

SECTION 31 32 13.26 - LIME-FLY ASH OR FLY ASH STABILIZATION

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. This Section specifies the requirements for treating and stabilizing existing subgrade material or select fill material under pavements or site structures as shown on the drawings, by pulverizing, adding lime and or fly ash, and finishing to the lines and grades shown on the drawings and constructed as specified herein.
- B. This section excludes work necessary for building pad preparations. Work within the building footprint and surrounding 5 feet shall be accomplished under technical specification 31 23 00 Excavation and Fill prepared by ***STRUCTURAL ENGINEER**].

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Drawings and general provisions of the Contract, including A-procurement and Contracting Requirements, Division 00 and Division 01 apply to this section.
- B. Clearing and Grubbing: Section 31 11 00
- C. Site Grading: Section 31 22 13
- D. Asphalt Concrete Paving: Section 32 12 16
- E. Concrete Pavement: Section 32 13 13

1.3 PROJECT/SITE CONDITIONS

- A. It is the primary requirement of this specification to secure a completed course of treated material containing a uniform lime fly ash or fly ash mixture free from loose or segregated areas, or uniform density and moisture content, well bound for its full depth and with a smooth surface suitable for placing subsequent courses. It is to be the responsibility of the Contractor to regulate the sequence of his work, to process a sufficient quantity of material to provide full depth as shown on PLANS, to use the proper amounts of lime and fly ash, maintain the work, and rework the courses as necessary to meet the above requirements.
- B. **[LIST ANY SPECIAL CONDITIONS UNIQUE TO THIS PROJECT THAT DEAL WITH LIME-FLY ASH OR FLYASH STABILIZATION]**

1.4 SUBMITTALS (Not Used)

1.5 APPLICABLE PUBLICATIONS

- A. American Society for Testing and Materials (ASTM) C977-03 Standard Specification for Quicklime and Hydrated Lime for Soil Stabilization.
- B. ASTM Specification C618-08 Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.

- C. Texas Department of Transportation Test Method Tex-114-E, Laboratory Compaction Characteristics and Moisture-Density Relationship of Subgrade, Embankment Soils, and Backfill Material
- D. Texas Department of Transportation 2004 Standard Specifications for Construction of Highways, Streets and Bridges (TxDOT) Item 420 Weighing and Measuring Equipment.

1.6 DEFINITIONS

- A. Subgrade: The uppermost surface of an excavation, including excavation for trenches, or the top surface of a fill or backfill immediately below the base course, pavement, granular leveling fill, or topsoil materials.
- B. Geotechnical Engineer: The Geotechnical Engineer responsible for geotechnical design and materials testing.
- C. Base Course: The granular material forming the pavement base supported by the subgrade in asphalt pavement or unit paver pavement sections.
- D. Embankment: soil material used to fill an excavation

1.7 QUALITY ASSURANCE

- A. Codes and Standards: Perform earthwork complying with requirements of authorities having jurisdiction.
- B. Testing and Inspection Service: **Owner** will employ a qualified independent geotechnical engineering testing agency to classify proposed on-site and borrow soil materials to verify that soils comply with specified requirements and to perform required field and laboratory testing. Contractor responsible to coordinate with the testing agency prior to start of work requiring testing so as to minimize unnecessary cost or delays to the project.
- C. Testing:
 - 1. **Owner** will retain and pay a qualified Geotechnical engineer to take all field samples and do all laboratory testing necessary to verify compliance of the work to these Specifications or as required by City or other regulatory agencies. The Geotechnical Engineer shall submit results of all testing done during the course of the work to the Owner, Architect, and Contractor.
 - 2. Notify testing lab a minimum of **48 hours** in advance of the time testing is required to satisfy requirements of this section.
 - 3. Should testing specified above show work which does not satisfy these Specifications, the Contractor shall pay, through the Owner, for all additional tests required to determine the extent of work that is not satisfactory and for all additional tests necessary to demonstrate compliance with these specifications.
 - 4. All tests shall be performed by the Geotechnical Engineer in accordance with Test Method Tex-114-E or other approved methods selected by Geotechnical Engineer.
- D. Certification: (none needed)

PART 2 - PRODUCTS

2.1 LIME

- A. Lime to meet the requirements of ASTM C977-03 for hydrated lime or quicklime. When Quicklime is specified, the Contractor is to select, prior to construction, the grade to be used and notify the Engineer in writing before changing from one grade to another.

