SECTION 500 – TRANSPORTATION SPECIFICATIONS

ITEM 501. HOT MIX ASPHALTIC CONCRETE PAVEMENT

501.1 SCOPE OF WORK

A. This specification covers the requirements for furnishing and installing hot mix asphaltic concrete as shown in the Plans and specified within. Construction shall include a base course, a level-up course, a surface course or any combination of these courses as shown on the Plans, each course being composed of a compacted mixture of aggregate and asphalt mixed hot in a mixing plant, in accordance with the details shown on the Plans and the requirements herein.

501.2 SUBMITTALS

A. Within 30 days after the Notice to Proceed, the Contractor shall provide a list of materials to be used from the TxDOT approved Materials Producer List (MPL) or submit to the Engineer or City Staff for approval, technical product literature including mix design, aggregate source, aggregate gradation, aggregate type, and all other pertinent data to illustrate conformance to the specification found within.

501.3 MATERIALS

A. The mineral aggregate shall be composed of a course aggregate, a fine aggregate, and if required, a mineral filler. Coarse aggregate shall be that part of the aggregate retained on the No. 10 sieve and shall be stone, crushed slag, crushed gravel, or gravel. Fine aggregate shall be that part passing the No. 10 sieve and shall consist of sand or screenings. Mineral filler shall consist of dry stone dust, Portland cement, or fly ash. Mineral aggregate shall meet the requirements of Item 340 (or 3268 for wide roadways or high speed roadways), Texas Department of Transportation (TxDOT), Standard Specifications for Construction of Highways, Streets and Bridges. The plasticity index of fine aggregate portion passing the No. 40 sieve shall not be more than six (6).

501.4 ASPHALTIC MATERIAL

A. Asphalt for the paving mixture shall meet the requirements of TxDOT Item 300 (or 3268 for wide roadways or high speed roadways) of the Standard Specifications for Construction of Highways, Streets and Bridges. The grade of asphalt used shall be designated by the Engineer or the City after design tests have been made using the mineral aggregate to be used in the job.

501.5 TACK COAT

A. Tack coat shall be in accordance with TxDOT Item 300 (or 3268 for wide roadways or high speed roadways) of the Standard Specifications for Construction of Highways, Streets and Bridges. Asphaltic material shall be approved by the Engineer or the City.

501.6 TYPES OF ASPHALTIC CONCRETE

A. The mixture shall be designed and tested in accordance with the current TxDOT Item 340 (or 3268 for wide roadways or high speed roadways) of the Standard Specifications for Construction of Highways, Streets and Bridges, Type D, and will have a laboratory density of not less than 94.5% nor more than 97.5%, and a stability of not less than 35.

B. The asphaltic material shall form from four to eight (4–8) percent of the mixture by weight or from nine to nineteen (9-19) percent of the mixture by volume.

501.7 EQUIPMENT

A Spreading and Finishing Machine

1. The spreading and finishing machine shall be a type approved by the Engineer, shall be capable of producing a surface that will meet the requirements of the typical cross section and the surface test, when required, and when the mixture is dumped directly into the finishing machine, shall have adequate power to propel the delivery vehicles in a satisfactory manner. 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.

2. The use of any vehicle which requires dumping directly into the finishing machine and which the finishing machine cannot push or propel in such a manner as to obtain the desired lines and grades without resorting to hand-finishing will not be allowed. Unless otherwise permitted by the Plans, vehicles of the semi-trailer type are specifically prohibited from dumping directly into the finishing machine while in contact with the finishing machine. Vehicles dumping directly or indirectly into the finishing machine shall be so designed and equipped that unloading into the finishing machine can be mechanically and/or automatically operated in such a manner that overloading the finishing machine being used cannot occur and the required lines and grades will be obtained without resorting to hand-finishing.

3. Dumping of the asphaltic mixture in a windrow and then placing the mixture in the finishing machine with loading equipment will be permitted, provided that the loading equipment is constructed and operated in such manner that substantially all of the mixture deposited on the roadbed is picked up and loaded in the finishing machine without contamination of foreign material of the mixture, and excessive temperature loss is not encountered. The loading equipment will be so designed and operated that the finishing machine being loaded will obtain the required line, grade, and surface without resorting to hand-finishing. Any operation of the loading equipment resulting in the accumulation and subsequent shedding of this accumulated material into the asphaltic mixture will not be permitted.

B. Rolling Equipment

1. Rolling equipment shall consist of pneumatic tire rollers, two-axle tandem roller weighing not less than eight (8) tons, three-wheel roller weighing not less than 10-tons, three-axle tandem roller weighing not less than 10-tons, and trench rollers having a 20-inch wheeldrive and producing 325 pounds per linear inch of roller width at a speed of 1.8 miles per hour in low gear.

C. Straight Edges and Templates

1. The Contractor shall provide an acceptable 10-foot straight edge for surface testing.

501.8 CONSTRUCTION METHODS

A. The prime coat, tack coat or the asphaltic mixture, when placed with a spreading and finishing machine, shall not be placed when the air temperature is below 50 degrees F and is falling, but it may be placed when the air temperature is above 40 degrees 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 temperature and moisture condition of the base, in the opinion of the Engineer or the City, are suitable.

B. Prime Coat

1. A prime coat is required, and shall be applied at the rate determined by the Engineer but not less than 0.2-gallons per square yard of AEP or MC-30 asphalt. The asphaltic concrete shall not be applied on a previously primed flexible base until the primed base has completely cured to the satisfaction of the Engineer and the City. Water-based prime coat is prohibited.

C. Transporting Asphaltic Concrete

1. The asphaltic mixture, prepared as directed above, shall be hauled to the work site 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 daylight hours. In cool weather, or for long hauls, canvas covers and insulating of the truck bodies may be required. The inside of the truck body may be given a light coating of oil, lime slurry or other material satisfactory to the Engineer and the City, if necessary, to prevent mixture from adhering to the body.

2. Contractor shall provide automated ticket printout for each truckload of material where payment is determined by weight. Each loading ticket must show the ticket number, truck number, gross weight, tare weight, and net weight, per TxDOT Item 520.

D. Placing

1. Asphalt shall be applied when the air temperature is above 50° F and rising. Asphalt shall not be applied when the air temperature is 60° F and falling. In all cases, asphalt shall not be applied when the surface temperature is below 60° F. Generally, the asphaltic mixture 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 meet the requirements of the typical cross-sections and the surface tests. During the application of asphaltic material, care shall be taken to prevent splattering of adjacent pavement, curb and gutter, and structures. When the asphaltic 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 or the City, provided a satisfactory surface can be obtained by other approved methods.

E. Compacting

1. Rolling: The pavement shall be compressed thoroughly and uniformly with the specified roller and/or other approved rollers. 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 wheel. Alternate trips of the roller shall be slightly different in length. Rolling with pneumatic-tire 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. One (1) tandem roller, one (1) pneumatic-tire roller, and at least one (1) three-wheel roller, as specified above, shall be provided for each job. If the Contractor elects, he may substitute the three-axle tandem roller for the two-axle tandem roller and/or the three-wheel roller; but in no case shall less than three rollers be in use on each job. 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 mixtures 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. Regardless of the method used for compaction, all rolling to achieve specified density shall cease when the Hot Mix Asphaltic Mixture drops below 175°F (80°C).

2. In-Place Density: The Hot Mix Asphaltic mixture shall be tested daily at the project site for conformance to specification requirements. Unless directed otherwise by the Engineer or designated representative, a bag sample and a core or section will be obtained for each 2,000 square yards or portion of paving each day, with a minimum of three bag samples and three cores for each day's paving.

