-	Quantitative Extraction of Bitumen for Bituminous Paving Mixtures
ISSA T139	-	Test Method to Classify Emulsified Asphalt/Aggregate Mixture Systems by Modified Cohesive Tester Measurement of Set and Cure Characteristics

2.5 EMULSIFIED ASPHALT

The emulsified asphalt shall conform to CQS-1h or CSS-1h as specified in AASHTO M208. The cement mixing test is waived.

2.6 AGGREGATE

- A. GENERAL - The mineral aggregate shall consist of natural or manufactured crushed stone such as granite, slag, limestone, or other high quality aggregates or a combination thereof. Smooth textured sands of less than 1.25% water absorption shall not exceed 50% of the total aggregate blend.
- B. QUALITY TESTS - When tested according to the following tests normal aggregates shall meet the following requirements:

TEST	QUALITY	SPEC
AASHTO T170 or ASTM 2149	Cleanness	55 min.
AASHTO T104 or ASTM C88	Soundness	15% max. using NA ₂ SO ₄ or 20% max. using Mg SO ₄
AASHTO T96 or ASTM C131	Hardness	35% max.

- C. GRADING - When tested by AASHTO T27, ASTM C136 and ASTM C117, the aggregate (including mineral filler) shall meet the following gradation:

SIEVE SIZE	TYPE II PERCENT PASSING
3/8	100
No. 4	90-100
No. 8	65-90
No. 16	45-70
No. 30	30-50
No. 50	18-30
No. 100	10-21
No. 200	5-15

2.7 MINERAL FILLER

Portland Cement, hydrated lime, limestone dust, fly ash or other approved filler meeting the requirements of ASTM D242 shall be used if required by the mix design. They shall be considered as part of the dry aggregate.

2.8 WATER

All water shall be potable and compatible with the slurry mix. Compatibility must be insured by the Contractor.

2.9 ADDITIVES

Additives may be used to accelerate or retard the break-set of the slurry seal, or improve the resulting finished surface. The use of additives in the slurry mix (or individual materials) shall be made initially in quantities predetermined by the mix design with field adjustments if required, after approval by the Owner.

2.10 EQUIPMENT

- A. GENERAL - All equipment, tools and machines used in the performance of this work shall be maintained in satisfactory working order at all times.
- B. SLURRY MIXING EQUIPMENT - The slurry seal mixing equipment shall be a continuous flow mixing unit, either an individual unit that returns to the stockpile for reloading or a continuous run unit that is resupplied on the job. All units must have suitable means of accurately metering each individual material being fed into the mixer. All feeding mechanisms must be continuous feed and proportioning must remain constant at all times. The units shall be equipped with approved devices so that the machine can be accurately calibrated, and the quantities of materials used during any one period can be estimated. In the event these metering devices stop working, the slurry unit(s) will stop the application process until they are fixed.

The mixer shall thoroughly blend all materials to form a homogeneous mass before leaving the mixer.

- C. SLURRY SPREADING EQUIPMENT - The spreader box shall be equipped to prevent loss of slurry seal from all sides and with a flexible rear strike-off. It shall be capable of producing a uniform surface its full width. It shall have suitable means for side tracking to compensate for deviations in pavement geometry. Any type drag used shall be approved by the Owner and kept in a completely flexible condition at all times. The box shall be kept clean and build-up of asphalt and aggregate shall not be permitted.
- D. AUXILIARY EQUIPMENT - Suitable crack and surface cleaning equipment, barricading equipment, hand tools and any support equipment should be provided as necessary to perform the work.

2.11 MACHINE CALIBRATION AND VERIFICATION

- A. CALIBRATION - Each slurry mixing unit to be used in performance of the work shall be calibrated in the presence of the Owner prior to construction. No machine will be allowed to work on the project until the calibration has been completed and/or accepted.
- B. VERIFICATION - Test strips will be made by each machine after calibration and prior to construction. Test strips shall be a portion of the project. Samples of the slurry seal will be taken and verification made as to mix consistency and proportioning. Verification of rate of application will also be made. Upon failure to any of the tests, additional tests strips, at no cost to the Owner, will be required until each unit is authorized to work. Any unit failing to pass the tests after the third trial will not be permitted to work on the project. Test strips must be accepted or rejected within 24 hours after application.

PART 3 – EXECUTION**3.1 EXAMINATION/QUALITY CONTROL**

- A. **MATERIALS** - The Contractor will permit the Owner to take samples of the aggregate and asphalt and asphalt emulsion used in the project at the Owner's discretion. Gradation and sand equivalent tests may be run on the aggregate and residual asphalt content tests on the emulsion. Test results will be compared to specifications. Tests will be run at the expense of the Owner. The Owner must notify the Contractor immediately if any test fails to meet the specifications.
- B. **SLURRY SEAL** - Samples of the slurry seal will be taken directly from the slurry units(s). Consistency and residual asphalt content tests may be made on the samples and compared to the specifications. Tests will be run at the expense of the Owner. The Owner must notify the Contractor immediately if any test fails to meet specifications.

The Owner may use the recorders and measuring facilities of the slurry seal unit to determine application rates, asphalt emulsion content, mineral filler and additives(s) content for an individual load.

It is the responsibility of the Contractor to check stockpile moisture content and to set the machine accordingly to account for aggregate bulking.

- C. **NON-COMPLIANCE** - If any two successive tests fail on the stockpile material, the job shall be stopped. It is the responsibility of the Contractor, at his own expense, to prove to the Owner that the conditions have been corrected. If any two successive tests on the mix from the same machine fail, the use of the machine shall be suspended. It will be the responsibility of the Contractor, at his own expense, to prove to the Owner that the problems have been corrected and that the machine is working properly.

3.2 LABORATORY EVALUATION

- A. **GENERAL** - Before work commences, the Contractor shall submit a signed original of a mix design covering the specific materials to be used on the project. This design must have been performed by a qualified laboratory. Previous lab reports covering the exact materials to be used may be accepted provided they were made during the calendar year. Once the materials are approved, no substitution will be permitted unless first tested and approved by the laboratory preparing the mix design.
- B. **LABORATORY REPORT** - The laboratory report will show the results of tests performed on the individual materials, comparing their values to those required by this specification. The report will provide the following information on the slurry seal mixture.

TEST PURPOSE	METHOD	SPEC
Slurry Seal Consistency	ISSA T106	2 - 3 cm
Wet Stripping Test	ISSA T114	Pass
Compatibility	ISSA T115	* Pass
Quick Set Emulsion	ISSA T102	** Pass
Wet Track Abrasion	ASTM D3919-Modified	50 gms/sq ft. max. (6 days soak)
Cohesive Test	ISSA T139	12 kg-cm, 30 min. 16 kg-cm, 60 min.

* Mixing tests must pass at the maximum expected air temperature

** Using job aggregate

The laboratory shall further report the quantitative effects of moisture content on the unit weight of the aggregate (bulking effect). The laboratory report must clearly show the proportions of aggregate, mineral filler (min and max), water (min and max), additive(s) (usage) and asphalt based on the dry aggregate weight.

3.3 COMPOSITION, RATE OF APPLICATION AND TOLERANCES

- A. COMPOSITION - The percentage of each individual material shall be as required by the laboratory report. Adjustments may be required during construction, based on field conditions. The Owner will give final approval for all such adjustments.
- B. RATE OF APPLICATION - The slurry seal mixture shall be of proper consistency at all times so as to provide the amount of mixture required by the surface condition. The average application rate as measured by the Owner shall be a minimum of 12 to maximum of 14 lbs. per s.y. based on dry aggregate weight.

The application rate must be a minimum of 10 lbs. per s.y. based on dry aggregate weight when tested in Place Paper Test or other approved test methods satisfactory to the Engineer.

- C. TOLERANCES - Tolerances for individual materials as well as the slurry seal mixture are as follows:
1. After the designed residual asphalt content is determined, a plus or minus one percentage point variation will be permitted.
 2. The percentage of aggregate passing each sieve shall not vary more than $\pm 4.0\%$ from the job mix formula.
 3. The percent of aggregate passing shall not go from the high end to the low of the specified range of any two successive sieves.
 4. The slurry consistency shall not vary more than ± 0.5 cm from the job mix formula after field adjustments.

3.4 NOTIFICATION AND TRAFFIC CONTROL

- A. NOTIFICATION - All homeowners and businesses affected by the construction shall be notified one day in advance of the surfacing. Should the work not occur on the specified day, new notification will be distributed when required. The Contractor must supply the

Engineer with a tentative schedule at least 10 days in advance of placement, along with weekly schedules.

- B. TRAFFIC CONTROL - Suitable methods shall be used by the Contractor to protect the slurry seal from all type of vehicular traffic until the new surface will support the traffic without damage. Opening to traffic does not constitute acceptance of the work. The Owner shall be notified of the methods to be used.

Traffic control measures shall be in accordance with the "Texas Manual on Uniform Traffic Control Devices for Streets and Highways".

3.5 PREPARATION OF THE SURFACE

- A. GENERAL - Immediately prior to applying the slurry seal, the surface shall be cleared of all loose material, silt spots, vegetation, oil spots and other objectionable material. Any standard cleaning method will be acceptable. If water is used, cracks will be allowed to dry thoroughly before slurry sealing. Manholes, valve boxes, drop inlets and other service entrances will be protected from the slurry seal by a suitable method. The Owner shall approve the surface preparation prior to sealing.

The Contractor shall remove and properly dispose of all debris, including any accumulations in the gutter lines.

3.6 APPLICATION

- A. GENERAL - The surface should be pre-wetted by fogging ahead of the slurry box when required by local conditions. Water used in pre-wetting the surface shall be applied such that the entire surface is damp with no apparent flowing water in front of the slurry box. The rate of application of the fog spray shall be adjusted during the day to suit temperatures, surface texture, humidity and dryness of the pavement surface.

The slurry mixture shall be of the desired consistency upon leaving the mixer and no additional materials shall be added. A sufficient amount of slurry shall be carried in all parts of the spreader at all times so that a complete coverage is obtained. Overloading of the spreader shall be avoided. No lumping, balling or unmixed aggregate shall be permitted.

No streaks, such as those caused by oversized aggregate, will be left in the finished surface. If excess oversize develops, the job will be stopped until the Contractor proves to Owner that the situation has been corrected.

- B. JOINTS - No excessive buildup, uncovered areas or unsightly appearance shall be permitted on longitudinal or transverse joints. An excessive overlap will not be permitted on longitudinal joints. The Contractor shall provide suitable width spreading equipment to produce a minimum number of longitudinal joints throughout the project. When possible, longitudinal joints shall be placed on lane lines. Half passes and odd width passes will be used only in minimum amounts. If half passes are used, they shall not be the last pass of any paved area.
- C. MIX STABILITY - The slurry mixture shall possess sufficient stability so that premature breaking of the slurry seal in the spreader box does not occur. The mixture shall be homogeneous during and following mixing and spreading, it shall be free of excess water or emulsion and free of segregation of the emulsion and aggregate fines from the coarser aggregate.

- D. HAND WORK - Areas which cannot be reached with the slurry seal machine shall be surfaced using hand squeegees to provide complete and uniform slurry seal coverage. The area to be hand worked shall be lightly dampened prior to mix placement and the slurry worked immediately. Care shall be exercised to leave no unsightly appearance from handwork. The same type finish as applied by the spreader box shall be required. Handwork shall be completed during the machine applying process.
- E. LINES - Care shall be taken to insure straight lines along curbs and shoulders. No runoff on these areas will be permitted. Lines at intersections will be kept straight to provide a good appearance.
- F. OPEN TO TRAFFIC - The surface shall be suitable to open to rolling traffic within a period of 2 hours after placement. Pneumatic rolling will be required on all slurry prior to opening to traffic.
- G. CLEAN-UP - All areas, such as manways, gutters and intersections, shall have the slurry seal removed as specified by the Owner. The Contractor shall remove any debris associated with the performance of the work, on a daily basis.

END OF SECTION

SECTION 32 05 16

AGGREGATE FOR SURFACE TREATMENTS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This item establishes the requirements for aggregates to be used in the construction of surface treatments.

1.2 MEASUREMENT AND PAYMENT

- A. Aggregates will not be paid for separately but will be considered as part of the unit price bid for "One Course Surface Treatment".

PART 2 – PRODUCTS

2.1 MATERIALS

- A. GENERAL: Aggregates shall be composed of sound and durable particles of gravel, crushed gravel, crushed stone, crushed slag, burned clay, burned shale or natural limestone rock asphalt. These materials shall contain not more than one (1) percent by weight of organic matter (other than native bitumen), clays, loam or pebbles coated therewith and shall contain not more than five (5) percent by weight of any one of or combination of slate, shale, schist or soft particles of sandstone when tested in accordance with Texas Highway Department Test Method Tex-217-F.

The natural limestone rock asphalt aggregate furnished shall have an average bitumen content from four to eight (4 - 8) percent by weight of naturally impregnated asphalt, as determined by Texas Highway Department Test Method Tex-215-F, and shall contain not more than two (2) percent by weight of any one of or combination of iron pyrites, or other objectionable matter, as determined by Texas Highway Department Test Method Tex-217-F.

No aggregate shall contain a total of more than five (5) percent by weight of impurities or objectionable matter listed above.

The percent of wear, as determined by Texas Highway Department Test Method Tex-410-A, for each of the materials shall not exceed thirty-five (35) percent.

The percent of wear on natural limestone rock asphalt aggregate, as determined by Texas Highway Department Test Method Tex-410-A, shall be made on that portion of the material retained on the No. 4 sieve, having a naturally impregnated asphalt content of less than one (1) percent.

Crushed gravel shall have a minimum of eighty-five (85) percent of the particles retained on the No. 4 sieve with at least on (1) crushed face.

- B. AGGREGATE TYPES :

The various types of aggregates are identified as follows:

- TYPE A Type A aggregate shall consist of gravel, crushed slag, crushed stone or natural limestone rock asphalt.
- TYPE B Type B aggregate shall consist of crushed gravel, crushed slag, crushed stone or natural limestone rock asphalt.
- TYPE C Type C aggregate shall consist of gravel, crushed slag or crushed stone.
- TYPE D Type D aggregate shall consist of crushed gravel, crushed slag or crushed stone.
- TYPE E Type E aggregate shall consist of natural limestone rock asphalt.
- TYPE F Type F aggregate shall consist of burned clay or burned shale.

C. AGGREGATE GRADES

When tested by Texas Highway Department Test Method Tex-200-F, the gradation requirements for the several grades of aggregate shall be as follows:

PERCENT BY WEIGHT

GRADE 1:	Retained on 1" sieve	0
	Retained on 7/8" sieve	0 - 2
	Retained on 5/8" sieve	15 - 45
	Retained on 3/8" sieve	85 - 100
	Retained on No. 4 sieve	95 - 100
	Retained on No. 10 sieve	98 - 100
GRADE 2:	Retained on 7/8" sieve	0
	Retained on 3/4" sieve	0 - 2
	Retained on 1/2" sieve	20 - 35
	Retained on No. 4 sieve	85 - 100
	Retained on No. 10 sieve	98 - 100
GRADE 3:	Retained on 3/4" sieve	0
	Retained on 5/8" sieve	0 - 2
	Retained on 1/2" sieve	5 - 20
	Retained on No. 4 sieve	85 - 100
	Retained on No. 10 sieve	98 - 100
GRADE 4:	Retained on 5/8" sieve	0
	Retained on 1/2" sieve	0 - 2
	Retained on 3/8" sieve	5 - 25
	Retained on No. 4 sieve	85 - 100
	Retained on No. 10 sieve	98 - 100
GRADE 5:	Retained on 1/2" sieve	0
	Retained on 3/8" sieve	0 - 2
	Retained on No. 4 sieve	40 - 85
	Retained on No. 10 sieve	98 - 100

**PERCENT BY
WEIGHT**

GRADE 6:	Retained on 1/2" sieve	0
	Retained on 3/8" sieve	0 - 2
	Retained on No. 4 sieve	5 - 40
	Retained on No. 10 sieve	70 - 100
	Retained on No. 20 sieve	99 - 100
GRADE 7:	Retained on 1/4" sieve	0
	Retained on No. 4 sieve	0 - 10
	Retained on No. 20 sieve	25 - 55
GRADE 8:	Retained on No. 4 sieve	0
	Retained on No. 10 sieve	0 - 10
	Retained on No. 20 sieve	10 - 55

END OF SECTION

SECTION 32 05 17

ASPHALTS, OILS AND EMULSIONS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This item establishes the requirements for oil asphalts, cut-back asphalts, flux oils, and emulsified asphalts to be used.

