

**CITY OF EDMOND**  
**STANDARD SPECIFICATIONS FOR CONSTRUCTION**

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**300.00 BASES**

**301.00 GENERAL REQUIREMENTS FOR BASES**

**301.01 DESCRIPTION.** This Section covers requirements common to all or designated types of base construction.

**301.02 MATERIALS.**

**A. General.** Unless otherwise shown on the Plans, the Contractor shall furnish all materials meeting the requirements of Section 300 Bases. The Contractor shall make such preliminary investigations as may be necessary to locate the proposed source of acceptable material.

**B. Density.** Standard density and field density of soils and aggregates shall be determined in accordance with Subsection 106.03 unless otherwise specified.

**301.03 EQUIPMENT.**

**A. General.** All equipment necessary for base construction shall meet the requirements of Subsection 108.06. The general requirements for certain types of equipment for base construction shall be that accepted by the industry which produce the quality of work specified.

**B. Mixing Equipment.**

*1. Traveling Plants.*

Traveling plants shall be approved types of either the single or multiple pass type which will thoroughly pulverize and mix the materials of the job-mix formula to the required size and uniformity. The plant shall be mounted on wheels or tread equipment of such type that when loaded to capacity, the sub-grade will not be rutted or damaged.

The plant shall have provisions for introducing water or other liquids at the time of mixing through a metering device or other approved methods. Leakage of liquids from the equipment shall be corrected before proceeding further. The single-pass machine shall be designed to pick up the material to be mixed from a windrow or blanket and shall be equipped so that during at least 50 percent of the mixing cycle all the material is picked up and mixed while separated from the mixing table.

*2. Stationary Plants.*

Stationary plants shall be either the batch type using revolving blade or rotary drum mixers or by continuous type mixing. The aggregates and other ingredients of the job-mix formula may be proportioned either by

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weight or by volume. There shall be means by which the Engineer can readily verify the proportions in each batch or the rate of flow for continuous mixing.

The charge and mixing time in a batch mixer or the rate of feed to a continuous mixer shall be such to obtain complete mixing of all the material. Dead areas in the mixer, in which the material does not move or is not sufficiently agitated, shall be corrected. The plant shall deliver a uniform mixture meeting all specification requirements.

**C. Compactors.**

1. *Nonvibratory Steel-Wheeled Roller.* Unless otherwise provided, non-vibratory steel-wheel rollers shall be of the tandem or 3-wheel self-propelled type or steel-wheel trailer type weighing not less than 5 tons. When drive rolls or trailer type rolls produce a compressive force of not less than 200 pounds per linear inch of contact area, a roller weighing less than 5 tons may be permitted. When the weight of the roller is specified in tons, the roller shall not be weighted above the manufacturer's maximum rating. The roller shall be operated within the manufacturer's speed range.
2. *Vibratory Compactors.* Vibratory compactors may be of the roller or pan type. The compactor shall be equipped with amplitude and frequency controls and specifically designed for the compaction of the material on which it is to be used.
3. *Pneumatic Tired Roller.* This shall be an approved type with pneumatic tired wheels mounted on two or more axles and spaced in such manner that all tires have uniform load and contact with the surface and that the rear group of tires will cover the gap between adjacent tires of the forward group. The roller shall be of the self-propelled or trailer type so constructed as to provide for the addition of weights.

It shall weigh, under operating conditions, not less than 5 tons for a rolling width of 60 inches. The pressure of the tires shall be such that the tire is riding square on the tread. The roller shall be operated at a speed neither less than 3 nor more than 8 miles per hours.

4. *Tamping Type Roller.* The tamping type roller, under working conditions, shall have a minimum weight of 90 pounds per linear inch of length of drum and a minimum load on each sheeps-foot of 100 pounds per square inch of cross-sectional area of the sheeps-foot in contact with the ground. Maximum area of the face of each sheeps-foot shall not be more than 12 square inches. The feet on the sheeps-foot roller shall project not less than 7 inches from the face of the drum and the roller shall be equipped with teeth cleaning devices. The feet in adjacent rows shall be spaced so

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that the distance from center to center of adjacent parallel rows is neither less than 6 inches nor more than 11 inches. Individual drums of the roller shall not exceed 5 feet in width and shall oscillate independently. Roller and tractor for pulling shall travel at a speed of approximately 3 to 6 miles per hour.

- D. *Sprinklers.*** Sprinklers shall be equipped with positive and rapidly working cut-off valves and approved spray bars, which will insure uniform and continuous discharge for its full length.
- E. *Distributors and Supply Tanks.*** Distributor and supply tanks shall meet the requirements of Subsection 401.03.

**301.04 CONSTRUCTION METHODS.**

- A. *General.*** In order to provide the required sub-grade, sub-base and pavement structure of acceptable smoothness and thickness, reasonably accurate control shall be maintained in the compaction of the sub-grade, smoothness of the sub-grade and smoothness and thickness of the component parts of the pavement structure.

The Contractor shall use equipment as may be required to provide acceptable construction within the prescribed tolerances. The Contractor's construction methods and equipment shall meet the requirements of Subsection 108.06. The sub-grade compaction requirement shall be 95 percent or greater of the standard density for acceptable construction. Unless otherwise provided, tolerances for the sub-grade, sub-base and various bases and surfaces of bases are as follows:

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BASES	SECTION	TOLERANCES	
		SURFACE	THICKNESS
Sub-grade	310	½ inch in 10 feet	
Sub-base	306	½ inch in 10 feet	Job average within ¼ inch of Plans. Not more than ½ inch deficient at any point except as provided in Subsection 301.04 B.
Aggregate Base	303	½ inch in 10 feet	Same as above
Caliche Base	305	½ inch in 10 feet	Same as above
Sand Cushion	308	½ inch in 10 feet	Same as above
Cement Treated Base	312	¼ inch in 10 feet	Same as above
Soil Asphalt Base	313	¼ inch in 10 feet	Same as above
Plant Mix Bituminous Base-Fine Aggregate	314	¼ inch in 10 feet	Reasonable conformity with Plans
Plant Mix Bituminous Base-Coarse Aggregate	315	¼ inch in 10 feet	Reasonable conformity with Plans

Surface tolerances of lower courses may be 1/8 inch more in 10 feet than the above tolerances specified for the surface of the completed base.

**B. Checking for Compliance with Tolerances.**

1. *Surface.* Testing with a 10-foot straightedge or other approved device for compliance with specified surface tolerances will be done by the Engineer at selected locations. The variation of the surface from the testing edge of the straightedge between any two contacts with the surface shall at no point exceed the specified tolerance. All humps or depressions exceeding the specified tolerance shall be corrected in an acceptable manner.
2. *Width and Thickness.* Width and thickness tolerances for bases and sub-bases paid for on the compacted volume in place (the theoretical cross-section shown on the Plans or established by the Engineer, multiplied by the length). Sections 303, 305, 306, 308, 312 and 313 will be determined as follows:

The minimum width shall be in reasonably close conformity with the dimensions shown on the Plans or established by the Engineer. The completed thickness of the base or sub-base shall be the nominal thickness shown on the Plans. The thickness of the base or sub-base shall be measured at intervals of not more than 500 feet for each dual lane width. Where the measured thickness of the base or sub-base is

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more than 1/2 inch deficient in the thickness, the Contractor shall correct the deficiency in an acceptable manner with no additional compensation. Where the measured thickness of the base or sub-base is thicker than shown on the Plans, it shall be considered as conforming with the specified thickness. All material and labor required in constructing the base in excess of the required width and thickness, including tolerances, will be considered as having been provided by the Contractor for his convenience and at his expense.

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**303.00 AGGREGATE BASE**

**303.01 DESCRIPTION.** This work shall consist of furnishing and placing one or more courses of aggregates and additives, if specified, on a prepared sub-grade or sub-base in accordance with these Specifications and in reasonably close conformity with the lines, grades, thicknesses and typical cross-sections shown on the Plans or established by the Engineer.

