***OPTION 3***

SECTION 32 11 30

**LIME FLY ASH STABILIZATION**

## PART 1 - GENERAL

### 1.1 DESCRIPTION

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

### 1.2 MEASUREMENT AND PAYMENT

A. Measurement for Lime Stabilized Subgrade is on a square yard basis. Separate measurement will be made for each different thickness of base course. Limits of measurement shall match actual pavement are, but no greater than the maximum pavement limits shown on Drawings. Limits for measurement will be extended to include installed lime/fly ash stabilized subgrade material that extends 1 foot beyond outside edge of pavement. No payment will be made for lime/fly ash stabilized subgrade in areas beyond these limits.

B. Measurement ~~for hydrated lime and~~ quicklime is by the ton of 2,000 pounds dry-weight basis.

C. Measurement for commercial lime slurry is by the ton of 2,000 pounds of lime calculated on the percentage by weight of dry solids for the grade slurry.

D. Measurement for fly ash is by the ton of 2,000 pounds dry-weight basis.

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

### 1.3 SUBMITTALS

Lime series Atterburg Limits

Lime series pH test (ASTM C977-83a-Annex Test Method)

Lime type

% Lime

Mix Design

## PART 2 – PRODUCTS

### 2.1 MATERIALS

A. The lime to be used for stabilization shall meet with requirements of TX DOT DMS-6350: "Lime and Lime Slurry" and DMS-6330, "Lime Sources Prequalification of Hydrated Lime and Quicklime". Use commercial lime slurry or pebble grade quicklime. When furnishing quicklime, provide it in bulk. Quicklime can be dangerous – use extreme caution if used for the Work. Contractor shall become informed about recommended precautions in the handling, storage and use of quicklime.

B. The amount of lime required for stabilization will be the percent by weight shown on the Plans, stated in the Special Provisions, or that amount which produces a pH not less than 12.4 and provides for a Plasticity Index less than 18.

C. The fly ash to be used shall conform to the requirements of TXDOT DMS-4615: "Fly Ash for Soil Treatment", Class C. Fly ash to also have a minimum CaO content of 20 percent and contain no lignite ash.

D. Water: clean, clear and free from oil, acids, alkali, or vegetable matter. Water sources other than the local municipal domestic water supply must be approved by the Engineer.

E. Mix Design – The Engineer will determine the target lime/fly ash content and optimum moisture content in accordance with Tex-127-E or prior experience with the project material. The Contractor may propose a mix design developed in accordance with Tex-127-E. The Engineer will use Tex-127-E to verify the Contractor's proposed mix design before acceptance.

### 2.2 TESTING REQUIREMENTS

A. After final mixing, a pH test, Atterberg Limit test and sieve analysis shall be performed in accordance with Tex-101-E, Part III.

B. Sampling and testing of lime slurry shall be in accordance with Tex-600-J.

C. Soil to be evaluated to establish percent of fly ash and lime slurry to be applied to subgrade material. Sample mixtures of lime slurry will be tested to establish compliance with specifications.

B. Moisture and Density tests shall be taken at each construction station to ensure a density of at least 98% of maximum dry density at a moisture content between optimum and 4% wet of optimum in accordance with Standard Proctor (ASTM D698). All tests meeting these requirements shall be paid by the City. The City will not pay for failing tests.

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

## PART 3 – EXECUTION

### 3.1. GENERAL:

A. It is the primary requirement of this specification to produce a completed course of treated material containing a uniform lime mixture, free of loose or segregated areas, of uniform density and moisture content, well bound for its full depth as shown on the detail sheet or specified in the Special Provisions and with a smooth surface suitable for placing

subsequent courses. It shall be the responsibility of the Contractor to regulate the sequence of his work, to use the proper amount of lime and fly ash, maintain the work and rework the courses as necessary to meet the above requirements.

B. The Contractor is required to ensure the existing sub-grade or embankment beneath the course to be lime/fly ash stabilized is of proper density, uniformity and quality. The Contractor may elect to proof roll, replace and/or compact, areas that exhibit instability. If necessary, the Contractor may need to scarify, dry and compact the existing sub-grade prior to addition of lime/fly ash. All work for the preparation of the existing sub-grade will not be paid directly, but will be considered a part of "Lime Fly Ash Stabilization".

## 3.2. LIME APPLICATION:

A. When treating with Lime/Fly Ash, apply, mix, and cure lime first unless otherwise directed. Lime shall be spread only on that area where the first mixing operations can be completed during the same working day.

B. Minimize dust and scattering by wind. Do not apply lime or fly ash when wind conditions, in the opinion of the Engineer, cause blowing lime or fly ash to become dangerous to traffic or objectionable to adjacent property owners.

C. Uniformly apply lime using dry or slurry placement as shown on the plans or as directed. Add lime at the percentage determined in approved mix design. Lime shall be spread only on that area where the first mixing operations can be completed during the same working day.

D. The lime shall be spread by a pre-approved screw type spreader box, or a pre-approved truck spreader, in the manner and at the rates directed by the Engineer. The lime shall be distributed at a uniform rate and in such a manner as to reduce the scattering of the lime by wind to a minimum. Lime shall not be applied when wind conditions, in the opinion of the Engineer, are such that blowing lime becomes objectionable. A motor grader shall not be used to spread the lime.