1.2 MEASUREMENT AND PAYMENT

- A. Asphalts, Oils and Emulsions will be paid for in accordance with the governing Specifications for the item(s) of construction in which they are used.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Terms relating to oil asphalt shall be as defined in the current "Definition of Terms Relating to Materials for Roads and Pavements", A.S.T.M. Designation D-6.
- B. The asphaltic material shall be of the grade and type shown on the Plans and/or otherwise specified, and shall meet the following requirements:
 - 1. Oil Asphalt: The material shall be homogeneous, shall be free from water, shall not foam when heated to 347° F., and shall meet the following requirements:

TYPE-GRADE	OA-55 Min-Max	OA-65 Min-Max	OA-75 Min-Max	OA-90 Min-Max	OA-135 Min-Max	OA-175 Min-Max
Penetration at 77° F., 100 gm, 5 sec.	50 - 60	60 - 70	70 - 85	85 -100	120-150	150-200
Ductility at 77° F., 5cm/min, cms	100 ---	100 ---	100 ---	100 ---	100 ---	70 ---
Flash Point C.O.C., ° F.	450 ---	450 ---	450 ---	450 ---	450 ---	450 ---
Softening Point R. & B., ° F.	113-140	113-140	113-140	113-140	113-140	113-140
Loss at 325° F., 50 gm., 5 hrs.,%	-- 0.75	-- 0.75	-- 0.75	-- 0.75	-- 0.75	-- 0.75
Penetration of Residue, 77° F. 100 gm, 5 sec.	30 ---	40 ---	45 ---	50 ---	70 ---	90 ---
Solubility in CCl 4, %	99.5 --	99.5 --	99.5 --	99.5 --	99.5 --	99.5 --

2. Cut-Back Asphalt: The material shall be free from water and shall meet the following requirements:

TYPE-GRADE	RC-1 Min-Max	RC-2 Min-Max	MC-1 Min-Max	MC-2 Min-Max	MC-3 Min-Max
Flash Point T.O.C., °F.	80 ---	80 ---	80 ---	150 ---	150 ---
Furol Viscosity at 77° F., Sec.	-----	-----	110-150	-----	-----
Furol Viscosity at 122° F., Sec.	100-160	200-275	-----	-----	-----
Furol Viscosity at 140° F., Sec.	-----	-----	-----	150-250	300-500
The distillate shall be as follows, expressed as percent by volume of total cut-back:					
Off at 437° F.	12 ---	10 ---	--- 10	--- 2	--- 2
Off at 600° F.	25 ---	-----	25 ---	10 - 20	8 - 20
Off at 680° F.	--- 40	--- 30	--- 50	--- 27	--- 25
Off between 600° F. and 680° F.	-----	--- 5	-----	-----	-----
Tests on residue:					
Penetration at 77° F., 100 gm, 5 sec.	70 100	120-150	100-200	100-200	100-200
Ductility at 77° F., 5 cm/min., cms.	100 ---	100 ---	100 ---	100 ---	100 ---
Solubility in CCl ₄ , %	99.5 --	99.5 --	99.5 --	99.5 --	99.5 --

3. Flux Oil: Fluxing material shall be homogeneous. It shall show no separation of asphalt after thorough mixing and shall meet the viscosity requirements at any time within thirty (30) days after delivery.

	<u>Min.</u>	<u>Max.</u>
Furol Viscosity at 122° F., Sec.	50	100
Flash Point C.O.C., °F.	250	---
Loss on Heating, 50 gms., 5 hrs., at 325° F., %	0	5

4. Emulsions: The material shall be homogeneous. It shall show no separation of asphalt after thorough mixing and shall meet the viscosity requirements at any time within thirty (30) days after delivery.

TYPE-GRADE	EA-HVRS Min-Max	EA-HVMS Min-Max	EA-10S Min-Max	EA-11M Min-Max
Furol Viscosity at 77 ^o F., Sec.	-----	-----	30-100	30-100
Furol Viscosity at 122 ^o F., Sec.	100-300	100-300	-----	-----
Residue by Distillation, %	60 ---	60 ---	57.5-65	57.5-65
Oil Portion of Distillate, %	-----	-----	--- 2	--- 2
Sieve Test, %	--- 0.05	--- 0.05	--- 0.05	--- 0.05
Miscibility (Standard Test)	-----	-----	Passing	Passing
Coating	-----	-----	Passing	Passing
Cement Mixing, %	-----	-----	--- 2	-----
Demulsibility 50 cc of N/50 CaCl 2, %	-----	-----	-----	--- 70
Demulsibility 35 cc of N/50 CaCl 2, %	30 ---	30 ---	-----	-----
Settlement, 5 days, %	--- 3	--- 3	--- 3	--- 3
Freezing Test 3 cycles (*)	-----	-----	Passing*	Passing*
Tests on residue:				
Penetration at 77 ^o F., 100 g, 5 Sec.	100-200	100-200	100-175	100-175
Solubility in CCl 4, %	97.5 ---	97.5 ---	97.5 ---	97.5 ---
Ductility at 77 ^o F., 5 cm/min., cms.	40 ---	40 ---	40 ---	40 ---

(*) Applies only when Engineer designates material for winter use.

2.2 TESTING REQUIREMENTS

- A. The properties enumerated herein for Asphalts, Oils and Emulsions shall be determined in accordance with the applicable current A.A.S.H.O. methods except where otherwise specified.

PART 3 – EXECUTION**3.1 GENERAL**

Oil Asphalts, Cut-Back Asphalts, and the temperatures which provide optimum fluidity for uniform and easy application. No Rapid Curing Cut-Back Asphalt shall be applied at a temperature in excess of 275° F. Recommended application temperature ranges for the types and grades of asphalts are as follows:

TYPE	GRADE	APPLICATION Minimum	TEMPERATURES Maximum
Oil Asphalts - All Types	All Grades	275° F	375° F
Cut-Back Asphalts - Rapid Curing	RC-1	80° F	150° F
	RC-2	100° F	175° F
Cut-Back Asphalts - Medium Curing	MC-1	70° F	150° F
	MC-2	100° F	200° F
	MC-3	175° F	250° F
Emulsified Asphalts - All Types	All Grades	50° F	140° F

All asphaltic materials which have been heated above 400° F. will be rejected.

END OF SECTION

SECTION 32 11 14

FLEXIBLE BASE CRUSHED LIMESTONE

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This item shall consist of a base course composed of crusher-run broken limestone. The base shall be constructed as specified in one or more courses in conformity with the typical section shown on the Plans, and to the line and grades established by the Engineer.

1.2 MEASUREMENT AND PAYMENT

- A. Payment for flexible base will be made at the unit price bid in the Proposal. The price shall include preparing and rolling the sub-grade, furnishing and placing the base material, all royalty and freight, hauling and delivery on the street, spreading, shaping, dragging, sprinkling or drying, compacting and finishing; for all manipulation, labor, tools and incidentals necessary to complete the work. Payment will not be made for unauthorized work.

1.3 SUBMITTALS

- A. The Contractor shall furnish the Engineer with two copies of all test results performed by a pre-approved independent testing laboratory. The documentation shall be specifically for the material that is to be used on the project.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. The material shall meet the material requirements of TX DOT 247, Type A, Grade 1. The Contractor shall be responsible for insuring that all materials delivered at the job site meet the specifications. The Engineer may require testing or retesting by an acceptable independent testing laboratory of any materials submitted. If this testing indicates the material to be unsatisfactory, the Contractor shall be required to pay for those tests, as well as supply materials which comply with said specifications. The material shall be obtained from pre-approved sources at the time of submittal, shall be crushed, and shall consist of durable particles of stone mixed with pre-approved binding materials. Unless otherwise specified on the Plans the processed material shall meet the following requirements:

- 1. Test Requirements: The processed material shall meet the following requirements when tested in accordance with procedures as outlined in TX DOT Item 247.

Retained on 1 3/4" sieve	0%
Retained on 7/8" sieve	10% - 35%
Retained on 3/8" sieve	30% - 50%
Retained on 4 mesh sieve	45% - 65%
Retained on 40 mesh sieve	70% - 85%

- a. Liquid Limit: The portion of material passing the 40 mesh sieve shall have a liquid limit of 35 or less, in accordance with TEX-104-E.
- b. Plasticity Index: The portion of material passing the 40 mesh sieve shall have a plasticity index of not less than 4 nor more than 10, in accordance with TEX-106-E.
- c. Abrasion: The crushed stone shall have an abrasion loss of not more than 40% when subjected to the Wet Ball Mill Test, TEX-116-E with a maximum of 20% increase in passing the No. 40 sieve.
- d. Triaxial Test: The crushed stone shall have a minimum compression strength of 45 psi at 0 psi lateral pressure and 175 psi at 15 psi lateral pressure in accordance with TEX-117-E.

2.4 EQUIPMENT

- A. All equipment shall be adequate for the purposes intended, meeting the approval of the Engineer prior to the start of work.

2.3 TESTING REQUIREMENTS

- A. The Contractor shall have field densities performed on the base for review by the Engineer. These tests shall be taken at points directed by the Engineer with a maximum of one test per construction station. The City will not pay for failing tests.
- B. Testing for required depth will be performed upon completion of the course to the lines and grades specified.

PART 3 – EXECUTION

3.1 PLACING

- A. The flexible base course shall be placed upon a previously approved sub-grade. Immediately before placing the flexible base material, the sub-grade shall be checked for conformance with the Plans and Specifications and any corrections as pre-approved by the Engineer shall be made.
- B. Material deposited upon the sub-grade shall be spread and shaped the same day. The material shall conform to the typical sections as shown on the Plans. All areas and "nests" of segregated coarse or fine materials shall be corrected or removed and replaced with well-graded material. The Contractor shall furnish and apply additional binder to the in-place material, if directed by the Engineer. Such binder material shall be carefully and evenly incorporated with the in-place material by scarifying, harrowing, brooming, or other pre-approved methods.

3.2 FINISHING AND COMPACTION

- A. The flexible base course shall be sprinkled as required and rolled until obtaining a uniform compaction and the required density.
- B. Compaction of the flexible base course shall be accomplished with a pneumatic. Rolling shall continue until the base course material has been compacted to ninety five percent (95%)

of the modified density (ASTM D1557). The allowable deviation from optimum moisture content is to +4%.

- C. The shape of the course shall be maintained by blading throughout the entire compacting operation. The completed surface shall be smooth and in conformance with the typical sections shown on Plans and to the established lines and grades. Completed surfaces that deviate in excess of one-fourth (1/4) inch in cross-section and in a length of sixteen (16) feet measured longitudinally shall be connected.
- D. The method of correction shall be by loosening, adding or removing material, and reshaping and recompacting by sprinkling and rolling. All irregularities, depressions or weak spots which develop shall be corrected immediately by scarifying the affected areas, adding suitable material as required, and reshaping and recompaction by sprinkling and rolling.
- E. When directed by the Engineer the base course may be opened to traffic. The Contractor shall direct and distribute the traffic uniformly over the entire width of the course. During the period traffic is being directed over the course, the surface shall be satisfactorily maintained by the use of blades, drags and other equipment. Maintenance operations shall continue until starting the application of the next course or the surface course.

END OF SECTION

SECTION 32 11 16

SUBGRADE PREPARATION AND COMPACTION**PART 1 - GENERAL****1.1 DESCRIPTION**

- A. This item shall consist of scarifying, blading and rolling the sub-grade to obtain a uniform texture and a uniform density throughout the required depth as shown on the Plans.

1.2 MEASUREMENT AND PAYMENT

- A. When the Contractor thinks the sub-grade is ready for acceptance by the Engineer, he will have field densities performed on the sub-grade at his expense by an independent testing laboratory approved by the Engineer. These tests shall be taken at points directed by the Engineer with a maximum of one test per station of construction. These tests shall be performed by the method outlined in A.S.T.M. Designation D-698, or an equivalent method approved by the Engineer (Balloon Density or Harris Cup). A section will be considered satisfactory as to density when no single test indicates less than 98% Standard ASTM D-698. A written report containing the dry density, the moisture content and location of each in place sample taken shall be submitted to the Engineer.
- B. Payment for compacted sub-grade shall be included in the unit price bid for "Concrete Pavement", "Flexible Base" or "Compacted Sand Sub-base" as the case may be. Price will be full compensation for removing excess material, shaping, fine grading and compacting the sub-grade; for furnishing and hauling all materials, blading, shaping, rolling and finishing, and all labor, tools and incidentals necessary to complete the work except roadway excavation. Payment will not be made for unauthorized work.

PART 2 – PRODUCTS

N/A

PART 3 – EXECUTION**3.1 GENERAL**

- A. The roadbed shall be excavated and shaped in conformity with the typical sections shown on the Plans and to the lines and grades established by the Engineer. The entire roadway cross-section including an area two (2) feet back of the proposed curb line shall be bladed clear of vegetation and scarified as directed by the Engineer. All unstable or otherwise objectionable material shall be removed or broken off to a depth of not less than six (6) inches below the surface of the sub-grade. Holes or depressions resulting from the removal of such material shall be backfilled with suitable material compacted in layers not to exceed six (6) inches. All soft and unstable material and other portions of the sub-grade which will not compact readily or serve the intended purpose shall be removed as directed. No direct payment will be made for such removal, except where each separate spot or area requiring removal exceeds ten (10) cubic yards, in which case measurement and payment will be made as provided in the SECTION 31 23 00 – EXCAVATION AND EMBANKMENT.

- B. The sub-grade shall be scarified to the depth shown on the Plans and bladed and compacted in the manner directed in the section on "Finishing and Compaction". The surface of the sub-grade shall be finished to line and grade as established, and be in conformity with the typical sections shown on the Plans. Any deviation in excess of one-half (1/2) inch in cross-section and in a length of sixteen (16) feet measured longitudinally shall be corrected by loosening, adding or removing material, reshaping or compacting by sprinkling and rolling. Material excavated in the preparation of the sub-grade shall be disposed of as directed by the Engineer.

3.2 FINISHING AND COMPACTION

- A. The sub-grade course, including an area two (2) feet back of the proposed curb line, shall be sprinkled as required and rolled as directed until a uniform compaction and required density is obtained. Compaction of the sub-grade may be done using any of the rolling equipment outlined in SECTION 31 11 29.02 - ROLLING. However, required densities must be met. Should the Engineer feel that too much time is being required to obtain those densities he can require that a heavy pneumatic roller be applied. Rolling shall continue until the sub-grade has been compacted to ninety-eight (98) percent of the Standard Density (A.S.T.M. Method D-698). The allowable deviation from optimum moisture content is 0 to +4%.
- B. Rolling shall progress gradually from the sides to the center of the lane under construction, by lapping uniformly each proceeding track by at least twelve (12) inches.
- C. After rolling and watering, the sub-grade shall be checked by the use of string line or instrument. All portions that do not conform to the lines and grades as shown on the Plans, shall be scarified for at least six (6) inches and re-compacted to correct elevation.
- D. Until the base course or pavement is placed, the sub-grade shall be maintained free from ruts and depressions, in a smooth and compacted condition true to lines and grade and to the density requirements contained herein. All of the Contractor's hauling and other equipment used in such a way as to cause rutting and raveling of the sub-grade shall either be removed from the work or suitable runways or other equivalent means shall be provided to prevent rutting.
- E. The Contractor shall be responsible for maintaining and protecting the roadbed for the entire length of the project.
- F. During construction, grading of the sub-grade shall be conducted so that the berm of earth or other material does not prevent immediate drainage of water to the side. Ditches and drains along the sub-grade shall be maintained so as to drain effectively.

END OF SECTION

SECTION 32 11 26

ASPHALT STABILIZED BASE**PART 1 - GENERAL****1.1 DESCRIPTION**

- A. This item shall consist of a base course composed of a compacted mixture of a mineral aggregate and asphaltic material. The mixture when designed and tested in accordance with these Specifications shall meet the following requirements:
1. Laboratory Density (THD BULLETIN C-14) (Unless otherwise shown on plans)
 - Minimum 92 percent
 - Optimum 96 percent
 - Maximum 99 percent
 2. Stability (THD BULLETIN C-14)
 - Shall not be less than 30 percent except when otherwise shown on plans. The base course shall be constructed on previously completed and approved sub-grade or sub-base, as herein provided, and in accordance with the details shown on the plans.

1.2 MEASUREMENT AND PAYMENT

- A. Asphalt concrete base shall be measured by the square yard for the thickness indicated in the Proposal.
- B. Tack coat will not be measured as a separate item. The cost of tack shall be included in the price bid for asphaltic concrete base.
- C. Prime coat will not be measured as a separate item. The cost of prime coat shall be included in the price bid for asphaltic concrete base.
- D. The work performed and materials furnished as prescribed by this item, and measured as provided under "Measurement", will be paid for at the unit price bid for "Hot Mix Asphaltic Base", of the type specified, which price shall be full compensation for quarrying, furnishing all materials, freight involved, for all heating, mixing, hauling, cleaning the existing base course or pavement, placing asphalt stabilized base, rolling and finishing, and for all manipulations, labor, tools, equipment and incidentals necessary to complete the work including tack coat and prime coat when required.

PART 2 – PRODUCTS**2.1 MATERIALS**

- A. The mineral aggregate shall be composed of a coarse aggregate and a fine aggregate. Samples of coarse aggregate and fine aggregate shall be submitted in accordance with the methods prescribed in the Special Provisions. Approval of both material and source must be obtained from the Engineer prior to delivery. Sources of material specified on the plans as being available for use will not require prior approval. The mineral aggregate shall contain not more than 2 percent by weight of organic matter, clays, loam or pebbles coated therewith, as determined by Test Method Tex-217-F. Mineral aggregates from each source shall meet the quality tests specified herein.

1. Coarse Aggregates: The coarse aggregates shall be that part of the aggregate retained on a No. 10 sieve; shall consist of clean, tough, durable fragments of stone, crushed gravel, iron ore, slag, or combinations thereof, and be of uniform quality throughout. Coarse aggregate will be tested in accordance with Test Method Tex-406-A for decantation. Material removal will not be more than 3 percent by weight. The coarse aggregate, when subjected to the Los Angeles Abrasion Test (Test Method Tex-410-A), shall have an abrasion not exceeding 45.
2. Fine Aggregate: The fine aggregate shall be that of the aggregate passing the No. 10 sieve and shall consist of sand or screening or a combination of sand and screening. The plasticity index of that part of the fine aggregate passing the No. 40 sieve shall be not more than 6 when tested by Test Method Tex-106-E. Sand shall be composed of durable stone particles free from injurious foreign matter. Screening shall be material produced during the production of the coarse aggregate.
3. Asphaltic Material Mixture: Asphalt for the mixture shall be of the types of oil asphalt as determined by the Engineer and shall meet the requirements of Section 32 05 17 - Asphalts, Oils and Emulsions. The grade of asphalt shall be designated by the Engineer. The Contractor shall notify the Engineer of the sources of his asphalt material prior to production of the asphaltic mixture and prior to any change desired during the course of the project.
4. Tack Coat: The asphaltic material for tack coat shall meet the requirements for Cut-Back Asphalt RC-2 and may, upon instructions from the Engineer, be diluted by the approved grade of gasoline and/or kerosene, not to exceed 15 percent by volume. Asphaltic materials shall meet the requirements of Section 32 05 17 - Asphalts, Oils and Emulsions.