   Bag samples shall be taken during lay-down operations. The primary sampling point for the bag samples shall be from the windrow if a windrow elevator is used. If a windrow elevator is not used, the sample shall be taken from the middle of the paving machine hopper. Gradation, asphalt content and stability value of the hot mix asphaltic mixture shall be reported for each of the bag samples. The stability value reported for each of the bag samples shall be the average of three (3) tests per bag.

   Pavement thickness and in-place density shall be determined from the field cores or sections. The average of all hot mix asphaltic concrete pavement core or section thicknesses shall meet the minimum thickness per the street classification as defined in Construction Standard T-06. No individual core or section thickness deficiency may be greater than 0.2 inches. Pavement that does not meet the thickness specification shall be removed and replaced as outlined below. The in-place density tests are intended for compaction-control tests and will be tested according to Test Method Tex-207-F. The core or section densities shall average from 91.0% to 96.0% of the maximum theoretical density except that the minimum acceptable density of an individual sample is 89.0% or the maximum acceptable density of an individual sample is 97.0%. There will be no two consecutive cores or section densities below 91.0% or above 96.0%. Asphalt pavement represented by a density less than 89.0%, more than 97.0% or two consecutive densities less than 91.0% or greater than 96.0% shall be removed and replaced.

   Any pavement to be removed and replaced will be removed and replaced from curb to curb or edge of asphalt to edge of asphalt at the contractor's expense. Additional density tests shall be used to delineate the limits of the in-place hot mix asphaltic pavement that does not meet the density specification and the results of the tests shall not be used in the calculation of the overall average density. Protocol to assess the area of asphalt pavement removal and replacement shall start between the failing density or two consecutive densities that are less than 91.0% and the next passing density to either side of the failing pavement. Additional cores or sections will be required to quantify the area of replacement back to an in-place density of 91.0%. Backscattering (nuclear densities) shall not be used to determine the actual density of asphaltic pavement.

   Pavements with low-density results may be retested; but the pavement shall not receive any additional compactive effort.

   Final acceptance of the pavements shall be the responsibility of the Engineer.

3. Hand-Tamping: The edges of the pavement along curbs, headers and similar structures, and all places not accessible to the roller or in such position as will not allow thorough compaction with the rollers, shall be thoroughly compacted with lightly oiled tamps.

F. Surface Tests

1. The surface of the pavement, after compaction, shall be smooth and true to the established line, grade, and cross-section, and when tested with a 10-foot straightedge placed parallel to the centerline of the roadway or tested by other equivalent and acceptable means, except as

provided herein, the maximum deviation shall not exceed 1/4-inch in 10-feet, and any point in the surface not meeting this requirement shall be corrected.

501.09 INSPECTION

A. If the TxDOT Item 340 specification is used for furnishing and installing hot mix asphaltic concrete, then 1B inspection per TxDOT shall be required.

B. If the TxDOT Item 3268 specification is used for furnishing and installing hot mix asphaltic concrete, then 1A and 1B inspection per TxDOT shall be required.

501.10 ROADS DAMAGED BY CONSTRUCTION

A. The Contractor shall reconstruct existing asphalt paved roads which are damaged as a result of construction of this project at no additional cost to the City. Reconstruction shall consist of reconstructing the road to an "as new condition" to the existing pavement cross section. The Contractor may use existing base material, adding new base material as needed. Contractor shall compact and reshape road subgrade to existing grade. The subbase and base shall be compacted in accordance with these specifications. The Contractor shall install at least the minimum depth of hot-mix asphalt pavement per the street classification as defined in Construction Standard T-06 and in accordance with these specifications.

501.11 PAYMENT

A. Payment for furnished and installed hot mix asphaltic concrete pavement shall be paid according to the unit price per square yard or per ton in the proper item of the Proposal and Bid Schedule.

B. All work and materials to complete the hot mix asphaltic concrete shall be subsidiary to this item.

END OF SECTION

SECTION 500 – TRANSPORTATION SPECIFICATIONS

ITEM 502. ROADWAY EXCAVATION

502.1 SCOPE OF WORK

A. This specification covers the requirements for shaping and finishing of all earthwork on the entire length of roadway, and approaches to same, in conformity with the required lines, grades and typical cross sections and in accordance with specification requirements herein outlined. Compaction shall conform to the method of "Density Control" and/or "Ordinary Compaction" as shown on the Plans and Specifications.

502.2 SUBMITTALS

A. None required unless specifically called for in the Plans, Standards, or requested by the City or Engineer.

502.3 CONSTRUCTION METHODS

A. All roadway excavation and corresponding embankment construction shall be performed as specified herein and in Section 503- EMBANKMENT, and the completed roadway shall conform to the established alignment, grades and cross sections. Construction of roadway excavation shall be in accordance with TxDOT Item 110 of the Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges.

B. Roadway excavation shall be extended to a minimum of two (2) feet behind the proposed back of curb for all street types.

C. All suitable excavated materials shall be utilized, insofar as practicable, in constructing the required roadway sections. Unsuitable roadway excavation and roadway excavation in excess of that needed for the construction of the roadway shall be disposed of outside the limits of the right-of-way. Unsuitable material encountered below subgrade elevation in roadway cuts, shall be removed and replaced, as directed by the Representative of the City with material from the roadway excavation or with other suitable material.

D. During construction, the roadbed and ditches shall be maintained in such condition as to insure proper drainage at all times and ditches and channels shall be so constructed and maintained as to avoid damage to the roadway section.

NOTE: **ALL UNDERGROUND UTILITIES SHALL BE INSTALLED PRIOR TO ANY LIME TREATMENT OR FLEXIBLE BASE PLACEMENT.**

NOTE: Blue-tops will be set on the center and crown of the streets or roads at every 50-foot station. These grade stakes will be to finished grade and visible for inspection before flexible base is applied.

502.4 PAYMENT

A. No separate payment will be made for work performed in accordance with this specification. Select back fill shall be paid for according to the unit price per cubic yard according to the appropriate item, and the cost thereof shall be included in the proper items of the Proposal and Bid Schedule.

END OF SECTION

SECTION 500 – TRANSPORTATION SPECIFICATIONS

ITEM 503. EMBANKMENT

503.1 SCOPE OF WORK

A. This specification covers the requirements for the placement and compaction of all materials obtained from roadway, borrow, channel and structural excavation for utilization in the construction of roadway embankments, levees and dikes (berms).

503.2 SUBMITTALS

A. Within 30 days after the Notice to Proceed, the Contractor shall provide a list of materials to be used from the TxDOT approved Materials Producer List (MPL) or submit to the Engineer or City Staff for approval, technical product literature including the source of the material, equipment and all other pertinent data to illustrate conformance to the specification found within.

503.3 MATERIALS

A. Where fill material is required for embankment, the material shall conform to the following class:

Class A (Select Borrow) – Class A Borrow material shall consist of suitable granular material, free from vegetation or other objectionable matter and reasonable free from lumps of earth. When tested by standard TxDOT laboratory methods Tex-104-E, Tex-106-E and Tex-107-E, the Class A, Select Borrow shall meet the following requirements:

1. Liquid Limit shall not exceed 45.

2. Plasticity index shall not exceed 15.

3. Bar linear shrinkage shall not be less than 2.

B. Class B – Materials such as rock, loam, clay, or other approved materials.

C. Class C – Material meeting the specification requirements shown on the plans.

D. Class D - Material from required excavation areas shown on the plans.

503.4 CONSTRUCTION METHODS

A. Construction of embankment shall be in accordance with this specification and TxDOT Item 132 of the Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges.