Aggregate base may be mixed off the roadbed and may be blended by plant mixing or other approved methods.

Aggregate base may be mixed on the roadbed with approved methods that will produce a uniformly blended material. Aggregate base shall not be mixed on any completed base or surface course.

**303.02 MATERIALS.** Materials shall conform to the requirements specified in the following Subsection of Section 700 – Materials, for the type gradation specified:

Aggregate Base	703.01
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The gradation may be either Type A or Type B unless otherwise specified on the Plans or in the Proposal. After work starts the same gradation type and source as specified or selected shall be used throughout the project unless otherwise permitted in writing by the Engineer, except as follows:

The gradation shall be Type A in the top 3 inches on any base course except when the specified thickness is 6 inches or less where it shall be for the total thickness.

**303.04 CONSTRUCTION METHODS.**

**A. Preparation of Sub-grade.** Prior to placing any new base material or sub-base and base course material on the roadbed, the sub-grade shall have been completed according to the requirements of Method B of Section 310, Sub-grade, of these Specifications or the method specified on the Plans or in the Proposal.

If there is an existing aggregate course in place, it shall be prepared in accordance with the requirements of the method of Section 311, Processing Existing Base and Surface, of these Specifications as indicated on the Plans and in the Proposal.

**B. Mixing Aggregate Base.**

1. *Offsite Mixing.* When mixing or blending of materials for aggregate base is done at an approved location off the roadbed one of the following procedures shall be used.

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- 1.1 *Stationary Plant – Mixing Method.* The aggregate and water shall be mixed in an approved central mixing plant of the pugmill type, rotary drum type, or in a continuous type of mixer.

Water shall be added during the mixing operation in the amount necessary to provide the proper moisture content for satisfactory compaction. If a pugmill type or rotary drum type of mixer is used, the materials shall be proportioned by batch weights, and if a continuous type of mixer is used, the materials may be proportioned by volume or by weight.

Should the Contractor elect to proportion the materials by volumetric methods and perform the mixing in a continuous type mixer, the completed mixture shall be uniform in character and of the same consistency with respect to aggregates and water as that obtained by weight proportioning and batch mixing.

If a continuous type mixer is used, the correct proportions of each aggregate size introduced into the mixer shall be drawn from storage by an approved type of continuous feeder through adjustable calibrated gates, which shall supply the correct amount of coarse aggregate and fine aggregate required to meet the specified gradation, and so arrange that the proportion of each aggregate size can be separately adjusted. The storage of materials shall be sufficient to supply the mixer when it is in operation at full capacity.

The weight of charge in a batch mixer or the rate of feed to a continuous type mixer shall not exceed that which will permit complete mixing of the material.

Mixing of materials shall be continued until a uniform mixture is obtained.

- 1.2 *Travel Plant-Mixing Method.* This method of producing aggregate base shall be performed at an approved location off the roadbed. The area selected to do this work shall be cleaned of vegetation or other deleterious substance, overlaid with a minimum of 3 inches of base material and compacted to provide a satisfactory working table for mixing operations.

When the aggregates required to produce the specified mixture are to be combined and blended on the working area, the weighed material shall be delivered and placed in measured windrows, each in the proper portions before blending. In the event a machine for mixing requires a blanket of material, the windrow shall be spread to a reasonably uniform depth and width which the machine is capable of handling. The water shall be applied by means of controls which

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will supply a uniform rate of water in the proper amount for satisfactory compaction. Application of excess water shall be avoided, either during mixing or during compaction, in order that undue softening of the sub-grade will not develop.

The device by which the mixing machine picks up the material shall be subject to control and shall be so controlled and operated on each pass of the mixer as to pick up the material to be treated and at the same time avoid cutting into the working area.

Mixing may be accomplished in one or more passes of the mixer through the material, but in any event shall be continued until the aggregate and water are evenly distributed through the mass and a uniform mixture meeting Specification requirements is obtained.

In the process of mixing, compensation shall be made for any tendency of the mixing equipment to shift material in a longitudinal direction.

2. *Onsite Mixing.* When the materials required to produce the specified mixture are to be combined and blended on the roadbed, the weighed material shall be delivered and placed in measured windrows, each in the proper proportions before blending. Fine aggregate to be added to the mixture shall be pulverized to 100 percent passing the one-inch sieve and not less than 80 percent passing the No. 4 sieve.

The total quantities for blending at one operation shall not be in excess of the amount that can be readily handled and thoroughly and uniformly mixed and blended to these requirements.

During the latter stages of the mixing and before the final mixing is completed, the mixture shall be moistened as deemed necessary to provide a suitable working condition during the final stages of mixing. Such application of water shall be accurate and uniform throughout the length of the section being treated so that no excess wet or dry spots will be evidenced in the finished blend. Application of excess water should be avoided, either during mixing or during compaction, in order that undue softening of the sub-grade will not develop.

- C. ***Spreading.*** Aggregate base materials mixed at locations off the roadbed shall be transported to the roadbed by means of suitable vehicles and deposited by means of approved spreading equipment. The layers shall be placed so that when compacted they will be true to the grades or levels required with the least possible surface disturbance. The Contractor shall make such adjustments in placing procedures or equipment as may be required to obtain true grades, to minimize segregation and degradation, to reduce or accelerate loss or accretion of water, and to assure an acceptable base.



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The aggregate base material shall be spread and compacted to the required density in one or more layers, as specified below, and of such width and thickness that after compacting, the finished base will conform to the required grade and cross-section. The aggregate base material for each separate course shall be spread for the full width of the roadbed before the placing of the succeeding courses. Longitudinal and transverse joints shall be staggered a minimum of 12 inches in succeeding course.

Aggregate base material shall be laid in courses of a minimum of 3 inches compacted thickness and shall not exceed a maximum of 6 inches compacted thickness, except when shoulders are shown on a typical section to be constructed as a separate operation, then they may be constructed in one course providing they do not exceed 8 inches in thickness, and in two approximately equal courses where they exceed 8 inches. In either case, the compacted shoulders shall meet specified density requirements.

After the blended and flattened windrow of aggregate base material mixed on the roadbed has been tested and approved by the Engineer, it shall be spread uniformly as specified above over the full length and width of the section to be compacted. This spreading shall be done in such a manner as to prevent segregation of the mixture.

**D. *Shaping and Compaction.*** Compaction of each layer shall continue until a density of not less than 100 percent of standard density, as determined by AASHTO T-180, Method D, has been achieved. Provided, that aggregate base outside the pavement edge for new construction, or outside the old pavement edge for widening, shall have a minimum density of 95 percent of standard density, AASHTO T-180, Method D. The surface of each layer shall be maintained during the compaction operations in such a manner that a uniform texture is produced and the aggregates firmly keyed. Water shall be uniformly applied over the base materials during compaction in the amount necessary for proper consolidation.

Before applying the prime coat, the aggregate base material shall have cured or seasoned sufficiently to permit the prime coat to be properly applied.

**E. *Tolerances.*** Tolerances for surface, width and thickness shall be in conformity with Section 301.

**303.05 METHOD OF MEASUREMENT.** Aggregate base will be measured by the cubic yard, compacted in place to the specified density. Measurement will be based on the actual length multiplied by the theoretical cross-section shown on the Plans.

**303.06 BASIS OF PAYMENT.** Accepted aggregate base, measured as provided above, will be paid for at the contract unit price for:

Aggregate Base

Cu. Yd.

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which shall be full compensation for furnishing all materials, equipment, labor and incidentals to complete the work as specified.

Rolling and water as required to obtain a specified density will not be a separate pay item, but the cost of same shall be included in the price of other bid items.

