

**SECTION 02720  
LIME-STABILIZED BASE SUBGRADE**

**PART I: GENERAL**

**1.1 GENERAL REQUIREMENTS**

- A. Foundation course of lime-stabilized subgrade material.
  - 1. Application of lime slurry to subgrade.
  - 2. Mixing, compaction and curing of lime slurry, water and subgrade into a stabilized foundation.

**1.2 MEASUREMENT AND PAYMENT**

- A. Unit Prices:
  - 1. Measurement and payment for lime-stabilized subgrade is on a square yard basis compacted in place to proper density. Separate measurement shall be made for each required thickness of subgrade course.
    - a. Limits of measurement shall be actual pavement replaced, but not beyond the maximum pavement replacement limits shown on the Drawings. Limits for measurement shall be extended to include installed lime-stabilized subgrade material that extends two feet (2 Ft) beyond outside edge of pavement to be replaced, except where proposed pavement section shares common longitudinal or transverse edge with existing pavement section. No payment shall be made for lime-stabilized subgrade in areas beyond these limits.
    - b. Limits of measurement and payment shall match pavement replacement limits shown on the Drawings, except as noted in Paragraph 1.2.A.1.a or as approved by the Project Manager.
  - 2. Measurement and payment for lime is by ton of two thousand pounds (2000 Lbs) dry weight basis. Calculate weight of dry solids for lime slurry based on percentage by dry weight solids.
  - 3. Refer to Section 01270 – Measurement and Payment for unit price procedures.
- B. Stipulated Price (Lump Sum):
  - 1. If Contract is Stipulated Price Contract, payment for Work in this Section is included in Total Stipulated Price.

**1.3 DEFINITION**

- A. Moist Cure: Curing soil and lime to obtain optimum hydration.
- B. One Thousand Foot (1000 Ft) Roadway Section: One thousand feet (1000 Ft) per lane width or approximately five hundred square yards (500 Sy) of compacted subgrade for other than full-lane-width roadway

sections.

#### 1.4 REFERENCES

- A. ASTM – American Society for Testing and Materials
  - 1. ASTM D698 – Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft<sup>3</sup> (600 kN-m/m<sup>3</sup>).
  - 2. ASTM D2922 – Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
  - 3. ASTM D4318 – Standard Test Method for Liquid Limit, Plastic Limit and Plasticity Index of Soils.
- B. CFTS – City of Friendswood Technical Specifications.
- C. TxDOT – Texas Department of Transportation.
  - 1. TxDOT Tex-101-E (Part III) – Preparation of Soil and Flexible Base Material for Testing. TxDOT Tex-140-E – Measuring Thickness of Pavement Layer.
  - 2. TxDOT Tex-600-J – Sampling and Testing Hydrated Lime, Quicklime and Commercial Lime Slurry.

#### 1.5 SUBMITTALS

- A. Conform to requirements of Section 01330 – Submittal Procedures.
- B. Submit certification that hydrated lime, quicklime or commercial lime slurry complies with the specifications.
- C. Submit weight tickets, certified by supplier, with each bulk delivery of lime to work site.

#### 1.6 DELIVERY, STORAGE AND HANDLING

- A. Bagged lime shall bear manufacturer's name, product identification and certified weight. Bags varying more than five percent (5%) of certified weight may be rejected; average weight of fifty (50) random bags in each shipment shall not be less than certified weight.
- B. Store lime in weatherproof enclosures. Protect lime from ground dampness.

#### 1.7 QUALITY ASSURANCE

- A. Provide manufacturer's affidavits that material was manufactured in compliance with standards referenced in this Section.

### PART II: PRODUCTS

#### 2.1 WATER

- A. Use clean, clear water, free from oil, acids, alkali or vegetation.

#### 2.2 LIME

- A. Type A – Hydrated Lime: Dry material consisting essentially of calcium hydroxide or mixture of calcium hydroxide and an allowable percentage of calcium oxide as listed in chemical composition chart.

- B. Type B – Commercial Lime Slurry: Liquid mixture consisting essentially of lime solids and water in slurry form. Water or liquid portion shall not contain dissolved material in sufficient quantity to be injurious or objectionable for purpose intended.
- C. Type C – Quicklime: Dry material consisting essentially of calcium oxide. Furnish quicklime in either of the following grades:
  - 1. Grade DS: Pebble quicklime of gradation suitable for use in preparation of slurry for wet placing.
  - 2. Grade S: Finely-graded quicklime for use in preparation of slurry for wet placing. Do not use grade S quicklime for dry placing if dry placing is permitted.
- D. Conform to the requirements in Table 4.1 – QUICKLIME PROPERTY SPECIFICATIONS in this Section.
- E. Deliver lime slurry to job site as commercial lime or prepare at job site by using hydrated lime or quicklime. Provide slurry free of liquids other than water and of consistency that can be handled and uniformly applied without difficulty.
- F. Lime containing magnesium hydroxide is prohibited.
- G. Lime containing fly ash is prohibited.