B. Prior to placing any embankment, all “Preparing Right of Way” operations shall have been completed on the excavation sources and areas over which the embankment is to be placed. Stump holes or other small excavations in the limits of the embankments shall be backfilled with suitable materials and thoroughly tamped by approved methods before commencing embankment construction. The surface of the ground, including plowed loosened ground or surface roughened by small washes or otherwise shall be restored to approximately its original slope by blading or other methods. Where indicated on the Plans, the ground surface thus prepared shall be compacted by sprinkling and rolling.

C. Unless otherwise indicated on Plans, the surface of the ground 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 six (6) inches. The loosened material shall be recompacted with the new embankment as hereinafter specified.

D. Where directed the surface of hillsides to receive embankment shall be loosened by scarifying or plowing to a depth of not less than six (6) 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 recompacted simultaneously with the embankment material placed at the same elevation.

E. 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 recompacted with the next layer of the new embankment. The total depth of the scarified and added material shall not exceed the permissible depth of layer.

F. Trees, shrubs, roots, vegetation or other unsuitable materials shall not be placed in embankment.

G. Except as otherwise required by the plans, all embankment shall be constructed in layers approximately parallel to the finished grade of the roadbed and unless otherwise specified, each layer shall be so constructed as to provide a uniform slope of ¼-inch per foot from the center line of the roadbed to the outside, except that on superelevated curves each layer shall be constructed to conform to the superelevation required by the governing standard.

H. Embankments shall be constructed to the grade established by the Engineer or the City and completed embankments shall correspond to the general shape of the typical sections shown on the plans and 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.

503.5 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 formed by being spread by blading or other acceptable methods from piles or windrows dumped from excavating or hauling equipment in such amounts that material is evenly distributed.)

D. Minor quantities of rock encountered in constructing earth embankment shall be incorporated in the specified embankment layers, or may be placed in accordance with the requirements for the construction of rock embankments in the deeper fills within the limits of haul shown on the Plans, provided such placement of rock is not immediately adjacent to structures. Also, rock may be placed in the portions of embankments outside the limits of the completed roadbed width where the size of the rock prohibits their incorporation in the normal embankment layers.

E. Each layer of embankment shall be uniform as to material, density and moisture content before beginning compaction. Where layers of unlike materials abut each other, each layer shall be feather edged for at least 100-feet or the material shall be so mixed as to prevent abrupt changes in the soil. No material placed in the embankment by dumping in a pile or windrow shall be incorporated in a layer in that position, but 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 to the end that a uniform material of uniform density is secured in each layer.

F. Water required for sprinkling to bring the material to the moisture content necessary for maximum compaction shall be evenly applied and it shall be the responsibility of the Contractor to secure a uniform moisture content throughout the layer by such methods as may be necessary.

G. In order to facilitate uniform wetting of the embankment material, the Contractor may apply water at the material source if the sequence and methods used are such as not to cause an undue waste of water. Such procedure shall be subject to the approval of the Representative of the City.

H. All earth cuts, full width or part width cuts in side hill, which are not required to be excavated below subgrade elevation for base and backfilled, shall be scarified to a uniform depth of at least six (6) inches below grade, and 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 that required for the adjacent embankment.

I. Compaction of embankments shall be obtained by the method hereinafter described as "Ordinary Compaction" or the method hereinafter described as the "Density Control" method.

503.6 ORDINARY COMPACTION (outside of Roadway Pavement)

A. When the "Ordinary Compaction" method is specified, the following provisions shall govern: Each layer shall not exceed eight (8) inches of loose depth, and shall be compacted until there is no evidence of further compaction. Prior to and in conjunction with the rolling operation, each layer shall be brought to the moisture content ordered by the Representative of the City, and shall be kept leveled with suitable equipment to insure uniform compaction over the entire layer.

503.7 DENSITY CONTROL

A. When the "Density Control" method compaction is specified, each layer shall be compacted to the required density by any method, type and size of equipment which will give the required compaction. The depth of layers, prior to compaction, shall depend upon the type of sprinkling and compacting equipment used. However, maximum depth 16-inches loose and 12-inches compacted shall not be exceeded unless approved by a representative of the City. Prior to and in conjunction with the rolling 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 over the entire layer.

B. For each layer of earth embankment and select material, it is the intent of this specification to provide the density as required in the table below, unless otherwise shown on the Plans.

Field Density Control Requirements

Description	Density	Moisture Control
	Tex-115-E	
PI≤15	≥98% Max. Dry Density	
15＜PI ≤35	98% ≤ Max. Dry Density ≤ 102%	≥ Optimum Moisture Content
PI＞35	95% ≤ Max. Dry Density ≤ 100%	≥ Optimum Moisture Content

Field density determinations will be taken every 750 square yards of roadbed surface at the Contractor's expense.

C. After each layer of earth embankment or select material is complete, tests will be required. If the material fails to meet the density specified, the course shall be reworked as necessary to obtain specified density. Such procedure shall be determined by, and subject to, the approval of the Representative of the City.

D. The Representative of the City may order proof rolling to test the uniformity of compaction of the embankment layers. All irregularities, depressions, weak or soft spots which develop shall be

corrected immediately by the Contractor at his expense.

E. Should the subgrade, due to any reason or cause, lose the required stability, density or finish before the pavement structure is placed, it shall be recompacted and refinished at the sole expense of the Contractor. Excessive loss of moisture in the subgrade shall be prevented by sprinkling, sealing or covering with a subsequent layer or granular material. Excessive loss of moisture shall be construed to exist when the subgrade soil moisture content is more than four (4) percent below the optimum for compaction ratio density.

503.8 ROCK EMBANKMENTS

A. Rock Embankments shall be defined as those composed principally of rock, and shall be constructed of accepted material from approved sources.

B. Except as otherwise specified, rock embankments normally shall be constructed in successive layers for the full width of the individual roadway cross section and of 18-inches or less in depth.

C. The maximum dimension of any rock used in embankment shall be less than the depth of the embankment layer. All oversized rock which is otherwise suitable for construction shall be broken to the required dimensions and utilized in embankment construction where proposed by Plans.

D. Unless otherwise provided, the upper or final layer of the embankment shall contain no stones larger than four (4) inches in their greatest dimension, and, insofar as such is available by selection from the excavation, shall be composed of material so graded that the density and uniformity of the surface layer may be secured by the methods and requirements as set forth for “Ordinary Compaction” or “Density Control” method.

E. When the “Ordinary Compaction“ method of compaction is specified, each embankment layer shall be rolled as directed, and where the embankment materials require, shall be sprinkled when and to the extent directed by the Representative of the City.

F. When the “Density Control” method of compaction is specified, each layer shall be compacted to the required density as outlined for “Earth Embankment”, except in those layers where rock will make density testing difficult, the Representative of the City may require the layer to be proof rolled to insure proper compaction.

503.9 AT CULVERTS AND BRIDGES

A. Embankments adjacent to culverts and bridges which cannot be compacted by use of the blading and rolling equipment used in compacting and adjoining sections of embankment shall be compacted in the manner prescribed under Section 309- STRUCTURAL EXCAVATION and Section 304- TRENCHING, BACKFILLING AND COMPACTION.

B. Embankments placed around spill-through type abutments, shall be constructed in six (6)-inch loose layers of uniform suitable material placed in such manner as to maintain approximately the same elevation on each side of the abutment, and all materials shall be mixed, wetted and compacted as specified above.

C. As a general rule, embankment material placed adjacent to any portion of any structure and in the first two (2) layers above the top of any culvert or similar structure shall be an earth, free of any appreciable amount of gravel or stone particles more than four (4) inches in greatest dimension and of such gradation as to permit thorough compaction. When, in the opinion of the Representative of the City, such material is not readily available, the use of rock or gravel mixed with earth will be permitted, in which case no particles larger than 12-inches in greatest dimension and six (6) inches in least dimension may be used and the percentage of fines shall be sufficient to fill all voids and insure a uniform and thoroughly compacted mass of proper density.

