APPENDIX I:

WATER CONTENT - GENERAL

1. DEFINITION. Water content, w, is defined as the ratio, expressed as a percentage, of the weight of water in a given soil mass to the weight of solid particles.

2. APPARATUS The apparatus should consist of the following:

a. Oven, preferably of the forced-draft type automatically controlled to maintain a uniform temperature of 110±5 C throughout the oven.

b. Balances, sensitive to 0.01 g for samples weighing less than 50 g; 0.1 g for samples weighing 50 to 500 g; 1.0 g for samples weighing over 500 g.

c. Specimen Containers. Seamless metal containers with lids are recommended. The containers should be of a metal resistant to corrosion (aluminum is satisfactory). They should be as small and light in weight as practicable in relation to the amount of material to be used in the determination. For routine water content determinations in which specimens weighing between 100 and 200 g are used, a 2-in.-high by 3-1/2-in. diameter container is adequate.

3. SPECIMEN. The amount of material used in the water content determination will generally depend on the maximum size of particles, the amount of material available, and the requirement that the specimen be representative of the material for which the determination is made. When the water is not uniformly distributed throughout the sample, larger specimens will be needed than would otherwise be required. For routine water content determinations on material passing a No. 4 sieve, specimens weighing between 100 and 200 g are adequate, A minimum specimen weight of 500 g is recommended for material having a maximum particle size in the range of the No. 4 to 3/4-in. sieves, and a minimum specimen

weight of 1000 g is recommended for material having a maximum particle size in the range of the 3/4-in. to 1-1/2-in. sieves. Specific amounts of material are required for water content determinations for other laboratory tests; the test procedures should be consulted to determine the proper amounts.

4. PROCEDURE. The procedure shall consist of the following steps:

a. Record all identifying information for the specimen, such as project, boring number, sample number, or other pertinent data, on a data sheet (Plate I-i is a suggested form).

b. Record the number and tare weight of the specimen container.

c. Place the specimen in the container, set the lid securely in position and immediately determine the weight of the container and wet soil by weighing on an appropriate balance.

d. Before the specimen is placed in the oven, remove the lid; the lid is usually placed under the container in the oven. Then place the specimen and container in the oven heated to 110±5C.† Leave the specimen in the oven until it has dried to a constant weight. The time required for drying will vary depending on the type of soil, size of specimen, oven type and capacity, and other factors. The influence of these factors generally can be established by good judgment, and experience with the soils being tested and the equipment available in the laboratory. When in doubt, reweigh the oven-dried specimens at periodic intervals to establish the minimum drying time required to attain a constant weight. For routine water content determinations, specimens consisting of clean sands and

† Laboratory oven drying at 110 C does not result in reliable water content values for soils containing gypsum or significant amounts of organic material. Reliable water content values for these soils can be obtained by drying in oven at 60 C±, or by vacuum desiccation. See: U. S. Army Engineer Waterways Experiment Station, CE, A Study of Moisture-Content Determinations on Selected Soils, Miscellaneous Paper No. 4-73 (Vicksburg, Miss., September 1954).

gravels should be oven-dried for a minimum of 4 hr. For most other soils a minimum drying time of 16 hr is adequate, Dry soil may absorb moisture from wet specimens; therefore, any dried specimens must be removed before wet specimens are placed in the oven.

e. After the specimen has dried to constant weight, remove the container from the oven and replace the lid. Allow the specimen to cool until the container can be handled comfortably with bare hands. If the specimen cannot be weighed immediately after cooling it should be placed in a desiccator; if a sample is left in the open air for a considerable length of time it will absorb moisture.

f. After the specimen has cooled, determine its dry weight and record it on the data sheet.

5. COMPUTATIONS. The following quantities are obtained by direct weighing:

a. Weight of tare plus wet soil, g

b. Weight of tare plus dry soil, g

The water content in percent of oven-dry weight of the soil is equal to:

$$\frac{\text{(weight of tare plus wet soil)} - \text{(weight of tare plus dry soil)}}{\text{(weight of tare plus dry soil)} - \text{(tare)}} \times 100$$

or

$$w = \frac{W_w}{W_s} \times 100$$

where w = water content, percent

W_w = weight of water, g

W_s = weight of dry soil, g

6. POSSIBLE ERRORS.. Following are possible errors that would cause inaccurate determinations of water content:

a. Specimen not representative. The specimen must be representative of the sample as required for the purpose of the determination. For example, a stratified soil may have a great variation in water content between adjacent strata; were it intended to evaluate the strength of the soil on the basis of water content, a large specimen that included material from several strata would not be representative of the weakest stratum. As another example, to determine the average water content of a gravelly clay, the specimen must be large enough to contain representative amounts of both coarse and fine fractions.

b. Specimen too small. As a rule, the larger the specimen, the more accurate the determination because of the larger weights involved.

c. Loss of moisture before weighing wet specimen. Even in a covered container a specimen can lose a significant amount of water unless weighed within a short period.

d. Incorrect temperature of oven. The oven-dry weight of many soils is dependent on the temperature of the oven, so variations in temperature throughout the interior of an oven can cause large variations in the computed water content.†

e. Specimen removed from oven before obtaining a constant oven-dry weight.

f. Gain of moisture before weighing oven-dry specimen.

g. Weighing oven-dry specimen while still hot. The accuracy of a sensitive balance may be affected by a hot specimen container.

h. Incorrect tare weight. The weights of specimen containers should be checked periodically and should be scratched on the containers to avoid possible errors in reading such weights from lists.

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† T. W. Lambe, Soil Testing for Engineers, John Wiley & Sons, Inc. (New York, 1951).

WATER CONTENT - GENERAL

DATE _____

PROJECT _____

BORING NO. _____

Sample or Specimen No.							
Tare No.							
Weight in grams: Tam plus wet soil							
Weight in grams: Tare plus dry soil							
Weight in grams: Water	W_w						
Weight in grams: Tare							
Weight in grams: Dry soil	W_s						
Water content	w	%	%	%	%	%	%

Sample or Specimen No.							
Tam No.							
Weight in grams: Tare plus wet soil							
Weight in grams: Tare plus dry soil							
Weight in grams: Water	W_w						
Weight in grams: Tare							
Weight in grams: Dry soil	W_s						
Water content	w	%	%	%	%	%	%

Sample or Specimen No.							
Tare No.							
Weight in grams: Tare plus wet soil							
Weight in grams: Tare plus dry soil							
Weight in grams: Water	W_w						
Weight in grams: Tare							
Weight in grams: Dry soil	W_s						
Water content	w	%	%	%	%	%	%

$$w\% = \frac{(\text{tare plus wet soil}) - (\text{tare plus dry soil})}{(\text{tare plus dry soil}) - (\text{tare})} \times 100 = \frac{W_w}{W_s} \times 100$$

Remarks _____

Technician _____ Computed by _____ Checked by _____