2.2 MIXTURES

- A. The mixtures shall consist of a uniform mixture of coarse aggregate, fine aggregate, and asphaltic material. The grading of each constituent of the mineral aggregate shall be such as to produce, when properly proportioned, a mixture which will conform to the limitations for master grading.

Retained on 1 1/2" sieve 0 to 3%
 Retained on no. 10 sieve 50 to 65%

Soil contents to be as follows:

Liquid limit shall not exceed 35
 Plasticity Index shall not exceed 12

The asphaltic material shall form from 3.5 to 7 percent of the mixture by weight.

- B. The Engineer will designate the grading of the aggregate and asphalt content to be used in the mixture. The mixture produced shall not vary from the designated grading for any sieve size plus or minus 4 percent by weight, and the asphaltic material shall not vary in content by more than 0.5 percent by weight.
- C. Samples of the mixture when tested by the THD Extraction Test, Tex-210-F, shall not vary from the grading proportions of the aggregate and the asphalt content designated by the Engineer by more than the respective tolerances specified above, and shall be within the limits specified for master grading.

PART 3 – EXECUTION**3.1 GENERAL**

- A. The base is to be placed in one course with a spreading and finishing machine of the type approved by the Engineer, equipped with an automatic grade control device capable of producing a surface that will meet the requirements or the specification surface test. The machine also shall have adequate paves to propel the delivery vehicles in a satisfactory manner when the mixture is dumped into the finishing machine. The finishing machine shall be equipped with a flexible spring and/or hydraulic type hitch sufficient in design and capacity to maintain contact between the rear wheels of the hauling equipment and the pusher rollers of the finishing machine while the mixture is being unloaded. Any vehicle the finishing machine cannot push or propel in such a manner as to obtain the desired line and grade without resorting to hand finishing will not be allowed to dump directly into the finishing machine. The mixture shall not be placed when the air temperature is below 50° F and is falling, but it may be placed when the air temperature is above 40° F and is rising. The air temperature shall be taken in the shade away from artificial heat. It is further provided that the prime coat, tack coat or asphaltic mixture shall be placed only when the humidity, general weather conditions and the moisture and temperature of the base, in the opinion of the Engineer, are suitable.
- B. If a prime coat is required, it will be applied but not paid for as a separate item. The tack coat of asphaltic mixture shall not be applied on a previously primed flexible base until the primed base has completely cured to the satisfaction of the Engineer.
- C. Before the asphaltic mixture is laid, the surface upon which the tack coat is to be placed shall be cleaned thoroughly to the satisfaction of the Engineer. The surface shall be given a uniform application of tack coat when directed by the Engineer. This tack coat shall be applied, as directed by the Engineer, with an approved sprayer at a rate not to exceed .05 gallon per square yard of surface. Where the mixture will adhere to the surface on which it is to be placed without the use of a tack coat, the tack coat may be eliminated by the Engineer. All contact surfaces of curbs and structures and all joints shall be painted with a thin uniform coat of the asphaltic material used for the tack coat. The tack coat shall be rolled with a pneumatic tire roller as directed by the Engineer.
- D. The mixture, prepared as specified above, shall be hauled to the work in tight vehicles previously cleaned of all foreign material. The dispatching of the vehicles shall be arranged so that all material delivered may be placed, and all rolling shall be completed during the daylight hours. In cool weather or for long hauls, canvas covers and insulating or the truck bodies may be required. The inside of the truck body may be given a light coating of oil, if necessary, to prevent mixture from adhering to the body.
- E. Generally, the mixtures shall be dumped and spread on the approved prepared surface with the specified spreading and finishing machine in such manner that when properly compacted, the finished pavement will be smooth, of uniform density, and will conform with the typical sections shown on the plans and to the lines and grades as established by the Engineer. During the application of asphaltic material, care shall be taken to prevent splattering of adjacent pavement, curb and gutter, and structures.
- F. The mixture will be spread and compacted in layers so specified on the plans or as directed by the Engineer.
- G. When the mixture is placed in a narrow strip along the edge of an existing pavement, or used to level up small areas of an existing pavement or placed in small irregular areas where the

use of a finishing machine is not practical, the finishing machine may be eliminated when authorized by the Engineer, provided a satisfactory surface can be obtained by other approved methods.

- H. As directed by the Engineer, the pavement shall be compressed thoroughly and uniformly with the specified rollers.
- I. Rolling with the three wheel and tandem rollers shall start longitudinally at the sides and proceed toward the center of the pavement, overlapping on successive trips by at least half the width of the rear wheels. Alternate trips of the roller shall be slightly different in length. On super-elevated curves, rolling shall begin at the low side and progress toward the high side. Rolling with pneumatic roller shall be done as directed by the Engineer. Rolling shall be continued until no further compression can be obtained and all roller marks are eliminated. Additional rollers shall be provided if needed. The motion of the roller shall be slow enough at all times to avoid displacement of the mixture. If any displacement occurs, it shall be corrected at once by the use of rakes and of fresh mixture where required. The roller shall not be allowed to stand on pavement which has not been fully compacted. To prevent adhesion of the surface mixture to the roller, the wheels shall be kept thoroughly moistened with water, but an excess of water will not be permitted. All rollers must be in good mechanical condition. necessary precautions shall be taken to prevent the dropping of gasoline, oil, grease or other foreign matter on the pavement, either when the rollers are in operation or when standing.
- J. The edges of the mixture along curbs, headers and similar structures, and all places not accessible to the roller, or in such positions as will not allow thorough compaction with the roller, shall be thoroughly compacted with lightly oiled tamps.
- K. The surface of the pavement, after compaction, shall be smooth and true to established line, grade and cross section, and acceptable to the Engineer. Unacceptable finished surface may be corrected by the addition of mixture, placed and finished at the entire expense of the contractor.
- L. Sections of the newly finished base course shall be cleaned prior to laying the surface course or additional base courses. No construction traffic will be allowed on the asphalt stabilized base unless authorized in writing by the Engineer.

3.2 MIXING

- A. Screening and Proportioning: The screening capacity and size of the bins shall be sufficient to screen and store the amount of aggregate required to properly operate the plant and keep the plant in continuous operation at full capacity. Provisions shall be made to enable inspection forces to have easy and safe access to the proper location on the mixing plant where representative samples may be taken from the hot bins for testing.
- B. Asphaltic material heating equipment shall be adequate to heat the amount of asphaltic material required to the desired temperature. Asphaltic material may be heated by steam coils which shall be absolutely tight. Direct fire heating of asphaltic materials will be permitted, provided the heater used is manufactured by a reputable concern and there is a positive circulation of the asphalt throughout the heater. Agitation with steam or air will not be permitted. The heating apparatus shall be equipped with a recording thermometer with a 24-hour chart that will record the temperature of the asphaltic material where it is at the highest temperature.

- C. The spreading and finishing machine shall be of a type approved by the Engineer and shall be capable of producing a surface that will meet the requirements of the typical cross section as shown on the plans.
- D. All equipment shall be maintained in good repair and operating condition and shall be approved by the Engineer.

3.3 STOCKPILING, STORAGE, PROPORTIONS AND MIXING

- A. Prior to stockpiling of aggregates the area shall be cleaned of trash, weeds and grass and be relatively smooth. Aggregates shall be stockpiled in such a manner as to prevent segregation and mixing of aggregates from one source with another. Suitable equipment of acceptable size shall be furnished by the Contractor to work the stockpiles and prevent segregation of the aggregates. The material shall be placed in layers not exceeding 2' in depth and the minimum height of each stockpile shall be 10'. No separate grading of aggregate will be required prior to delivery to the cold aggregate bin.
- B. The asphaltic material storage shall be ample to meet the requirements of the plant. Asphalt shall not be heated to a temperature in excess of 350° F. All equipment used in the storage and handling of asphaltic material shall be kept in a clean condition at all times and shall be operated in such manner that there will be no contamination with foreign matter.
- C. The feeding of various sizes of aggregate to the dryer shall be done through the cold aggregate bin and proportioning device in such a manner that a uniform and constant flow of materials in the required proportions will be maintained. The aggregate shall be dried and heated to the temperature necessary to produce mixture having the specified temperature. In no case shall the aggregate be introduced into the mixing unit at a temperature more than 375° F.
- D. The proportioning of the various materials entering into the asphaltic mixture shall be as directed by the Engineer and in accordance with these Specifications. Aggregate shall be proportioned by weight using the weight box and batching scales herein specified when the weight-batch type of plant is used and by volume using the hot aggregate proportioning device when the continuous mixer type of plant is used. The asphaltic material shall be proportioned by weight or by volume based on weight using the specified equipment.
- E. In the charging of the weight box and mixer, such methods or devices shall be used as are necessary to secure a uniform asphaltic mixture. In introducing the batch into the mixer, all mineral aggregate shall be introduced first; shall be mixed thoroughly for a period of 5 to 20 seconds, as directed to uniformly distribute the various sizes throughout the batch before the asphaltic material is added; the asphaltic material shall then be added and the mixing continued for a total mixing period of not less than 30 seconds. This mixing period may be increased, if in the opinion of the Engineer, the mixture is not uniform.
- F. The amount of aggregate and asphaltic material entering the mixer and the rate of travel through the mixer shall be so coordinated that a uniform mixture of the specified grading and asphalt content will be produced. The mixture produced from each type of mixer shall not vary from the specified mixture by more than the tolerances herein specified. The mixture shall be at a temperature designated by the Engineer but not to exceed 325° F when dumped from the mixer. The Engineer will determine the temperature and the mixture when dumped from the mixer and when dumped from the mixer shall not vary from this selected temperature more than 25° F.

END OF SECTION

SECTION 32 11 27

REWORKING BASE MATERIAL

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This item consists of reworking existing base material (with or without an asphaltic surface). This item also consists of the blending of new base material when specified in the Contract Documents.

1.2 MEASUREMENT AND PAYMENT

- A. Reworking Base Material by scarifying and reshaping or by scarifying, salvaging and replacing will be measured by the square yard of existing base or pavement in the original position. This is a plans quantity measurement and the quantity to be paid will be that shown in the proposal. No payment will be made for thickness or width exceeding that shown on the typical sections or provided by the Contract Documents.
- B. The bid price includes full compensation for scarifying, salvaging, mixing, spreading, blading, shaping, wetting, compacting, and finishing of new and/or existing base material and for all labor, material, tools, equipment and incidentals necessary to complete the work including warranty work performed to satisfy the guarantee. Payment will not be made for unauthorized work.
- C. When new base material is mixed with the existing base material, furnishing and delivery of the new base will be paid for in accordance with SECTION 32 11 14 - FLEXIBLE BASE CRUSHED STONE LIMESTONE.

PART 2 – PRODUCTS

2.1 TESTING REQUIREMENTS

- A. A compaction curve (ASTM D 1557) shall be developed on the mixed or blended material.
- B. In-place field density shall be determined by Nuclear Methods (ASTM D 2922) or by Sand Cone Methods (ASTM D 1556) at locations selected by the Engineer. The frequency of tests shall be at least one every 300 lineal feet or a minimum of three (3) tests, whichever is greater.
- C. The base course shall be proof rolled as directed if, in the opinion of the Engineer, the blended material is non-uniform and a representative sample cannot be obtained for developing a compaction curve.

PART 3 – EXECUTION

3.1 GENERAL

- A. The work shall be performed to the width and depth specified in the Contract Documents.
- B. Reworking base material shall consist of either scarifying and reshaping or scarifying, salvaging and replacing existing base material as defined below;

1. Scarifying consists of loosening and breaking the existing base material.
2. Reshaping consists of reworking the scarified in-place base material with or without additional new base material.
3. Salvaging consists of removing, saving and temporarily stockpiling, if necessary, the existing scarified base material.
4. Replacing consists of returning and reworking the salvaged base material, with or without additional new base material, on the prepared roadbed.

New base material, when required, shall meet the requirements of SECTION 32 11 14 – FLEXIBLE BASE CRUSHED STONE LIMESTONE.

3.2 SCARIFYING AND RESHAPING

- A. The existing base, with or without existing asphaltic concrete pavement, shall be cleaned of all objectionable materials by blading, brooming or other approved methods, prior to scarifying. After cleaning, the existing material shall be scarified for its full width and depth, unless otherwise shown on the plans. The underlying sub-grade shall not be disturbed. The material shall be broken into pieces not more than two-and-one-half (2 1/2) inches in size.
- B. After completion of scarifying, the existing base shall be mixed and shaped to conform to the lines, grades, and typical sections shown on the Plans.
- C. New base material shall be placed on the existing scarified material and uniformly mixed when required by the Contract Documents.

3.3 SCARIFYING, SALVAGING AND REPLACING

- A. The existing base, with or without existing asphaltic concrete pavement, shall be cleaned of all objectionable materials by blading, brooming or other approved methods, prior to scarifying. After cleaning, the existing material shall be scarified for its full width and depth, unless otherwise shown on the plans. The underlying sub-grade shall not be disturbed. The material shall be broken into pieces not more than two-and-one-half (2 1/2) inches in size.
- B. The scarified material shall be removed from the roadbed. The scarified material may be salvaged by placing in temporary stockpiles or windrows until preparation of the sub-grade is complete.
- C. All salvaging operations shall not interfere with traffic, proper drainage or the general requirements of the work. All material to be salvaged shall be kept reasonably free of soil from the sub-grade or roadbed.
- D. Prior to replacing the salvaged material, the sub-grade shall be constructed and shaped to conform to the requirements of the Contract Documents. This work shall be done in accordance with the provisions of applicable bid items.
- E. The salvaged material shall be deposited on the prepared sub-grade, wetted if needed, bladed and shaped to conform to the lines, grades, and typical sections shown on the Plans or as directed by the Engineer. New base material shall be placed and uniformly mixed with the salvaged material when required by the Contract Documents.

- F. All areas of segregated material shall be corrected or removed and replaced with well graded material. All salvaged material shall be kept reasonably free of objectionable materials during the replacing operations.

3.4 COMPACTION

- A. The reshaped or replaced material shall be wetted as required and compacted to a uniform density of not less than 95 percent of the modified density (ASTM D 1557) The allowable deviation from optimum moisture content is to +4%.
- B. The Contractor shall rework the base material at his expense if the material fails to meet the required density or, for any reason, loses stability and finish before the next course is placed. The method of reworking shall be by loosening, adding or removing material, and reshaping and recompacting by wetting and rolling. All irregularities, depressions or weak spots which develop shall be corrected immediately by scarifying the affected areas, adding suitable material as required, reshaping and recompacting.
- C. The shape of the course shall be maintained by blading throughout the entire compacting operation. The completed surface shall be smooth and in conformance with the lines, grades, and typical sections shown on Plans. The Contractor shall check the elevation by blue topping on at least fifty (50) foot centers along the centerline and curb lines. Any deviation more than one-fourth (1/4) inch from the established section and grade shall be corrected by loosening, adding or removing material, reshaping and compacting.
- D. The base shall be cured to the approval of the Engineer prior to placing the final surface on the completed base. The base course may be opened to traffic if allowed by the Engineer.

END OF SECTION

SECTION 32 11 29
LIME STABILIZATION

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This item shall consist of admixing commercial lime and/or lime slurry with the existing material, and mixing and compacting the mixed material to the required density. All work performed in this item shall be constructed as specified herein and in conformity with the typical cross-sections, lines and grades as shown on the Plans and as directed by the Engineer.

1.2 MEASUREMENT AND PAYMENT

- A. Lime stabilized material as described in this section will be paid for at the unit price bid in the Proposal for the lime stabilized treatment, which price shall be full compensation for scarifying, preparation below secondary grade, furnishing, distributing, and mixing the lime and for all labor, supplies, water, fuel, tools, equipment and incidentals necessary to mix and compact the stabilized soil to the density specified in these Specifications. Payment will not be made for unauthorized work.

1.3 SUBMITTALS

- Lime series Atterburg Limits
- Lime series pH test (ASTM C977-83a-Annex Test Method)
- Lime type
- % Lime

PART 2 – PRODUCTS

2.1 MATERIALS

- A. The lime to be used for stabilization shall meet with requirements of TX DOT DMS-6350: Lime and Lime Slurry” and DMS-6330, “Lime Sources Prequalification of Hydrated Lime and Quicklime”. Use hydrated lime, commercial lime slurry, or pebble grade quicklime.
- B. The amount of lime required for stabilization will be the percent by weight shown on the Plans, stated in the Special Provisions, or that amount which produces a pH not less than 12.4 and provides for a Plasticity Index less than 18.

2.2 TESTING REQUIREMENTS

- A. After final mixing, a pH test, Atterberg Limit test and sieve analysis shall be performed in accordance with Tex-101-E, Part III.
- B. Moisture and Density tests shall be taken at each construction station to ensure a density of at least 98% of maximum dry density at a moisture content between optimum and 4% wet of optimum in accordance with Standard Proctor (ASTM D698). All tests meeting these requirements shall be paid by the owner. The City will not pay for failing tests.

- C. When requested by the Engineers Inspector, the contractor will proof roll areas in question with a 25 ton pneumatic tired roller or approved equal after lime stabilization is complete.