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**306.00 SUB-BASE**

**306.01 DESCRIPTION.** This work shall consist of furnishing and placing sub-base of the type shown on the Plans and in reasonably close conformity with the lines, grades and typical cross-sections shown on the Plans or established by the Engineer.

**306.02 MATERIALS.** Materials shall meet the requirements specified in Section 704 for the type and gradation specified.

Sub-base material shall meet the specified requirements prior to final incorporation in the work. After work starts, the same type, gradation and source as specified or selected by the Contractor shall be used throughout the project unless otherwise permitted in writing by the Engineer.

**306.04 CONSTRUCTION METHODS.**

**A. Preparation of Sub-grade.** The sub-grade shall be constructed as specified for Method B of Section 310 of these Specifications, or the method indicated on the Plans and in the Proposal.

**B. Compaction-Density.** The sub-base material shall be placed on the roadbed in sufficient quantities and uniformly spread to such thickness and width that the completed sub-base will conform to the Plan width, thickness and grade within the specified tolerances.

The sub-base material shall be compacted to not less than 100 percent of standard density as determined by AASHTO T-99, Method D.

**C. Tolerances.** Tolerances for surface, width and thickness shall be in conformity with Section 301.

**306.05 METHOD OF MEASUREMENT.** Sub-base will be measured by the cubic yard, compacted in place, to the specified density. Measurement will be based on the actual length multiplied by the theoretical cross-section shown on the Plans.

**306.06 BASIS OF PAYMENT.** Accepted sub-base, measured as provided above, will be paid for at the contract unit price for:

Sub-Base

Cu. Yd.

which shall be full compensation for furnishing all materials, equipment, labor and incidentals to complete the work as specified.

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**307.00 LIME TREATED SUB-GRADE**

**307.01 DESCRIPTION.** This work shall consist of furnishing and placing one or more courses of a mixture of soil, lime and water in accordance with these Specifications and in reasonably close conformity with the lines, grades, thickness and typical cross-sections shown on the Plans or established by the Engineer.

In sub-grade extents designated on the Plans or by the Engineer as having excessive rock, the dimensions or quantities of which 25 percent or more is greater than 2.5 inches which makes full compliance impractical, the Engineer may waive certain portions of the Standard Specifications as described below. The Engineer may require exploratory scarifying by the Contractor before designation of extents for which the full compliance of Specifications is waived.

**307.02 MATERIALS.** Materials shall meet the requirements specified in the following Subsections of Section 700 – Materials.

Water	701.04
Hydrated Lime	706.01
Quick Lime	706.02
By-Product Lime	706.03

When lime is stored, it shall be stored in a suitable weather-tight building or compartment that will protect the lime from dampness and placed in such a manner as to permit easy access for proper inspection and identification of each shipment. Lime, which for any reason has become partially set or which contains hard lumps or cakes, shall not be used. Lime from different sources, although tested, shall not be mixed in storage.

By-product lime from residual or waste piles from approved sources may be used in lieu of hydrated or quick lime.

**307.03 EQUIPMENT.** Equipment meeting the requirements of Subsection 301.03 shall be used on the project.

**307.04 CONSTRUCTION METHODS.**

**A. General.** It is the primary requirement of these Specifications to secure a completed course of treated material containing a uniform lime mixture, free from loose or segregated areas, of uniform density and moisture content, well bound for its full depth 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, to maintain the work, and to rework the courses as necessary to meet the above requirements.

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- B. *Weather Limitations.*** Lime shall not be applied unless the air temperature is at least 40° F and rising. The air temperature shall be taken 4 feet above the ground in the shade and away from artificial heat. Lime shall be applied when the low temperature for a minimum of 48 hours is projected to fall below 35° F.
- C. *Preparation of Existing Roadbed.*** Prior to beginning any lime treatment, the roadbed shall be compacted and shaped to reasonably close conformity with the typical sections, lines and grades as shown on the Plans or established by the Engineer. The Contractor shall be required to roll the sub-grade as directed by the Engineer, and to correct any soft areas that this rolling may reveal.
- D. *Scarifying and Loosening.*** Scarifying and loosening may be required prior to the application of lime to achieve the desired results as determined by the Engineer. Precautions shall be taken to avoid forming furrows of loosened material below the depth specified for the bottom of the treated sub-grade. Except by special permission from the Engineer, the length of roadway scarified and loosened at any time shall not exceed the length in which the first mixing (paragraph 307.04 F. 1.) can be completed in two calendar days.
- E. *Application of Lime. General.*** The proportion of lime indicated on the Plans is approximate.

Lime shall be applied at the rate as prescribed by the Engineer, based on tests of the sub-grade soil. Equipment necessary for proper control of application rate of the lime shall be provided by the Contractor. Where tests indicate a significant change in the sub-grade soil, the Engineer will establish a new rate as deemed necessary for the section of road affected, and at the time of placing and spreading the lime, will advise the Contractor of the final rate for said section.

Lime shall not be applied when wind conditions are such that blowing lime becomes objectionable to traffic and adjacent property owners. A motor grader shall not be used to spread hydrated lime.

When lime is applied to the soil ahead of the mixing plant, the lime shall be placed only on that area where the first mixing operations can be completed during the same working day. During the interval of time between application and mixing, lime that has been exposed to the open air for a period of 6 hours or more may not be accepted for payment. Payment will not be made for lime loss due to excessive washing or blowing.

1. *Dry Method.*

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- 1.1 *Quick Lime.* When quick lime is used, the equipment for spreading lime shall be an approved type which shall demonstrate its ability to distribute the lime at controlled amounts uniformly.
  - 1.2 *Hydrated Lime.* Bagged hydrated lime may be used for dry method application only under unusual circumstances when it would be impossible or impracticable to use other methods and only upon written approval of the Engineer provided that all applicable Federal, State and local laws are met. The bagged lime shall bear the manufacturer's certified weight.
2. *Slurry Method.* Lime shall be mixed with water into a slurry by either of the following methods.
- 2.1 *Central Plant.* Agitation shall be accomplished through integral paddles, recirculating pumps, or a combination of these devices. The slurry distributor truck, hauling from the central plant, shall be equipped with a recirculating pump or agitator of sufficient size which will keep the lime and water in a uniform mixture until spread.
  - 2.2 *Transit Mix.* The lime from the storage bin shall be metered or weighed by an approved method into the tank transit mix equipment. The tank truck shall be equipped with a recirculating pump or agitator to maintain a uniform mixing of the lime and water while in transit.
- The distributor using either method, shall be equipped with a pump. The slurry will be applied through the spray bars under pressure to assure a uniform flow and distribution.
- Use of compressed air for mixing will not be permitted. The slurry produced by either method shall consist of a minimum mixture of approximately one ton of lime to each 500 gallons of water and shall not contain more than 40 percent lime.
3. *By-Product Lime.* When by-product lime is used, the equipment for spreading lime shall be an approved type which will demonstrate its ability to uniformly distribute the lime at controlled amounts.

**F. *Mixing.*** The mixing procedure shall be as hereinafter described:

1. *First Mixing.* The soil, lime, and water shall be mixed until a uniform mixture is obtained in which all clods and non-aggregate lumps are reduced to a maximum of 2.5 inch diameter size. The quantity of water necessary for the first mixing operation will vary with the nature of the material, normally 3 to 5 percentage points above the optimum moisture content of the compacted treated soil. Sufficient water shall be added in

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the first mixing process to insure proper chemical action between the lime and soil. When proper mixing has been accomplished, the mixture shall be left to cure. During the curing period the material shall be maintained in a moist condition.

It will be permissible to seal the surface of the modified area by light rolling to the extent that the surface will repel water and contain the moisture below, provided that the material is evenly distributed in the roadway.

When deemed necessary by the Engineer, any portion of the area under modification shall be rescarified for additional sprinkling to insure proper moisture for the curing.