### 2.3 SOIL

- A. Soil to receive lime treatment may include borrow or existing subgrade material, existing pavement structure or combination of all three (3). Where existing pavement or base material is encountered, pulverized or scarify material so that one hundred percent (100%) of sampled material passes two inch (2 In) sieve.

## PART III: EXECUTION

### 3.1 EXAMINATION

- A. Verify compacted subgrade shall support imposed loads.
- B. Verify subgrade lines and grades.

### 3.2 PREPARATION

- A. Complete backfill of utilities prior to stabilization.
- B. Cut material to bottom of subgrade using an approved cutting and pulverizing machine meeting following requirements:
  - 1. Cutters accurately provide smooth surface over entire width of cut to plane of secondary grade.
  - 2. Provide cut to depth as specified or shown in the Drawings.
- C. Alternatively, scarify or excavate to bottom of stabilized subgrade. Remove material or windrow to expose secondary grade. Obtain uniform stability.
- D. Correct wet or unstable material below secondary grade by scarifying, adding lime and compacting as directed by the Project Manager.
- E. Pulverize existing material so that one hundred percent (100%) passes

a one and three-quarters inch (1-3/4 In) sieve.

**3.3 LIME SLURRY APPLICATION**

- A. Apply slurry with distributor truck equipped with an agitator to keep lime and water in consistent mixture. Make successive passes over measured section of roadway to attain proper moisture and lime content. Limit spreading to an area where preliminary mixing operations can be completed on same working day.
- B. Minimum lime content shall be six percent (6%) of dry unit weight of subgrade as determined by ASTM D698.

**3.4 PRELIMINARY MIXING**

- A. Use approved single-pass or multiple-pass rotary speed mixers to mix soil, lime and water to required depth. Ensure homogeneous friable mixture free of clods and lumps.
- B. Shape mixed subgrade to final lines and grades.
- C. Eliminate following operations and final mixing if pulverization requirements of Paragraph 3.5.C can be met during preliminary mixing:
  - 1. Seal subgrade as precaution against heavy rainfall by rolling lightly with light pneumatic rollers.
  - 2. Cure soil lime material for twenty-four hours (24 Hrs) to seventy-two hours (72 Hrs) or as required to obtain optimum hydration. Keep subgrade moist during cure.

**3.5 FINAL MIXING**

- A. Use approved single-pass or multiple-pass rotary speed mixers to uniformly mix cured soil and lime to required depth.
- B. Add water to bring moisture content of soil mixture to optimum or above.
- C. Mix and pulverize until all material passes one and three-quarters inch sieve (1-3/4 In); a minimum of eighty-five percent (85%), excluding non-slacking fractions, passes three-quarters inch (3/4 In) sieve; and a minimum of sixty percent (60%) excluding non-slacking fractions passes No. 4 sieve. Test according to TxDOT Tex-101-E, Part III using dry method. Sieve analysis shall conform to the requirements of TABLE 4.2 – LIME-STABILIZED SUBGRADE SIEVE ANALYSIS in this Section.
- D. Shape mixed subgrade to final lines and grades.
- E. Do not expose hydrated lime to open air for six hours (6 Hrs) or more during interval between application and mixing. Avoid excessive hydrated lime loss due to washing or blowing.

**3.6 COMPACTION**

- A. Aerate or sprinkle to attain optimum moisture content to three percent (3%) above optimum, as determined by ASTM D698 on material sample from roadway after final mix with lime.
- B. Start compaction immediately after final mixing.
- C. Spread and compact in two (2) or more equal layers where total

compacted thickness is greater than equipment manufacturer's recommended range of mixing and compaction.

- D. Compact with approved heavy pneumatic or vibrating rollers or combination of tamping rollers and light pneumatic rollers. Begin compaction at bottom and continue until entire depth is uniformly compacted.
- E. Do not allow stabilized subgrade to mix with underlying material. Correct irregularities or weak spots immediately by replacing material and re-compacting.
- F. Compact subgrade to a minimum density of ninety-five percent (95%) of a maximum dry density, according to ASTM D698, at moisture content of optimum to three percent (3%) above optimum, unless otherwise indicated on the Drawings.
- G. Seal with approved light pneumatic tired rollers. Prevent surface hair line cracking. Rework and recompact at areas where hairline cracking develops.