503.10 SELECTION OF MATERIALS

A. In addition to the requirements in the excavation items of the specifications covering the general selections and utilization of materials to improve the roadbed, embankments shall be constructed in proper sequence to receive the select material layers shown on the plans, with such modifications as may be directed by the Representative of the City. 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.

NOTE: ALL UNDERGROUND UTILITIES SHALL BE INSTALLED PRIOR TO ANY LIME TREATMENT OR FLEXIBLE BASE PLACEMENT.

NOTE: Bluetops will be set on the center, crown, and back of curb of the streets or roads every 50-foot station. These grade stakes will be to finished grade and visible for inspection before flexible base is applied.

503.11 PAYMENT

A. No separate payment will be made for work performed in accordance with this specification, and the cost thereof shall be included in the proper items of the Proposal and Bid Schedule.

END OF SECTION

SECTION 500 – TRANSPORTATION SPECIFICATIONS

ITEM 504. FLEXIBLE BASE
(Crushed Stone)

504.1 SCOPE OF WORK

A. This specification covers the requirements for the use of "Flexible Base (Crushed Stone)" for this project.

504.2 SUBMITTALS

A. Within 30 days after the Notice to Proceed, the Contractor shall provide a list of materials to be used from the TxDOT approved Materials Producer List (MPL) or submit to the Engineer or City Staff for approval, technical product literature including binding material, additives, aggregate source, aggregate type, aggregate gradation and all other pertinent data to illustrate conformance to the specification found within.

504.3 GENERAL

A. "Flexible Base (Crushed Stone)"shall consist of a foundation course for surface course or for other base courses; shall be composed of crusher-run broken stone; and shall be constructed as herein specified and as specified in TxDOT Item 247 of the Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges in one or more courses in conformity with the typical sections shown on Plans and to the lines and grades as established by the Plans.

504.4 MATERIAL

A. The material shall be crushed and shall consist of durable particles of stone mixed with approved binding material. The material source shall be approved by the Representative of the City, and conform to the requirements as follows:

B. When properly slaked and tested by standard Texas Department of Transportation laboratory methods, the flexible base material shall meet the following requirements:

C. Physical requirements

1. General. All types shall meet the physical requirements for the specified grade(s) as set forth in Table 1. When material meeting the requirements of Table 1 is unavailable within a 5-mile radius of the City of Killeen, alternate materials may be submitted to the Department of Public Works for review.

   Additives, such as, but not limited to, lime, cement or fly ash, shall not be used to alter the soil constants or strengths shown in Table 1, unless otherwise shown on the Plans.

   Unless otherwise shown on the Plans, the base material shall have a minimum Bar Linear Shrinkage of two (2) percent as determined by Test Method Tex-107-E, Part II.

2. The flexible base shall be:

   a. Type A. Type A material shall be crushed stone produced from oversized quarried aggregate, sized by crushing and produced from a naturally occurring single source. Crushed gravel or uncrushed gravel shall not be acceptable for Type A material. No blending of sources and/or additive materials will be allowed in Type A material.

   b. Grade 2 or better. Aggregate shall be of Grade 2 or better physical requirements as

specified in Table 1.

TABLE 1 – Type A, Grade 2
PHYSICAL REQUIREMENTS

Grade 2	
Triaxial Class 1: Min. compressive strength, psi: 45 at 0 psi lateral pressure and 175 at 15 psi lateral pressure	
Master Grading	
1-3/4"	0-10
7/8"	-
3/8"	-
No. 4	45-75
No. 40	60-85

Grade 2*
Max LL 40
Max PI 12
Wet Ball Mill Max..... 50
Max increase in passing No. 40..... 20

* Wet Ball Mill, % Max modified from TxDOT Item 247 requirements for Grade 2

1. Gradation requirements are percent retained on square sieves.

2. When a magnesium soundness value is shown on the Plans the material will be tested in accordance with Test Method Tex-411-A.

Sieve Analysis	Tex-110-E
Moisture-Density Determination	Tex-113-E
Roadway Density	Tex-115-E
Wet Ball Mill	Tex-116-E
Triaxial Tests (Part I or II as selected by the Engineer)	Tex-117-E
Particle Count	Tex-460-A, Part I

Samples for testing the base material for triaxial class, soil constants, gradation and wet ball mill will be taken prior to the compaction operations.

504.5 TOLERANCES

A. The limits establishing reasonably close conformity with the specified gradation and plasticity index are defined by the following:

B. The City may accept the material, providing not more than two (2) out of 10 consecutive gradation tests performed are outside the specified limit on any individual or combination of sieves by no more than five (5) percent and where no two (2) consecutive tests are outside the specified limit.

C. The City may accept the material providing not more than 2 out of 10 consecutive plasticity index samples tested are outside the specified limit by no more than two (2) points and where no two (2) consecutive tests are outside the specified limit.

D. When material meeting Type A, Grade 2 (as defined in TABLE 1 above) or better requirements is unavailable within a 50-mile radius of the City of Killeen (101 N. College Street, Killeen, Texas 76541), alternate materials may be submitted to the Public Works Director or his designee for review.

504.6 CONSTRUCTION METHODS

A. Preparation of Subgrade

1. The roadbed shall be excavated and shaped in conformity with the typical sections, lines and grades as shown on the Plans. All unstable or otherwise objectionable material shall be removed from the subgrade and replaced with approved material. All holes, ruts and depressions shall be filled with approved material, and if required, the subgrade shall be thoroughly wetted with water and reshaped and rolled to the extent directed in order to place the subgrade in an acceptable condition to receive the base material. The surface of the subgrade shall be finished to line and grade as established and in conformity with the typical section shown on the Plans, and any deviation in excess of ½-inch in cross section and in a length of 16-feet measured longitudinally shall be corrected by loosening, adding or removing material, reshaping and recompacting by sprinkling and rolling. Sufficient subgrade shall be prepared in advance to insure satisfactory prosecution of work.

B. First Course

1. Immediately before placing the base material, the subgrade shall be checked as to conformity with grade and section. Subgrade shall be at optimum moisture or above prior to placing the base material.

2. The material shall be delivered in approved vehicles of a uniform capacity and it shall be the charge of the Contractor that the required amount of specified material shall be delivered in each 100-foot station. Material deposited upon the subgrade shall be spread and shaped the same day unless otherwise directed by the City in writing. In the event inclement weather or other unforeseen circumstances render impractical the spreading of the material during the first 24-hour period, the material shall be scarified and spread as directed by the City. The material shall be sprinkled, if directed, and shall then be bladed, dragged and shaped to conform to typical sections as shown on the Plans. The base layer shall be constructed in lifts not less than four (4) inches and not exceeding eight (8) inches compacted thickness with each course being of equal thickness. All areas and "nests" of segregated coarse or fine material shall be corrected or removed and replaced with well graded material, as directed by the City.

3. The course shall be compacted by the method of compaction hereinafter specified as the "Density Control" method of compaction.

   a. The course shall be sprinkled as required and compacted to the extent necessary to provide not less than the percent density as hereinafter specified under "Density". In addition to the requirements specified for density, the full depth of flexible base shown on the Plans shall be compacted to the extent necessary to remain firm and stable under construction equipment. After each section of flexible base is completed, density tests shall be taken every 750 square yards of roadbed surface or every 250 linear feet, whichever is the least. 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. In that area on which pavement is to be placed, any deviation in excess of ¼-inch in cross section and in a length of 16-feet measured longitudinally shall be corrected by loosening, adding or removing material, reshaping and recompacting by sprinkling and rolling. All irregularities, depressions or weak spots which develop shall be corrected immediately by scarifying the areas affected, adding suitable material as required, reshaping and recompacting by sprinkling and rolling. Should the base course, due to any reason or cause, lose the required stability, density and finish

before the surfacing is complete, it shall be recompacted and refinished at the sole expense of the Contractor. The base material shall be placed at the optimum moisture contents to ± 3%.