2. *Final Mixing.* After the required curing time, the material shall be uniformly mixed by approved methods. All clods shall be reduced in size until the soil-lime mixture meets the following requirements when tested dry by laboratory sieves:

Minimum passing 1.5 inch	100%
Minimum passing No. 4 sieve	60%

3. *Depths of 2 feet or greater.* For depths of 2 feet or greater either the dry or slurry method may be used. When the dry method is used, the lime may be spread either before or after initial plowing. Following application of lime, alternate plowing and wetting shall continue until the lime and moisture are dispersed throughout the required depth of the course.

It is the intent that no course treated shall exceed 2 feet in depth. If the depth of material to be treated in cut sections is more than 2 feet, that portion above the lower 2 feet shall be removed so the bottom course can be treated in place. The upper portions of the cut section shall be treated in courses not more than 2 feet in depth. Lime treatment may be accomplished by adding and mixing the amount of lime as required on the Plans to each 8-inch lift during normal fill construction or by completing a 2-foot depth of fill to the typical section shown on the Plans and then adding lime in the required amount for the 2 feet of fill.

On each properly compacted 2-foot course, the initial mixing shall be considered the final and only mixing necessary.

4. *Designated Excessive Rock Areas.* In areas designated by the Engineer as excessive rock areas, it is the intent that the completed course of treated material shall comply with the Standard Specifications as to uniformity of lime mixture, density, moisture content and depth insofar as practicable. Mixing and pulverization shall be accomplished in two stages and shall be

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sufficient to accomplish the intent of the Specifications. The particle size requirement may be waived by the Engineer.

5. *Quick Lime Mixing.* Within two hours after spreading quick lime and before water is added, approved means shall be used to turn under a significant portion of the quick lime to reduce harmful exposure to the heat of hydration. (Caution – uncovered quick lime may be hazardous when in the presence of moisture.) Sufficient water shall be added within 6 hours after spreading to permit hydration of the quick lime.

**G. *Compaction.*** Compaction of the mixture shall be accomplished during the same day as the final mixing unless approval is obtained from the Engineer to continue compaction on the following day. The target density shall be determined in the field by the soil-lime mixture obtained from the roadway when compaction is started. The test method for the target density will be as specified in Subsection 106.03 modified to provide one compacted specimen of the soil-lime mixture as obtained from the roadway and separate portions of the sample used for additional specimens with the moisture reduced or increased. The material shall be aerated or sprinkled as necessary to provide the optimum moisture within plus or minus 2 percentage points. Compaction shall continue until the entire depth of mixture is uniformly compacted to not less than 100 percent of the target density. Field density will be determined in accordance with Subsection 106.03.

Depths of 2 feet compacted thickness may be compacted in one operation. The material shall be sprinkled or dried as necessary to provide the moisture for proper compaction. Compaction shall continue until the entire depth of mixture is compacted to a satisfactory condition as demonstrated by test rolling (Section 203) with the further requirement that the top 6 inches of the uppermost course be compacted to not less than 100 percent of the target density established in accordance with the paragraph above.

The material shall be sprinkled and rolled. All irregularities, depressions, or weak spots which develop shall be corrected immediately by scarifying the areas affected, adding or removing material as required, and reshaping and re-compacting by sprinkling and rolling.

In addition to the requirements specified for density, the full depth of the material shown on the Plans shall be uniformly compacted to the extent necessary to remain firm and stable under construction equipment. After each section is completed, tests as necessary will be made by the Engineer. 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 and the surface upon completion shall be smooth and in conformity with the typical sections 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 or finish before the next course is



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placed or the work is accepted, it shall be re-compacted and refinished at the sole expense of the Contractor.

In areas designated by the Engineer as excessive rock areas, it is the intent that compaction be in substantial compliance with the Standard Specifications. However, it is recognized that the soil-lime mixture may not be uniform and some variation is to be expected in both the target density and optimum moisture dependent on the lime content of a given sample. In the event that the in-place density tests are not practical because of rock in the soil-lime mixture, the Engineer may waive the density and moisture content requirements and approve compaction by visual observation in lieu of such tests.

**H. *Finishing and Curing.*** After the final layer of the lime treated sub-grade has been compacted, it shall be brought within reasonable compliance to the lines, grades and typical sections. The completed section shall then be finished with a suitable roller sufficiently light to prevent hair cracking. The treated material shall be maintained at a moisture content satisfactory for proper curing by sprinkling for a period of 14 days or until a prime, seal, or succeeding course is placed, whichever occurs first.

**I. *Tolerance.*** The finished surface tolerance shall be in conformity with Section 301.

**307.05 METHOD OF MEASUREMENT.**

**A.** Hydrated lime or quick lime will be measured by the ton.

**B.** Lime treatment sub-grade will be measured by the square yard.

**C.** Water and rolling will not be measured for payment.

**307.06 BASIS OF PAYMENT.** Accepted quantities, measured as provided above, will be paid for at the contract unit price for:

(A)	Lime	Ton
(B)	Lime Treated Sub-grade	Sq. Yd.

which shall be full compensation for furnishing all materials, equipment, labor and incidentals to complete the work as specified.

Rolling and water as required to obtain a specified density will not be a separate pay item, but the cost of same shall be included in the price of other bid items.

Payment for quick lime shall be based upon a 90 percent available lime index by rapid sugar method, calculated as percent CaO by weight. Payment for hydrated

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lime shall be based upon a 90 percent available lime index by rapid sugar method, calculated as percent Ca(OH)<sub>2</sub> by weight.

By-product lime will be paid for as hydrated or quick lime based on a substitution ratio calculated on a 90 percent available lime index by rapid sugar method.

When the available lime index percentage falls below 90 percent, payment will be made at an adjusted price. The adjusted price shall be reduced at the rate of one percent of the contract unit bid price for lime for each percent, or fraction thereof, from 90.0 percent down to and including an available lime index of 80.0 percent.

When the available lime index falls below 80.0 percent for the type of lime used, the Contractor shall add a sufficient quantity of additional lime of the same type to bring the total amount to the required 90.0 percent of available lime index at no additional cost to the City.

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**308.00 SAND CUSHION**

**308.01 DESCRIPTION.** This work shall consist of furnishing and placing a course of sandy material as a foundation for concrete in accordance with these Specifications and in reasonably close conformity with the lines, grades and typical cross-sections shown on the Plans or established by the Engineer.

**308.02 MATERIALS.** Materials shall meet the requirements specified in Subsection 704.02.

**308.04 CONSTRUCTION METHODS.**

**A. Preparation of Sub-Grade.** The sub-grade shall be constructed as specified for Method B of Section 310 of these Specifications or the method indicated on the Plans and in the Proposal.

**B. Compaction-Density.** The sand cushion material shall be placed in sufficient quantities and uniformly spread to such a thickness and width that the completed sand cushion will conform to the Plan width, thickness and grade within the specified tolerances.

The sand cushion material shall be manipulated, sprinkled and rolled to secure not less than 100 percent of standard density.

**C. Tolerances.** Tolerances for surface, width and thicknesses shall be in conformity with Section 301.

**308.05 METHOD OF MEASUREMENT.** Sand cushion will be measured by the square yard or cubic yard as show on the Plans and in the Proposal.

**308.06 BASIS OF PAYMENT.** Accepted quantities of sand cushion, measured as provided above, will be paid for at the contract unit price for:

Sand Cushion	Sq. Yd. or Cu. Yd.
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which shall be full compensation for furnishing all materials, equipment, labor and incidentals to complete the work as specified.

Rolling and water as required to obtain a specified density will not be a separate pay item, but the cost of same shall be included in the price of other bid items.