### 3.7 CURING

- A. Moist cure for a minimum of three days (3 D) before placing base or surface course or opening to traffic. Subgrade may be opened to traffic after two days (2 D) when adequate strength has been attained to prevent damage. Restrict traffic to light pneumatic rollers or vehicles weighing less than ten tons (10 Tn).
- B. Keep subgrade surface damp by sprinkling. Roll with light pneumatic roller to keep surface knit together.
- C. Place base or surface within fourteen days (14 D) after final mixing and compaction. Restart compaction and moisture content of base material when time is exceeded.

### 3.8 TOLERANCES

- A. Completed surface: smooth and conforming to typical section and established lines and grades.
- B. Top of compacted surface: Plus or minus one-quarter inch ( $\pm 1/4$  In) in cross section or in sixteen feet (16 Ft) of length.
- C. Depth of lime stabilization shall be a minimum specified depth for each one thousand foot (1000 Ft) roadway section, unless otherwise noted on the Drawings.

### 3.9 FIELD QUALITY CONTROL

- A. Testing shall be performed under provisions of Sections 01470 – Testing Laboratory Services and 01475 – Quality Control Testing Procedures.
- B. Test soils, lime and mixtures as follows:
  - 1. Tests and analysis of soil materials shall be performed in accordance with ASTM D4318, using the wet preparation method.
  - 2. Sampling and testing of lime slurry shall be in accordance with

- TxDOT Tex-600-J, except using a lime slurry cup.
3. Sample mixtures of hydrated lime or quicklime in slurry form shall be tested to establish compliance with the specifications.
  4. Moisture-density relationship shall be established on material sampled from roadway, after stabilization with lime and final mixing, in accordance with ASTM D698, Moist preparation Method.
- C. In-place depth shall be evaluated for each one thousand foot (1000 Ft) roadway section and determined in accordance with TxDOT Tex-140-E in hand excavated holes. For each one thousand foot (1000 Ft) section, three (3) phenolphthalein tests shall be performed. Average stabilization depth for one thousand foot (1000 Ft) section shall be based on average depth for three (3) tests.
- D. Perform compaction testing in accordance with ASTM D2922. Three (3) tests shall be performed for each one thousand foot (1000 Ft) roadway section.
- E. Pulverization analysis shall be performed as required by Paragraph 3.5.C on material sampled during mixing of each production area. Three (3) tests shall be performed per six hundred foot (600 Ft) roadway section or a minimum one (1) for each day of production.

### 3.10 REWORK OF FAILED SECTIONS

- A. Rework sections that do not meet specified thickness.
- B. Perform the following steps when more than seventy-two hours (72 Hrs) have lapsed since completion of compaction:
  1. Moist cure for a minimum of three days (3 D) after compaction to required density.
  2. Add lime at rate of twenty-five percent (25%) of specified rate at no additional cost to the City.
  3. Moisture density test of reworked material must be completed by laboratory before field compaction testing can be completed.

### 3.11 PROTECTION

- A. Maintain stabilized subgrade to lines and grades and in good condition until placement of base or surface course. Protect asphalt membrane from being picked up by traffic.
- B. Repair defects immediately by replacing material to full depth.

**PART IV: TABLES**

**4.1 QUICKLIME PROPERTY SPECIFICATIONS**

CHEMICAL COMPOSITION	TYPE		
	A	B	C
Active lime content, % by weight Ca(OH)+CaO	90.0 min. <sup>1</sup>	87.0 min. <sup>2</sup>	--
Unhydrated lime content, % by weight CaO	5.0 max.	--	87.0 min.
Free water content, % by weight H <sub>2</sub> O	5.0 max.	--	--
SIZING			
Wet Sieve, as % by weight residue retained:			
No. 6	0.2 max.	0.2 max. <sup>2</sup>	8.0 max. <sup>3</sup>
No. 30	4.0 max.	4.0 max. <sup>2</sup>	--
Dry Sieve, as % by weight residue retained:			
1-inch	--	--	0.0
1/2-inch	--	--	10.0 max.
NOTES: 1. Maximum five percent (5%) by weight CaO shall be allowed in determining total active lime content. 2. Maximum solids content of slurry. 3. Total active lime content, as CaO, in material retained on No. 6 sieve shall not exceed two percent (2%) by weight of original Type C Lime.			

**4.2 – LIME-STABILIZED SUBGRADE SIEVE ANALYSIS**

SIEVE SIZE	PERCENT PASSING
1 3/4" Sieve	100%
3/4" Sieve	85%
Number 4 Sieve	60%

**END OF SECTION**