C. Succeeding Courses

1. Construction methods and testing shall be the same as prescribed for the first course.

D. Density

1. Each course of flexible base shall be compacted to 95% of the maximum density as determined by ASTM D1557 (Method D) at ±2% of optimum moisture.

E. Curing

1. Cure the finished section until the moisture content is at least 2 percentage points below optimum or as directed before applying the next successive course or prime coat.

504.7 NOTES

A. Invoices showing total amount of flexible base delivered to each street or road shall be furnished to the City before asphalt is applied.

B. Bluetops will be set on the center, crown and back of curb of the streets or roads every 50-foot station or sufficient to maintain line and grade. These grade stakes will be to finished grade and visible for inspection before asphalt is applied.

504.8 PAYMENT

A. Payment for furnished and installed flexible base shall be paid according to the unit price per square yard in the proper item of the Proposal and Bid Schedule.

B. All work and materials to complete the installation of flexible base shall be subsidiary to this item.

END OF SECTION

SECTION 500 – TRANSPORTATION SPECIFICATIONS

ITEM 505. STRIPING

505.1 SCOPE OF WORK

A. This specification covers the requirements for furnishing and installing pavement markings as shown on the Plans and specified within.

505.2 SUBMITTALS

A. Within 30 days after the Notice to Proceed, the Contractor shall provide a list of materials to be used from the TxDOT approved Materials Producer List (MPL) or submit to the Engineer or City Staff for approval, technical product literature including material type, test data, and all other pertinent data to illustrate conformance to the specification found within.

505.3 MATERIALS

A. Unless otherwise shown on the Plans, all permanent pavement markings shall be thermoplastic type materials (Type I) that require heating to elevated temperatures for application in accordance with TxDOT Items 662, 666, 668, 672, 677, and 678 of the Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges. They shall conform to Texas Department of Transportation Materials Specification D-9-8220. Each container of thermoplastic material shall be clearly marked to indicate the color, weight, type of material, Manufacturer's name and the lot/batch number.

B. Work zone pavement markings shall be provided in accordance with TxDOT Item 662.

C. Temporary pavement markings (Type II) shall be provided in accordance with TxDOT DMS-8200, "Traffic Paint."

D. All pavement markings shall include drop-on glass beads conforming to TxDOT DMS-8290, "Glass Traffic Beads."

1. Type I Markings. Furnish Type III drop-on glass beads. Furnish Type II or double-drop of Type II and Type III drop-on glass beads where each type bead is applied separately in equal portions (by weight), only when specified in the plans. When furnishing a double-drop system, apply the Type III beads before applying the Type II beads.

2. Type II Markings. Furnish Type III drop-on glass beads or other beads specified on the plans.

505.4 EQUIPMENT

A. All equipment used to place pavement markings shall be maintained in a satisfactory condition. The equipment shall be able to place markings at a rate that will produce a uniform product meeting all the requirements set within TxDOT Item 666 of the Standard Specifications for Construction of Highways, Streets and Bridges. It shall be capable of placing linear markings up to eight (8) inches in width in a single pass and able to place a center line and no passing barrier line configuration of one (1) broken line with two (2) solid lines at the same time to the alignment and spacing shown on the Plans. Equipment shall be capable of placing lines with clean edges of a uniform cross section within a tolerance of $^{1}/_{8}$ of an inch per four (4) inches width of marking. It shall have an automatic cut-off device with manual operating capabilities to provide clean, reasonably square marking ends to the satisfaction of the Engineer or the City and provide a method of applying broken line in an approximate stripe-to-gap ratio of 10 to 30. The length of the stripe shall not be less than 10-feet or more than 10.5-feet. The total length of any stripe-gap cycle shall not be less than 39.5-feet or more

than 40.5-feet. It shall provide a continuous mixing and agitation of the pavement marking material. The use of pans, aprons or similar appliances will not be permitted for longitudinal striping applications. Beads shall be applied by an automatic bead dispenser that is attached to the pavement marking equipment in such a manner that the beads are dispensed uniformly and almost instantly as the marking is placed on the pavement surface. The bead dispenser shall have an automatic cut-off control, synchronized with the cut-off of the pavement marking equipment. A hand held thermometer shall be kept on the project during the placement of pavement markings capable of measuring the temperature of the pavement marking material.

505.5 CONSTRUCTION METHODS

A. Pavement marking shall be applied with an approximate stripe-to-gap ratio of 10 to 30 when the application is broken line striping. The length of the broken stripe shall not be less than 10-feet nor more than 10.50-feet. The total length of any stripe-gap cycle shall not be less than 39.50-feet nor more than 40.50-feet.

B. With prior approval from the City of Killeen, pavement markings may be placed on roadways open to traffic. When markings are to be placed under traffic, a minimum of interference to the operation of the traffic flow shall be maintained. Traffic control shall be maintained as shown on the approved Traffic Control Plan. All markings placed under open-traffic conditions shall be protected from traffic damage and disfigurement.

C. The deviation rate in pavement marking alignment shall not exceed one (1) inch per 200-feet of roadway and the maximum deviation shall not exceed two (2) inches nor shall any abrupt deviations be acceptable.

D. Markings shall have a uniform cross section. The density and quality of the markings shall be uniform throughout their thickness. The applied markings shall have no more than five (5) percent, by area, of holes or voids and shall be free of blisters.

E. Markings shall be reflectorized both internally and externally. Glass beads shall be applied to the materials at a uniform rate sufficient to achieve uniform and distinctive retroflective characteristics when observed in accordance with Test Method Tex-828-B.

F. Pavement markings that are not in alignment or sequence, as shown on the Plans or Standards, shall be removed and replaced at the sole expense of the Contractor.

505.6 SURFACE PREPARATION

A. New Portland cement concrete surfaces shall be cleaned to remove curing membrane, dirt, grease, loose and/or flaking existing construction markings and other forms of contamination.

B. Older Portland cement concrete surfaces and asphalt surfaces that exhibit loose and/or flaking existing markings shall be cleaned to remove all loose and flaking markings.

C. All pavement on which pavement markings are to be placed shall be completely dry.

505.7 APPLICATION

A. Unless otherwise shown on the Plans, Portland cement concrete surfaces and asphaltic surfaces that are three (3) years old or older shall be sealed by the use of paint type striping. The paint type markings shall be placed a minimum of two (2) and a maximum of 30 calendar days in advance of placing the thermoplastic type pavement markings. If the paint type markings become dirty for any reason prior to placing the thermoplastic type markings, they shall be cleaned by washing, brushing, compressed air or other means approved. The pavement and paint type marking shall both be thoroughly dry before any thermoplastic type markings are placed. The color of the paint type markings shall be the same as the thermoplastic type markings.

B. Pavement markings shall not be applied when the temperature and moisture limitations are beyond the Manufacturer's recommendation. The minimum thickness for thermoplastic markings shall be 0.060-inches (60-mil) for edgeline markings and 0.090-inches (90-mil) for stop bars, legends, symbols, gore and centerline/no passing barrier line markings, when measured in accordance with Test Method Tex-854-B. The maximum thickness of all thermoplastic type markings shall be 0.180-inches (180 mil).