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**309.00 ROLLING AND SPRINKLING**

**309.01 DESCRIPTION.** This work shall consist of authorized rolling of embankments, sub-grades, sub-bases, bases or surface courses. When specified, rolling and/or sprinkling shall be done as directed by the Engineer in accordance with the Specifications for the particular type of work under construction.

**309.03 EQUIPMENT.**

**A. General.** When end results only are specified, the Contractor will have the option of using compaction methods that will satisfactorily produce the end results. When specific equipment is designated, it shall meet the requirements of Subsection 301.03.

**309.04 CONSTRUCTION METHODS.** Water shall be applied in the amount required to place the course or layers in the most satisfactory condition for proper compaction. Rolling shall be done in the amount required to obtain the required density for the type of material being compacted.

Rolling shall begin at the edges and be continued until the outside portion and the edges of the course are thoroughly compacted. After the edges have been firmly rolled, the rolling shall progress gradually toward the center, parallel to the center line of the roadway, uniformly lapping each preceding track and covering the entire surface with the rear wheels for the full width of the course. Subsequent rolling shall start at the edges and proceed as before, covering the full width across the road, and continuing until all parts of the course are thoroughly keyed and compacted to the satisfaction of the Engineer. On super elevated curves after the edges have been thoroughly rolled as specified above, the rolling shall continue from the inside edge to the outside edge instead of from the edges to the center. The rollers shall be operated at the speed previously specified. When operations are such that one roller unit cannot perform the required compaction satisfactorily, additional roller units shall be provided and operations continued in a manner approved by the Engineer.

**309.05 METHOD OF MEASUREMENT.**

**A.** When an item for rolling is shown on the Plans or in the Proposal as a pay item, rolling will be measured by the hour and pay quantities will be as follows:

The number of hours that the roller actually works will be divided by 5 and the quotient thus obtained multiplied by the actual outside rolling width in feet of the roller tread. In case of sheeps-foot rollers, the width to be used will be the sum of the widths in feet of the individual drums composing the roller. No time will be allowed for moving the roller to and from the location of the work being rolled.

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**B.** When an item for sprinkling is shown on the Plans or in the Proposal as a pay item, sprinkling will be measured by the 1,000 gallon increments or fractional part thereof, of water used and will be measured as delivered in calibrated tank trucks, or if water is obtained by pipe line, the Contractor shall supply an accurate water meter for measuring the water.

**309.06 BASIS OF PAYMENT.** When an item for rolling is shown on the Plans or in the Proposal as a pay item, rolling, measured as provided above, will be paid for at the contract unit price per hour for rolling and such payment shall be full compensation for furnishing the roller, operator, all equipment, fuel and incidentals necessary to complete the work as specified.

When an item for sprinkling is shown on the Plans or in the Proposal as a pay item, sprinkling, measured as provided above, will be paid for at the contract price per 1,000 gallons for sprinkling, and such payment shall be full compensation for the cost of the water, for hauling, applying and furnishing all equipment, tools, labor and incidentals necessary to complete the work as specified.

- |     |            |         |
|-----|------------|---------|
| (A) | Rolling    | Hr.     |
| (B) | Sprinkling | M. Gal. |

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**310.00 SUB-GRADE**

**310.01 DESCRIPTION.** This work shall consist of preparing the sub-grade for the immediate construction of sub-base, base, sand cushion, pavement or surface.

The sub-grade shall be constructed in accordance with one of the methods specified herein or by the method indicated on the Plans or in the Proposal for the work.

**310.04 CONSTRUCTION METHODS**

**Method A (Traffic Bound Surface Course).** The full width of the existing roadbed shall be shaped and crowned with a blade grader to the approximate grade and section required. Unless otherwise indicated the completed section shall have a crown of at least 0.25 inch per foot. All exposed rock larger than 3 inches in diameter and any unstable soil shall be removed and replaced with acceptable material. The finished roadbed shall be smooth and uniform and be maintained in this condition until the next specified course is placed.

**Method B (All other sub-bases, bases, pavement or surface).** When an item under Section 311 is not included in the Contract, any asphalt surfacing shall be removed and disposed of by the Contractor at locations shown on the Plans. The stockpile shall be left in a neat and workmanlike manner. The aggregate in place shall be used on or incorporated in the full width of the sub-grade to provide a uniform sub-grade as specified.

The sub-grade shall be scarified or otherwise processed to permit uniform dispersion of moisture to a depth of approximately 6 inches. Areas of the sub-grade through rock cuts that cannot be scarified or otherwise processed shall be shaped with soil meeting the requirements of select borrow Subsection 202.02 F, unless otherwise specified, to conform to the planned profile and cross-section. When the loosened soil has been pulverized, it shall be thoroughly and uniformly compacted with the suitable equipment to at least 95 percent of standard density in accordance with Subsection 106.03 for a depth of approximately 6 inches. Moisture content of the sub-grade material at the time of compaction shall be within two points of the optimum moisture content as determined by AASHTO T 99 unless otherwise specified. Areas of the sub-grade which are not accessible to rolling equipment shall be compacted to the required density with approved mechanical tampers.

The surface of the finished sub-grade will be tested by the Engineer at selected locations. The variation of the surface shall meet the tolerance requirements of Subsection 301.04. Unless otherwise provided, points closer than 50 feet shall not vary more than 0.5 inch from the approved grade in place.

Tests of the sub-grade in place shall be made immediately in advance of placing the subsequent course and shall not vary more than the tolerances heretofore specified

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and any deficiency shall be corrected before material is placed for the subsequent course.

When the condition of the sub-surface materials in excess of 12 inches below sub-grade elevations prevents the satisfactory construction of the sub-grade, all of the excavation required to remove the unstable material for an area and to a depth designated by the Engineer and the backfill with acceptable material to sub-grade elevation shall be done in accordance with Subsection 202.04. Material unsuitable for backfill shall be wasted as directed by the Engineer and the backfill made with acceptable material obtained from borrow in accordance with Subsection 202.04.

When grading and surfacing operations are let in one contract, removal and replacement of unstable material will not be measured or paid for in fill areas.

Instability due to excess moisture in the top 12 inches will not be recognized as justification for removal of unstable material, and payment will not be made for manipulation and aeration of materials in place, necessary to establish a satisfactory sub-grade.

Measurement of the excavation required for removal of unstable material and excavation for borrow required for backfill with acceptable material as provided above will be made in accordance with Subsection 202.05.

Excavation required for removal of unstable material and excavation for borrow for backfill with acceptable material measured as provided above will be paid for at the contract unit price per cubic yard for unclassified excavation.

**310.05 METHOD OF MEASUREMENT.** Sub-grade will be measured by the square yard.

**310.06 BASIS OF PAYMENT.** Accepted sub-grade quantities, measured as provided above, will be paid for at the contract unit price for:

- |     |                    |         |
|-----|--------------------|---------|
| (A) | Sub-grade Method A | Sq. Yd. |
| (B) | Sub-grade Method B | Sq. Yd. |

which shall be full compensation for furnishing all materials, equipment, tools, labor and incidentals to complete the work as specified.

It is the intent of this Specification that payment for this item will be made only one time for work performed on the sub-grade as defined in Subsection 101.75 regardless of the number of sub-base or base courses placed on the sub-grade.

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**311.00 PROCESSING EXISTING BASE AND SURFACE**

**311.01 DESCRIPTION.** This work shall consist of the removal, processing, re-use or disposal of existing aggregate surface course or base course and asphalt surface.

This work shall be done in accordance with one of the following methods as specified herein and shown on the Plans or as indicated by a pay item on the Plans and in the Proposal.

**311.04 CONSTRUCTION METHODS.**

**General.** The aggregate or other materials in place shall be loosened by scarifying or the use of other suitable methods to its full depth and width. All loosened aggregate or asphalt shall be processed and broken into pieces which will pass a 3-inch sieve. The materials shall be windrowed on the sub-grade or shoulder as the case may require. Care shall be exercised in loosening, removing, processing and storage of aggregate to avoid the addition of excess amounts of soil or other foreign material which would render it unsuitable for the use hereafter specified. Damaged material resulting from improper workmanship of the Contractor will not be measured for payment.

