Test Procedure for

TRIAXIAL COMPRESSION FOR DISTURBED SOILS AND BASE MATERIALS

TxDOT Designation: Tex-117-E

Effective Date: January 2010

1. SCOPE

1.1 This method determines the shearing resistance, water absorption, and expansion of soils and/or soil-aggregate mixtures.

1.2 Use Part I when triaxial classification is required. Use Part II for flexible base materials and low to non-plastic soils.

1.3 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. DEFINITIONS

2.1 *Triaxial Test*—measures stresses in three mutually perpendicular directions.

2.2 *Axial Load*—the sum of the applied load and the dead load (including the weight of the top porous stone, metal block and bell housing) applied along the vertical axis of the test specimen.

2.3 *Lateral Pressure (Minor Principal Stress)*—the pressure supplied by air in the triaxial cell, applied in a radial or horizontal direction.

2.4 *Axial (Major Principal Stress)*—the axial load divided by the average area of the cylindrical specimen.

2.5 *Strain*—the vertical deformation of the specimen divided by the original height, often expressed as a percentage.

2.6 *Mohr's Diagram*—a graphical construction of combined principal stresses in static equilibrium.

2.7 *Mohr's Failure Cycle*—a stress circle constructed from major and minor principal stresses of the specimen at failure.

2.8 *Mohr's Failure Envelope*—the common tangent to a series of failure circles constructed from different pairs of principal stresses required to fail the material. The envelope is generally curved, with its curvature depending on the factors related to the characteristics of the material.

3. APPARATUS

3.1 *Apparatus* used in Tex-101-E, Tex-113-E, and Tex-114-E.

3.2 *Triaxial cells for base material*, lightweight stainless steel cylinders with 6.75 in. (171.5 mm) inside diameter (ID) and 12 in. (304.8 mm) height, fitted with standard air valve and tubular rubber membrane.

3.3 *Triaxial cells for subgrade*, lightweight stainless steel cylinders with 4.5 in. (114.3 mm) ID and 9 in. (228.6 mm) height, fitted with standard air valve and tubular rubber membrane.

3.4 *Aspirator or other vacuum pump*.

3.5 *Air compressor*.

3.6 *Automated load frame or screw jack press.*

3.7 *Pressure regulator, gauges, and valves,* to produce lateral pressure in curing and testing.

3.8 *Equipment to measure deformation of specimen*, accurate to 0.001 in. (0.025 mm).

3.9 *Proving ring* (for use with screw jack press).

3.10 *Load cell,* 10K (for use with automated load frame).

3.11 *Circumference measuring device*, accurate to 0.05 in. (1.0 mm).

3.12 *Lead weights*, for surcharge loads.

3.13 *Curing pans*, at least 2 in. (51 mm) deep, with porous plates.

3.14 *Filter paper,* medium flow porosity, such as VWR No. 413.

3.15 *Non-porous paper discs,* 6 in. (150 mm) diameter, Gilson MSA-121 or equivalent.

4. TEST RECORD FORMS

4.1 Record test data on:

- Form Tx113,4, “Moisture-Density Relations of Base Material & Sand or Subgrade & Embankment Soils” and “Moisture-Density Mold Information Sheet,”
- Form 1964, “Triaxial Compression Test Capillary Wetting Data,” and
- Form 1062, “"Triaxial Test Data Sheet” (use with screw jack press) or Form Tx117, “Triaxial Compression Tests” (use with automated compression machine).

PART I—STANDARD TRIAXIAL COMPRESSION TEST

5. PROCEDURE

5.1 Prepare all materials in accordance with Tex-101-E, Part II.

5.2 Determine optimum water content and maximum dry density of the material in accordance with Tex-113-E for base material and Tex-114-E for subgrade, embankment, and backfill.

5.3 Mold seven specimens at optimum moisture and maximum dry density in accordance with Tex-113-E for base and sub-base materials; mold six specimens at optimum moisture and maximum dry density in accordance with Tex-114-E for subgrade, embankment, and backfill materials.

5.3.1 These specimens should be 6 in. (152.4 mm) in diameter ± 0.0625 in. (1.6 mm) and 8 in. (203.2 mm) in height ± 0. 250 in. (6.4 mm) or 4 in. (101.6 mm) in diameter ± 0.0156 in. (0.4 mm) and 6 in. (152.4 mm) in height ± 0.0026 in. (0.07 mm) using a straight edge to strike off the top and bottom.

5.3.2 These specimens should be wetted, mixed, molded, and finished as nearly identical as possible.

5.4 Record the weight of the compacted specimens on Form Tx113,4, “Moisture-Density Relations of Base Material & Sand or Subgrade & Embankment Soils” and “Moisture-Density Mold Information Sheet.”

5.5 Extrude the specimens from the molds and identify each test specimen by laboratory number and specimen number.

5.6 Immediately after extruding the specimens from the molds, enclose the specimens in triaxial cells, with porous stones on top and bottom and a non-porous paper disc between the top of the specimen and the top porous stone to prevent moisture from traveling from the specimen into the porous stone. Allow all the specimens to remain undisturbed at room temperature until the entire set of test specimens has been molded.

5.7 After all specimens in the set have been molded, remove the triaxial cells, leaving the top and bottom porous stones in place. Dry the specimens according to the type of material described below.

5.7.1 *For Flexible Base Materials and Select Granular Soils with Little or No Tendency to Shrink:*

5.7.1.1 Place specimens in the oven and remove one third of the molding moisture content at a temperature of 140°F (60°C). Record the weight after drying.

5.7.1.2 Allow the specimens to return to room temperature.

5.7.2 *For Very Plastic Clay Sub-Grade Soils that Crack Badly if Subjected to Large Volume Changes during Shrinkage:*

5.7.2.1 Air dry these soils at room temperature, inspecting specimens frequently by looking at the sides of the specimens and raising the top porous stones to examine the extent of cracking at the top edges of the specimens.

5.7.2.2 When these cracks have formed to a depth of approximately 1/4 in. (6.4 mm), replace the triaxial cell and prepare the specimens for capillary wetting.