PART 3 – EXECUTION

3.1. GENERAL:

- A. It is the primary requirement of this specification to produce a completed course of treated material containing a uniform line mixture, free from loose or segregated areas, of uniform density and moisture content, well bound for its full depth as shown on the detail sheet or specified in the Special Provisions and with a smooth surface suitable for placing subsequent courses. It shall be the responsibility of the Contractor to regulate the sequence of his work, to use the proper amount of lime, maintain the work and rework the courses as necessary to meet the above requirements.
- B. The Contractor is required to ensure the existing sub-grade or embankment beneath the course to be lime stabilized is of proper density, uniformity and quality. The Contractor may elect to proof roll, replace and/or compact, areas that exhibit instability. If necessary, the Contractor may need to scarify, dry and compact the existing sub-grade prior to addition of lime. All work for the preparation of the existing sub-grade will not be paid directly, but will be considered a part of “Lime Stabilization”.

3.2. APPLICATION:

- A. Lime shall be spread only on that area where the first mixing operations can be completed during the same working day.
- B. The lime shall be spread by a pre-approved screw type spreader box, bag distribution, or a pre-approved truck spreader, in the manner and at the rates directed by the Engineer. The lime shall be distributed at a uniform rate and in such a manner as to reduce the scattering of the lime by wind to a minimum. Lime shall not be applied when wind conditions, in the opinion of the Engineer, are such that blowing lime becomes objectionable. A motor grader shall not be used to spread the lime.
- C. When pebble grade quicklime is placed dry, mix the material and lime thoroughly at the time of lime application.

3.3. MIXING:

- A. The material shall be dried or wetted as directed by the Engineer, until the proper moisture content has been secured. All lime shall be mixed with the material to be treated immediately after application of lime. During the interval of time between application and mixing, hydrated lime that has been exposed to the open air for a period of six (6) hours or more or had excessive loss due to washing or blowing will not be accepted until totally reprocessed, refinished and retested. This will be done at the sole expense of the Contractor.
- B. The soil-lime mixture shall be sprinkled during the mixing process as directed by the Engineer, to provide optimum moisture plus four (4) percent in the mixing immediately prior to starting the compaction operation.
- C. The stabilized soil shall then be lightly sealed to allow for the mixture to mellow for 1 to 4 days. When pebble grade quicklime is used, allow the mixture to mellow for 2 to 4 days. The mixed material shall be kept moist during this period and traffic shall not be allowed on

the treated portion. The moisture content of the mixture should be within, optimum and four percent of optimum for the compactive effort specified.

- D. After mellowing, resume mixing until a homogeneous friable mixture of material and lime is obtained, such that when all nonslaking aggregates retained on the 3/4" sieve are removed, the remainder of the material shall meet the following requirements when tested from the roadway in the roadway conditions by standard laboratory sieves:

Sieve	Percent Passing
1-3/4"	100%
3/4"	85%
#4	60%

After final mixing, the stabilized soil shall be bladed and compacted as specified below.

3.4. COMPACTION:

- A. Compaction of the mixture shall begin immediately after final mixing. The material shall be aerated or sprinkled as necessary to provide the proper moisture. Compaction shall begin at the bottom and shall continue until the entire depth of mixture is uniformly compacted.
- B. The course shall be sprinkled as required and compacted to the extent necessary to provide no less than ninety-eight (98) percent of the density measured by ASTM D698 at a moisture content between optimum and +4% wet of optimum moisture content. Grades shall be "blue-topped" during the compaction effort and the lime soil mixture shall be compacted to within 0.1 ft in cross-section and 0.1 ft in 16 ft measured longitudinally. In addition to the requirements specified for density, the full depth of the material shown on the plans shall be compacted to the extent necessary to remain firm and stable under construction equipment. Depth tests shall occur every 200 lf and shall be performed after compliance with density requirements.
- C. If the material fails to meet the density requirements, it shall be reworked as necessary to meet these requirements. Throughout this entire operation the shape of the course shall be maintained by blading, and the surface upon completion shall be smooth and in conformity with the typical section shown on the plans and to the established lines and grades. Should the material due to any reason or cause, lose the required stability, density and finish it shall be re-compacted, refinished and retested at the sole expense of the Contractor.

3.5 EQUIPMENT

- A. The machine, tools and equipment necessary for the proper prosecution of the work shall be on the project and pre-approved by the Engineer prior to the beginning of construction operations.
- B. All machinery, tools and equipment used shall be maintained in a satisfactory and workmanlike manner.
- C. To insure thorough mixing of the lime into the material to be stabilized, equipment shall be a pulverizer mixer equivalent to a Seaman Mixer, or soil stabilizing machine shall be used.
- D. Hydrated lime shall be stored and handled in closed weatherproof containers until immediately before distribution on the road. If storage bins are used they shall be completely

enclosed. Hydrated lime in bags shall be stored in weatherproof buildings with adequate protection from ground dampness.

- E. If lime is furnished in trucks, each truck shall have the weight of lime certified on public scales or the Contractor shall place a set of standard platform truck scales or hopper scales at a location pre-approved by the Engineer. Scales shall be certified as to accuracy by an independent pre-approved testing laboratory.

3.6 FINISHING AND CURING OF LIME-STABILIZED MATERIAL:

- A. After the lime treated material has been compacted and brought to the required lines and grades in accordance with the typical sections, the completed section shall then be finished by rolling as directed with a pneumatic or other suitable roller sufficiently light to prevent hair cracking. The completed section shall be moist-cured for a minimum of five (5) days before further courses are added or any traffic is permitted, unless otherwise directed by the Engineer. If the sub-grade sets up sufficiently to prevent objectionable damage from traffic, the layer may be opened to traffic the day following compaction, unless otherwise directed by the Engineer.
- B. Apply seals or additional courses within fourteen (14) calendar days after final compaction, unless otherwise directed by the Engineer.

END OF SECTION

SECTION 32 11 29.01

SPRINKLING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section shall consist of the authorized application of water on those portions of roadway shown on the Plans or as directed by the Engineer.
 - 1. Compacting and preparing roadbed excavations, roadbed embankments, backfills, subgrades, subbases, bases and surfacings.
 - 2. Preventing or alleviating dust nuisance originating within the highway right-of-way and the Project limits, which is not caused by Contractor operations at the Contractor's plants or plant setups.
 - 3. Other watering when ordered, except for Extra Work.

1.2 MEASUREMENT AND PAYMENT

- A. The water furnished and the work performed, as prescribed by this section, will be paid for in the unit price bid for the various items pertaining to the construction of embankment, sub-grade, sub-base and base. Price will include full compensation for all costs in connection with furnishing the water, including the city of Bryan tapping fee, and for all costs in connection with furnishing and operating approved sprinklers and necessary measuring devices. Payment is to include the application of the water as directed, all hauling, equipment, tools, labor, materials and incidentals necessary to complete the work. Payment will not be made for unauthorized work.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Water shall be furnished by the Contractor and shall be clean and free from industrial wastes and other objectionable matter.

PART 3 – EXECUTION

3.1 CONSTRUCTION METHODS

The Contractor shall furnish and operate approved sprinklers equipped with positive and rapidly working out-off valves and approved spray bars which will insure the distribution of water in a uniform and controllable rate of application. The Contractor shall apply the water in the required quantity where shown on the Plans and/or as directed by the Engineer.

END OF SECTION

SECTION 32 11 29.02

ROLLING**PART 1 - GENERAL****1.1 DESCRIPTION**

This section shall consist of the compaction of sub-grade, sub-base, base or asphaltic concrete pavements by the operation of approved power rollers, tamping rollers, or pneumatic tired rollers as herein specified and/or directed by the Engineer.

1.2 MEASUREMENT AND PAYMENT

The work prescribed by this section will not be paid for directly, but shall be considered as subsidiary work pertaining to the construction of embankments sub-grade, sub-base, base and surface, as the case may be.

PART 2 – PRODUCTS

N/A

PART 3 – EXECUTION**3.1 GENERAL**

- A. This work shall be done only when ordered by the Engineer. The compaction shall be accomplished by the methods outlined in the SECTIONS 32 11 16 - SUB-GRADE PREPARATION AND COMPACTION, SECTION 32 11 14 - FLEXIBLE BASE CRUSHED LIMESTONE, and SECTION 32 12 16 - HOT-MIX ASPHALTIC CONCRETE PAVEMENT. Tracked or lugged equipment will not be allowed on pavements at any time. In the event indicated rollers are not sufficiently weighted, nor have sufficient tire inflation capacity to produce the required degree of compaction, additional larger sized rollers will be required at no additional expense to the city.
- B. Sufficient rollers shall be provided to compact the material in a satisfactory manner.

3.2 EQUIPMENT FOR SUBGRADE, SUB-BASE AND BASE

- A. **PNEUMATIC TIRED ROLLERS:** Large pneumatic tired rollers shall be of a type having five (5) or more tires, with each tire being inflated to a pressure of 100 pounds per square inch. Total weight of the unit when loaded shall not be less than twenty-five (25) tons. The load shall be equally distributed to all wheels and the tires shall be uniformly inflated.
 - 1. Small pneumatic tired rollers shall consist of not less than nine (9) pneumatic tired wheels running on axles in such a manner that the rear group will not follow in the tracks of the forward group and mounted in a rigid frame and provided with a body suitable for ballast loading. The wheel base of the roller shall be not less than five (5) nor more than ten (10) feet. The front axle shall be attached to the frame in such a manner that the roller may be turned within a minimum circle. The pneumatic tired roller under working conditions shall have an effective rolling width of approximately sixty (60) inches. It shall be so designed that by ballast loading, the load may be

varied uniformly from a minimum of one hundred (100) to a maximum of four hundred (400) pounds per inch of width of tire tread.

2. The tire pressure and the compression to be provided by the pneumatic roller shall be as directed by the Engineer. Pneumatic tired rollers shall be drawn by either a suitable crawler-type tractor, a pneumatic-tired tractor or a truck of adequate tractive effort, or may be of the self-propelled type and the roller when drawn or propelled by either type of equipment shall be considered a pneumatic tired roller unit. Unless otherwise directed, pneumatic tired rollers shall be operated within a speed range from two (2) to four (4) miles per hour.
- B. **TAMPING ROLLERS:** Tamping rollers shall consist of two (2) metal rollers, drums or shells of forty (40) inches minimum diameter. Each not less than forty-two (42) inches in length and unit mounted in a rigid frame in such a manner that each roller may oscillate independently of the other. Each roller, drum or shell shall be surmounted by metal studs with tamping feet projecting not less than seven (7) inches from the surface and spaced not less than six (6) nor more than ten (10) inches measured diagonally center to center. The cross sectional area of each tamping foot measured perpendicularly to the axis of the stud, shall be not less than five (5) nor more than eight (8) square inches. The roller shall be supplemented with cleaning teeth to provide self cleaning. The roller shall be so designed that by ballast loading, the load on each tamping foot may be varied uniformly from one hundred, twenty-five (125) to one hundred, seventy-five (175) pounds per square inch of cross sectional area. The load per tamping foot will be determined by dividing the total weight of the roller by the number of tamping feet in one (1) row parallel to (or approximately so) the axis of the roller. The compression to be provided shall be as directed by the Engineer. The tamping roller shall be drawn by suitable power equipment of adequate tractive effort. Two (2) tamping rollers, consisting of four (4) cylinders, drawn by approved power equipment shall be considered a roller unit. Unless otherwise directed, tamping rollers shall be operated within a speed range of two (2) to three (3) miles per hour.

3.3 EQUIPMENT FOR HOT MIX ASPHALTIC CONCRETE PAVEMENT

- A. **POWER FLAT WHEEL ROLLERS:** Power flat wheel rollers shall be of the three (3) wheel self-propelled type only, weighing not less than eight (8) tons nor more than twelve (12) tons. Power flat wheel rollers shall be operated with a speed range from two (2) to three (3) miles per hour and/or as directed.
- B. **PNEUMATIC TIRED ROLLERS:** Pneumatic tired rollers for hot mix asphaltic concrete pavement shall conform to the Specifications as noted above for pneumatic rollers.

END OF SECTION

SECTION 32 11 34

CEMENT STABILIZATION OF MATERIAL IN PLACE

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This item consists of cement stabilizing existing granular type soil by pulverizing, adding Portland cement, mixing, wetting and compacting to the required lines, grades, and typical.

1.2 MEASUREMENT AND PAYMENT

- A. Payment for measured cement stabilization base will be made at the unit price bid in the Proposal. The bid price includes full compensation for loosening, preparation of secondary grade, furnishing, distributing, and mixing the cement and for all labor, material, tools, equipment and incidentals necessary to complete the work. Payment will not be made for unauthorized work.

1.3 SUBMITTALS

- Supplier's certification showing specification compliance of Portland cement.
- Asphaltic material for sealing.
- Traffic Control Plan

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Portland cement shall be Type I and shall conform to the requirements of ASTM Designation C 150.

2.2 TESTING REQUIREMENTS

- A. A compaction curve (ASTM D698) shall be performed for each type of material which is to be stabilized.
- B. In-place field density shall be determined by Nuclear Methods (ASTM D 2922) immediately upon completion of compaction. The cement treated material shall be tested for moisture content and density at locations selected by the Engineer. The frequency of tests is at least one every 100 lineal feet or a minimum of three (3) tests, whichever is greater.

PART 3 – EXECUTION

3.1. GENERAL:

- A. The completed course shall be uniformly treated, free from loose or segregated areas, and have uniform density and moisture content its full depth. The surface shall be smooth and suitable for placing subsequent courses. The Contractor has the responsibility to regulate

the sequence and continuity of work, to use the proper amount of cement, and maintain the work as necessary to meet the requirements of this specification.

- B. The Contractor shall insure that cement is adequately stored and protected from moisture before usage.
- C. All machinery, tools and equipment necessary for the proper prosecution of the work shall be on the project and available for inspection and approval by the Engineer prior to the beginning of construction operations.

3.2. PREPARATION AND PULVERIZATION

- A. The roadbed shall be shaped to conform to the lines, grades and typical sections shown on the Plans prior to beginning any cement treatment.
- B. The material to be treated shall be spread uniformly to the required cross-section, mixed and pulverized so that at least 80 percent passes the No. 4 sieve. This pulverization requirement may be waived when the material contains a substantial amount of aggregate and is approved by the Engineer.
- C. The Contractor may elect to use a cutting and pulverizing machine that will process the material to be stabilized in-place rather than excavate and windrow. This method will be permitted only if a machine is provided which will insure that the material is cut uniformly to the proper depth and which has cutters that will plane the secondary grade to a uniform surface over the entire width of the cut. The machine shall provide a visible indication of the depth of cut at all time. If this method is used the Contractor will be required to roll the subgrade prior to pulverization and correct any soft or unstable areas as directed by the Engineer.

3.3. APPLICATION

- A. Portland cement shall be spread uniformly on the soil at the specified rate. Cement shall be applied only on an area where the mixing, compacting, and finishing operations can be completed during the same working day.
- B. The cement shall be spread by an approved spreader or by bag distribution. Cement distribution shall be at a uniform rate and in a manner to minimize scattering by wind.

3.4. MIXING

- A. Single or multiple soil stabilizer mixers shall be used. The cement shall be dry-mixed with the soil prior to the addition of water. Immediately after dry-mixing, water shall be uniformly applied. After mixing, the cement treated soil shall be in a loose, evenly spread state ready for compaction. The soil and cement mixture shall not remain undisturbed for more than 30 minutes before compacting.

3.5. COMPACTION

- A. The mixture shall be wetted or dried to provide a moisture content within +4- percent of optimum and compacted until the entire depth is at a uniform density of at least 98 percent of maximum as determined by ASTM D698.

- B. Compaction shall be completed within 2 hours of the addition of water to the dry-mixed material. If the material fails to meet the moisture and density requirements within the 2 hour time frame, or for any reason or cause, lose the required stability, density and finish before the next course is placed. The treated material shall be removed and replaced unless otherwise approved by the Engineer. Removal and replacement with acceptable treated material will be at the Contractor's expense.

3.6. FINISHING AND CURING

- A. Immediately after compaction, the surface shall be bladed to a depth of 1/4 inch, removing all loosened materials. The loosened materials shall be disposed of at the Contractor's expense and at a location approved by the Engineer. The surface shall then be rolled with a pneumatic tire roller, adding small increments of moisture as needed during rolling.
- B. The completed section shall be moist cured for three (3) days or prevented from drying by addition of an asphaltic material at a rate of 0.10 to .030 gallons per square yard. The Contractor will be responsible for protecting any asphalt membrane from being picked up by traffic.
- C. The completed sections of soil cement may be opened immediately to local traffic and construction equipment, and to all traffic after the three (3) day curing period, provided the soil cement has hardened to prevent rutting and surface marring.

END OF SECTION

SECTION 32 12 13.16

**TACK COAT
(ASPHALTIC)**

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This item shall consist of an application of asphaltic material on a completed base course, after the prime coat has sufficiently cured; or on an existing pavement; bituminous surface and/or other approved area in accordance with these Specifications.

1.2 MEASUREMENT AND PAYMENT

- A. The asphaltic material for tack coat will be measured at point of delivery on the project in gallons at the applied temperature. The quantity to be paid for shall be the number of gallons used, as directed by the Engineer.
- B. The work performed and materials furnished as prescribed by this item will be paid for at the unit price bid per gallon for "Tack Coat". This price shall be full compensation for cleaning the surface, for furnishing, heating, hauling and distributing the tack coat as specified; for all freight involved; and for all manipulations, labor, tools, equipment and incidentals necessary to complete the work. Where no pay item is provided for in the Contract Documents the work performed and materials furnished as specified by this item shall be considered as subsidiary to the appropriate bid items.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. The asphaltic material used for tack coat shall meet the requirements for cut-back asphalt or emulsified asphalt as defined in SECTION 32 05 17 - ASPHALTS, OILS, AND EMULSIONS, and as approved by the Engineer. Cut-back asphalt can be made by combining 50% - 70% by volume of the asphaltic materials as specified for the type of paving mixture, with 30% -50% by volume of either gasoline and/or kerosene.
- B. The asphaltic material used for the tack coat may be further cut back by the addition of an approved grade of gasoline and/or kerosene not to exceed 15%, by volume, upon approval by the Engineer.