**Method A – for Salvage and Stockpiling.** The processed materials shall not contain detrimental amounts of sub-grade or soil or other foreign materials. The processed material shall be loaded and hauled to storage locations indicated on the Plans. All materials shall be stored in a neat and workmanlike manner. All grass, weeds and other rubbish shall be removed from the storage area prior to stockpiling material.

**Method B – for Use in Sub-grade.** The processed materials shall be windrowed on the shoulders during the shaping and conditioning of the sub-grade. The materials shall then be spread uniformly over the full width of the section and compacted and completed with the sub-grade in accordance with the method specified.

**Method C – for Use as a Sub-base.** The processed materials shall be spread evenly on the previously completed and compacted sub-grade and then compacted to the requirements specified for the method of sub-grade preparation.

**Method D – for Use in New Base Courses, Shoulders, or Ramps.** The processed materials may be placed on the completed sub-grade as a base course, shoulders or ramps, or it may be blended uniformly with new material for any course. The suitability of the removed materials shall be determined by the Engineer and materials used as authorized.

These materials shall be compacted to not less than 95 percent of standard density for shoulders, ramps and base courses.



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**311.05 METHOD OF MEASUREMENT.** Processing existing base and surface will be measured by the station of 100 feet or fraction thereof measured along the center line of the roadbed.

**311.06 BASIS OF PAYMENT.** Accepted quantities for processing existing base and surface, measured as provided above, will be paid for at the contract unit price for:

- |   |      |
|---|------|
| (A) Processing Existing Base and Surface,<br>Method A | Sta. |
| (B) Processing Existing Base and Surface,<br>Method B | Sta. |
| (C) Processing Existing Base and Surface,<br>Method C | Sta. |
| (D) Processing Existing Base and Surface,<br>Method D | Sta. |

which shall be full compensation for furnishing all equipment, tools, labor and incidentals necessary to complete the work as specified.

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**312.00 PORTLAND CEMENT TREATED BASE**

**312.01 DESCRIPTION.** This work shall consist of constructing one or more courses of a mixture of soil-aggregate and portland cement on a prepared sub-grade or sub-base in accordance with these Specifications and in reasonably close conformity with the lines, grades and typical cross-sections shown on the Plans or established by the Engineer.

**312.02 MATERIALS.** Materials shall meet the requirements specified in the following Subsections of Section 700 – Materials.

Soil-Aggregate	704.04
Portland Cement	701.02
Water	701.04
Asphalt Membrane, RC-250 or MC 250, unless otherwise specified	708.03

Cement in bulk, meeting the above requirements, may be used provided the manner and method of handling is approved by the Engineer. Bulk cement shall be weighed on approved scales as prescribed under Section 414.

When cement is stored, it shall be stored in a suitable weather tight storage facility, which will protect the cement from dampness, and stored in such manner as to permit easy access for proper inspection and identification of each shipment. Any cement which for any reason has become partially set or which contains hard lumps or cakes shall be rejected. Cement salvaged from discarded or used bags shall not be used. Cement from different mills, although tested and approved, shall not be mixed.

**312.03 EQUIPMENT.** Equipment necessary for the proper construction of the work shall meet the requirements of Subsection 301.03.

**312.04 CONSTRUCTION METHODS.**

**A. Weather Limitations.** Mixing will not be permitted when the aggregate or sub-grade is frozen. The air temperature shall be at least 40° F in the shade and rising. The Contractor shall be responsible for the protection and quality of the base under any weather conditions.

**B. Preparation of Existing Roadbed.** When grading and surfacing operations are let as one contract, prior to start of paving, base or sub-base operations, the sub-grade shall be prepared as specified under Section 310, Method B, of these Specifications.

Asphalt surfacing which cannot be pulverized to meet gradation requirements shall be removed from the existing roadbed and disposed of by the Contractor at locations shown on the Plans or directed by the Engineer. The existing

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roadbed then shall be graded and shaped to conform with the grades, lines and cross-sections shown on the Plans or directed by the Engineer. Where the addition of suitable soil is required, it shall be spread uniformly to the specified width and depth over the previously shaped roadbed.

All loose material shall be disked, harrowed or otherwise processed to break up all clods and pulverize the material sufficiently to permit uniform dispersion of moisture. Then the roadbed shall be thoroughly and uniformly compacted with suitable equipment to at least 95 percent of standard density.

- C. Application of Cement.** Cement shall not be applied when the moisture content of the loose soil exceeds the specified optimum moisture for the soil-cement mixture by more than 2 percentage points.

Only spreading and mixing equipment will be allowed to pass over the freshly spread cement.

When bulk cement is used, the Contractor shall have equipment for handling, weighing and spreading the cement in a satisfactory manner.

The Contractor will be required to replace cement lost at his own expense.

**D. Mixing.**

1. *General.* Imported soil-aggregate or roadbed soil shall be pulverized to the extent that 80 percent of the cement treated mixture by dry weight shall pass a No. 4 sieve, exclusive of gravel or stone retained on a No. 4 sieve. Gravel or stone retained on a 2.5 inch sieve shall be removed before mixing. When sandstone is approved for use, 80 percent of the entire mix shall pass the No. 4 sieve except as provided herein.

A job-mix design will be set by the Engineer based on a representative sample submitted by the Contractor. The job-mix formula for the mixture shall establish a single percentage of aggregate passing each sieve. The aggregate shall meet this established percentage within +7 percent as set by the design mix except that in no event shall the amount passing the No. 4 sieve be less than 55 percent.

2. *Traveling Plant.* The cement shall not be applied to the soil for a greater distance than the traveling plant will normally mix in one hour. Mixing shall continue at such a rate of speed of the traveling plant as will produce a uniform mixture of soil-cement and water.

The compaction operation shall be a continuation of the mixing operation in such a manner that the moistened soil-cement mixture does not remain undisturbed after mixing and before compacting for more than 30 minutes.

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3. *Stationary Plant.* The aggregate shall be proportioned and mixed with cement and water in a stationary plant meeting the requirements of Subsection 301.03 B. 2. Mixing shall continue until a uniform mixture of aggregate, cement and water has been obtained.

Mixed material shall be transported to the roadway in suitable vehicles and spread on a moistened sub-grade or base in a uniform layer by a self-propelled or other approved spreader. Not more than 60 minutes shall elapse between the addition of cement to the mixer and starting compaction of the mixture on the prepared sub-grade.

- E. *Compacting and Finishing.*** Compaction of the cement treated mixture shall begin not later than 30 minutes after the mixture is spread on the roadbed. The target density shall be determined in the field by moisture density tests on representative samples of cement treated mixture obtained from the roadway at the conclusion of spreading operations. The test method for the target density will be as specified in Subsection 106.03, Method C, modified to provide one compacted specimen of the soil-cement mixture as obtained from the roadway, and separate portions of the sample used for additional specimens with the moisture reduced or increased. The soil-cement mixture shall be mixed and compacted within plus or minus 2 percentage points of optimum moisture content specified by the Engineer before there is any appreciable moisture loss. Compaction shall continue until the entire depth of cement treated mixture is uniformly compacted free of laminations and to a minimum density of 95 percent of target density. Field density will be determined in accordance with Subsection 106.03. The rate of operation and the number of rollers shall be sufficient to uniformly compact the section of roadway being processed to the specified width and depth within 2 hours.

After the mixture is compacted, the surface of the treated roadway shall be moistened and reshaped to the required lines, grades and cross-sections, and if necessary, shall be lightly scarified to remove any imprints left by the compacting or shaping equipment. The surface then shall be thoroughly rolled with steel wheel and pneumatic tired rollers.