5.7.3 *For Moderately Active Soils that Might Crack Badly if Placed in an Air Dryer for the Full Curing Time:*

5.7.3.1 Dry at 140°F (60°C) and check frequently for the appearance of shrinkage cracks.

5.7.3.2 If cracks appear, examine the extent of cracking as described above and allow some air-drying at room temperature during the cooling period before enclosing specimens in cells.

5.8 Prepare the specimens for capillary wetting.

5.8.1 Do not change the porous stones or remove them until the specimens have been tested.

5.8.2 Weigh each specimen and its accompanying stones and record the mass.

5.8.3 Cut a piece of filter paper to approximately 12 × 20 in. (300 × 508 mm), fold into 5 × 20 in. (127 × 508 mm), and make several slits perpendicular to the folded edge with scissors. These cuts will prevent any restriction by the paper.

5.8.4 Unfold the filter paper and wrap it around the specimen and stones so the cuts are parallel with the length of the specimen, allowing the bottom of the paper to be near the bottom of the bottom porous stone, and fasten with a piece of tape.

5.8.5 Replace cell by applying a partial vacuum to the cell, deflating the rubber membrane, then place the cell over the specimen and release the vacuum.

5.9 Transfer the specimens to a temperature controlled environment and place them into the rectangular pans provided for capillary wetting. Adjust the water level on the lower porous stones to approximately 0.5 in. (12.5 mm) below the bottom of the specimens. Add water later to the pans, as necessary, to maintain this level. (See Figure 1.)

5.10 Connect each cell to an air manifold and open the valve to apply a constant lateral pressure of 1 psi (6.9 kPa). Maintain this constant pressure throughout the period of absorption.

5.11 Place a suitable vertical surcharge load (which will depend upon the proposed use or location of the material in the roadway) on the top porous stone. (See Table 1.) When determining the mass for the surcharge, include the mass of the top porous stone as part of the surcharge mass.

5.12 Subject all flexible base materials and soils with plasticity index of 15 or less to capillary absorption for 10 days. Use a period of days equal to the plasticity index of the material for sub-grade soils with PI above 15. Keep the specimens at 77 ± 9°F (25 ± 5°C) during the period of capillary absorption.

5.13 Disconnect the air hose from the cell and remove the surcharge weight. Use a vacuum and deflate the rubber membrane to aid in removing the cell from specimens and discard filter paper. If any appreciable material clings to paper, carefully press it back into the available holes along the side of the specimen.

5.14 Weigh the specimens and record as total mass after capillary absorption. Note that the wet mass of the stones is obtained after the specimens are tested. Record on Form 1964.

5.15 Measure the circumference of each specimen by means of the metal measuring tape. Measure the height of the specimen including the stones, and enter on the data sheet as height in/out capillarity. Record the height of each stone.

5.16 Ready the specimen to be tested by replacing the triaxial cell to eliminate any moisture loss from the specimen and then releasing the vacuum. When a specimen is designated to be tested at zero lateral pressure, remove the cell just before testing. It is important to keep the correct identification on the specimens at all times because weights, measurements, test values, and calculations are determined for each individual specimen.

5.17 Test the specimens in compression while they are being subjected to their assigned lateral pressure. The usual lateral pressures used for a series of tests are 0 psi (0 kPa), 3 psi (20.7 kPa), 5 psi (34.5 kPa), 10 psi (69.0 kPa), 15 psi (103.5 kPa), and 20 psi (138.0 kPa). In cases where the load or stress is high, 175–180 psi (1207–1241 kPa), for the specimen tested at 15 psi (103.5 kPa) lateral pressure, use 7 psi (48.3 kPa) instead of 20 psi (138.0 kPa) for the last specimen.

5.18 Operate the automated load frame (or screw jack press) at a rate of 2.0 ± 0.3% strain per minute.

5.19 *Automated Load Frame:*

5.19.1 Lower the load frame bottom platen to allow for adequate room to place the specimen in the load frame. Ensure that load frame platform is clean of debris that may cause the specimen to sit irregularly.

Note 1—Follow the instruction manual furnished with the load frame and data acquisition software for specifics on the operation of the load frame. This is essential, due to the fact that various load frame models and brands are in standard use by the Department.

5.19.2 Carefully transfer the specimen with porous stones and triaxial cell in place to the bottom platen of the load frame. For specimens broken at 0 psi lateral pressure, a pan may be placed beneath the specimen to catch any small fragments that may fall off the specimen during testing.

5.19.3 Place the end cap, with ball bearing, onto the top porous stone.

5.19.4 Raise the crossbar or lower the bottom platen to a height that allows for movement of the specimen without causing damage to or disturbing the specimen.

5.19.5 Shift the end cap and porous stone laterally to bring the ball bearing directly over the vertical axis of the specimen. Adjust the specimen in the load frame such that the ball bearing is centered with the load cell button and the axial load will be applied along the vertical axis of the specimen.

5.19.6 Tare the load cell, using the data acquisition software.

5.19.7 Raise the bottom platen so that the load cell is in contact with the ball bearing. The ball bearing should be seated in the button of the load cell.

5.19.8 Apply a vertical load of approximately 1/2–1 psi (15–30 lb.)

5.19.9 Connect the air line, with electronic pressure sensor, to the triaxial cell and apply the designated lateral pressure, as defined in Section 5.17, to the specimen. Allow the pressure to stabilize prior to proceeding. (The lateral pressure applied by the air will tend to change the initial load cell reading.)

5.19.10 Once the lateral pressure has stabilized, zero the deformation gauge, begin testing the specimen in compression, and start data acquisition.

5.19.11 Initiate the software and load frame testing sequence.

5.19.12 Manually or via the testing software, record the initial load cell reading when data acquisition begins.

5.19.13 Record load and specimen deformation in 0.02 in. (0.5 mm) increments.

5.19.14 Follow the data acquisition software instructions to monitor test progress.

5.19.15 Continue readings until failure has occurred as defined in Section 5.22.

5.20 *Screw Jack Press (See Figure 2):*

5.20.1 Lower the load frame platen far enough to have room to place the specimen, loading blocks, and deformation measuring equipment in the press.

5.20.2 Center the specimen with upper and lower loading blocks in place in the load frame. Determine if the deformation gauge will compress or extend during testing and set the dial stem accordingly. Set the dial of the strain gauge to read zero.