PART 3 – EXECUTION

3.1 GENERAL

- A. Before the tack coat is applied, the surface shall be cleaned thoroughly to the satisfaction of the Engineer. The asphaltic material shall be applied on the clean surface by an approved type of self-propelled pressure distributor so operated to distribute the tack coat at a rate not to exceed 0.10 gallon per square yard of surface. Proper distribution shall be considered as applying the tack coat evenly and smoothly while under pressure as well as other specified requirements. Where the pavement mixture will adhere to the surface on which it is to be placed without the use of a tack coat, the tack coat may be eliminated by the Engineer. All contact surfaces of curbs and structures and all joints shall be painted with a thin uniform

coat of the asphaltic material used for tack coat. The tack coat shall be applied only when the atmospheric temperature in the shade is 50° F or above and when the temperature has not been below 35° F for 12 hours immediately prior to application. The tack coat shall be rolled with a pneumatic tire roller as directed by the Engineer. During the application of tack coat, care shall be taken to prevent splattering of adjacent pavement, curb and gutters or structures. The Contractor shall be responsible for cleaning splattered areas as determined and directed by the Engineer.

END OF SECTION

SECTION 32 12 13.23

PRIME COAT - ASPHALTIC

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This item shall consist of the application of asphaltic material on the completed base course in accordance with these Specifications.

1.2 MEASUREMENT AND PAYMENT

- A. This item will not be considered a separate cost item. Cost for work herein specified, including the furnishing of all materials, equipment, tools, labor and incidentals necessary to complete the work shall be included in the unit price bid for Hot Mix Asphaltic Concrete.

1.3 SUBMITTALS

- A. Supplier and Material Safety Data Sheet.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. The asphaltic material used for the prime coat shall be MC-30 or RC-250. It shall meet the requirements of Texas Department of Transportation Specification 2004 Item 300 “Asphalts, Oils, and Emulsions”.

2.2 TESTING REQUIREMENTS

- A. If requested by the Engineer, the Contractor shall produce the calibration papers and certifications for the distributor being used on the project.

PART 3 – EXECUTION

3.1 GENERAL

- A. The following construction methods shall be used when applying asphaltic material:
 - 1. **SURFACE PREPARATION:** The surface shall be cleaned by sweeping, brooming or other approved methods when the base is satisfactory to receive the prime coat in the opinion of the Engineer.
 - 2. **PRIME COAT:** Prime coat shall not be applied when the atmospheric temperature is below 60 °F and falling. However, it may be applied when the temperature is above 50 °F and rising. The temperature determination shall be made by taking the temperature in the shade and away from artificial heat. Asphaltic material shall not be placed when general weather conditions are not suitable in the opinion of the Engineer.

3. APPLICATION: The surface shall be lightly sprinkled with water just prior to application of the asphaltic material if found necessary by the Engineer. The asphaltic material shall be applied to the cleaned base by an approved self-propelled pressure distributor. The distributor shall distribute the material evenly and smoothly under an adequate pressure for proper distribution. Uniform coverage is desired without pooling of excess material. The Contractor shall provide all necessary facilities for determining the temperature of the asphaltic material in all heating equipment and distributor. This information is to be used for determining the application rate and for securing uniformity at the junction of successive distributor loads. Asphaltic material shall be applied at a temperature consistent with and the range recommended in Texas Department of Transportation Specification 2004 Item 300 “Asphalts, Oils, and Emulsions.” The Engineer shall select the temperature of application and the Contractor shall apply the material at a temperature within 15° F of the selected temperature.
4. EQUIPMENT: All storage tanks, piping, retorts, booster tanks, and distribution equipment used in handling asphaltic material shall be kept clean and in good operating condition at all times. The equipment shall be operated in a manner which prevents contamination of the asphaltic material (with any foreign substance). It shall be the responsibility of the Contractor to provide and maintain in good working order at all times, a recording thermometer at the storage heating unit. The distributor shall have been recently calibrated and the Engineer shall be furnished an accurate and satisfactory record of the calibration. Should the yield on the applied asphaltic material appear to be in error after beginning the work, the distributor shall be re-calibrated in a manner satisfactory to the Engineer before proceeding with the work.
5. SURFACE MAINTENANCE: The Contractor shall be responsible for the maintenance of the surface until the work is accepted by the Engineer. No traffic, hauling or placement of final surface material will be permitted over the freshly applied prime coat until authorized by the Engineer.

END OF SECTION

SECTION 32 12 16

HOT MIX ASPHALTIC CONCRETE PAVEMENT

(Sentences and/or paragraphs that are double underlined indicate revisions that were made from the 2009 specification.)

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This item covers Hot Mixed Asphaltic Concrete Paving and consists of any combinations of base, level up, and finish courses.

1.2 MEASUREMENT AND PAYMENT

- A. Unless otherwise modified by the design engineer, Hot Mix Asphaltic Concrete Paving shall be measured by the square yard of each HMA CP course in conformity with the requirements, and meeting all requirements of the plans and special provisions (if any) with regards to line, grade, compacted thickness, air voids, and final cross section.
- B. Sliding scale pay factors or alternative remedies may be applied for City capital projects at the City’s discretion. Sliding scale factors will be applied for the unit price bid for Hot-Mix Asphaltic Concrete, which fail to meet the density requirements. The sliding scale pay factors are shown in the table below. They shall be applied to each day’s production.

The table below applies to both development and capital projects. In the case of a development project the column titled “Percent Payment” does not apply.

<u>Average Percent Air Voids*</u>	<u>Alternate Remedies</u>	<u>Percent Payment</u>
8.0 or Less	Do Nothing	100
8.1 to 10.0	1” HMA CP Overlay w/ Wedge Grind	85
10.1 to 12.0	1” HMA CP Overlay w/ Wedge Grind	75
Above 12.0	Remove and Replace	Reject **

* Average of 4 samples

**If the Engineer agrees to accept densities below 88.0%, the pay factor shall be 50%.

- C. Unless otherwise modified by the design engineer, all labor, equipment and materials necessary to provide Hot Mix Asphaltic Concrete Paving in place in accordance with the plans, special provisions and these specifications will be paid for at the unit price designated in the proposal and included in the construction contract. Any tack and/or prime coat shall be considered subsidiary to the bid item “Hot Mix Asphaltic Concrete”.

1.3 SUBMITTALS

- A. Mix Design
- B. Aggregate Properties

PART 2 – PRODUCTS

2.1 MATERIALS

HMAC shall be composed only of the following materials:

- A. **MINERAL AGGREGATE:** Mineral aggregates shall consist of sound, durable stone particles of limestone, slag, or a mixture thereof of uniform quality throughout and free from dirt, organic or other deleterious material occurring either freely in the material or as a coating on the aggregate. Abrasion loss of aggregate material shall not exceed 40% (unless lightweight) when tested in accordance with the Los Angeles Abrasion Test (ASTM C-131).
- B. **MINERAL FILLER:** Mineral filler shall consist of thoroughly dry stone dust of uniform quality throughout and free from dirt, organic or other deleterious material occurring either freely in the material or as a coating on the material. The plasticity index of any mineral filler shall be less than 6.
- C. **ASPHALT:** Asphalt shall be grade PG64-22, PG 70-22 or PG76-22 as designated by the design engineer and the same shall be used on all HMAC provided for any one project.
- D. The paving mixture shall consist of a uniform mixture of aggregates, fillers and asphaltic material as required to meet the following requirements:
 - 1. **Coarse Aggregate:** Coarse aggregate (retained on the No. 10 sieve) shall be so crushed as to have a minimum of 85% of the particles retained on the No. 4 sieve with two or more mechanically induced crushed farces as determined by Tex-460-A (Part 1). Field sand, if used, shall not exceed fifteen (15%) percent of the total aggregate mix.

GRADATION AND ASPHALT CONTENT

Column 1	Column 2						Column 3
AGGREGATE GRADATION (ASTM C-136)	TOLERANCE FOR JOB-MIX FORMULA * PERCENT BY WEIGHT						TOLERANCE FOR COMPANY FIELD SAMPLE LAB RESULTS TO JOB MIX FORMULA **
PASSING	TYPE 'D'		TYPE 'C'		TYPE 'B'		TOLERANCE
	Low %	High %	Low %	High %	Low %	High %	
1-1/2" sieve							+/- 5%
1" sieve					98	100	+/- 5%
3/4" sieve			95	100	<u>84</u>	<u>98</u>	+/- 5%
1/2" sieve	98	100					+/- 5%
3/8" sieve	85	100	70	85	60	80	+/- 5%
No. 4 sieve	50	70	43	63	40	60	+/- 5%
No. 8 sieve	<u>35</u>	<u>46</u>	<u>32</u>	<u>42</u>	<u>29</u>	<u>43</u>	+/- 3%
No. 30 sieve	<u>15</u>	<u>29</u>	<u>14</u>	<u>28</u>	<u>13</u>	<u>28</u>	+/- 3%
No. 50 sieve	<u>7</u>	<u>20</u>	<u>7</u>	<u>21</u>	<u>6</u>	<u>20</u>	+/- 3%
No.200 sieve	<u>2</u>	<u>7</u>	<u>2</u>	<u>7</u>	<u>2</u>	<u>7</u>	+/- 3%
VMA % Min	14		13		12		
Asphalt Content	4	8	4	8	3.5	7	+/- 0.5%

* Column 2 above is the tolerance to be used when creating the job-mix formula

** Column 3 above is the tolerance to be used when comparing the field sample lab results to the job-mix formula. The lab results must fall within the given tolerance when compared to the job-mix formula.

*** A copy of the job-mix formula must be given to the city inspector or representative prior to the placement of asphalt on the job site.

The City, at any time, may require a test be performed to determine if anti-stripping agents are needed for a particular mix. Samples not meeting the specifications listed above will be rejected or may be negotiated for a reduced payment if allowed by the City Engineer.

2. Laboratory Stability: When the proposed mix is prepared in accordance with TxDOT Item 340 (HVEEM Method) the stability shall be at least 35 percent. The tolerance for the density shall be +/- 1% based on the density provided on the job mix formula.
3. Laboratory Density: When the proposed mix is prepared in accordance with ASTM D-1559 the air voids of the material as determined by ASTM D-3203 shall be between two percent (2%) and five percent (5%).

2.2 TESTING REQUIREMENTS

The following processes shall be undertaken to assure the desired quality in the constructed product:

- A. MIX VERIFICATION: The testing laboratory representative in accordance with both of the following guidelines shall take HMAC samples from the delivering trucks:
 1. One sample for each day of delivery and placement.
 2. For larger jobs, the City may require two samples be taken, one in the morning and one in the afternoon.

The testing laboratory shall:

1. Note the location where the HMAC being sampled is to be placed.
 2. Determine the temperature of the mix at the time the sample is taken. If the temperature is outside of the allowable range as specified in Section 3.1 of this specification, the laboratory representative shall immediately inform the paving contractor's superintendent and the City Inspector.
 3. Transport the sample to the laboratory and perform the necessary tests and operations to verify the compliance with the mix design set forth by the design engineer within the tolerances given in Section 1.3 of this specification.
 4. Provide written results to the tests and operations as described above to both the paving contractor's superintendent and the City Inspector within 5 working days.
- B. COMPACTION VERIFICATION: Compaction tests shall be made following the same schedule of testing as the sampling operations listed above with the City Representative determining the exact location for testing.

The testing laboratory representative shall:

1. Note the location of the compaction test performed
2. Obtain core samples of the paving via ASTM D-5361
3. Transport the cores to the laboratory and perform the necessary operation per ASTM D-3203 to determine the resulting pavement air void percentage.

- 4. Provide written results of the tests and operations as described above to both the paving contractor’s superintendent and the City Inspector within 5 working days.

Compacted HMAC pavement meeting this specification shall have between two percent (2%) and eight percent (8%) air voids.

COMPACTED LIFT THICKNESS AND REQUIRED CORE HEIGHT

Mixture Type	Compacted Lift Thickness	
	Minimum (in.)	Maximum (in.)
A	3.00	6.00
B	2.50	5.00
C	2.00	4.00
D	1.50	3.00
E	1.25	2.50

- C. **THICKNESS VERIFICATION:** For each core sample taken from the finished paving, the thickness of the HMAC portion of the section shall be measured, noted and provided to the City for review. The thickness shall be as required on the table above.
- D. **FINISH SURFACE TOLERANCES:** The finish surface of the compacted pavement shall be sealed, smooth and true to the line, grade and cross section as established in the contract documents. There shall be no deviation in excess of 1/8 inch per foot of distance from the nearest point of contact when tested with a 10-foot straight edge placed parallel to the centerline of the roadway. There shall be no deviation from the straight edge in excess of 1/4 inch at any point.
- E. The hot-mix asphaltic concrete will be accepted for density based on one day’s production. Each day’s production will be divided into four sections and one cored or sawed sample will be taken for each section. Each day’s production will be accepted, with respect to density, when the average field density determined from the cores is equal to or greater than 92 percent of the maximum theoretical density as determined in accordance with ASTM D2041, and when no individual core density is less than 88.0 percent of the maximum theoretical density. If the Contractor elects to have the density testing rechecked, another group of four cores per each day’s production will be obtained. The recheck group will not be averaged with any previous tests.

PART 3 – EXECUTION

3.1 GENERAL

- A. The Contractor shall retain full control of all materials, labor methods and equipment used in the placement and compaction of HMAC paving with the following exceptions:
 - 1. Temperature – HMAC and/or tack coat materials shall not be placed when the air temperature is 50° F or lower and falling. Placement may be allowed if roadway surface temperature is 60 degrees or higher. Measure roadway surface temperature with a handheld IR thermometer.
 - 2. Tack Coat – Tack coat shall be applied to clean, dry asphalt surfaces and between asphalt lifts only and shall be applied just prior to placement of HMAC materials. The Contractor shall neatly tack all gutter edges before placing any HMAC. The tack coat material shall be SS-1 applied at a rate of 0.04 to 0.10 gal/sy.

3. **HMAC Temperature** – HMAC materials shall be placed between 250° F and 340° F. Compaction is not allowed on HMAC that has cooled below 210° F at the pavement surface.
4. **Rolling Water** – Small amounts of water may be used to keep the HMAC from adhering to the placement and compaction equipment. Excessive water and/or any use of petroleum products for this purpose are not allowable.
5. **Compaction Roller Traffic** – Compaction rollers shall be kept at a slow enough speed to prevent any displacement of material. Rollers shall not be allowed to stand or park on the finished and compacted paving until after 12 hours has passed after final compaction.

END OF SECTION

SECTION 32 12 36.13

SEAL COAT**PART 1 - GENERAL****1.1 DESCRIPTION**

- A. This item shall consist of a surface treatment composed of a single application of asphalt covered with aggregate for sealing existing pavements in accordance with these Specifications. Asphaltic material shall not be placed when general weather conditions, in the opinion of the Engineer, are not suitable.

1.2 MEASUREMENT AND PAYMENT

- A. Seal-coat will be measured and computed in square yards of material "in-place".
- B. The work performed and materials furnished as prescribed and measured will be paid for at the unit price bid for "Seal-coat" which price shall be full compensation for furnishing, freight involved, preparing, hauling, and placing all materials: and for all manipulations, labor, tools, equipment and incidentals necessary to complete the work, including the necessary rolling and sweeping.

1.3 SUBMITTALS

- A. Testing Reports showing conformance to Item No. 302 and Item No. 300 per Texas Department of Transportation Specifications 2004.
- B. Calibration papers and certifications for the distributor to be used.
- C. Material Safety Data Sheets.

1.4 WEATHER LIMITATIONS

- A. The seal coat shall be applied when the air temperature is will not drop below 75° F for a period of 72 hours.

PART 2 – PRODUCTS**2.1 MATERIALS**

- A. Asphaltic materials used in the application of the seal coat shall be AC15-5TR or HFRS-2-P as prescribed in Texas Department of Transportation Specifications 2004 Item No. 300 "Asphalts Oils and Emulsions." Aggregate used shall be Type PB, Grade 4 or Grade 5 or Trap Rock Type B, Grade 5 with grading and consensus properties as specified in Texas Department of Transportation Specifications 2004 Item No. 302 "Aggregates for Surface Treatments."

2.2 CONSTRUCTION EQUIPMENT

- A. Asphaltic material shall be applied on the cleaned surface by an approved type of self-propelled pressure distributor operated as to distribute the material in the quantity specified, evenly and smoothly, under a pressure necessary for proper distribution. The contractor shall provide all necessary facilities for determining the temperature of the asphaltic material in all of the heating equipment and in the distributor, for determining the rate at which it is applied, and for securing uniformity at the junction of two distributor loads. The distributor shall have been recently calibrated and the Engineer shall be furnished with an accurate and satisfactory record of such calibration. After beginning the work, should the yield on the asphaltic material appear to be in

error, the distributor shall be calibrated in a manner satisfactory to the Engineer before proceeding with the work. All storage tanks, piping, booster tanks, and distributors used in storing or handling asphaltic material shall be kept clean and in good operating condition at all times, and they shall be operated in such a manner that there will be no contamination of the asphalt with foreign materials. It shall be the responsibility of the contractor to provide and maintain in good working order a recording thermometer at the storage heating unit at all times.

2.2 TESTING REQUIREMENTS

- A. At the discretion of the Engineer, the aggregate and asphalt may be sampled and tested for conformance to Item No. 300 and 302 of the Texas Department of Transportation Specifications, 2004.