When necessary to eliminate irregularities to meet surface tolerance, the trimming of not more than 0.25 inch average thickness of the base is recognized as a construction operation for which no deduction in pay quantities will be made. The excess material shall be deposited on the shoulder slopes or as directed by the Engineer.

Surface finishing methods may be varied from this procedure provided a dense, uniform surface free of surface compaction planes is produced. The surface shall be maintained in a moist condition during finishing operations. Compaction and finishing shall be done in such a manner as to produce a

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smooth, dense surface free of surface compaction planes, ridges, or loose material.

At all places inaccessible to rollers or finishing and shaping equipment (such as immediately adjacent to the completed base, approach slabs to bridges, etc.), the mixture shall be thoroughly compacted to the required density by other compacting methods approved by the Engineer and shaped and finished as specified.

- F. Asphalt Membrane.** The top of the base course shall be finished to within the specified tolerances and kept moist until the asphalt seal is applied. Excessive flushing of the surface will not be permitted. Asphalt shall be uniformly applied through spray nozzles at the rate of 0.15 to 0.3 gallons per square yard as directed by the Engineer.

At the time of bituminous material application, the soil-cement surface shall be dense, free of all loose and extraneous material, and shall contain sufficient moisture to prevent penetration of the bituminous material. If needed, water shall be applied to fill the surface voids of the soil-cement immediately before the bituminous material is applied.

Should it be necessary for construction equipment or other traffic to use the bituminous covered surface before the bituminous material has dried sufficiently to prevent pickup, sufficient sand cover shall be applied before such use.

The curing, including the asphaltic seal, shall be maintained by the Contractor for a period of 7 days so that all of the soil-cement base course will be covered effectively during this period.

Any finished portion of the base course adjacent to construction which is traveled by equipment used in constructing an adjoining section shall be protected in such a manner as to prevent equipment from marring or damaging the completed work. Unless otherwise provided, the asphalt seal shall be maintained by the Contractor until the treated base is protected by a subsequent course.

- G. Construction Joints and Traffic.** At the start of the day or in case of an unavoidable interruption of operations that would form a joint in the base, the edge of the base shall be cut back to leave a vertical face or as is necessary to secure a satisfactory riding surface. All base removed shall be replaced by the Contractor at his own expense.

Base courses for roads, streets or similar areas shall be processed and finished full width each day without longitudinal construction joints. The turning or operation of rollers, sprinklers, maintainers or other equipment on the

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previously completed or previously compacted and shaped base during the operations of laying, compacting and shaping base will not be permitted.

The passage of traffic or equipment over, along or across the base from the time the compaction and shaping of the base is completed will not be permitted until after 7 days have elapsed except as otherwise provided hereinafter.

Crossing the base after it has been cured for a period of 14 hours will be permitted provided such crossing is made over satisfactorily protected crossing areas constructed and maintained in accordance with one of the following requirements:

1. A layer of sand-clay, or other equally stable earth, of not less than 8 inches compacted depth, placed over the base for such width as required to adequately protect the base during such crossings.
2. A solid mat consisting of a floor of timbers or other suitable material laid across the base on not less than one inch of earth cover of such length, width, and thickness as required to adequately protect the base from damage.

**H. Tolerances.** Tolerances for surface, width and thickness shall be in conformity with Section 301.

**I. Maintenance.** The Contractor shall maintain the entire base course within the limits of his Contract in good condition to the satisfaction of the Engineer from the time he first starts work until the base has been completed and accepted. Maintenance shall include immediate repairs of any defects that may occur either before or after the cement is applied. Such work shall be done by the Contractor at his own expense and repeated as often as may be necessary to keep the area continuously intact. Repairs are to be made in a manner to insure restoration of a uniform surface and durability of the part repaired. Faulty work shall be replaced for the full depth of treatment. Any low areas shall be remedied by replacing the material for the full depth of treatment rather than by adding a thin layer of soil-cement to the completed work.

**312.05 METHOD OF MEASUREMENT.**

- A.** Cement will be measured by the ton. When bulk cement is used, the Contractor shall furnish the Engineer with copies of bills for shipments. Only the actual amount of cement used in the construction as directed by the Engineer will be measured for payment.
- B.** Imported soil-aggregate for cement treated base will be measured by the cubic yard, compacted in place, to the specified density. Measurement will be based

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on the actual length multiplied by the theoretical cross-section shown on the Plans.

- C.** Processing (manipulation) of the soil-aggregate and cement, whether mixed with a traveling or stationary plant, will be measured by the cubic yard compacted in place to the specified density. Measurement will be based on the actual length multiplied by the theoretical cross-section shown on the Plans.
- D.** Asphalt for asphalt membrane will be measured by the gallon in accordance with Section 109.

**312.06 BASIS OF PAYMENT.** The accepted quantities, measured as provided above, will be paid for at the contract unit price for:

(A)	Cement for Stabilization	Ton
(B)	Imported Soil-Aggregate	Cu. Yd.
(C)	Processing (Manipulation)	Cu. Yd.
(D)	Asphalt for Asphalt Membrane	Gal.

which shall be full compensation for furnishing all materials, equipment, labor and incidentals to complete the work as specified.

Water will not be a separate pay item, but the cost of same shall be included in the price of other bid items.

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**317.00 FLY ASH MODIFIED SUB-GRADE**

**317.01 Description.** This work shall consist of constructing one or more courses of a mixture of soil, fly ash, lime as required and water, in accordance with these Specifications and in reasonably close conformity with the lines, grades and typical cross-sections shown on the Plans or established by the Engineer.

**317.02 Materials.** Materials shall meet the requirements specified in the following Sections and Subsections of Section 700 – Materials:

Fly Ash	702
Hydrated Lime	706.01
Quick Lime	706.02
By-Product Lime	706.03
Water	701.04

**317.03 Equipment.**

**A. General.** All equipment necessary for construction of fly ash modified sub-grade shall be furnished in accordance with the requirements of Subsection 108.06 and the following.

**B. Traveling Plants.** Traveling plants used for soil pulverization and mixing shall be approved in accordance with the requirements of Subsection 301.03 B.

**C. Compactors.** Equipment for compaction shall meet the requirements of Subsection 301.03 C.

**D. Sprinklers.** Sprinklers shall meet the requirements of Subsection 301.03 D.

**317.04 CONSTRUCTION METHODS.**

**A. General.** It is the primary requirement of these Specifications to secure a completed course or courses of sub-grade material containing a uniform fly ash mixture of uniform density and moisture content, free from loose or segregated areas and well bound for its full depth 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 prescribed amount of fly ash, to maintain the work and rework the courses as necessary to meet the above requirements.

**B. Weather Limitations.** Fly ash mixing operations shall not be performed when the sub-grade is frozen or when the air temperature is less than 40° F. The air temperature shall be taken 4 feet above the ground in the shade and away from artificial heat. Fly ash shall not be applied when the low temperature for a minimum of 12 hours after final compaction is projected to fall below 40° F.



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- C. Preparation of Existing Roadbed.** Prior to the application of fly ash, the roadbed shall be compacted and shaped to reasonably close conformity with the typical sections, lines and grades as shown on the Plans or established by the Engineer.

The Contractor shall be required to roll the sub-grade and to correct any soft areas that this rolling may reveal.

- D. Scarifying and Loosening.** Scarifying and loosening may be required prior to the application of fly ash to achieve the desired results as determined by the Engineer. Precautions shall be taken to avoid forming furrows of loosened material below the depth specified for the bottom of the fly ash modified sub-grade. Except by special permission from the Engineer, the length of roadway scarified and loosened at any time shall not exceed the length in which mixing and compaction can be completed in two calendar days.

