Test Procedure for

LIME FLY-ASH COMRESSIVE STRENGTH TEST METHODS

TxDOT Designation: Tex-127-E

Effective Date: August 1999

1. SCOPE

1.1 This method determines unconfined compressive strength (UCS) as an index of the effectiveness of lime-fly ash (LFA) treatment in imparting desirable properties to flexible base and sub-grade materials (10 lb. hammer, 18 inch drop, 50 blows/layer using 6 x 8 in. mold).

1.2 The values given in parentheses (if provided) are not standard and may not be exact mathematical conversions. Use each system of units separately. Combining values from the two systems may result in nonconformance with the standard.

2. APPARATUS

2.1 Apparatus outlined in test methods:

- Tex-101-E
- Tex-113-E
- Tex-117-E.

2.2 Compression testing machine, with a capacity of 267 kN (60,000 lb.) or equal, meeting the requirements of ASTM D 1633.

2.3 Triaxial screw jack press, as described in Tex-117-E, may be used when anticipated strengths are not in excess of 2757 kPa (400 psi).

3. MATERIALS

3.1 Fresh supply of tested fly ash (FA), meeting the specification requirements.

3.2 Fresh supply of tested hydrated lime, meeting the requirements of the Department’s Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges, Item 264.

3.3 Flexible base or soil, to be stabilized.

3.4 Good quality tap water.
4. PREPARING SAMPLE

4.1 Select an adequate size representative sample of the material and prepare in accordance with Tex-101-E, Part II.

5. PROCEDURE

5.1 Use the method described in Tex-113-E to determine the optimum moisture and maximum density for the LFA treated mixtures. Each amount of lime selected for investigation is a percentage based on the selected dry mass of the soil.

5.1.1 Blend sufficient FA with each selected lime content to form several dry LFA ratios.

5.1.2 Recombine the sizes prepared in accordance with Tex-101-E, Part II, to make three individual samples and add the optimum moisture content to each sample. Mix thoroughly.

5.1.3 Cover the mixture to prevent loss of moisture by evaporation. Allow the wetted samples to stand for at least 12 hours before compaction. When the PI is less than 12, the standing time may be reduced to not less than three hours. Split or referee samples should stand the full term.

5.1.4 Prior to compaction, replace any evaporated water and thoroughly mix each specimen. Add LFA uniformly and mix thoroughly.

5.2 Compact three specimens at the optimum moisture and density found by using four lifts and a compactive effort of 1100 kN-m/m³ (13.26 ft-lb/in.³).

5.2.1 Investigate other LFA ratios using the optimum moisture determined for each LFA ratio.

5.2.2 These LFA treated materials should be compacted as nearly identical as possible.

5.3 Cover the test specimens with top and bottom porous stones and place in triaxial cells immediately after extruding from the forming molds.

5.3.1 Then store the specimens at room temperature for a period of seven days.

5.4 After the seven-day curing period, remove the cells and place the specimens in an oven and dry at a temperature not to exceed 60°C (140°F) for about six hours or until 1/3 to 1/2 of the molding moisture has been removed.

5.4.1 Dry all LFA treated soils as given above even though a considerable amount of cracking may occur.

5.4.2 Allow the specimens to cool to room temperature before continuing the test.

5.5 Weigh, measure, and enclose the specimens in triaxial cells and subject to capillarity for ten days. Use a constant lateral pressure of 6.9 kPa (1 psi) and surcharge of 3.5 kPa (0.5 psi) for base and 6.9 kPa (1 psi) for subgrade.
5.6 Remove the specimens from the moist room and prepare for testing in unconfined compression in accordance with Tex-117-E.

5.6.1 A compression testing machine of adequate range and sensitivity will be used.

5.7 If the second specimen tests within ten percent of the first, the engineer may elect to test the third specimen in indirect tension.

6. **CALCULATIONS AND GRAPHS**

6.1 The calculations are similar to those made for Tex-117-E.

6.2 A graph is normally prepared showing compressive strength versus percent stabilizer used.

7. **REPORTING TEST REPORTS**

7.1 The laboratory report should include, but is not necessarily limited to:

- Soil constants
- Molding, curing, swell, strain, and strength test data
- Plot strength graph if applicable.

8. **GENERAL NOTES**

8.1 **Testing Notes:**

8.1.1 Store hydrated lime in an airtight container to ensure a fresh supply.

8.1.2 Wetted stabilized materials taken from the roadway during construction should be prepared for testing without drying back.

8.1.2.1 The engineer will select the method of sample preparation best suited for construction control.

8.1.2.2 The desired intent is to have the capability of weighing identical samples for strength and density control specifications.

8.1.2.3 The sample may have moisture added and remixed or removed with a fan while stirring for developing compaction curves.

8.1.3 To determine the moisture-density relationship of fine-grained materials with less than 20% retained on the 6.3 mm (1/4 in.) sieve and 100% passing the 9.5 mm (3/8 in.) sieve, the engineer may elect to use a mold with approximate dimensions of 101.6 mm (4.0 in.) in diameter by 152.4 mm (6.0 in.) in height. The number of blows must be calculated when changing mold size to maintain a compactive effort of 1100 kN-m/mm³ (13.26 ft-lb/in.³).
8.1.4 The engineer may select and specify other conditioning procedures for construction control purposes.

8.1.4.1 The district laboratory should develop design strength data for these and other conditioning procedures.

8.1.4.2 In any event, the curing and conditioning procedures should be given in detail in the report.

8.1.5 Follow Tex-120-E, Part II, for testing FA stabilized materials in the roadway condition, to determine $D_A$ for contractor.

8.2 Design Notes:

8.2.1 When water, lime, FA, and material have been brought together during construction, the mixture should receive final mixing and compaction during that same working day.

8.2.2 Lime contents less than 2.0% are not recommended due to difficulty in obtaining distribution under construction conditions.

8.2.3 FA or LFA stabilized soils are not recommended at this time as final base courses in primary highways because of limited performance records.

8.2.4 Unconfined compressive strengths of at least 103.5 kPa (150 psi) are suggested as adequate for FA or LFA stabilized subbase soils cured at room temperature and subjected to 10 days capillarity.

8.2.5 Unconfined compressive strengths for FA or LFA base courses should approach the strength requirements of soil cement.

8.2.6 LFA stabilized base courses will perform as semi-rigid pavement. The engineer should not specify this type of pavement design on a soft foundation where relatively large deflections are likely to occur.

8.2.7 Field density control should be based on testing road mixed samples in accordance with Tex-113-E. Obtain a minimum of 95% of the maximum density for both subgrade and base course stabilized with FA or LFA.

8.2.8 A density control specification is recommended for this type of stabilization.

8.2.9 Provisions should be made in the contract to control dusting of FA and lime.

8.2.10 It is recommended that LFA base stabilization receive an asphaltic surface course from base crown to base crown to reduce erosion along the pavement edge.

8.2.11 FA should not be used alone to stabilize stiff clays or materials that will not be free from clods or lumps after pulverization without a stabilization additive being applied. FA has not been observed to aid pulverization.

8.2.12 FA cementing characteristics vary widely with source. The engineer should perform strength tests with the FA to be used on the project.
8.2.13 The Department will provide the contractor with an initial optimum moisture content based upon preliminary laboratory tests.