5.20.3 Next, set the bell housing, if used, over the deformation gauge and adjust so that it does not touch the gauge or its mounting.

5.20.4 Shift the bell housing laterally to bring the ball directly over the vertical axis of the specimen in order to apply the compressive force along the vertical axis of the test specimen.

5.20.5 Raise the platen by means of the motor, align, and seat the ball on the bell housing into the socket in the proving ring.

5.20.6 Apply just enough pressure to obtain a perceptible reading on the proving ring gauge (not to exceed 5 lb.)

5.20.7 Read the deformation gauge and record as deformation under dead load.

5.20.8 Connect the air line to the triaxial cell and apply the designated lateral pressure, as defined in Section 5.17, to the specimen. Allow the pressure to stabilize prior to proceeding.

Note 2—In testing specimens with aggregates, the slipping and shearing of aggregates will cause temporary decreases in proving ring readings.

5.20.9 The lateral pressure applied by the air will tend to change the initial proving ring and deformation gauge readings. Start the motor momentarily to compress the specimen until the deformation gauge reads the same as the reading obtained in Section 5.20.7.

5.20.10 Record the proving ring reading.

5.20.11 Turn the motor on and read the proving ring dial in 0.02 in. (0.5mm) increments.

5.20.12 Continue the test until failure has occurred as defined in Section 5.22.

5.21 Continue reading until 0.60 in. (15.2 mm) of deformation is reached or failure has occurred. After 0.60 in. (15.2 mm) of deformation the cross sectional area of the specimen has increased so that the subsequent small increase in load readings is little more than the increase in tension of the membrane acting as lateral pressure.

5.22 Failure is reached when the proving ring dial or load cell readings remain constant or decrease with increased deformation.

5.23 The above procedure also applies to an unconfined specimen, except that no air or axial cell is used. For materials that contain a large amount of aggregate, test two specimens at zero lateral pressure. Use average of test results unless large rocks appear to have created point bearing; in this case use highest value.

5.24 Remove the cell and stones from the specimen over a flat, tared drying pan. Use a spatula to clean the material from the inside of cell and stones. Break up the specimen taking care to lose none of the material and place the identification tag in the tray.

5.25 Dry material to constant mass at a temperature of 230°F (110°C) and determine the dry mass. Determine and record the moisture content of the entire specimen after breaking, in accordance with Tex-103-E.