PART 3 – EXECUTION

3.1. CONSTRUCTION:

- A. **GENERAL:** The area to be treated shall be cleaned of dirt, dust or other deleterious matter by sweeping or other approved methods. If it is found necessary by the Engineer, the surface shall be lightly sprinkled with water just prior to the application of asphaltic material.
- B. **AGGREGATE:** Aggregate shall be immediately and uniformly applied and spread by an approved self-propelled continuous feed aggregate spreader, unless otherwise shown on the Plans or authorized by the Engineer in writing. The aggregate shall be applied at the rate of approximately one (1) cubic yard per 110 to 125 square yards of surface area. The rock shall be rolled to provide proper embedment of the aggregate to the asphalt.

Temporary stockpiling of aggregates on the roadway will be permitted provided the stockpiles are spaced not less than 1,000 feet apart. They are to be placed so that they neither obstruct traffic nor interfere with roadway drainage. The contractor shall be responsible for proper preparation of the temporary stockpile areas before aggregates are placed thereon, including leveling and cleaning of debris necessary for protection of the aggregate to prevent any contamination.

- C. **SURFACE:** All surfaces will be rolled first with self-propelled pneumatic rollers. The entire surface shall then be broomed and excess aggregate removed. The removal of the excess rock shall take place in sufficient time so that the loose rock does not begin to break down the aggregate in place.

The contractor shall be responsible for the maintenance of the surface until the work is accepted by the Engineer. All holes or failures in the seal coat surface shall be repaired by use of additional asphalt and aggregate and all fat or bleeding surfaces shall be covered with approved cover material in such a manner that the asphaltic material will not adhere to or be picked up on the wheels of vehicles.

END OF SECTION

SECTION 32 12 36.14

ONE COURSE SURFACE TREATMENT**PART 1 - GENERAL****1.1 DESCRIPTION**

- A. This item shall consist of a wearing surface composed of a single application of asphaltic material covered with aggregate, constructed on the prepared base course in accordance with these specifications.

1.2 MEASUREMENT AND PAYMENT

- A. Asphaltic materials will be measured at the point of application on the road in gallons at the applied temperature. Aggregate will be measured by the cubic yard of material in vehicles at the point of stockpiling.
- B. The work performed and materials furnished as prescribed by this item will be paid for at the unit prices bid for "Asphalt" and "Aggregate" of the specified type and grade which shall be full compensation for cleaning and sprinkling the base; for furnishing, preparing, hauling, and placing all materials; for all freight; for rolling; and for all manipulations, labor, tools, equipment, and incidentals necessary to complete the work.

PART 2 – PRODUCTS**2.1 MATERIALS**

- A. ASPHALTIC MATERIALS: The asphaltic material used shall be one or more of the materials prescribed in SECTION 32 05 17 - ASPHALTS, OILS AND EMULSIONS.
- B. AGGREGATE: The aggregate used shall be Type C, Grade 3, unless otherwise specified in the Plans and Specifications, and shall meet the requirements of SECTION 32 11 34 - AGGREGATE FOR SURFACE TREATMENTS.

PART 3 – EXECUTION**3.1. CONSTRUCTION:**

- A. GENERAL: One course surface treatment shall not be applied when the atmospheric temperature is 60° F and falling. However, it may be applied when the temperature is above 50° F and rising. The temperature must be taken in the shade and away from artificial heat. Asphaltic material shall not be placed when general weather conditions are not suitable in the opinion of the Engineer.

The area to be treated shall be cleaned of dirt, dust, or other deleterious matter by sweeping or other approved methods. If necessary the surface shall be lightly sprinkled with water just prior to the application of the asphaltic material.

- B. EQUIPMENT: Asphaltic material shall be applied on the clean surface by an approved type of self-propelled pressure distributor. The distributor shall be able to distribute the material in the specified quantity evenly and smoothly under pressure. The contractor shall provide all necessary facilities for determining the temperature of asphaltic material in the heating equipment and the distributor. This will aid in determining the application rate and for

securing uniformity at the junction of two distributor loads. The distributor shall have been recently calibrated and the Engineer shall be furnished an accurate and satisfactory record of the calibration. Should the yield on the asphaltic material appear to be in error after beginning the work, the distributor shall be recalibrated in a manner satisfactory to the Engineer before proceeding with the work. All storage tanks, piping, retorts, booster tanks and distributors used in storing or handling asphaltic materials shall be kept clean and in good operating condition at all times. They shall be operated in a manner so that there will be no contamination of the asphaltic materials with foreign material.

- C. APPLICATION: Asphaltic material shall be applied for the full width of the surface treatment in one application, unless the width exceeds twenty-six (26) feet. No traffic or hauling will be permitted over the freshly applied asphaltic material. Asphaltic material shall not be applied until the contractor can assure immediate covering.
- D. AGGREGATE: Aggregate shall be immediately and uniformly applied and spread by an approved self-propelled continuous feed aggregate spreader. The aggregate shall be applied at the approximate rates indicated in the specification or as directed by the Engineer.
- E. SURFACE: The entire surface shall be broomed, bladed or raked as required by the Engineer. The surface shall also be thoroughly rolled with the type or types of rollers as specified in the Plans and Specifications and/or as approved by the Engineer. Rolling equipment shall meet the requirements for SECTION 32 11 29.02 - ROLLING. The Contractor shall be responsible for the maintenance of the surface until the work is accepted by the Engineer.
- F. TEMPERATURE AND VISCOSITY: It shall be the responsibility of the contractor to provide and maintain in good working order a recording thermometer at the storage heating unit at all times. The Engineer will select the temperature of application. This temperature will be based on the temperature-viscosity relationship that will permit application of the asphalt within the limits recommended in SECTION 32 05 17 - ASPHALTS, OILS AND EMULSIONS. The recommended range for the viscosity of the asphalt is 100 to 120 centistokes. The contractor shall apply the asphalt at a temperature within 15° F of the selected temperature.

END OF SECTION

SECTION 32 13 13

CONCRETE PAVEMENT

(Sentences and/or paragraphs that are double underlined indicate revisions that were made from the 2009 specification.)

PART 1 - GENERAL

1.1 DESCRIPTION

This item shall consist of a pavement of Portland cement concrete as herein specified on the prepared base, subbase or subgrade course in conformity with the thickness, typical cross-sections, and to the lines and grades shown on the Plans by the Engineer.

1.2 MEASUREMENT AND PAYMENT

- A. Concrete pavement shall be measured by the square yard of surface area of completed and accepted pavement or as shown on the bid documents. When the Plans, Specifications and Proposal required the construction of a "Monolithic Curb" the limits of measurement for concrete pavement shall be from back to back of curb.
- B. The work performed and the materials furnished under this item and measured as provided under "Measurement" shall be paid for at the unit price bid per square yard for the thickness indicated in the Proposal. The unit price bid for "Concrete Pavement" shall be full compensation for shaping and fine grading the subgrade, forming, mixing, placing, jointing, finishing and curing all concrete; for furnishing all labor, tools, equipment, materials, and incidentals necessary to complete the work..

1.3 SUBMITTALS

- See SECTION 03 30 00 - CONCRETE
- Paving Plan
- Joint Sealing Compound
- Expansion Joint Material

PART 2 – PRODUCTS

2.1 MATERIALS

See SECTION 03 30 00 - CONCRETE

2.2 TESTING REQUIREMENTS

See SECTION 03 30 00 - CONCRETE

PART 3 – EXECUTION

3.1 GRADE CONTROL

The lines and grades shown on the contract drawings for each pavement category of the contract shall be established and maintained by means of line and grade stakes. The finished pavement grade lines and elevations shown on the contract drawings shall be established and controlled at the site of the work by the Contractor in accordance with benchmark elevations furnished by the Owner. The pavements shall be constructed to the indicated thicknesses and elevations. The tolerances permitted in thickness, smoothness, and grades are the normal deviations that may occur in pavement construction under good supervision. However, construction of pavement or any part thereof with intent to use maximum tolerances will not be permitted.

3.2 SUBGRADE, SUBBASE, BASE AND FORMS

A. EQUIPMENT:

1. Subgrade Planer: Subgrade planer mounted on visible rollers riding on the forms or edges or previously constructed slabs shall be provided for shaping the final surface of the subgrade, subbase, or base course. Any power equipment used to pull the subgrade planer shall not produce ruts or indentations in the subgrade, subbase or base course. The subgrade planer shall be equipped with steel cutting edge capable of being accurately adjusted to the required cross section. When the subgrade planer rides on the edges of the surface of previously constructed slabs, the planer shall be provided with rubber-tired rollers to prevent damage to surfaces and edges of the existing concrete.
2. Templates: The Contractor shall provide and operate a scratch template for checking the contour of the subgrade, subbase, or base course. The template or roller is to be mounted with the wheels supported on the side forms or concrete in adjacent lanes. It shall be of such strength and rigidity that under a test made by changing the support to the center the template will not show a deflection of more than 1/8 inch. The template shall be provided with adjustable rods projecting downward to the subgrade at not more than 1-foot intervals. These rods shall be adjusted to the required cross section of the bottom of the slab when the ends of the template are supported on the side forms or concrete in the adjacent lanes. The template shall be checked frequently during use to assure that the rods are in the correct position.
3. Forms: The forms shall be made of metal unless noted. Wood forms may be used on curves having a radius of 150 feet or less, as well as for fillets. Forms shall be equal in depth to the edge thickness of the slab as shown on the drawings. Forms shall be in one piece for the full depth required, except as noted. Where the drawings provide several different slab thicknesses, forms may be built up of metal or wood as provided. Forms may be increased in depth 25 percent by securely bolting or welding to the bottom a tubular metal section of the proper thickness or by securely bolting wood planks to the bottom of the steel form. The tubular metal section or wood planks shall completely cover the under side of the base of the steel form. It shall extend beyond the edge of the base a sufficient distance to provide the necessary stability against movement along the vertical face. The base width of the one-piece form, or built-up form, shall be not less than eight-tenths of the vertical height of the form.
 - a.) Metal Forms: Metal forms shall be of a cross section and shall be furnished in sections not less than 10 feet in length. Curves having a radius of 150 feet or less the length of the sections shall be 5 feet unless the sections are flexible or curved to the proper radius. Each 10-foot length of form shall be provided with at least three form braces and pin sockets. The number and spacing of the form braces and pin sockets shall be such that the form will be rigidly braced

uniformly throughout its length and at the joints between form sections. Lock joints between form sections shall be free from play or movement. Metal forms shall have such strength that when tested as simple beam with a load equal to the weight of the heaviest machine to be used on the forms, the deflection will not exceed 1/8 inch in 10 feet. Forms shall be provided with adequate devices for secure setting to prevent springing, weaving, or settling from the impact and vibrations of the machine. Forms shall be free of warps, bends, or kinks. The top surface of a form shall not vary more than 1/8 inch in 10 feet from a true line. The face of the form shall not vary more than 1/4 inch in 10 feet from a true plane. Forms with battered top surfaces distorted faces or bases shall not be used. They are to be removed from the project site.

- b.) Wood Forms: Wood forms for curves and fillets shall be made from well-seasoned, surfaced plank or plywood. The wood shall also be straight, free from warp or bend, and not less than 2 inches in nominal thickness. Wood forms shall be furnished in sections approximately 5 feet in length and shall be provided with adequate devices for secure setting to withstand springing, weaving, or settling from the impact and vibration of the placing and finishing operations.
4. Subgrade, Subbase or Base Course: The subgrade, subbase or base course shall be tested as to crown, elevation, and density in advance of setting the forms. The subgrade prior to final planing shall be completed to or above the plane of the typical sections shown on the drawings and the lines and grades established by the drawings or as directed. Any discrepancies shall be corrected in accordance with the requirements for subgrade, subbase or base course construction as specified.
5. Form Setting: After the subgrade, subbase or base course has been prepared as described above, the forms shall be set. The subgrade, subbase, or base course under the forms shall be firm and cut true to grade so that each in place form section will be firmly in contact for its entire length and base width. The form shall be staked into position. The top of the form will conform to the requirements specified for the finished surface of the concrete, and the longitudinal axis of the upstanding leg will not vary more than 1/4 inch from the straight-edge when tested by a 12-foot straight-edge. The length and number of pins in any section shall be sufficient to hold the form at the correct line and grade. Form sections shall be tightly locked together. Conformity to the alignment and grade elevations shown on the drawings shall be checked and necessary corrections made by the Contractor immediately prior to placing the concrete. Forms shall be set well in advance of concrete placement. At least 250 feet of forms and prepared subgrade, subbase or base course shall be provided before concrete placement starts. The forms shall be cleaned and oiled each time before concrete is placed.
6. Subgrade Between Forms: The subgrade, subbase, leveling course or base course shall be free of foreign matter, waste concrete, cement and debris at all times; shall be finished to the required section of the bottom of the pavement as shown on the drawings with specified equipment; shall be tested with a template operated and maintained by the Contractor; shall be maintained in a smooth, compacted condition, in conformity with the required section and established grade until the concrete is in place; shall be wetted down sufficiently in advance to insure a firm, moist, and satisfactory condition when the concrete is placed; shall, if required, be thoroughly wetted down the previous night or not less than 6 hours before placing the concrete; shall not be traversed with equipment or hauling on the prepared surface between

forms; in cold weather shall be prepared and protected in a satisfactory condition and entirely free from frost when the concrete is placed; and shall not be treated with chemicals to eliminate frost.

7. Form Removal: Forms shall remain in place at least 12 hours after the concrete has been placed. Should weather conditions delay the early-strength gain of the concrete, the forms shall remain in place for a longer period. Forms shall be removed without injuring the concrete. Bars or heavy tools are not to be used against the concrete in removing the forms. Any concrete damaged in form removal will be repaired promptly by the Contractor at no cost to the Owner.

3.3 FINISHING

Finishing operations shall be started immediately after placement of the concrete. The sequence of operations shall be as follows: transverse finishing, longitudinal floating, straight-edge finishing, carpet drag finishing, and finally the edging of joints. The machine method of finishing shall be employed, except that hand methods may be permitted as approved by the engineer. Finishing equipment and tools shall be maintained clean, free from hardened concrete or grout, and in an approved condition.

A. MACHINE FINISHING:

1. Equipment: The transverse and longitudinal finishing machines shall be power driven, be of ample weight and power to produce proper finishing, and be able to withstand the roughest treatment anticipated under job conditions. The transverse-finishing machine shall be designed and operated to strike off, screed, and consolidate the concrete. It shall be equipped with two screeds readily and accurately adjustable for changes in pavement crown and compensation for wear and other causes. The longitudinal - finishing machine shall be provided with a longitudinal float not less than 10 feet in length, readily adjustable to a true plane and properly stiffened to prevent distortion during use. Screed and float adjustments of these machines shall be checked at the start of each day's paving operations and as often as required. Machines that cause frequent delays due to mechanical failure shall be replaced. Finishing machines that ride the edge of a previously constructed slab shall have rubber-tired wheels to prevent damaging the surface and edges of the concrete.
2. Transverse finishing: Concrete, as soon as placed, shall be accurately struck off and screeded to the crown and cross section shown on the drawings. The final surface elevation or grade is to be non-porous when properly consolidated and finished. The finishing machine shall make at least two trips over each area of pavement, and may make one or two additional trips as necessary to properly compact the concrete and produce a surface of uniform texture, as well as true to grade. However, excessive manipulation that brings to the surface an excess of mortar and water will not be permitted. Any equipment that cannot produce the required compaction and surface finish with the indicated number of trips will be considered unsatisfactory. The top of the form or pavement edge upon which the finishing machine travels shall be kept clean by an effective device attached to the machine, and by necessary hand methods. This will insure that the travel of the machine will be maintained true without lift, wobble, or other variation that would affect the precision of the finish.
3. Longitudinal Floating: After completion of finishing with the transverse-finishing machine, the longitudinal mechanical float shall be operated to smooth and finish the pavement to grade. The float shall be operated parallel to the centerline of the

pavement with a short, quick motion, and shall travel slowly along the pavement, maintaining contact with the surface at all times. If contact with the surface is not made at all points, additional concrete as required shall be placed and screeded. The float is to be operated over the same area until a satisfactory surface is produced. In advancing the float, each new position shall lap the previous position by not less than one-half the float length.

4. Other Types of Finishing Equipment: Other types of concrete finishing equipment may be used on a trial basis. Such finishing equipment shall be approved by the Engineer before being put into service. The use of equipment that fails to produce approved results when finishing concrete of the quality and consistency required by these specifications shall be discontinued. The concrete shall then be floated and finished with equipment in the manner as specified above.
- B. HAND FINISHING: This method shall be employed only under the conditions previously specified, except as otherwise permitted and authorized by the Engineer.
1. Equipment: An approved strike and tamping template and a longitudinal float shall be provided for hand finishing. The template shall be at least 1 foot longer than the pavement width, be equipped with handles, and have edges at least 4 inches wide. The longitudinal float shall be 10 to 16 feet in length, with a cross section of an inverted T made of a 2 X 6 inch or wider plank for the base and a 2 X 8 inch plank for the vertical leg. The float shall be rigid, substantially braced, be able to maintain a plane surface on the bottom of the base, and shall have suitable handles for smooth and effective manipulation from the foot bridges. The bottom edges of the base of the float shall be rounded on a radius not exceeding 3/8 inch. Floats made of metal or a combination of wood and metal may be used provided they conform to the requirements for wood floats.
 2. Finishing and Floating: Immediately after placement, concrete shall be struck off and screeded to the crown and cross section shown on the drawing. The consolidated and furnished surface elevation shall be in accordance with the drawings or as specified. The entire surface shall be tamped, and the tamping operation is to be continued until accomplishing the required compaction and reduction of internal and surface voids. Concrete that is inaccessible to the vibrating consolidating equipment shall be consolidated with the aid of hand-manipulated vibrators under provisions of the subparagraph 125.06 (C)"Vibration". Immediately following the final tamping of the surface, the pavement shall be floated longitudinally by hand from bridges resting on the side forms and spanning but not touching the concrete. If contact with the pavement is not made at all points by the float, additional concrete shall be placed as required and screeded, and the float operated until a satisfactory surface has been produced. After a section has been smoothed so that the float maintains contact with the surface of the concrete at all points, the bridges may be moved forward half the length of the float. The operation is to be repeated over the new and previously floated surfaces.
 3. Straight-edge Finishing: Minor irregularities and score marks in the pavement surface shall be eliminated by means of long-handled wood floats and straight-edges after the longitudinal floating is completed, but while the concrete is still plastic. When necessary, excess water and laitance shall be removed from the surface transversely by means of a finishing straight-edge. The long-handled floats may be used to smooth and fill in open-textured areas in the pavement surfaces. The final finish shall be made with the straight-edges. The use of long-handled floats shall be held to a minimum as necessary to correct local surface unevenness not corrected by the longitudinal float.