2.2 FLY ASH

- A. Fly ash to meet ASTM Specification C618-05, Class C. Fly ash to also have a minimum CaO content of 20 percent.

2.3 WATER

- A. Water used for mixing or curing shall be reasonably clean and free of oil, salt, acid, alkali, sugar, vegetable matter or other substances injurious to the finished product.
- B. Water sources other than the local municipal domestic water supply must be approved by the Owner.
 - 1. If onsite reclaimed water sources are used, tanks and appertices must be clearly marked with the words "non-potable" water.

2.4 SOIL

- A. Soil should be a clayey type soil, free of organic material, large rocks and other unsuitable materials with a plasticity index greater than 10 and a liquid limit in excess of 30. The soil should not contain more than twenty percent sands or silts.

PART 3 - EXECUTION

3.1 EQUIPMENT

- A. All machinery, tools, and equipment used are to be maintained in a satisfactory and workmanlike manner.
- B. Lime and fly ash is to be stored and handled in closed weather-proof containers until immediately before distribution on the road. If storage bins are used, they are to be completely enclosed. Material in bags to be stored in weatherproof buildings with adequate protection from ground dampness.
- C. If lime and/or fly ash is furnished in trucks, each truck is to have the weight of lime and fly ash verified on public scales. Scales are to conform to the requirements of the TxDOT Item 420 "Weighing and Measuring Equipment."
- D. If lime and/or fly ash is furnished in bags, each bag is to bear the manufacturer's certified weight. Bags varying more than 5 percent from that weight may be rejected. The average weight of bags in any shipment, as shown by weighing 50 bags taken at random, is to be not less than the manufacturer's certified weight.

3.2 CONSTRUCTION

- A. Preparation of Roadbed: Before other operations are begun, the roadbed is to be graded and shaped as required to construct in conformance with the lines, grades, thickness, and typical cross-section on the PLANS. Unsuitable soil or material to be removed and replaced with acceptable material. The subgrade to be firm and able to support, without displacement, the construction equipment and the compaction hereinafter made stable by scarifying, and aeration or adding lime and/or fly ash, and compacting until it is of uniform stability. If the Contractor elects to use a cutting and pulverizing machine to remove the subgrade material accurately to the secondary grade and pulverizing the material at the same time, there is no requirement to neither expose the secondary grade nor windrow the material. However, the Contractor will be required to roll the subgrade, as directed by the geotechnical engineer, before using the pulverizing machine and correct any soft areas that this riling may reveal. This method to be permitted only where a machine is provided, which ensures that the material is cut uniformly to the proper depth and which has cutters to plane the secondary grade to a smooth surface over the entire width of the cut. The machine to be of such design that a visible indication is given at all times that the machine is cutting to the proper depth.
- B. Application: Lime to be spread only on that area where the first mixing operation can be completed during the same working day. The sequence for application of lime and fly ash to be as specified below. The application and mixing of lime or fly ash with the material to be accomplished by the methods hereinafter described as "Slurry Placing."
1. Slurry Placing: The lime or fly ash to be mixed with water in vehicles with approved distributors and applied as a thin water suspension or slurry. Quicklime to be applied with a lime percentage not less than that applicable for the grade used. The distribution of lime or fly ash as directed by the Owner to be attained by successive passes over a measured section of roadway until the proper moisture and lime or fly ash content has been secured. The distributor vehicle to be equipped with an agitator to keep the lime or fly ash and water in a uniform mixture.
- C. Mixing
1. Mixing: The materials to be uniformly mixed by approved methods.
 - a. If the soil binder lime mixture contains clods, they are to be reduced in size by raking, blading, sinking, barrowing, scarifying, or the use of other approved pulverization methods. This shall be done in a way such that when all nonslaking aggregates retained on the No. 4 sieve are removed, the remainder of the material is to meet the following requirements when tested at the field moisture condition or dry by laboratory sieves.
 - 1) Minimum Passing 1-3/4-inch Sieve: 100 percent.
 - 2) Minimum Passing No 4 Sieve: 60 percent.
 - b. It is the intent of this specification that lime and fly ash may be spread sequentially prior to commencement of mixing operations.
 - c. During the interval of time between application and mixing, hydrated lime or fly ash that has been exposed to excessive loss due to washing or blowing not to be accepted for payment. Spreading, mixing, compaction, and finishing for lime-fly ash stabilized subgrade to be completed during daylight hours of the same day.