5.26 Clean the damp stones and then dry at 140°F (60°C) to constant mass.

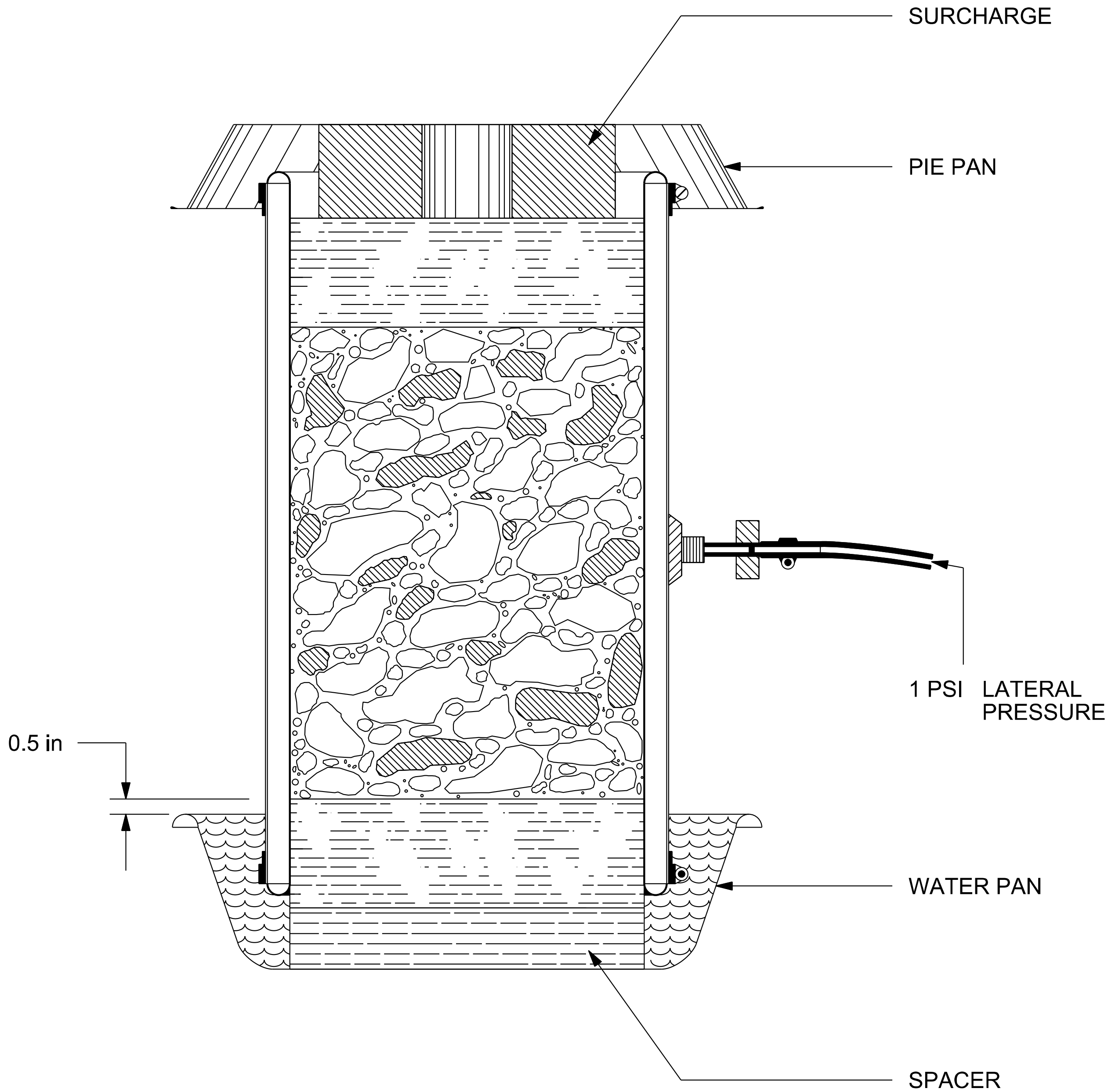

Figure 1—Schematic Arrangement for Capillary Wetting

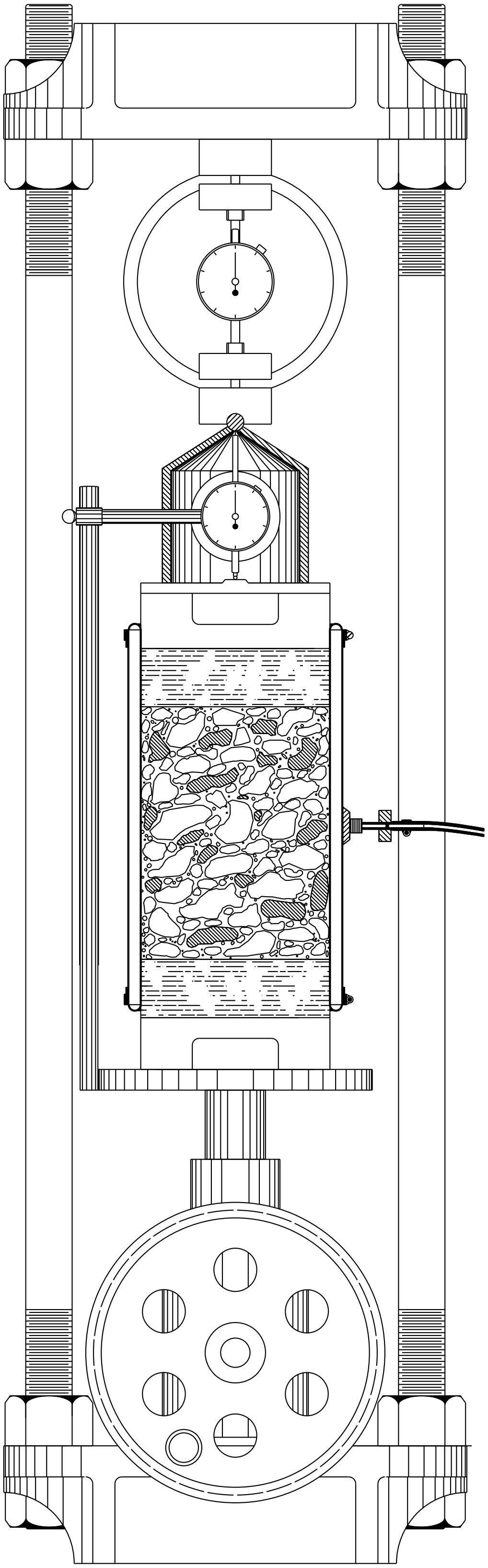

Figure 2—Assembly for Screw Jack Press

Table 1—Vertical Surcharge Load

Mold Diameter	Flexible Base	Sub-grade Soil
6 in. (152 mm)	14.1 lb. (6.4 kg)	28.3 lb. (12.8 kg)
4 in. (102 mm)	N/A	12.6 lb. (5.7 kg)

6. CALCULATIONS

6.1 Use the electronic worksheets contained in Form Tx113,4 and Form 1062 (use with screw jack press) or Form Tx117 (use with automated compression machine) to calculate and record the following:

6.2 Calculate dry density (D_D) in lb./ft.^{3} (pcf):

$$D_D = W_D / V$$

Where:
V = volume of compacted specimen, ft.^{3} (m^3)
W_D = dry mass of specimen, lb. (kg).

6.3 Calculate the percent molding moisture (M_M):

$$M_M = [100(W_W - W_D) / W_D]$$

Where:
W_W = wet mass of specimen, lb. (kg)

6.4 Calculate the percent of volumetric swell (V_S):

$$V_S = 100(V_A - V) / V$$

Where:
V_A = volume of specimen after capillary absorption, ft.^{3} (m^3).

6.5 Calculate the percent moisture in the specimen after capillarity (M_C):

$$M_C = 100(W_A - W_B - W_D) / W$$

Where:
W_A = wet mass of specimen and stones after absorption, lb. (kg)
W_B = wet mass of stones, lb. (kg)
W_D = correct oven-dry mass of specimen, lb. (kg).

6.6 Calculate the percent moisture in the specimen before capillarity (M_B):

$$M_B = 100(W_C - W_S - W_D)/W_D$$

Where:

W_S = dry mass of stones, lb. (kg)

W_C = mass of specimen and stones before capillarity, lb. (kg).

6.7 Calculate the corrected vertical unit stress in psi (kPa). A correction is necessary because the area of the cross-section increases as the specimen is reduced in height. Assume that the specimen deforms at constant volume.

$$S = 100(d/h) = \text{percent strain}$$

Where:

d = total vertical deformation at a given instant, in. (mm), by deformation gauge

h = the height of the specimen, in. (mm), measured after specimen is removed from capillarity.

6.8 Calculate the corrected vertical unit stress (p):

$$p = 9.81\,[P(1 - S/100)/A], \text{in kPa} \quad \text{or} \quad p = P[(1 - S/100)/A], \text{in psi}$$

Where:

A = the end area of the cylindrical specimen at the beginning of test, $in.^2$ (mm^2)

P = the total vertical load on the specimen at any given deformation expressed in lb. (g). It is the sum of the applied load measured by the proving ring plus the dead mass of the upper stone, loading block, and dial housing.

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7. GRAPHS AND DIAGRAMS

7.1 Use the electronic worksheets contained in Form Tx113,4 and Form 1062 (use with screw jack press) or Form Tx117 (use with automated compression machine) to plot the following.

7.2 Plot the moisture-density curve shown in Tex-113-E, Figure 1.

7.3 Plot the stress-strain diagram as shown in Figure 3, when requested.

7.4 Construct the Mohr's Diagram of stress upon coordinate axes in which ordinates represent shear stress and abscissas represent normal stress, both expressed as psi (kPa) to the same scale. (See Figure 4.)

- L = Minor principal stress which is the constant lateral pressure applied to the specimen during an individual test.
- V = The major principal stress which is the ultimate compressive strength or the highest value of p determined at the given lateral pressure.