Long-handled floats shall not be used to float the entire pavement surface. Straight-edges shall be 12 feet in length and may be operated from bridges and from the side of the pavement. A straight-edge operated from the side of the pavement shall be equipped with a handle 3 feet longer than one-half the width of the pavement. The surface shall then be tested for trueness with a 12-foot straight-edge held in successive positions parallel and at right angles to the centerline of the pavement in contact with the surface. The whole area is to be covered as to detect variations. The straight-edge shall be advanced along the pavement in successive stages of not more than one-half the length of the straight-edge. Depressions shall be immediately filled with freshly mixed concrete, struck off, consolidated, and refinished. Projections above the required elevation shall also be struck off and refinished. The straight-edge testing and finishing shall continue until the entire surface of the concrete is free from observable departure from the straight-edge, conforms to the required grade and contour and when hardened, will satisfy the surface requirements specified under subparagraph 125.13(B) "Surface Smoothness".

4. Carpet Drag Finishing: Use an artificial grass-type carpet having a molded polyethylene pile face with a blade length of 5/8 inch to 1 inch, a minimum weight of 70 ounces/square yard, and a strong, durable, rot-resistant backing material bonded to the facing. The surface of the pavement shall be dragged longitudinally in the direction of the concrete placement with the carpet drag when most of the water glaze or sheen has disappeared and before the concrete becomes non-plastic. The carpet drag should be of sufficient transverse length to span the full width of the pavement being placed and adjustable so that a sufficient longitudinal length of carpet is in contact with the concrete being placed to produce the desired texture. The leading transverse edge of the drag shall be securely fastened to a traveling bridge or a moveable support system. The carpet drag shall be cleaned and changed as required. The dragging shall be carefully done to produce a finished surface having a fine granular or sandy texture without leaving disfiguring marks. The surface of the pavement at joint edges shall be dragged as necessary with a small hand-operated drag following edge tooling. No tool marks of any kind shall be present on the finished surface.

3.4 CONSTRUCTION JOINTS

Construction joints shall be prepared for receiving the next pour by sweeping the surface of the joint clean with a stiff broom or wire brush to remove all laitance. All loose particles and debris shall be removed. The surface is to be dampened just prior to casting of concrete against the joint. Construction joints will be made only at locations shown on the Plans unless written permission is granted by the Engineer to make additional joints.

- A. LONGITUDINAL CONSTRUCTION JOINTS: Longitudinal construction joints between paving lanes shall be located as indicated on the drawings. Dowels or keys shall be installed in the longitudinal construction joints as required and in accordance with the indicated details. Metal keyway forms shall be used for forming horizontal keyways. The dimensions of the keyway forms shall not vary more than plus or minus 1/16 inch from the indicated dimensions. The keyway form shall be securely fastened to the concrete form so that it will be at the mid-depth of the pavement within a tolerance of plus or minus 1/8 inch. All longitudinal construction joints shall be edged and subsequently sawed to provide a groove at the top conforming to the indicated details and dimensions.

- B. **TRANSVERSE CONSTRUCTION JOINTS:** Transverse construction joints shall be installed at the end of each day's placing operations and at any other points within a paving lane when concrete placement is interrupted for 30 minutes or longer. All transverse construction joints in non-reinforced pavements shall be installed in the location of a planned transverse contraction or expansion joint. Transverse construction joints located at planned transverse joints shall be of the doweled type with one end of each dowel painted and greased to permit movement at the joint. These joints shall be edged and subsequently sawed to provide a groove at the top conforming to the indicated details and dimensions. When concrete placing is resumed, the planned joint spacing shall be used beginning with the first regularly scheduled transverse joint.

3.5 EXPANSION JOINTS

Three quarter (3/4) inch expansion joints shall be provided at forty (40) feet on center or of the type, size, and spacing shown on the Plans. The expansion joint materials shall be as shown on the plans or a recycled material, 3/4" thick as manufactured by J.D. Russel Co., or approved equal. The joint sealing compound shall be Sonneborn SL-1 or approved equal. Manufacturers' recommendations must be strictly adhered to. Devices used for installing the joints shall be adequate to hold the parts of the joint in proper position while protecting the filler from damage during concreting operation. The devices shall also be removable without permanent detriment to the pavement. Adjacent sections of filler shall be fitted tightly together and held in line to insure continuity. Concrete shall be prevented from entering the expansion space. Any concrete that has flowed into a gap between an expansion joint strip and edge forms of the pavement shall be cut out immediately after removing the forms. Expansion joints shall be formed about structures and features that project through, into, or against the pavement. Joint filler must be of the type, thickness, and width as indicated or directed and installed to form a complete, uniform separation between the structure and pavement.

3.6 CONTRACTION JOINTS

- A. Contraction joints shall be provided at twenty (20) feet on center or of the type, size, and spacing shown on the Plans. Contraction joints may be either tooled or sawed but must provide a minimum depth of 1/4 of the thickness of the concrete and sealed as shown on the plans or with Sonneborn SL-1 or approved equal. When sawed joints are used, the sawing should begin as soon as the concrete has obtained adequate strength to resist raveling of the joint edges, generally between 4 and 24 hours. The joints must be flushed or blown clean immediately after sawing to keep the residue from setting up.
- B. Transverse and longitudinal contraction joints shall be of the weakened-plane or dummy type, and shall be constructed in conformance with the indicated details and dimensions. Longitudinal contraction joints shall be constructed by sawing a groove in the hardened concrete with a power-driven saw. Tie bars in longitudinal contraction joints shall be prepared and placed across joints where indicated in the plans. They shall be correctly aligned and securely held in the proper horizontal and vertical position during the placing and finishing operations to the satisfaction of the Engineer.
1. **Sawed Joints:** The groove of contraction joints shall be not less than 1/4 inch nor greater than 3/8 inch in width for the entire depth of saw cut shown on the drawings. The upper portion of the groove is to be widened to not less than 3/8 inch nor more than 5/8 inch for a depth of 1/4 of the pavement thickness, plus or minus 1/8 inch, below the pavement surface.

The time of sawing shall be varied, depending on existing and anticipated weather conditions. Uncontrolled cracking of the pavement shall be prevented. Sawing of the joints shall commence as soon as the concrete has hardened sufficiently to permit cutting the concrete without excessive chipping, spalling, or tearing. The sawed faces of joints will be inspected for undercutting or washing of the concrete due to early sawing. If this action is sufficiently deep to cause structural weakness or excessive cleaning difficulty, as determined by the Engineer, the sawing operation shall be delayed until directed to resume. The sawing operation shall be carried on regardless of weather conditions. The joints shall be sawed at the required spacing consecutively in the sequence of the concrete placement. A chalk line or other suitable guide shall be used to mark the alignment of the joints. The saw cut shall be straight from edge to edge of the pavement and shall not vary more than 1/2 inch from the true joint alignment. Before sawing a joint, the concrete shall be examined closely for cracks. The joint shall not be sawed if a crack has occurred near the location chosen for a joint. Sawing shall be discontinued when a crack develops ahead of the saw cut.

The surface of pavement cured with membrane-curing compound shall be wetted with water in the region of the intended saw cut prior to sawing to protect the curing membrane from abrasion. Workmen and inspectors shall wear clean, rubber soled footwear, and the number of persons walking on the pavement shall be limited to those actually performing the sawing operation. Immediately after each joint is sawed, the saw cut and adjacent concrete surface shall be thoroughly flushed with water until all waste from sawing is removed from the joint. Any membrane-cured surface damaged during the sawing operations shall be re-sprayed as soon as the free water disappears. The sawing equipment shall be adequate in number of units and power to complete the sawing at the required rate. An ample supply of saw blades shall be available on the job before concrete placement is started. At least one standby sawing unit in good working order shall be available at the job site at all times during the sawing operations.

2. Dowels and Tie Bars: Dowels and tie bars shall be prepared and placed across joints where indicated. They are to be correctly aligned, and securely held in the proper horizontal and vertical position during the placing and finishing operations. Dowels shall be placed by the bonded-in-place method. The portion of the dowel inside the form shall be the bonded end. Dowels may be cut to length at the mill or shop by shearing in lieu of sawing, provided the deformation from true shape caused by shearing does not exceed the diameter of the bar by more than 0.04 inch and provided such deformation does not extend more than 0.04 inch from the end of the dowel. Dowels shall be clean, straight, and cut true to length with ends square and free from burs.

In longitudinal and transverse construction joints, threaded split dowels may be used in lieu of one-piece dowels. The assembled split dowels shall have a length and diameter at least equal to that of a one-piece dowel of the required size. The screw-threaded portions of split dowels shall have a pitch diameter at least equal to the diameter of the one-piece dowel of the required size. The sleeve connector shall be of such length that when the split dowel is assembled the entire screw-threaded portions of the dowel are encased by the sleeve with dowel ends butting each other. Dowels in longitudinal and transverse construction joints shall be held securely in place by means of devices fastened to the forms.

Dowels and tie bars installed within the paving lane shall be held securely in position by means of rigid metal frames or basket assemblies. The assemblies shall consist of a

framework of metal bars or wires arranged to provide rigid support for the dowels and tie bars throughout the paving operation. The assemblies shall also have a minimum of four transverse bars or wires, one of which shall be at or near each end of the dowel or tie bars with one for each end of the dowel bar at or near the subgrade. The dowels shall be welded to the assembly or held firmly by mechanical locking arrangements that will prevent the dowels from rising, sliding out, or becoming distorted under paving operations. The wires shall not be used as locking devices. The dowel-holding devices shall be held securely in the proper location by means of suitable pins or anchors. Dowels in longitudinal and transverse construction joints shall be held securely in place parallel to the surface and within 1/2 dowel diameter of the center of the slab depth. Dowels in expansion joints and tie bars installed within the paving lane shall be held securely in place with the center of the dowel or tie bar within 1/8 inch of the center of the slab depth.

The spacing of dowels in longitudinal construction joints shall be as indicated except where the planned spacing cannot be maintained due to form length or interference with form braces. Spacing shall be closer with additional dowels. Dowels in longitudinal joints shall be omitted when the center of the dowel would be located within a horizontal distance from a transverse joint equal to 1/4 of the slab thickness. The method used in holding dowels in position shall be accurate to detect errors in alignment of any dowel from its required position after the finished pavement. There shall not be an angle greater than one whose tangent is 1/96. The Contractor shall furnish a template for checking the position of the dowels.

The portion of each dowel intended to move within the concrete or expansion cap shall be coated with a thin film of grease or other approved de-bonding material. Provide dowel caps on the lubricated end of each dowel bar used in an expansion joint. Provide dowel caps filled with a soft compressive material with enough range to allow complete closure of the expansion joint.

3.7 LONGITUDINAL JOINTS

Longitudinal joints may be provided to assist in grade control or of the type, size, and frequency shown on the Plans. The longitudinal joint shall consist of a steel keyway or as shown on the plans. Manufacturer's recommendations must be strictly adhered to.

3.8 PAVEMENT PROTECTION:

The Contractor shall protect the paving against all damage prior to final acceptance of the work by the Owner. Traffic shall be excluded from the pavement by erecting and maintaining barricades and signs until the concrete is at least 3 days old or for a longer period if so directed. As a construction expedient in paving intermediate lanes between newly paved lanes, operation of the paving mixer and batch-hauling equipment will be permitted on the pavement after the pavement has been cured for seven days and the joints have been sealed or otherwise protected. Also, the subgrade planer, concrete finishing machines, and similar equipment may be permitted to ride upon the edges of the previously constructed slabs provided the concrete is more than 72 hours old and has attained a minimum flexural strength of 450 psi or a compressive strength of 2,800 psi. Additional protection to the slab edge may be required to prevent damage. The pavement carrying traffic or equipment shall be kept clean. All spillage of materials on concrete shall be cleaned up immediately upon occurrence, at no cost to the Owner.

3.9 PLAN GRADE AND SURFACE-SMOOTHNESS REQUIREMENTS:

The finished surfaces of all pavements shall conform to the grade line and elevations shown on the contract drawings and the surface-smoothness requirements:

- A. **PLAN GRADE:** The finished surfaces of all pavements shall conform, within the tolerances specified and to the lines, grades, and cross sections shown on the contract drawings. The finished surfaces of the pavements shall not vary more than 0.04 foot above or below the plan-grade line or elevation established and approved at the site of the work. The finished surfaces of new abutting pavements shall coincide at their juncture. An approved transition pavement strip of the type and width shown on the drawings or as directed shall be installed where a new pavement abuts an existing pavement to provide the required and satisfactory pavement surface at the juncture of the new and existing pavements. Further, the 0.04 foot deviation from the approved grade line and elevation will not be permitted in any area of these pavements where closer conformance with planned grade and elevation is required for the proper functioning of any and all applicable structures.
- B. **SURFACE SMOOTHNESS:** The finished surfaces of all pavements shall not deviate from the testing edge of an approved 12-foot straight-edge more than the tolerance shown for the respective pavement category of Table 350-1. In no instance shall the tolerance exceed more than 1/16 of an inch per foot.

TABLE 350-1		
Pavement Category	Direction of Testing	Tolerances
Pavements having cross slopes of 1% or less	Longitudinal Transverse	1/8 inch 3/16 inch
Pavements having cross slopes greater than 1%	Longitudinal Transverse	1/8 inch 1/4 inch

- C. **EQUIPMENT:** The Contractor shall furnish and maintain at the site one straight-edge in good condition for each longitudinal finishing machine for use by the Owner in testing the hardened portland-cement-concrete surfaces. These straight-edges shall be constructed of aluminum or other approved lightweight metal. They shall have blades with a box or box-girder cross-section with a flat bottom, adequately reinforced to insure rigidity and accuracy. Straight-edges shall be equipped with handles for operation on the pavement. The Contractor shall furnish and maintain at the site devices other than straight-edges, if approved, for surface-smoothness determinations. There shall be one such device for each longitudinal finishing machine for use by the Owner.

3.10 CURING

See SECTION 03 30 00 - CONCRETE

END OF SECTION

SECTION 32 13 16

CONCRETE PAVERS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This item shall consist of the placement of a sand laying course on an approved subgrade or base and the installation of interlocking concrete pavers in the quality, shape, thickness and color specified.

1.2 MEASUREMENT AND PAYMENT

- A. Accepted work performed as prescribed by this item will be measured by the square foot of surface area.
- B. The work performed by this item will be paid for at the unit price bid for “Concrete Pavers” which price shall be full compensation for preparing the subgrade, placement of base course, placement of lateral restraint curb, installation of concrete pavers on a sand laying course and for furnishing all materials, labor, tools, equipment and incidentals necessary to complete the work.

1.3 QUALITY ASSURANCE

- A. Manufacturer: Company specializing in the manufacturing of solid concrete interlocking pavers for a minimum of four (4) years.
- B. Installer: Company specializing in the installation of solid concrete interlocking pavers with three (3) years documented experience (and accredited by the manufacturer in relation to the paver type and project requirements).

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Pavers shall be solid concrete interlocking paving units complying with ASTM Designation C936.
 - 1. The stone’s thickness shall be 80 millimeters in all areas or as shown on the plans.
 - 2. Contractor shall submit color samples for City selection prior to any construction activity relative to this item. Color shall be “River Red” or as shown on the plans.
 - 3. Cementitious Material: Portland cement shall conform to ASTM Specification C-150.
 - 4. Aggregates shall conform to ASTM Specification C-33 for Normal Weight Concrete Aggregate (no expanded shale or lightweight aggregates) except that grading requirements shall not necessarily apply.
 - 5. Other Constituents: Coloring pigments, air-intraining agents, integral water repellants, finely ground silica, etc., shall conform to ASTM standards where applicable, or shall be previously established as suitable for use in concrete.
 - 6. Compressive Strength – At the time of delivery to the work site, the average compressive strength shall not be less than 8,000 psi with no individual unit strength less than 7,200 psi, with testing procedures in accordance with ASTM Standard C-140.