C. All markings which do not meet the specifications found within or are not satisfactory to the striping plan, installation of the markings, or do not meet the requirements of the project, shall be removed and replaced at the sole expense of the Contractor. In the event that damage is done to the pavement surface in the replacement operation, the damage shall be corrected to the satisfaction of the City at the sole expense of the Contractor.

505.8 MEASUREMENT AND PAYMENT

A. Payment for furnished and installed pavement markings shall be paid according to the unit price per linear foot in the proper item of the Proposal and Bid Schedule.

B. All work and materials to complete the pavement markings shall be subsidiary to this item.

END OF SECTION

SECTION 500 – TRANSPORTATION SPECIFICATIONS

ITEM 506. LIME TREATMENT FOR MATERIALS IN PLACE

506.1 SCOPE OF WORK

A. This specification covers the requirements for the preparation and treatment of the subgrade, existing subbase or existing base by pulverizing the existing materials; furnishing and applying lime; mixing; mellowing for a minimum of 12 hours and compacting the mixed material to the required depth and density. This item applies to treatment of natural ground, embankment or existing pavement structure and shall be constructed as specified herein and in conformity with the typical sections, lines and grades on the drawings or as directed by the Engineer or designated representative. If the type of lime to be placed is not indicated on the drawings, the Contractor shall use Type B, Commercial Lime Slurry or Type C quick lime pebbles for all applications on areas larger than 100 square feet (10 square meters).

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text inch-pound units are given preference followed by SI units shown within parentheses.

506.2 SUBMITTALS

A. Within 30 days after the Notice to Proceed, the Contractor shall provide a list of materials to be used from the TxDOT approved Materials Producer List (MPL) or submit to the Engineer or City Staff for approval, technical product literature including material type, test data, and all other pertinent data to illustrate conformance to the specification found within. Items required for submittal shall include, but are not limited to the following:

1. Mix design information (TxDOT Item 260, “Lime Treatment (Road-Mixed)”),

2. Type of lime and rate of lime application, and

3. Equipment proposed for use in proof rolling, pulverizing, mixing, placement and compaction operations.

506.3 MATERIALS

A. Lime.

1. The lime shall meet the requirements of TxDOT Item 260, “Lime Treatment (Road-Mixed)” for the type of lime specified in the drawings or as directed by the Engineer or designated representative.

2. When Type B, Commercial Lime Slurry, is specified, the Contractor shall select the “Dry Solids” content to be used in the slurry prior to construction and shall notify the Engineer in writing 5 working days before changing the “Dry Solids” content.

3. When dry placement of Type C quicklime pebbles are indicated on the Drawings or approved by the Engineer or designated representative, the pebbles shall conform to TxDOT Grade DS (TxDOT Item 264) and shall have a gradation suitable for dry placement.

4. If lime is furnished in bags, each bag shall bear the manufacturer's certified weight (mass). Bags varying more than 5 percent from that weight (mass) may be rejected and the average weight (mass) of bags in any shipment, as shown by weighing 10 bags selected at random, shall not be less than the manufacturer's certified weight (mass).

B. Water. The water shall meet the material requirements of TxDOT Item No. 204, "Sprinkling"

C. Asphalt. The asphalt shall conform to the requirements of TxDOT Item No. 300, "Asphalts, Oils and Emulsions"

506.4 EQUIPMENT

A. The pulverizing, mixing and proof rolling machinery, tools and equipment, which are necessary for the proper execution of the work, shall be approved by the Engineer or designated representative. The equipment shall be located on the project site prior to the initiation of construction operations.

B. During the conduct of the Work all in-use machinery, tools and equipment shall be maintained in a satisfactory and workmanlike manner.

C. Hydrated lime shall be stored and handled in closed, weatherproof containers up to the time that mixing is initiated to form a slurry for distribution on the areas to be treated. 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.

D. If lime is furnished in trucks, each truck shall have the weight (mass) of lime certified on public scales or the Contractor shall place a set of standard platform truck scales or hopper scales at a location approved by the Engineer or designated representative.

506.5 CONSTRUCTION METHODS

A. General

1. Prior to commencement of the work, all required erosion control and tree protection measures shall be in place and the utilities located and protected as specified in the City of Killeen Standard Contract Document Section 205, "Site Conditions" and Section 206 "Contractor Use of Premises". Construction equipment shall not be operated within the drip line of trees unless otherwise indicated on the drawings or directed by the Engineer or designated representative. Construction materials shall not be stockpiled under the canopies of trees. Excavation or embankment materials shall not be placed within the drip line of trees until appropriate tree wells are constructed.

2. The placement of lime shall not be allowed to adversely impact vegetation, drainageways or waterways, storm water inlets or overflow channels. Structures shall be screened, blocked or protected to prevent lime from entering any structure or waterway.

3. It is the primary requirement of this specification to secure a completed course of treated material, which contains a uniform lime mixture at the rate specified on the drawings or directed by the Engineer or designated representative, is free from loose or segregated areas, exhibits uniform density and moisture content, is well bound for its full depth and displays a smooth surface suitable for placement of subsequent courses. It shall be the responsibility of the Contractor to: regulate the sequence of his work, use the proper amount of lime, maintain the work and rework the courses as necessary to meet the above requirements.

B. Preparation of Subgrade or Existing Base.

1. Unless indicated otherwise on the drawings or directed otherwise by the Engineer or designated representative, the Contractor shall proof roll the roadbed/subgrade in accordance with TxDOT Item No. 216, "Proof Rolling" prior to pulverization or scarification of the existing material and/or subgrade. Any unstable or spongy subgrade

areas identified by proof rolling shall be corrected either by additional re-working, drying and compaction, or by removal and replacement of unsuitable materials. When specifically directed by the Engineer or designated representative, the Contractor shall re-work the subgrade in accordance with TxDOT Item 251, "Reworking Base Courses".

2. Prior to treatment of existing material and/or subgrade the layer to be treated shall be constructed shaped to conform to the typical sections, lines and grades as indicated on the Drawings or as established by the Engineer or designated representative. This work shall be done in accordance with the provisions of applicable bid items. When shown on the Drawings, any existing asphaltic concrete pavement shall be removed and the work will be paid for in accordance with the applicable bid items.

3. When the Contractor elects to use a cutting and pulverizing machine that will process the material to the specified depth, the Contractor will not be required to excavate to the secondary grade or windrow the material. 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 times.

4. The material, either before or after lime is applied, shall be excavated to the secondary grade (i.e. proposed depth of lime treatment) and removed or windrowed to expose the secondary grade. The secondary grade shall be blue topped at the edge, 1/4 points and along the centerline at not more than 50-foot (15.25 meters) centers. Any wet or unstable materials, located below the secondary grade, shall be corrected, as directed by the Engineer or designated representative, by removing the unstable material or by scarifying, adding lime and compacting until uniform stability is attained.

5. The Contractor shall instruct their crews in the proper handling of lime to ensure that the workers and the public are adequately protected during lime handling and application operations.

C. Premixing Surface

When any material is uncovered during the premixing operation that exhibits properties different from the anticipated material, the Engineer or designated representative shall secure a sample of the material for appropriate testing to establish a suitable rate of lime application for the material.

D. Lime Application

The percentage of lime to be added by weight (mass) in pounds per square yard (kilograms per square meter) shall be as prescribed by a qualified geotechnical report and may be varied by the Engineer or designated representative if conditions warrant.

Unless otherwise approved by the Engineer or designated representative, the lime operation shall not be started when the air temperature is below 41°F (5°C) and falling, but may be started when the air temperature is above 35°F (2°C) and rising. The temperature will be taken in the shade and away from artificial heat.

Lime shall not be placed when weather conditions in the opinion of the Engineer or designated representative are unsuitable.