7.5 Show each individual test by one stress circle.

- Plot L and V on the base line of normal stress.
- Locate the center of each circle a distance of (V + L)/2 from the origin and construct a semi-circle with its radius equal to (V - L)/2 intersecting the base line at V and L.
- Repeat these steps for each specimen tested at different lateral pressures to provide enough stress circles to define the failure envelope on the Mohr's diagram.

7.6 Draw the failure envelope tangent to all of the stress circles. Since it is practically impossible to avoid compacting an occasional specimen that is not identical with the other specimens in the same set, disregard any stress circle that is obviously out of line when drawing the tangent line.

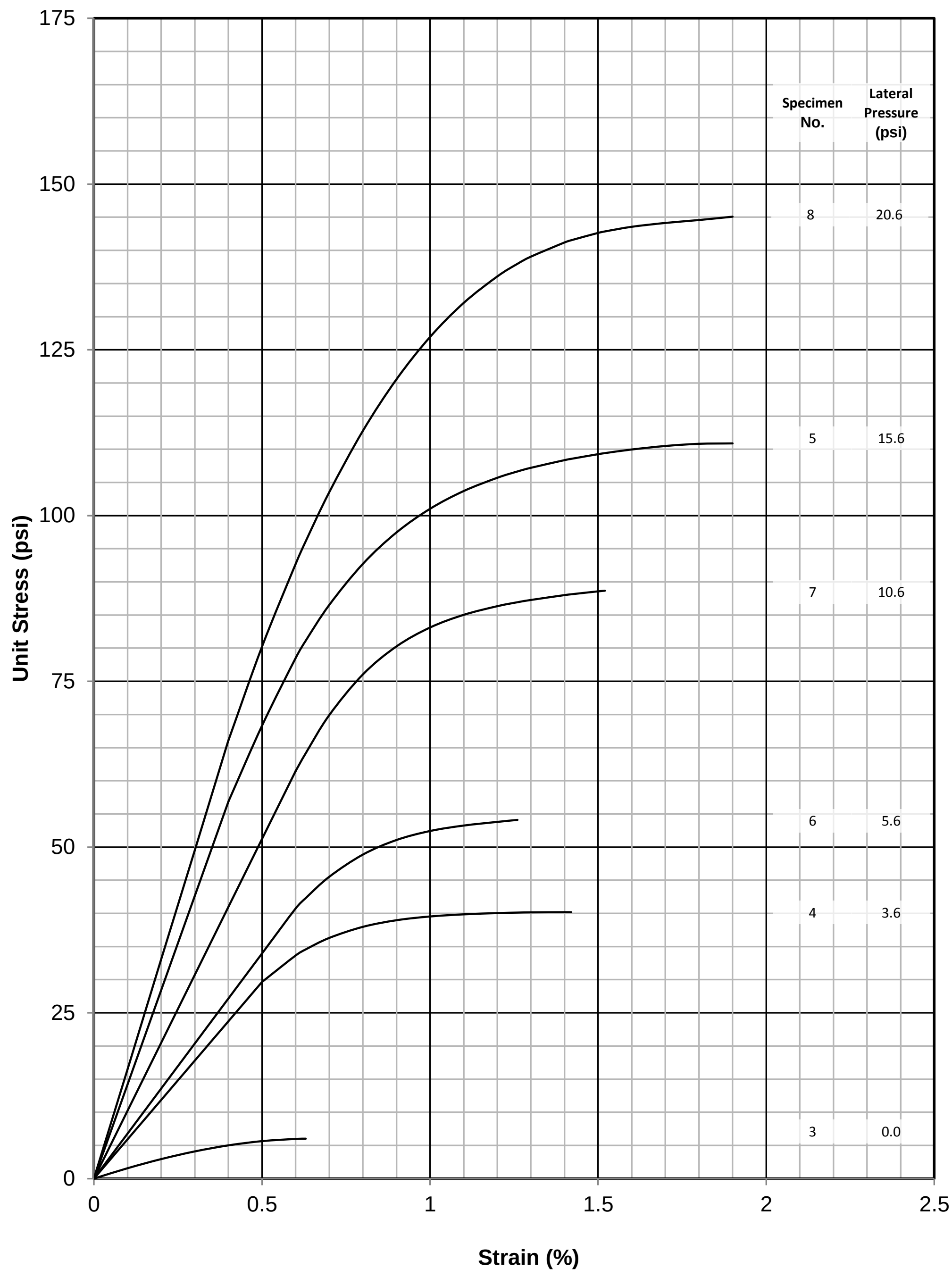

Figure 3—Stress-Strain Diagram

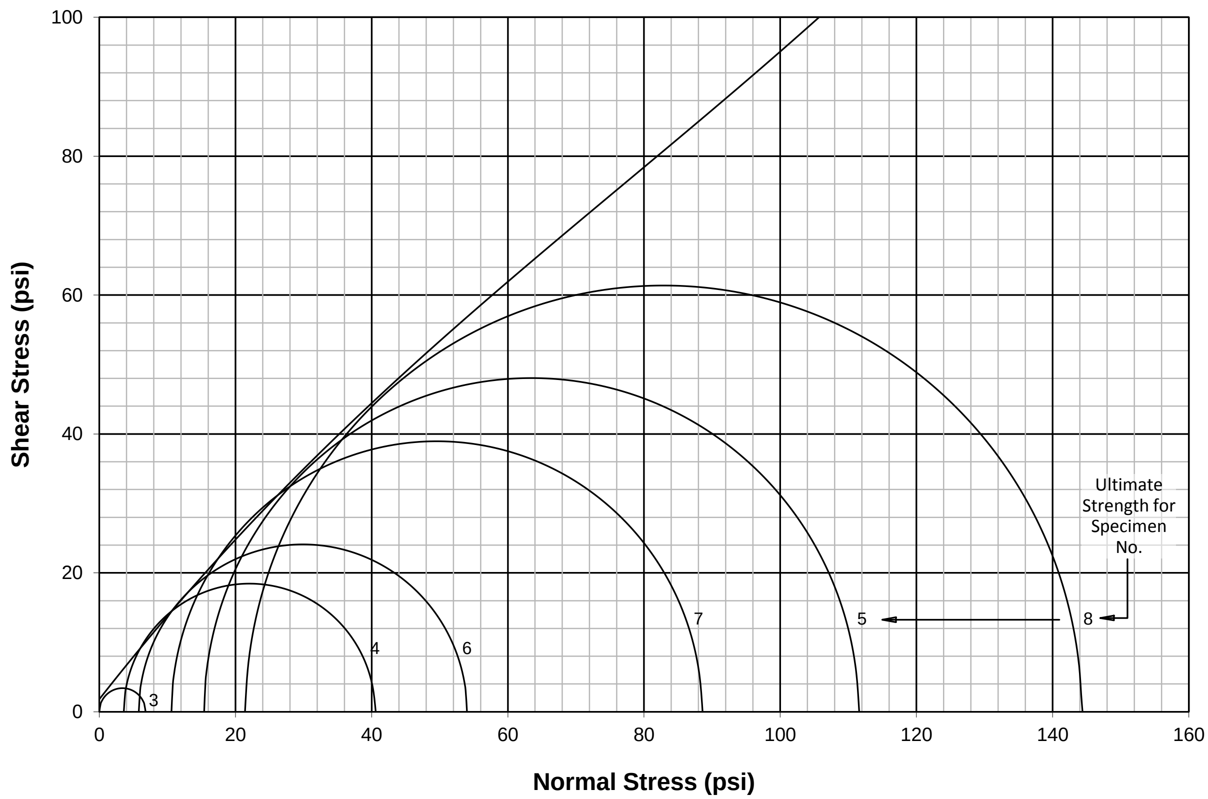

Figure 4—Mohr's Diagram

8. CLASSIFICATION OF MATERIAL

8.1 Use Form Tx117 to classify the material to the nearest one-tenth of a class.

8.2 When the envelope of failure falls between class limits, select the critical point or weakest condition on the failure envelope.

8.3 Measure the vertical distance down from a boundary line to the point to obtain the exact classification (3.7) as shown in Figure 5.

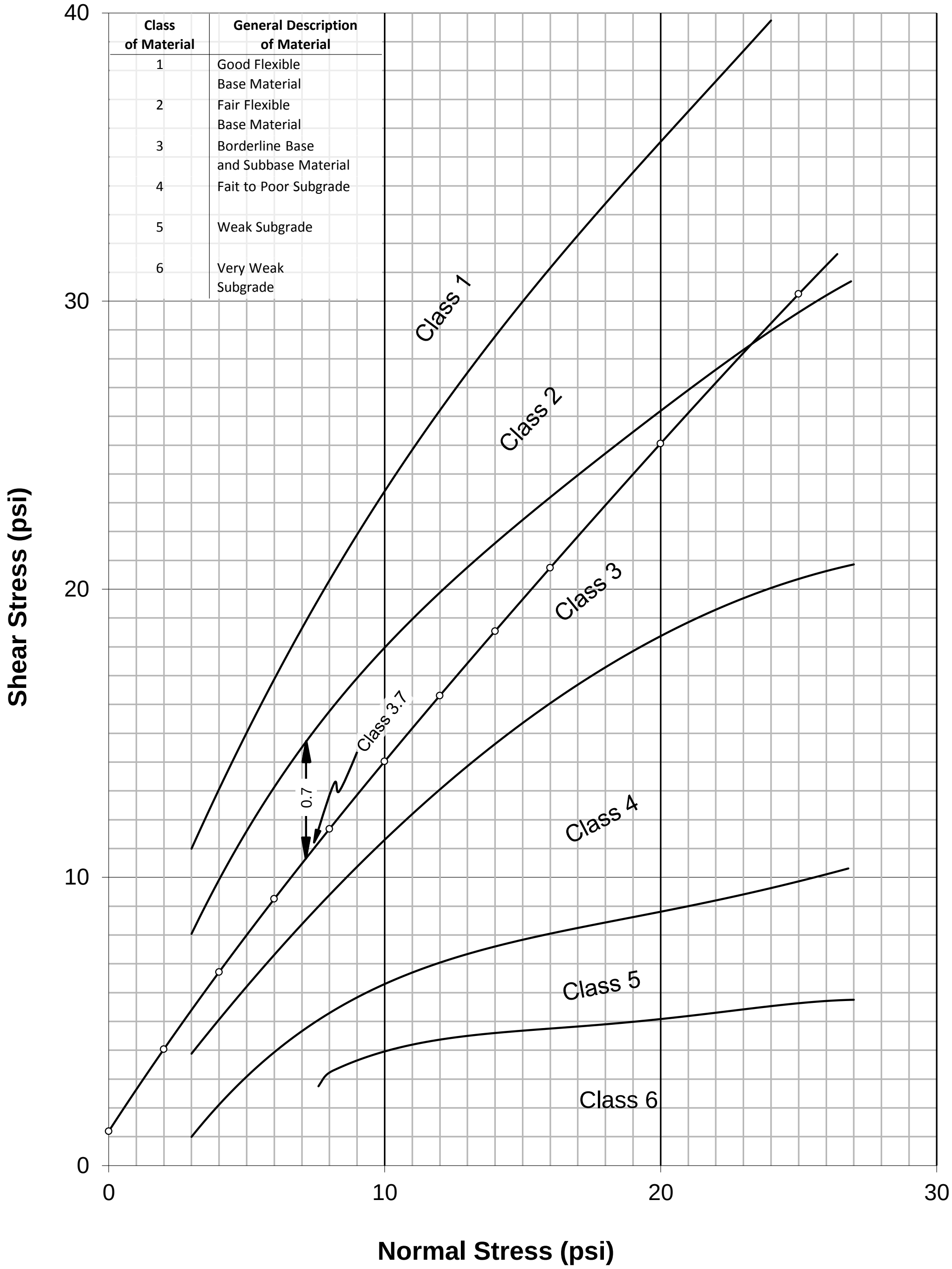

Figure 5—Chart for Classification of Sub-Grade and Flexible Base Material

9. TEST REPORT

9.1 Report the soil constants, grading, and wet ball mill value for the base material. Summarize test results on Form Tx117.