7. Absorption – The average absorption shall not be greater than 5% with no individual unit absorption greater than 7%.
 8. Proven Field Performance – Satisfying field performance is indicated when units smaller in composition, and made with the same manufacturing equipment as those to be supplied to the purchaser, do not exhibit objectionable deterioration after at least one (1) year.
 9. All units shall be sound and free of defects that would interfere with the proper placing of unit or impair the strength or performance of the construction. Minor cracks incidental to the usual methods of handling in shipment and delivery, shall not be deemed ground for rejection.
 10. The purchaser or his authorized representative shall be accorded proper facilities to inspect and sample the units at the place of manufacture from lots ready for delivery.
 11. Sample and test units in accordance with ASTM Method C-140.
 - a.) Manufacturer shall provide a minimum of three (3) years testing backup data showing manufactured products that meet and exceed ASTM 936-82 when tested in compliance with ASTM C-140.
 - b.) Sampling shall be random with a minimum of nine (9) specimens per 20,000 sq.ft. per product shape and size, with repeated samples taken every additional 20,000 sq.ft. or fraction thereof.
 - c.) Test units in accordance with ASTM for compressive strength, absorption and dimensional tolerance. A minimum of three (3) specimens per test required for average value.
 12. Rejection – In case the shipment fails to conform to the specified requirements, manufacturer may sort it, and new test units shall be selected at random by the purchaser from the retained lot and tested at the expense of the manufacturer. In case the second set of test units fails to conform to the specified requirements, the entire lot shall be rejected.
 13. Expense of Tests – The expense of inspection and testing shall be borne by the Contractor unless otherwise agreed.
- B. SAND LAYING COURSE: the sand laying course shall be well-graded, clean, washed, sharp sand with 100% passing a 3/8" sieve size and a maximum 2% passing a No. 200 sieve size. Use concrete sand or similar. **DO NOT USE MASON SAND OR LIMESTONE SCREENING**. The sand shall contain no more than 10% of acid soluble material. The sand laying course is the responsibility of the paving stone installer.
- C. EDGE RESTRAINT: All edges of the installed pavers shall be restrained. The type of edge restraint shall be approved at locations and to details noted on plans.
- D. BASE COURSE: The material shall consist of reinforced concrete placed on a stabilized subgrade as detailed in the plans.
- E. JOINT FILLING SAND: The joint filling sand shall be graded, clean, washed sand with 100% passing the No. 16 sieve size and a maximum of 5-10% passing the No. 200 sieve size. The sand shall contain no more than 10% of acid soluble material.

PART 3 – EXECUTION**3.1 GENERAL**

A suitable base shall be prepared as specified and detailed in the construction drawings. The base course shall be shaped to grade and the cross section with an allowable tolerance of 0-1/4" (relative to specified dimensions below finish design elevation with a 10-foot straight edge).

- A. The Contractor shall inspect and approve the finished base course prior to placement of the sand laying course.
- B. The un-compacted sand laying course shall be spread evenly over the area to be paved and then screeded to a level that will produce 1" (26mm) thickness when the paving stones have been placed and vibrated. Provide the proper level of sand such that the final elevation of paving stones will be nominally 1/4" to 3/8" higher than adjacent curb, gutters, other paving, to allow for free drainage from chambers or block edges any minor settling that may occur within the base.
- C. Once screeded and leveled to the desired elevation, the sand laying course shall not be disturbed in any way.
- D. Placement
 - 1. The pavers shall be placed in the approved pattern as noted or shown on the drawings. (Herringbone pattern is recommended for vehicular traffic.)
 - 2. The pavers shall be placed in such a manner that the desired pattern is maintained and the joints between the pavers are nominally 1/8" with no individual gap exceeding 3/16".
 - 3. Use string lines to hold all patterns true. Lines shall not deviate more than $\pm 1/2$ of an inch in 100 linear feet.
 - 4. The gaps at the edge of the paver surface shall be filled with standard pavers or with pavers cut to fit. No pavers shall be installed which are less than 1/2 of the original unit's surface area.
 - 5. The cutting of pavers, using a double headed breaker or a masonry saw shall leave a maximum 1/4" underbite.
 - 6. The finished elevation of pavers shall not deviate more than 1/4" within a 10' straight edge.
 - 7. When cutting precision designed areas, as directed by the engineer, a masonry saw shall be used.
 - 8. Pavers to be alternately selected from at least three (3) pallets, working from top to bottom of each pallet stack.
 - 9. Pavers shall be vibrated into the sand laying course using a vibrator capable of 3,000 to 5,000 pounds compaction force with the surface clean and the joints open.
 - 10. After vibration, washed sand shall be spread over the paver stone surface, allowed to dry, and vibrated into the joints with additional vibrator passes and brushing so as to completely fill the joints.
 - 11. Surplus material shall be swept from the surface. (Or left on the surface during construction to insure complete filling of the joints during initial use. This sand may also provide surface protection from construction debris.)

12. Upon completion of work covered in this section, the contractor shall clean up all work by removing all debris, surplus material, and equipment from the site.
13. The re-sanding as necessary of paver joints shall be provided by Contractor for a period of 90 days after completion of work.

END OF SECTION

SECTION 32 16 13

CONCRETE CURB AND GUTTER

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This item shall consist of Reinforced CONCRETE CURB AND GUTTER constructed on approved subgrade in conformity with the lines and grades established by the City Engineer. CONCRETE CURB AND GUTTER shall also be in accordance with the standard section, specifications and ordinances for sidewalks adopted by the city in which CONCRETE CURB AND GUTTER is to be placed.

1.2 MEASUREMENT AND PAYMENT

- A. Concrete curb and gutter shall be measured by the linear foot of length when complete and in place.
- B. The work performed and the materials furnished and measured shall be paid for at the contract unit price bid for concrete curb and gutter. This shall include full compensation of all materials, labor, tools, equipment and incidentals necessary to complete the work. Payment will not be made for unauthorized work.

1.3 SUBMITTALS

See SECTION 03 30 00 - CONCRETE.

PART 2 – PRODUCTS

2.1 MATERIALS

This item shall consist of a mixture of reinforcing steel, coarse aggregate, fine aggregate, cement and water. The mixture shall conform to SECTION 03 30 00 - CONCRETE.

2.2 TESTING REQUIREMENTS

See SECTION 03 30 00 - CONCRETE.

PART 3 – EXECUTION

3.1 CONSTRUCTION METHODS

- A. CONVENTIONALLY FORMED CONCRETE: Shape and compact subgrade, foundation, or pavement surface to the line, grade and cross section shown on the plans. Lightly sprinkle subgrade or foundation material immediately before concrete placement. Pour concrete into forms, and strike off with a template ¼ to 3/8 inches less than the dimensions of the finished curb unless otherwise approved. After initial set, plaster surface with mortar consisting of 1 part hydraulic cement and 2 parts fine aggregate. Brush exposed surfaces to a uniform texture.

- B. EXTRUDED OR SLIP FORMED CONCRETE: Hand tamp and sprinkle subgrade or foundation material before concrete placement. Provide clean surfaces for concrete placement. If required, coat cleaned surfaces with approved adhesive or coating at the rate of application shown on the plans or as directed. Place concrete with approved self-propelled equipment. The forming tube of the extrusion machine or the form of the slip form machine must be easily adjustable vertically during the forward motion of the machine to provide variable heights necessary to conform to the established grade line. Attach a pointer or gauge to the machine so that a continual comparison can be made between the extruded or slip form work and the grade guideline. Other methods may be used when approved. Finish surfaces immediately after extrusion or slip forming.
- C. JOINTS: Unless otherwise shown on the plans, the walk shall be cut transversely with a jointing tool every ten (10) feet after the concrete has been thoroughly worked and has sufficiently set. Expansion joints shall be located every forty (40) feet.
- D. CURING: After the finished concrete has sufficiently set, it shall be covered with burlap and kept wet for a period of four (4) days. As an alternate the concrete may be cured by the application of a clear membrane seal coat that will retain 85% of the original mixing water at the end of three (3) days.
- E. CLEANUP: After the construction work has been completed, the Contractor shall remove all debris, trash, excess materials, forms, stakes, empty sacks, etc. occasioned by his work from the premises. The site shall be left with a neat appearance. All excavation shall be backfilled and all excess excavated materials shall be disposed of.

END OF SECTION

SECTION 32 16 13.01
CONCRETE SIDEWALK

PART 1 - GENERAL

1.1 DESCRIPTION

This item shall consist of Reinforced Concrete Sidewalk constructed on approved subgrade in conformity with the lines and grades established by the City Engineer. Sidewalks shall also be in accordance with the standard section, specifications and ordinances for sidewalks adopted by the city in which sidewalk is to be placed.

1.2 MEASUREMENT AND PAYMENT

- A. Concrete sidewalk shall be measured by the square foot of surface area when complete and in place.
- B. The work performed and the materials furnished and measured shall be paid for at the contract unit price bid for concrete sidewalk. This shall include full compensation of all materials, labor, tools, equipment and incidentals necessary to complete the work. Payment will not be made for unauthorized work.

1.3 SUBMITTALS

See SECTION 03 30 00 - CONCRETE.

PART 2 – PRODUCTS

2.1 MATERIALS

This item shall consist of a mixture of reinforcing steel, coarse aggregate, fine aggregate, cement and water. The mixture shall conform to SECTION 03 30 00 - CONCRETE.

2.2 TESTING REQUIREMENTS

See SECTION 03 30 00 - CONCRETE.

PART 3 – EXECUTION

3.1 GENERAL

- A. The subgrade shall be excavated and fine graded to a true grade. Any backfill shall be watered and tamped well ahead of the placing of the concrete. If dry, the subgrade shall be sprinkled immediately before depositing any concrete. Forms shall be metal or wood, free of warp and of a depth equal to the depth of the concrete. They shall be secured and accurately staked to line and grade and held in a true position during the placing of the concrete. Expansion joints of an approved material shall be used between the sidewalk and all abutting concrete. Placement of concrete may begin after the subgrade is thoroughly compacted and the forms, expansion joints (where necessary) and reinforcing steel are in place. The concrete shall be thoroughly worked with a flat spade or similar tool along the forms as the pouring continues to insure the absence of honeycombs. No concrete over thirty (30)

minutes old or retempered concrete shall be used. After the placing of the concrete has sufficiently advanced, the concrete shall be struck off flush with the forms. Then the concrete shall be worked with a wooden float to flush excess mortar to the surface. All exposed corners are to be edged or rounded to the radius shown on the Plans.

- B. Unless otherwise shown on the plans, the walk shall be cut transversely with a jointing tool at a width equal to the sidewalk width after the concrete has been thoroughly worked and has sufficiently set. Expansion joints shall be located every forty (40) feet.
- C. After the finished concrete has sufficiently set, it shall be covered with burlap and kept wet for a period of four (4) days. As an alternate the concrete may be cured by the application of a clear membrane seal coat that will retain 85% of the original mixing water at the end of three (3) days.
- D. After the construction work has been completed, the Contractor shall remove all debris, trash, excess materials, forms, stakes, empty sacks, etc. occasioned by his work from the premises. The site shall be left with a neat appearance. All excavation shall be backfilled and all excess excavated materials shall be disposed of.

END OF SECTION

SECTION 32 17 23.23

REFLECTORIZED PAVEMENT MARKERS (RPMs)

PART 1 - GENERAL

1.1 DESCRIPTION

This item shall govern for the furnishing and installing of raised reflectORIZED pavement markers (RPMs) at locations designated on the plans or as directed by the Engineer.

1.2 MEASUREMENT AND PAYMENT

- A. Pavement markers will be measured as each pavement marker complete and in place.
- B. The price shall be full compensation for furnishing all materials, all preparation and installation, all labor, equipment, tools and incidentals necessary to complete the work.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. The RPMs shall be conform to Item No. 672, Texas Department of Transportation’s Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges, June 2004; provided, however, that all buttons used on any one project shall be of the same material and same manufacture.
- B. The base of the marker shall be flat (the deviation from a flat surface shall not exceed 1/16 inch), and designed to be bonded to either asphaltic or portland cement concrete pavement, with an approved adhesive meeting the requirements stated in Test Method TEX-611-J.

2.2 OPTICAL REQUIREMENTS

The specific intensity of each reflective surface shall not be less than the following values when tested at a 0.2 angle of divergence and when the incident light is parallel to the base of the marker.

Horz. Ent. Angle	Crystal	Amber	Red
4 degrees	3.00	2.00	0.75
20 degrees	1.50	1.00	0.30

- A. **ANGLE OF INCIDENCE:** The angle of incidence is the angle formed by a ray from the light source to the marker, and normal to the leading edge of the marker face.
- B. **ANGLE OF DIVERGENCE:** The angle of divergence is the angle formed by a ray from the light source to the marker, and the returned ray from the marker to the measuring receptor.

- C. SPECIFIC INTENSITY: The specific intensity is the mean candle power of the reflected light at a given incidence and divergence angle for each foot candle at the reflector on a plane perpendicular to the incident light. (Test Method TEX-842-B)

2.3 STRENGTH REQUIREMENTS

The markers shall comply with the adhesion requirements of Test Method TEX-611-J. The marker shall withstand a falling-ball impact of 5 (five) feet without breaking, cracking or being significantly deformed when tested according to Test Method TEX-430-A. The marker shall show no change in shape or color when subjected to the requirements of Test Method TEX-846-B. The temperature shall be 140° F with the marker in a vertical position.

2.4 MARKER TYPES

The color and number of reflective surfaces of the buttons or markers shall be as designated in the Plans and Specifications.

2.5 SAMPLING

Should any of the specimens selected for strength testing, as specified in the section, "Strength Requirements", fail to comply with the strength requirements of this specification; five (5) additional specimens will be tested. The failure of any one of these five (5) specimens shall be cause for the rejection of the entire lot or shipment represented by the sample.

PART 3 – EXECUTION

3.1 GENERAL

The RPMs shall be placed in accordance with the plans or as directed by the Engineer. The pavement surface shall be prepared by buffing, grinding, or other methods approved by the Engineer. After preparation, the surface must be free of dirt, grease, oil, moisture, loose unsound pavement, and any other material, which would adversely affect the bond of the adhesive. The wet epoxy or bituminous material shall be applied so that 100% of the bonding area of the button will be in contact and shall be of sufficient thickness so that the excess adhesive shall be forced out around the perimeter of the button. When the project is complete, the button shall be firmly bonded to the pavement. Lines formed by the buttons shall be true, and the entire installation shall present a neat appearance.

END OF SECTION

SECTION 34 41 13

SIGNAGE

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Provide all products, equipment, transportation, protection and labor required to construct and install warning, regulatory, directional, entrance and information signage, including sign posts and associated hardware, as shown on the plans, or as directed by the City.

1.2 MEASUREMENT AND PAYMENT

- A. Signage will be paid for per each unit sign. All sign components (substrate, sheeting, post, support, mounting hardware, etc.) will not be measured or paid for directly but will be subsidiary to each unit sign. This compensation shall include all labor, materials, equipment and incidentals necessary to complete the work. The signage to be installed includes warning, regulatory, directional, entrance and information types.

1.3 SUBMITTALS

- A. Shop Drawings: Show shop drawings, not necessarily to scale, but sufficient enough in detail to show color, wording, lettering size and style, overall sign size, construction details and installation details for each type of sign.

PART 2 - PRODUCTS

2.1 SIGN SUBSTRATE

- A. Sign substrate (except street name signs) shall meet requirements for ASTM B 209 and have the following thicknesses: 0.080” for signs less than 7.5 sq. feet, 0.100” for signs 7.5 to 15 sq. feet, and 0.125” for signs greater than 15 sq. feet.
- B. For street name signs in the areas governed by the City of College Station, contact the city’s Planning and Development Services Department for the requirements and standards.
- C. In the City of Bryan, all street name signs shall be green unless otherwise specified or located within the bounds of Sims Street to the east, Texas Avenue to the west, Martin Luther King Boulevard to the north, and E. 29th Street to the south, where street name signs shall be brown and include the Downtown Bryan logo as provided by the City of Bryan Traffic Department.

2.2 SIGN SHEETING

- A. All sign sheeting materials shall meet the requirements of ASTM D 4956 Type, as follows:
 - 1. Red background – ASTM Type VII, VIII, IX, or X (or TxDOT Type D), with ASTM Type III or IV (TxDOT Type C) legend/border
 - 2. White background – ASTM Type III or IV (TxDOT Type C), with black acrylic legend/border

3. Fluorescent Yellow-Green background – ASTM Type VII, VIII, IX, or X (TxDOT Type E), with black acrylic legend/border (school-related warning signs)
4. Green, Brown, Blue backgrounds – ASTM Type III or IV (TxDOT Type C), with white ASTM Type VII, VIII, IX, or X (TxDOT Type D) legend/border

2.3 SIGN POST

- A. All sign posts shall be 13 BWG galvanized steel tubing (as per ASTM 123 or ASTM A653 G210), and have 2.375” outside diameter and 0.095” nominal wall thickness. In the City of Bryan, posts shall be black powder-coated when specified and in the City of College Station, posts shall always be bronze powder-coated. Painted or spliced posts are not acceptable. Posts shall be seamless steel tubing, with 50,000 PSI minimum yield strength, and 70,000 PSI minimum tensile strength. Length shall be determined as per Texas MUTCD sign height requirements. All sign posts shall be delineated with a 12-inch retroreflective strip (yellow or red) as per Section 2A.21 of the Texas MUTCD.

2.4 SIGN SUPPORT

- A. For the City of Bryan, sign supports shall meet crashworthy requirements of NCHRP 350, and unless otherwise specified, shall be the steel “Wedge Anchor System”, except for when sign is in the TxDOT right-of-way. Signs located within TxDOT right-of-way shall be the “Triangular Slipbase System” as shown on TxDOT standard detail SMD(Slip-1)-08.
- B. City of College Station shall require, as shown on the TxDOT standard details, the “Triangular Slipbase System” on collectors and above and the “Wedge Anchor Systems” on local streets.

2.5 MISCELLANEOUS

- A. Use galvanized steel, stainless steel, or dichromate-sealed aluminum for bolts, nuts, washers, lock washers, screws, and other sign assembly hardware. Use plastic or nylon washers to avoid tearing the sheeting material.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Erect signs in their designated locations, as indicated and in accordance with the approved shop drawings and the applicable requirements of DOT Section 645.
- B. Examine proposed sign location, mark with stake and seek City representative’s approval before installation.
- C. Protect surfaces and finishes from abrasion and other damage during handling and installation.
- D. Replace damaged or faulty signs.

END OF SECTION