E. When pebble grade quicklime is placed dry, mix the material and lime thoroughly at the time of lime application. Conform to cautionary requirements of Paragraph 2.1A concerning use of quicklime.

## 3.3. LIME MIXING:

A. Do not mix and place material when temperature is below 40 degrees F and falling. The temperature will be taken in the shade and away from artificial heat. Suspend operations when the Engineer determines that weather conditions are unsuitable. Begin mixing within 6 hours of lime application.

B. Begin mixing within 6 hours of lime application. The material shall be dried or wetted as directed by the Engineer, until the proper moisture content has been secured. All lime shall be thoroughly mixed with the material to be treated immediately after application of lime.

C. Use approved single-pass or multiple-pass rotary speed mixers to mix soil, lime, fly ash, and water to required depth. Obtain a homogeneous friable mixture free of clods and lumps.

D. The soil-lime mixture shall be sprinkled during the mixing process as directed by the Engineer, to provide optimum moisture plus four (4) percent in the mixing immediately prior to starting the compaction operation.

E. The stabilized soil shall then be lightly sealed to allow for the mixture to mellow for 1 to 4 days. When pebble grade quicklime is used, allow the mixture to mellow for 2 to 4 days. The mixed material shall be kept moist during this period and traffic shall not be allowed on the treated portion. The moisture content of the mixture should be within optimum and four percent of optimum for the compactive effort specified.

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

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

## 3.3. APPLICATION AND MIXING OF FLY ASH:

A. Uniformly apply fly ash in dry form unless otherwise approved. Apply at the percentage determined in the approved mix design. Apply fly ash only on that area where the mixing and compacting operations can be completed during the same working day. Do not use a motor grader to spread fly ash.

B. During the interval of time between application and mixing, fly ash that has been exposed to the open air for a period of six (6) hours or more or had excessive loss due to washing or blowing will not be accepted until totally reprocessed, refinished and retested. This will be done at the sole expense of the Contractor.

C. Begin fly ash application within 4 days after the lime mixing operation has been completed unless otherwise approved.

D. Thoroughly dry-mix the material and fly ash using approved equipment until a loose, homogeneous mixture is obtained. The fly ash mixture shall be sprinkled during the mixing process as directed by the Engineer, to achieve adequate mixing and hydration moisture. Prevent formation of fly ash balls.

E. Shape mixed subgrade to final lines and grades.

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

## 3.4. COMPACTION:

A. Compaction of the mixture shall begin immediately after final mixing. Complete all compaction operations within 6 hours of fly ash application. The material shall be aerated or sprinkled as necessary to provide the proper moisture. Compaction shall begin at the bottom and shall continue until the entire depth of mixture is uniformly compacted. Spread and compact in two or more approximately equal layers where total compacted thickness is to be greater than 8 inches. Do not allow stabilized base to mix with underlying material. Correct irregularities or weak spots immediately by replacing material and recompacting.

B. The course shall be sprinkled as required and compacted to the extent necessary to provide no less than ninety-eight (98) percent of the density measured by ASTM D698 at a moisture content between optimum and +4% wet of optimum moisture content. Grades shall be “blue-topped” during the compaction effort and the lime soil mixture shall be

compacted to within 0.1 ft in cross-section and 0.1 ft in 16 ft measured longitudinally. In addition to the requirements specified for density, the full depth of the material shown on the plans shall be compacted to the extent necessary to remain firm and stable under construction equipment. Depth tests shall occur every 200 lf and shall be performed after compliance with density requirements. Fill test sections with new compacted lime stabilized subgrade.

C. If the material fails to meet the density requirements, it shall be reworked as necessary to meet these requirements. Throughout this entire operation the shape of the course shall be maintained by blading, and the surface upon completion shall be smooth and in conformity with the typical section shown on the plans and to the established lines and grades. Should the material due to any reason or cause, lose the required stability, density and finish it shall be re-compacted, refinished and retested at the sole expense of the Contractor.

## 3.5 EQUIPMENT

A. The machine, tools and equipment necessary for the proper prosecution of the work shall be on the project and pre-approved by the Engineer prior to the beginning of construction operations.

B. All machinery, tools and equipment used shall be maintained in a satisfactory and workmanlike manner.

C. Use slurry tanks equipped with agitation devices to keep lime, fly ash, and water in a consistent mixture.

D. To insure thorough mixing of the lime into the material to be stabilized, equipment shall be a pulverizer mixer equivalent to a Seaman Mixer, or soil stabilizing machine shall be used.

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

## 3.6 FINISHING AND CURING OF LIME-STABILIZED MATERIAL:

A. After the lime/fly ash treated material has been compacted and brought to the required lines and grades in accordance with the typical sections, the completed section shall then be finished by rolling as directed with a pneumatic or other suitable roller sufficiently light to prevent hair line cracking. Complete finishing operations within 2 hours after final compaction. Rework and recompact at areas where hairline cracking develops.

B. The completed section shall be moist-cured for a minimum of seven (7) days before further courses are added or any traffic is permitted. During this time period the presence of sulphates should be evident by excessive swelling. If sulphates are found, seek direction from Engineer. Subgrade may be opened to traffic after 2 days if adequate strength has been attained to prevent damage. Restrict traffic to light pneumatic rollers or vehicles weighing less than 10 tons.

C. Apply seals or additional courses within fourteen (14) calendar days after final compaction, unless otherwise directed by the Engineer.

**END OF SECTION**