2. Mixing Procedures for Fly Ash Only: If fly ash only is to be used without lime, the following mixing procedures to apply.
 - a. The raw material to be thoroughly mixed by approved road mixers or other approved equipment, and the mixing continued until a homogeneous, friable mixture is obtained, free from all clods or lumps.
 - b. The fly ash to be distributed at a uniform rate and in such manner as to reduce the scattering of fly ash by wind. Fly ash not to be applied when wind conditions are such that blowing fly ash becomes objectionable to traffic or adjacent property owners. A motor grade shall not be used to spread fly ash.
 - c. The material and fly ash to be thoroughly mixed by approved road mixers or other approved equipment, and the mixing continued until a homogeneous, friable mixture of material is obtained, free from all clods or lumps. If the soil bind-fly ash mixture contained clods, they are to be reduced in size by raking, blading, discing, hallowing scarifying, or the use of other approved pulverization methods. This shall be done in a way such that when all nonslaking aggregates retained on the No. 4 sieve are removed, the remainder of the material meets the following requirements when tested at the field moisture condition or dry by laboratory sieves:
 - 1) Minimum Passing 1-3/4-inch Sieve: 100 percent.
 - 2) Minimum Passing No. 4 Sieve: 60 percent.
 - d. Fly ash to be applied only to such an area that all the operations can be continuous and completed in daylight.
 - e. During the interval of time between application and mixing, fly ash that has been exposed to the open air for a period of 6 hours or more or to excessive loss due to washing or blowing not to be accepted for payment. It is recommended that mixing and compaction of fly ash stabilized subgrade be completed within 2 hours in order to take advantage of rapid initial set characteristics.
 - f. Mixing after the addition of fly ash to be accomplished dry or with a minimum amount of water to prevent fly ash balls.
- D. Compaction: Compaction of the mixture to begin immediately after adding and mixing of the last stabilizing agent and be completed within 6 hours. The material to be aerated or sprinkled as necessary to provide the optimum moisture. Compaction to begin at the bottom and continue until the entire depth of mixture is uniformly compacted by the "Density Control" method.

Description	Density
For Lime-Fly Ash or Fly Ash Treated Subgrade	Not less than 95 percent

The testing to be as outlined in Test Method Tex-114-E or other approved methods. In addition to the requirements specified for density, the full depth of the material shown on the PLANS to be compacted to the extent necessary to remain firm and stable under

construction equipment. Throughout this entire operation, the shape of the base course to be maintained by blading, and the surface upon completion to be smooth and in conformity with the typical section shown on the PLANS and to the established lines and grades.