In sub-grade extents designated on the Plans or by the Engineer as having excessive rock, the dimensions or quantities of which 25 percent or more are greater than 2.5 inches in size makes compliance with these Specifications impractical, the Engineer may waive certain portions of the work as described below. The Engineer may require exploratory scarifying by the Contractor before the designation of extents for which full compliance of these Specifications is waived.

- E. Application of Fly Ash. General.** Fly ash shall be applied at the rate prescribed by the Engineer based on tests of the sub-grade soil. Equipment necessary for proper control of the application rate of fly ash shall be provided by the Contractor. Where tests indicate a significant change in the sub-grade soil, the Engineer will establish a new rate as deemed necessary for the section of road affected and at the time of placing and spreading the fly ash will advise the Contractor of the final application rate.

Fly ash shall not be applied by the slurry method. The fly ash shall not be placed on wet sub-grade or otherwise allowed to become wet during application.

Dry methods of application shall be utilized for placement of the fly ash onto the sub-grade. Equipment for spreading shall be approved types which demonstrate the ability to distribute fly ash uniformly.

Fly ash shall not be applied when wind conditions are such that blowing fly ash becomes objectionable to traffic or adjacent property owners. Fly ash shall be placed only that area of roadway where mixing, compaction and finishing can be completed in the allotted time. During the interval of time between application and completion of the first mixing operations, fly ash that has been exposed to weather conditions resulting in wetting or excessive loss by blowing

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will not be accepted for payment. Fly ash unacceptable as the result of wetting shall be removed from the roadway at the direction of the Engineer.

**F. *Mixing.***

1. *General.* Mixing of the fly ash with the sub-grade soil shall follow application and spreading as a continuous construction operation. Work areas for mixing shall not exceed 5,000 square yards unless otherwise authorized by the Engineer.

The mixing procedure shall be as hereinafter described:

- 1.1 *First Mixing.* The moisture content of the sub-grade soil shall not exceed 80 percent of optimum as determined by AASHTO T 99 at the time of first mixing. The soil and fly ash shall be mixed until a uniform mixture is obtained in which all clods and non-aggregate lumps are reduced to a maximum of 2.5 inch diameter size. The addition of water will not be permitted during the first mixing. First mixing operations shall begin no later than one hour after application of the fly ash.

When deemed necessary by the Engineer, any portion of the work area shall be re-scarified and additional fly ash added to ensure adequate soil modification.

The fly ash and soil shall be thoroughly mixed prior to the beginning of final mixing operations.

- 1.2 *Final Mixing.* After the dry soil and fly ash have been satisfactorily mixed, additions of water shall be made in the final mixing operations to initiate soil-fly ash reaction. The method of mixing shall be an approved procedure utilizing a traveling mixing plant which demonstrates uniform dispersion of fly ash and water throughout the soil materials. The quantity of water necessary for the final mixing operations will vary with the nature of the materials, normally 2 to 5 percentage points above the optimum moisture content of the compacted modified soil. Sufficient water in any case shall be added in the final mixing process to insure chemical action between the fly ash and soil.

All clods shall be reduced in size by mixing until the soil-fly ash mixture meets the following size requirements when tested with laboratory sieves:

<b>SIEVE SIZE</b>	<b>PERCENT PASSING</b>
1 inch	100
¾ inch	50 minimum

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2. *Lime Additive.* The addition of lime may be specified or approved to facilitate mixing fly ash with soil materials. When specified or directed by the Engineer in writing, lime shall be used to prevent fly ash flash set or retard soil-fly ash reactivity occurring during final mixing. Lime additive shall be uniformly blended with the fly ash on the roadway for incorporation with soil materials during first mixing operations unless other methods of application are approved.

The proportion of lime additive with the fly ash will be based on laboratory testing and field trial procedures necessary to determine proper soil modification. The addition of lime will permit a reduction of the fly ash requirement on a replacement basis as approved by the Engineer.

- G. *Compaction.*** Compaction of the soil-fly ash mixture shall be performed immediately after final mixing, wherein the compaction operation shall be a continuation of the final mixing operation. The target density shall be determined in the field by moisture density tests on representative samples of the soil-fly ash mixture obtained from the roadway when compaction is started. The test method for the target density will be as specified in Subsection 106.03 modified to provide one compacted specimen of the soil-fly ash mixture as obtained from the roadway, and separate portions of the sample used for additional specimens with the moisture reduced or increased.

The soil-fly ash mixture shall be compacted without delay and before any appreciable loss of mixing moisture occurs. Mixing and compaction operations shall be performed in such a manner that the mixture will be compacted within plus or minus 3 percentage points of optimum moisture content. However, during the course of construction, changes or adjustments in the specified moisture requirements to meet field conditions may be authorized.

Compaction shall continue until the entire depth of the mixture is uniformly compacted to not less than 100 percent of target density. Field density will be determined in accordance with Subsection of 106.03. The rate of operation and the number of rollers shall be sufficient to uniformly compact the section of roadway being processed within 2 hours of final mixing.

The material shall be sprinkled and rolled. All irregularities, depressions or weak spots which develop shall be corrected immediately by scarifying the areas affected, adding or removing material as required and reshaping and re-compacting by sprinkling and rolling.

In addition to the requirements specified for density, the full depth of the material shown on the Plans shall be uniformly compacted to the extent necessary to remain firm and stable under construction equipment. After each section is completed, density tests as necessary will be made by the Engineer for acceptance. If the material fails to meet the density requirements, it shall

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be reworked as necessary to meet these requirements. Throughout this entire operation the shape of the course shall be maintained 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, or finish before the next course is placed or the work is accepted, it shall be reworked and refinished at the sole expense of the Contractor.

In areas designated by the Engineer as excessive rock areas, it is the intent that compaction be in substantial compliance with these Specifications. However, it is recognized that the soil-fly ash mixture may not be uniform and some variation is to be expected in both the target density and optimum moisture dependent on the fly ash content of a given sample. In the event the in-place density tests are not practical because of rock in the soil-fly ash mixture the Engineer may waive the density and moisture content requirements and approve compacting by visual observation in lieu of such tests.

**H. *Finishing and Curing.*** After the final layer of the fly ash modified sub-grade has been compacted, the completed section shall then be finished with a suitable roller sufficiently light to prevent hair cracking. The modified material shall be maintained at a moisture content satisfactory for proper curing by sprinkling for a period of 14 days or until a prime, seal, or succeeding course is placed, whichever occurs first.

**I. *Surface Tolerance.*** The finished surface tolerance shall be in conformity with Section 301.

**317.05 METHOD OF MEASUREMENT.**

- A.** Fly ash will be measured by the ton.
- B.** Lime will be measured by the ton.
- C.** Fly ash modified sub-grade will be measured by the square yards of sub-grade modification completed in place.
- D.** Water will not be measured for payment.

**317.06 BASIS OF PAYMENT.** Accepted quantities for fly ash modified sub-grade, measured as provided above, will be paid for at the contract unit price for:

(A) Fly Ash	Ton
(B) Lime	Ton
(C) Sub-grade Modification	Sq. Yd.

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which shall be full compensation for furnishing all materials, equipment, labor and incidentals to complete the work as specified.

Payment for quick lime shall be based upon a 90 percent available lime index by rapid sugar method, calculated as percent CaO by weight. Payment for hydrated lime shall be based upon a 90 percent available lime index, by rapid sugar method, calculated as percent Ca(OH)<sub>2</sub> by weight.

When the available lime index percentage falls below 90 percent, payment will be made at an adjusted price. The adjusted price shall be reduced at the rate of one percent of the Contract unit bid price for lime and for each percent, or fraction thereof, from 90.0 percent down to and including an available lime index of 80.0 percent.

When the available lime index falls below 80.0 percent for the type of lime used, the Contractor shall add a sufficient quantity of additional lime of the same type to bring the total amount to the required 90.0 percent of the available lime index at no additional cost to The City.