APPENDIX E

DENVER/COLORADO/SWELL-CONSOLIDATION TEST

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Denver/Colorado/Swell-Consolidation Test

A. Test Objectives:

To determine the magnitude of swell/consolidation of soil sample under a given surcharge load with 1-dimensional consolidometer (DENVER MACHINE).

B. References:

ASTM D-2435-80, Part 1
F.H. Chen, Foundations on Expansive Soils, 1988

C. Equipment:

1. *Trimming equipment*
2. Calipers, sensitive to 0.001 inch
3. Balance, sensitive to 0.1 grams
4. Oven, set a 110 $\pm$ 5 degree C
5. Moisture dishes
6. Consolidometer ring 1.94 inch diameter by 1.00 inch depth
7. Porous stones
8. Loading device
9. Dial Indicator, sensitive to 0.001 inch
10. Weights

D. Procedure:

1. Sample Preparation

   a. Use a California sample driven through a proctor sample compacted to the specified density and moisture content.

2. Testing

   a. Assemble by placing the ring sample with top and bottom porous stones in the consolidometer dish. Place the top loading cap on top of the porous stone, and place the consolidometer dish into the loading device.

   b. Once the sample is placed in the consolidometer, adjust the dial to read 0 (zero) or a round number (i.e., 200). Record this dial reading.

   c. Apply the specified surcharge load equal to the anticipated weight of the pavement structure. If no surcharge load is specified, use 100-150 psf.

   d. Record dial readings hourly until the readings remain constant, or a minimum of 4 hours.

   e. Add water to the consolidometer.

f. Record dial readings periodically until sample movement stabilizes, and a minimum of 24 hours.

g. Add additional loads to bring the sample to its original height. The following load increments are suggested 500, 1000, 3000, 6000, 10,000, 15,000 and 20,000 psf. As a minimum, load the sample to 6000 psf. Record dial readings constant, or a minimum of 2 to 4 hours, before additional load increment application.

h. At completion of all load increments, dismantle the consolidometer and obtain final sample moisture content.

E. Calculations:

1. Obtain final dial reading for each load increment (correct for machine deflection by adding the deflection when sample swells, and subtracting when sample consolidates).

2. Calculate percent swell (+) or consolidation (-) as follows:

$$\text{Percent Swell} = \frac{\text{Corrected Final Dial Reading}}{\text{Sample Height After Initial Consolidation}} \times 1000$$

3. Prepare plot of swell % - Consolidation % versus log of pressure curve; include sample number, location, proctor density, and optimum moisture content.

4. Atterberg Limits - ASTM D-4318-83

   One test on every gradation test sample of Zone A fill, Zone B fill and initial backfill (Item 4) and each compaction test (Item 1).

5. Specific Gravity - ASTM D-854-83

   One test on every other gradation test sample of Zone A and Zone B fill (Item 4), and for each compaction test (Item 1).

6. Swell-Consolidation - Attachment 1

   One test for each 20,000 cubic yards of Zone A fill placed. Test to be made adjacent to in-place soil density test (Item 2) and each Atterberg Limit test (Item 5) for correlation.

7. Classification - ASTM D-2487-83/ASTM D-2488-75

   Classify each sample of the above tests (Items 1 through 7) using data from those tests and visual methods.

8. Sodium Soundness - ASTM C-88

   One test on sample of drainage soils from each different source of material and one test for each 10,000 cubic yards placed.

9. Abrasion - ASTM C-131

   One test on sample of drainage soils from each different source of materials and one test for each 10,000 cubic yards placed.

10. Abrasion - ASTM C-535

    One test on sample of riprap from each source of material and one test for each 10,000 cubic yards placed.

11. Freeze - Thaw - AASHTO-T103 Procedure

    One test on sample or riprap from each source of materials and one test for each 10,000 cubic yards placed.