Test Procedure for

DETERMINING POTENTIAL VERTICAL RISE

TxDOT Designation: Tex-124-E

Effective Date: March 2014

1. SCOPE

1.1 This procedure determines the potential vertical rise in soil strata encountered in the placement of a roadway, bridge, or building foundation.

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. DEFINITIONS

2.1 *Potential Vertical Rise*—Potential vertical rise (PVR), expressed in in. (mm), is the potential of a soil to swell at a given density, moisture, and loading condition when exposed to capillary or surface water, and thereby increase the elevation of its upper surface, along with anything resting on it.

2.2 *Liquid Limit*—Liquid limit (LL) is the moisture content at which a soil changes from a plastic to a liquid state. LL, determined in accordance with Tex-104-E, is expressed as a percentage of the weight of oven-dried soil.

2.3 *Plastic Limit*—Plastic limit (PL) is the moisture content at which a soil changes from a plastic to a semisolid state. PL, determined in accordance with Tex-105-E, is expressed as a percentage of the weight of oven-dried soil.

2.4 *Plasticity Index*—Plasticity index (PI) is a range of moisture content over which a soil remains in a plastic state. PI is determined in accordance with Tex-106-E.

2.5 *Overburden*—Overburden is the soil above the layer or layers being investigated. Example: A clay layer covered with 10 ft. (3.1 m) of sand would have 10 ft. (3.1 m) of overburden.

2.6 *Layer*—Layer is a horizontal soil structure of uniform or nearly uniform material. Changes in material color, texture, moisture, density, or composition constitute a new layer.

2.7 *Loading*—Loading is the vertical pressure (load) per unit area from both the structure and overburden of each layer of soil involved. Loading is expressed in lb./ft.^{2} (kPa).

3. APPARATUS

3.1 Apparatus listed in test methods:

- Tex-104-E
- Tex-105-E
- Tex-106-E
- Tex-110-E.

3.2 *Supply of paraffin, small cutting knives*, etc.

3.3 *Sampling device*, Shelby tube, split spoon, or core-drilling rig equipped to take undisturbed core samples of the material in place.

Note 1—Undisturbed cores are not necessary if an approximate wet density is known.

4. TEST REPORT FORMS

4.1 Tex-124-E Potential Vertical Rise (PVR) Excel Workbook

5. SAMPLING

5.1 Perform exploration and sampling in accordance with the *Geotechnical Manual*, except place greater emphasis on sampling of top strata to a depth of 15 ft. (4.5 m) in most cases, and as much as 20 ft. (6.0 m) when highly expansive clays (PI > 35 and LL > 60) are encountered. These depths may be less when sampling devices are pushed to refusal.

5.1.1 In some instances, the presence of rock, gravel, or sand substrata will eliminate the necessity for drilling a large number of deep exploration holes.

5.1.2 Determine thicknesses of soil layers—especially clay layers—existing below the proposed structure.

5.1.3 In the case of massive clay layers, the maximum depth to investigate will depend on the position and amount of load proposed and the expansive characteristics of the clay.

5.1.4 Secure cores to represent these layers as shown in Form 513, "Drilling Log."

5.1.5 In sampling, log all holes and determine moisture contents.

6. PROCEDURE

6.1 Determine percent moisture. It is preferable to take moisture samples for each layer at the time of sampling.

6.1.1 Select cores representative of each swelling layer. If fresh samples are not available, use samples paraffined for moisture preservation.

6.1.2 Trim cores into right circular cylinders using knives or other convenient hand tools.

6.1.3 Measure the height (h) and diameter (D), and calculate the volume of the core in cubic feet (cubic meters).

6.1.4 Determine the mass of the wet core to the nearest 0.001 lb. (0.5 g).

6.1.5 Calculate the wet density by dividing the wet mass by the volume of the core and record to the nearest 0.001 lb./ft.^{3} (0.02 kg/m^3).

Note 2—If desired, use other accepted methods for determining density of cores, such as that described in Tex-207-F, Part II.

6.1.6 Where wet densities vary from 125 lb./ft.^{3} (2002.5 kg/m^3), and greater accuracy is desired, apply a correction factor to that layer equivalent to 125 pcf (2002.5 kg/m^3) divided by the actual wet density.

Note 3—In the 2 ft. (0.6 m) layer at the surface, the "average" load in the layer is 1 psi (6.9 kPa). Likewise, in the 2–4 ft. (0.6–1.2 m) layer, the load is 2 psi (13.8 kPa) for the top 2 ft. (0.6 m) plus half of the 2–4 ft. (0.6–1.2 m) layer, or 3 psi (20.7 kPa) total. Therefore, the average load in any 2 ft. (0.6 m) layer is the average depth of the layer (subject to the correction factor as described above).

6.2 From representative portions of the cores, determine LL, PI, and percent soil binder (minus No. 40 material) in the soil layers in accordance with the following test methods, and record test results:

- Tex-104-E
- Tex-105-E
- Tex-106-E
- Tex-110-E, Part I.

6.3 When calculating PVR using the Excel workbook, use 2-ft. (0.6-m) increments for convenience, provided the moisture contents and the log of the hole permit. Input the layer depths in Column B.

Note 4—Thicker layers may be used in this calculation where they consist of uniform soil having similar PI and moisture contents.

6.3.1 Input the LL for each layer in Column D.

6.3.2 Input the percent moisture for each layer in Column G.

6.3.3 Input the percent soil binder (minus No. 40 material) in Column I.

6.3.4 Input the PI for each layer in Column J.

6.3.5 The Excel workbook will automatically calculate PVR Top of Layer (Column M), PVR Bottom of Layer (Column N), and Total PVR (in.) (Column S). The program will also plot a graph to aid in determination of depth of modification based on the allowable pavement surface PVR.

Note 5—The tables have been calculated for no loading due to the structure. When loads due to the structures are known, add in "Average Load, psi (kPa)" and increase each figure in the column by the amount of structure load. Note that the swell will be reduced due to increased loading.

7. ARCHIVED VERSIONS

7.1 Archived versions are available.