Lime shall only be applied to those areas that can be properly processed during the same working day.

The application and mixing of lime with the existing material shall be accomplished by the methods hereinafter described as "Dry Placement" or "Slurry Placement." Dry placement will only be

permitted for small isolated areas as indicated on the drawings or as directed by the Engineer or designated representative. The minimum rate of lime solids application shall be seven (7) percent by weight (mass), unless indicated otherwise on the Drawings or as directed by the Engineer or designated representative.

Any lime exposed to the air for more than six (6) hours and any lime lost or damaged before application due to rain, wind or other cause will be rejected and replaced by the Contractor at its own expense.

1. Dry Placement

   The lime shall be spread by a spreader approved by the Engineer or designated representative or by bag distribution at the rates shown on the Drawings or as directed by the Engineer or designated representative.

   The lime shall be distributed at a uniform rate and in such manner as to reduce the scattering of lime by wind. Lime shall not be applied when the wind conditions, in the opinion of the Engineer or designated representative, are such that blowing lime becomes objectionable to adjacent property owners or dangerous to traffic. A motor grader will not be used to spread Type A Hydrated lime but may be used to spread Type C Quicklime Grade "DS" pebbles.

   The material shall be sprinkled, as approved by the Engineer or designated representative, until the proper moisture content has been secured.

2. Slurry Placement

   The lime shall be mixed with water in a mixer or trucks with approved distributors to form a slurry with a solids content approved by the Engineer or designated representative. Application of the slurry shall be attained by successive passes over a measured section of roadway until the proper moisture and lime content has been secured. The distributor truck shall be equipped with an agitator, which will keep the lime and water in a uniform mixture.

E. Mixing

The mixing procedure shall be the same for "Dry Placement" or "Slurry Placement" as herein described.

During the interval of time between application and mixing, hydrated lime that has been exposed to the open air for a period of 6 hours or more or to excessive loss due to washing or blowing will not be accepted and the area shall be retreated.

In addition to the above, when Type C Quicklime, Grade "DS", is used under "Dry Placing", the material and lime shall be mixed as thoroughly as possible at the time of the lime application. Sufficient moisture shall be added during the mixing to hydrate the quicklime. After mixing, and prior to compaction, the mixture of material, quicklime and water, shall be moist cured for two (2) to seven (7) days, as approved by the Engineer or designated representative. After curing, mixing shall continue until the material and lime are thoroughly blended to the satisfaction of the Engineer or designated representative.

The material and lime shall be thoroughly mixed by road pulverizer equipment approved by the Engineer or designated representative. The material and lime shall be brought to the proper moisture content and the mixing shall be continued until a homogeneous, friable mixture of material and lime is obtained. The lime-material mixture shall be free from all clods or lumps so that, when all non-slaking aggregates retained on the #4 (4.75 mm) sieve are removed, the

remainder of the material shall meet the following pulverization requirements, when tested in accordance with TxDOT Test Method Tex-101-E, Part III:

	Percent
Minimum Passing the 1 3/4 inch (45 mm) Sieve	100
Minimum Passing the 3/4 inch (19 mm) Sieve	85
Minimum Passing the No. 4 (4.75 mm) Sieve	60

When the lime-material mixture satisfies the requirements above, the mixture shall be allowed to "mellow" for a minimum of 12 hours prior to the initiation of compaction.

F. Compaction

Prior to initiation of compaction, the material shall be aerated or sprinkled as necessary to provide the optimum moisture. The lime-conditioned materials shall then be shaped and uniformly compacted to the sections; lines and grades indicated on the drawings or as directed by the Engineer or designated representative. Compaction shall continue until the entire depth of mixture is uniformly compacted as shown on the Drawings, as specified herein, or as directed by the Engineer or designated representative.

When shown on the Drawings or approved by the Engineer or designated representative, multiple lifts will be permitted; however the 12-hour "mellowing" procedure is required for each lift. Individual lift thickness should not exceed 8 inches (200 mm).

The course shall be sprinkled as required and compacted to the extent necessary to provide the density specified below:

Description	Density, Percent
For lime-conditioned subgrade, existing subbase or existing base that will receive subsequent subbase or base courses.	Not less than 95% of 'optimum density' or as otherwise indicated on the drawings.
For lime-conditioned existing base that will receive surface courses	Not less than 98% of 'optimum density' or as otherwise indicated on the drawings.

Testing for the 'optimum density' used for compaction control shall conform to TxDOT Test Method Tex-115-E. In addition to the requirements specified for density, the full depth of the material indicated shall be compacted to the extent necessary to remain firm and stable under construction equipment. After each section is completed and proof rolled in accordance with Specification Section No. 236S, in place compaction tests will be conducted, as necessary, by the Engineer or designated representative in accordance with TxDOT Test Method, Tex 115-E. If the material fails to meet the density requirements, it shall be reworked as necessary to meet these requirements. Throughout the 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 sections, lines and grades as shown on the Drawings or as established by the Engineer or designated representative.

If the lime-conditioned material, due to any reason or cause, loses the required stability, density and finish before the next course is placed, it shall be re-compacted and refinished at the sole expense of the Contractor.

G. Reworking a Section

When a section is reworked within 72 hours after completion of compaction, the Contractor shall rework the section to provide the required compaction. When a section is reworked more than 72 hours after completion of compaction, the Contractor shall add 25 percent of the original specified rate of lime application during the reworking operation.

Reworking shall include loosening, road mixing as approved by the Engineer or designated representative, compacting and finishing. When a section is reworked, a new optimum density will be determined from the reworked material in accordance with TxDOT Test Method Tex-115-E.

506.6 FINISHING, CURING AND PREPARATION FOR SURFACING

A. After the final layer or course of the lime conditioned subgrade, subbase or base has been compacted, it shall be brought to the required lines and grades in accordance with the typical sections indicated on the drawings. The completed section shall then be "finished off" by rolling with a pneumatic tire or other suitable roller, approved by the Engineer or designated representative, that is sufficiently light in loading to prevent hair cracking.

B. The Contractor shall set blue tops at edges, 1/4 point, and along the centerline at not more than 50 foot (15.25 meter) spacing. The completed section shall be maintained in a moist cured condition for the time specified in the table below either by maintenance of moist conditions by water sprinkling or by the prevention of moisture loss due to drying by the addition of an asphalt prime coat as indicated on the drawings or as directed by the Engineer or designated representative at the rate of 0.05 to 0.20 gallons per square yard (0.2 to 0.9 liters per square meter) before further courses are added or any through traffic is permitted, unless otherwise directed by the Engineer or designated representative. Curing shall continue for a minimum of seven (7) days before further courses are added or traffic is permitted access, unless a shorter curing period is approved by the Engineer or designated representative.

Minimum Curing Requirements Before Placing Subsequent Courses

Untreated Material	Curing (Days)
PI $\leq$ 35	2
PI $>$ 35	5

C. If the drawings require the lime-conditioned material to be sealed or covered by other courses of material, the seal or other course shall be applied within 14 days after final mixing is completed, unless otherwise directed by the Engineer or designated representative. If the 14 day limit cannot be achieved because of insufficient strength gain or other problem with the lime-treated layer, the Contractor shall rework the section in accordance with Section 203S.5(G) above.

506.7 SAMPLING AND TESTING

A. The lime-conditioned mixture shall be tested daily at the Project site for conformance to specification requirements. The Engineer or designated representative shall determine sample locations based on the Contractor's anticipated production. Each day's anticipated production shall be sectioned into three (3) equal, single-pass, sub-area lots. Each day's sample locations shall be equally distributed over the three (3) sub-areas. Also, no more than one location of the three (3) sub-areas is to be located in an irregular shaped area such as a cul-de-sac.