PART II—ACCELERATED METHOD FOR TRIAXIAL COMPRESSION OF SOILS

10. SCOPE

10.1 This accelerated procedure is based on a correlation with Part I, performed on a large number of different types of materials. Generally, use the accelerated test to control the quality of base materials with low absorption in group (d) during stockpiling. In such cases, roadway samples will not be considered representative.

11. PROCEDURE

11.1 Group the materials into one of the following five general types of materials:

- A—Fine granular materials with plasticity index less than 5.
- B—Very low swelling soils with plasticity index of 5 through 11.
- C—Swelling sub-grade soils with plasticity index of 12 or more.
- D—Flexible base with or without recycled materials.
- E—Combination soil types.

11.2 Prepare all materials in accordance with Tex-101-E, Part II.

11.3 Determine optimum moisture content and maximum dry density of the material in accordance with Tex-113-E for base material and Tex-114-E for subgrade, embankment, and backfill.

11.4 Molded specimens should be 6 in. (152.4 mm) in diameter ± 0.0625 in. (1.6 mm) and 8 in. (203.2 mm) in height ± 0.250 in. (6.4 mm) or 4 in. (101.6 mm) in diameter ± 0.0156 in. (0.4 mm) and 6 in. (152.4 mm) in height ± 0.0026 in. (0.07 mm) using a straight edge to strike off the top and bottom.

11.5 Record data on Form Tx113,4.

11.6 Follow the correct procedure for the specimen soil type, as shown below

11.6.1 *Group A—Fine Granular Materials with Plasticity Index Less Than 5:*

11.6.1.1 Mold six specimens 6 in. (152.4 mm) in diameter and 8 in. (203.2 mm) in height at the optimum moisture and density in accordance with Tex-113-E.

11.6.1.2 Cover the specimen (with stones in place) with a triaxial cell immediately after removing from mold and allow to set for 24 ± 1 hr. undisturbed at room temperature.

Note 3—Do not dry or subject specimens to capillary absorption.

11.6.1.3 Test the specimens at the usual lateral pressures.

11.6.1.4 Calculate unit stress, plot diagrams, and classify material.

11.6.2 *Group B—Very Low Swelling Soils with Plasticity Index of 5 through 11:*

11.6.2.1 Compact a set of six identical specimens at the optimum moisture and density condition in accordance with Tex-113-E.

11.6.2.2 Use filter paper, lead surcharge weight, and air pressure for lateral support and subject the specimens to capillary absorption overnight as described in Part I, Sections 5.8–5.12.

11.6.2.3 The next morning, remove filter paper and test the specimens at the usual lateral pressure shown above. Calculate unit stress, plot diagrams, and classify material.

11.6.3 *Group C – Swelling Sub-Grade Soils, Plasticity Index of 12 or More:*

11.6.3.1 Obtain the plasticity index and hygroscopic moisture of these soils in advance of molding specimens.

11.6.3.2 Calculate the Percent Molding Moisture:

Percent Molding Moisture = (1.4 × optimum moisture) – 2.2

11.6.3.3 Obtain the desired molding density from the following expression:

Molded Dry Density = Optimum dry density (from Section 11.2) / [1 + (% volumetric swell / 100)]

11.6.3.4 To determine the percent volumetric swell to be expected, use average condition in chart shown in Figure 6. It is important to modify the percent volumetric swell by multiplying by percent soil binder divided by 100 to obtain the percent volumetric swell to be expected.

11.6.3.5 Use the moisture content (Section 11.6.3.2), adjusted if necessary, and adjust the blows per layer to obtain the desired density (Section 11.6.3.3). Where this moisture content is too great to permit the desired density, reduce the molding water slightly (usually about 1%) and continue molding. Mold six specimens, in accordance with Tex-114-E, at the water content established for the desired density. The specimens, being in capillarity overnight, will pick up the moisture that was left out.

11.6.3.6 When the six specimens have been molded, put them to capillary absorption (as in Part I) overnight. Test at the usual lateral pressures and classify.

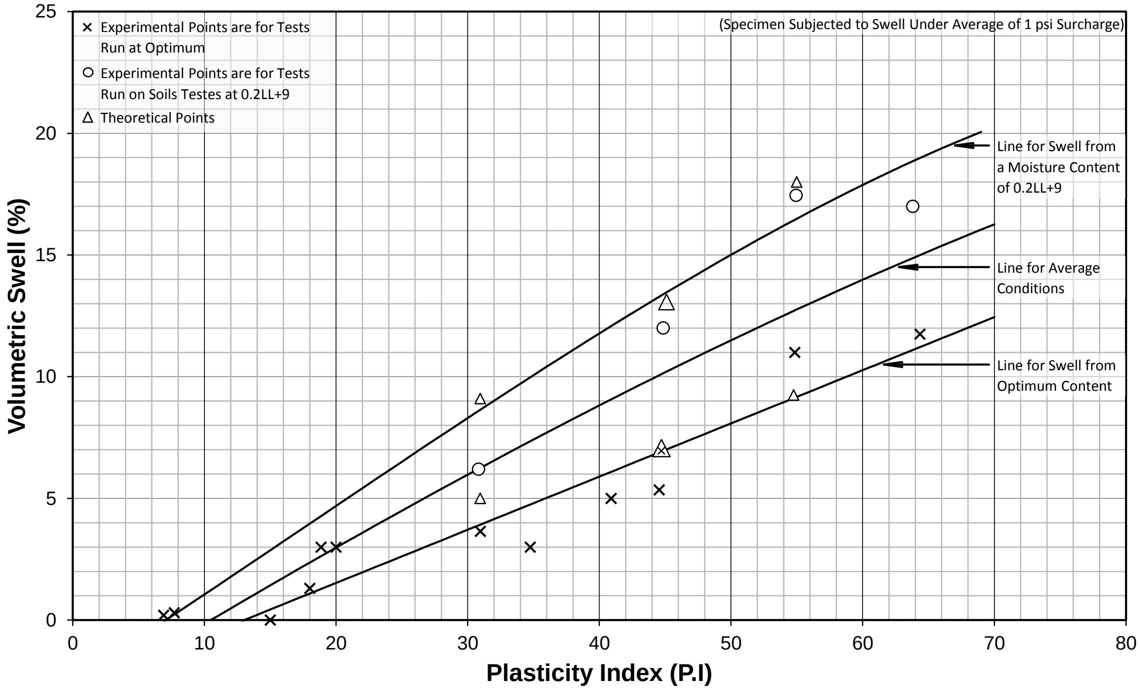

Figure 6—Interrelationship of PI and Volume Change

11.6.4 *Group D – Flexible Base With or Without Recycled Materials:*

11.6.4.1 Mold specimens at optimum moisture and maximum dry density in accordance with Tex-113-E.

11.6.4.2 All specimens should be wetted, mixed, molded, and finished as nearly identical as possible.

11.6.4.3 Identify each test specimen by laboratory number and specimen number.

11.6.4.4 Immediately after extruding the specimens from the molds, enclose the specimens in triaxial cells, with porous stones on top and bottom and non-porous paper discs between the specimen and porous stones to prevent moisture from traveling from the specimen into the porous stone.