- E. Finishing, Curing, and Preparation for Surfacing: After the final layer or course of the lime-fly ash or fly ash treated subgrade, subbase, or base has been compacted, it is to be brought to the required lines and grades in accordance with the typical sections.
1. The resulting base surface to be thoroughly rolled with a pneumatic tire roller and "clipped," "skinned," or "tight bladed" by a power grader to a depth of approximately 1/4-inch, removing all loosened stabilized material from the section. The surface then to be thoroughly compacted with the pneumatic roller, adding small increments of moisture as needed during rolling. If plus No. 4 aggregate is present in the mixture, one complete coverage of the section with the flat wheel roller to be made immediately after the "clipping" operation. Surface finishing methods to be varied from this procedure provided a dense, uniform surface free of surface compaction planes is produced. The moisture content of the surface material must be maintained at optimum during all finishing operations. Surface compaction and finishing to proceed in such a manner as to produce, in not more than 2 hours, a smooth, closely knit surface, free of cracks, ridges, or loose material conforming to the crown, grade, and line shown on the plans.
 2. After the lime-fly ash or fly ash treated course has been finished as specified herein, the surface is to be protected against rapid drying by either of the following curing methods for a period of not less than 3 days or until the surface or subsequent courses are placed.
 - a. Maintain a thorough and continuously moist condition by sprinkling.
 - b. Apply a 2-inch layer of earth on the completed course and maintain in a moist condition.
 3. Completed sections of lime-fly ash or fly ash treated material in place may be opened immediately to local traffic and to construction equipment and to all traffic after the curing period, provided the lime-fly ash or fly ash treated course has hardened sufficiently to prevent marring or distorting the surface by equipment or traffic.

3.3 MEASUREMENT

- A. Lime-fly ash or fly ash treatment of the subgrade, existing subbase, and existing base to be measured by the square yard to neat lines as shown on the typical sections. When dry lime or quick lime is used, the quantity of lime to be measured by the ton of 2,000 pounds dry weight. When Quicklime is used, the quantity of lime to be calculated from the required minimum percent solids based upon the use of Grade 1, Grade 2, or Grade 3 as follows.
1. Grade 1: The "Dry Solids Content" to be at least 31 percent by weight of the slurry and the quantity of lime to be calculated by the ton of 2,000 pounds based on the 31 percent, as delivered on the road.
 2. Grade 2: The "Dry Solids Content" to be at least 35 percent by weight of the slurry and the quantity of lime to be calculated by the ton of 2,000 pounds based on the 35 percent, as delivered on the road.

3. Grade 3: The "Dry Solids Content" to be at least 46 percent by weight of the slurry and the quantity of lime to be calculated by the ton of 2,000 pounds based on the 46 percent, as delivered on the road.
- B. Fly ash to be measured by the ton of 2,000 pounds dry weight. Fly ash may be applied in dry or in Slurry form. Moisture content in the final mix not to exceed moisture by more than 2 percent.

3.4 PAYMENT

Work performed and materials furnished as prescribed by this Item and measured as provided under paragraph 3.3A are to be paid at the lump sum price bid in the proposal.

- A. Fly ash to be paid for at the unit bid per ton of 2,000 pounds for "Fly Ash," which price to be full compensation for furnishing all fly ash.
- B. "Lime-Fly Ash Treated Subgrade (Density Control)" and "Fly Ash Treated Subgrade (Density Control)" to be paid for at the unit price bid per square yard of compacted subgrade.
 1. Manipulation of "Lime-Fly Ash Treated Subgrade" and "Fly Ash Treated Subgrade" to be paid for at the unit price bid per square yard per Item "Manipulation of Lime, Fly Ash, and or Cement for Stabilization of Compacted Subgrade."
 2. "Density Control" is required on this project. Sprinkling and rolling not to be paid for directly, but the cost of all sprinkling and rolling to be subsidiary to other bid items.
 3. The unit price bid to be full compensation for all correction of secondary subgrade; for loosening, mixing, pulverizing, spreading, drying, application of lime and/or application of fly ash, water content of the slurry, shaping, and maintaining; for all manipulations required; for all hauling and freight involved; for all tools equipment, labor, and for all incidentals necessary to complete the work.

END OF SECTION