B. When, in the opinion of the Engineer or designated representative, test results appear unrepresentative, additional testing may be authorized. Retesting due to failures or to resolve unrepresentative results will be at the expense of the Contractor and the results of the retesting shall be averaged with the results of the original testing. If the results of retesting indicate that the original testing was erroneous, the original test results will be discarded.

C. The Engineer will obtain samples of completed work to conduct the following tests:

Testing Requirement	TxDOT Test Procedure
Optimum Moisture Density	Test Method Tex-115E
In-Place Density of Lime Conditioning	Test Method Tex 115-E
Thickness of Lime Conditioning	Test Method Tex-140-E & Tex-600-J
PI Reduction	Test Method Tex-106-E

The contractor shall repair areas disturbed while obtaining samples.

506.8 TOLERANCES

A. In-Place Density

The Work may be accepted provided no more than one (1) out of the most recent five (5) density tests performed is below the specified density, provided that the failing test is not more than 3 pounds per cubic foot (50 kilograms per cubic meter) below the specified density.

B. Dimensional

Areas of lime conditioning which do not meet the tolerances specified below will be delineated and shall be corrected to drawing dimensions by scarifying, remanipulating and recompacting the deficient areas at the Contractor's sole expense.

1. Thickness Requirements:

Under thickness shall not exceed ¾ inch (19 mm). Overthickness will be waived at no additional cost to the City.

2. Widths Requirements:

Roadway under width shall not exceed 6 inches (150 mm). Shoulder underwidth shall not exceed 3 inches (75 mm). If lime conditioning for both roadway and shoulder is constructed at the same time, the 6-inch (150-mm) underwidth tolerance shall apply. Overwidth will be waived at no additional cost to the City.

506.9 MEASUREMENT

A. Lime-conditioning of the type, grade and rate of application on the subgrade, existing subbase and existing base shall be measured by the square yard (square meter: 1 square yard equals 0.836 square meters) to neat lines as shown on the typical sections.

B. Reworking a section to provide the proper compaction shall be measured by the square yard (square meter: 1 square yard equals 0.836 square meters).

506.10 PAYMENT

A. Work performed and materials furnished as prescribed by this item and measured as provided under "Measurement" will be paid for as follows:

"Lime Treated Subgrade," "Lime Treated Existing Subbase" and "Lime Treated Existing Base" will be paid for at the unit bid price per square yard.

B. The unit bid prices shall include full compensation for: preparing the roadbed; furnishing all materials; all freight involved; public scales weighing charges or furnishing scales and labor involved in weighing the material; loosening, mixing, pulverizing, spreading, drying, furnishing and application of lime, sprinkling, rolling, shaping, proof rolling, maintenance and all manipulations, reworking, labor, equipment, fuels, tools and incidentals necessary to complete the work.

C. Reworking a section shall include full compensation for: loosening lime treated layer, furnishing and application of additional lime, road mixing, sprinkling, rolling, shaping, proof rolling, maintenance and all manipulations, labor, equipment, fuels, tools and incidentals necessary to complete reworking.

END OF SECTION

SECTION 500 – TRANSPORTATION SPECIFICATIONS

ITEM 507. GEOGRID

507.1 SCOPE OF WORK

A. This specification governs the materials, composition, quality, sampling, and testing of synthetic geogrid. Install geogrid in accordance with the lines and grades shown on the plans. Two grades of geogrid, Types 1 and 2, are specified for different loads.

507.2 SUBMITTALS

A. Within 30 days after the Notice to Proceed, the Contractor shall provide a list of materials to be used from the TxDOT approved Materials Producer List (MPL) or submit to the Engineer or City Staff for approval, technical product literature including material type, test data, and all other pertinent data to illustrate conformance to the specification found within. Items required for submittal shall include, but are not limited to the following:

1. Aperture Size, (in.),
2. Percent Open Area, %,
3. Thickness (in.) of MD ribs, CMD ribs, and Junctions,
4. Tensile Modulus @ 2% elongation (lb./ft.) of MD & CMD
5. Junction Efficiency, % of rib ultimate tensile strength for MD & CMD

507.3 MATERIALS

A. Geogrid.

1. The structure should be capable of maintaining dimensional stability during placement and under normal construction traffic.
2. The geogrid should be resistant to damage during construction, including ultraviolet degradation, and it should have long-term resistance to chemical and biological degradation caused by the materials being reinforced.
3. The geogrid supplied must meet the requirements listed in Table 1 when sampled and tested in accordance with Tex-621-J.

Table 1
Geogrid Requirements

Property	Type 1	Type 2
Aperture Size, mm (in.)	25-51 (1.0-2.0)	25-51 (1.0-2.0)
Percent Open Area, %	70 minimum	70 minimum
Thickness, mm (in.) MD ribs CMD ribs Junctions	 0.77 (0.03 minimum) 0.64 (0.025 minimum) 1.50 (0.06) minimum)	 1.27 (0.05) minimum 1.15 (0.045) minimum 2.54 (0.10) minimum
Tensile Modulus @ 2% elongation[1], N/m (lb./ft.) MD & CMD CMD	 204,260 minimum (14,000) minimum	 291,000 minimum (20,000) minimum
Junction Efficiency, % of rib ultimate tensile strength MD & CMD	 90 minimum	 90 minimum

507.4 CONSTRUCTION METHODS

A. General

1. Prepare the subgrade as indicated on the plans or as directed. Set string lines for alignment if directed. Install geogrid in accordance with the lines and grades as shown on the plans. Place base material in lift thicknesses and compact as shown on the plans or as directed. Do not operate tracked construction equipment on the geogrid until a minimum fill cover of 6 in. is achieved. Rubber tire construction equipment may operate directly on the geogrid at speeds of less than 5 mph if the underlying material will support the loads. Where excessive substructure deformation is apparent, correct grid placement operations as recommended by the manufacturer or as directed.

a. Fabric Placement. Orient the geogrid length as unrolled parallel to the direction of roadway. Overlap geogrid sections as shown on the plans or as directed. Use plastic ties at overlap joints or as directed. Placement of geogrid around corners may require cutting and diagonal lapping. Pin geogrid at the beginning of the backfill section as directed. Keep geogrid taut at the beginning of the backfilling section but not restrained from stretching or flattening.

1. Longitudinal Joints. Overlap longitudinal joints by a minimum of 1 ft. Space longitudinal ties 10 ft. to 20 ft. or as directed.

2. Overlap transverse joints by a minimum of 1 ft. Space transverse ties 4 ft. to 5 ft. or as directed.

b. Damage Repair. As directed, remove and replace contractor damaged or excessively deformed areas without additional compensation. Lap repair areas a minimum of 3 ft in all directions. Tie each side of repair grid in at least 3 locations but do not exceed normal construction spacing; tie spacing for odd shapes will be as directed. Repair excessively deformed materials underlying the grid as directed.

507.5 TOLERANCES

A. Basis for Rejection

If any individual sample selected at random from 100 rolls or fraction thereof fails to meet any specification requirement, that roll will be rejected. Two additional samples will be taken, one

from each of two other rolls selected at random from the same 100-roll lot or fraction thereof. If either of the additional samples fails to comply with any portion of the Specification, the entire quantity of rolls represented by that sample will be rejected.

507.6 MEASUREMENT

A. Geogrid base reinforcement will be measured by the square yard of roadway placement as shown in the plans with no allowance for overlapping at transverse and longitudinal joints.

507.7 PAYMENT

A. 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 "Geogrid Base Reinforcement" of the type specified. This price is full compensation for furnishing, preparing, hauling and placing materials including labor, materials, freight, tools, equipment and incidentals.

END OF SECTION