11.6.4.5 Allow specimens to set 24 ± 1 hr. undisturbed at room temperature.

Note 4—Do not air dry or subject specimens to capillary absorption.

11.6.4.6 Test specimens in compression in accordance with Section 5.19 when using an automated load frame or Section 5.20 when using a screw jack press. Test three specimens at 0 lateral confinement, three specimens at 3 psi (20.6 kPa) lateral confinement and three specimens at 15 psi (103.4 kPa) lateral confinement.

11.6.4.7 Continue reading until 0.60 in. (15.2 mm) of deformation is reached or failure has occurred. After 0.60 in. (15.2 mm) of deformation the cross sectional area of the specimen has increased so that the subsequent small increase in load readings is little more than the increase in tension of the membrane acting as lateral pressure.

11.6.4.7.1 Failure is achieved when the proving ring dial or load cell readings remain constant or decrease with increased deformation.

11.6.4.7.2 The above procedure also applies to an unconfined specimen, except that no air or triaxial cell is used. For materials that contain a large amount of aggregate, test two specimens at zero lateral pressure. Use average of test results unless large rocks appear to have created point bearing; in this case use highest value.

11.6.4.8 Remove the cell and stones from the specimen over a flat, tared drying pan. Use a spatula to clean the material from the inside of cell and stones. Break up the specimen taking care to lose none of the material and place the identification tag in the tray.

11.6.4.9 Dry material to constant mass at a temperature of 230°F (110°C) and determine the dry mass. Determine and record the moisture content of the entire specimen after breaking, in accordance with Tex-103-E.

11.6.4.10 Clean the damp stones and then dry at 140°F (60°C) to constant mass.

11.6.4.11 Calculate and record dry density (D_D) in lb./ft.^{3} (pcf) on Form Tx113,4 for each specimen:

$$D_D = W_D / V$$

Where:

V = volume of compacted specimen, ft.^{3} (m^3)

W_D = dry mass of specimen, lb. (kg).

11.6.4.12 Calculate and record the percent molding moisture (M_M) on Form Tx113,4 for each specimen:

$$M_M = [100(W_W - W_D) / W_D]$$

Where:

W_W = wet mass of specimen, lb. (kg).

11.6.4.13 The percent molding moisture of the individual specimens calculated in Section 11.6.4.12 must be within 0.3 percentage points of the optimum moisture content determined by Tex-113-E and the dry density of the individual test specimens calculated in Section 11.13 must be within 1.0 pcf (16.0 kg/m^3) of the maximum dry density determined by Tex-113-E. Specimens not meeting these tolerances may be used in Section 11.6.4.14 only if their strength is within 10 psi of the other test specimens broken at the same lateral confinement.

11.6.4.14 Average and record the strengths for each state of confinement on Form Tx117. A minimum of two samples per lateral confinement must be used to determine the average strength.

11.6.5 *Group E – Combination Soil Types:*

11.6.5.1 This group includes all materials with enough soil binder to separate the aggregate particles or overfill the voids of the compacted specimen. For example, if the material is a clayey gravel with high plasticity:

- Treat the material as a swelling soil.
- Allow the material to soak a minimum of 12 hours as in the case of aggregate materials.

11.6.5.2 Note that the total swelling is figured only for that part passing the No. 40 (425 μm) sieve. Other combinations must be recognized and tested in the proper group.

11.6.5.3 Mold six specimens at optimum moisture and maximum dry density in accordance with Tex-114-E for subgrade, embankment, and backfill materials.

11.6.5.4 Subject all specimens to overnight capillarity, test, and classify.

11.6.5.5 When testing aggregate materials under Part II where classification is required:

11.6.5.5.1 Test two specimens at 0 psi (0 kPa).

11.6.5.5.2 Test the others at 3 psi (20.7 kPa), 5 psi (34.5 kPa), 10 psi (69.0 kPa), and 15 psi (103.4 kPa).

11.6.5.5.3 Average the result of the zero lateral pressure tests as one value.

11.6.5.5.4 Classify fine grain soils using lateral pressures of 0 psi (0 kPa), 3 psi (20.7 kPa), 5 psi (34.5 kPa), 10 psi (69.0 kPa), 15 psi (103.4 kPa).

12. REPORTING TEST RESULTS

12.1 The reports and forms are the same as given in Part I of this procedure.

13. GENERAL NOTES

13.1 Wetted stabilized materials taken from the roadway during construction should be screened over a 1/4 in. (6.3 mm) sieve at the field moisture content without drying.

13.1.1 Each of these two sizes is mixed for uniformity and weighed.

13.1.2 Specimens are then weighed and recombined to produce multiple identical specimens with the received gradation.

13.1.3 Moisture can be adjusted in each specimen by adding water to the material or removing from the material by a fan, as needed.

13.1.4 See the appropriate test method (listed below) for testing wetted stabilized materials taken form the roadway during construction:

- Tex-120-E, “Soil-Cement Testing”
- Tex-121-E, “Soil-Lime Testing”
- Tex-127-E, “Lime Fly-Ash Compressive Strength Test Methods”

13.2 In any event, the stabilized material should not be completely air-dried.

13.3 When molding a set of preliminary specimens for testing lime stabilized sub-grades and base materials, refer to Tex-121-E, Figure 1, for the recommended amounts of lime to use.

14. ARCHIVED VERSIONS

14.1 Archived versions are available.