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THE TREATMENT OF CLAYEY SOILS IN THE MOISTURE-DENSITY TEST

by

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INTRODUCTION

Along with wood and stone, soil has been employed as a construction material for thousands of years. Its diverse applications have included roles in military fortifications, roadways, and water retention projects.

In addition to improved design techniques, a quality that separates today's earthwork projects from those of the past is improved methods of soil compaction. Compaction of a soil, accomplished through repeated passes of high-weight machinery over the surfaces of successive, thin layers of soil material, improves the characteristics of an earthen structure in three ways. In general, a compacted structure will have increased resistance to shear stress because of the denser arrangement of its soil particles. A compacted earthen structure will also be less susceptible to compression than its uncompacted counterpart because of the lesser volume of voids contained in a given volume of the material. In structures such as earthen dams, where the permeability of the embankment is of prime importance, the permeability characteristics of the structure can be controlled by the amount of compaction to which the embankment is subjected.

The current laboratory methods used to determine the degree to which a soil may be compacted in the field are termed "moisture-density" or "compaction" tests. The basis of today's laboratory compaction techniques was laid by R. R. Proctor in a series of articles published in 1933 (1). His writings

detail a method of determining the density to which a soil may be compacted employing the standard compaction techniques of 1933 and the water content at which that density may be most easily obtained. His articles were the forerunner of today's compaction test ASTM D698 (2).

PURPOSE OF THE STUDY

Much research has been done on the moisture-density test (whose basic principles are outlined in the REVIEW OF LITERATURE section of this thesis) to determine what factors influence the test's results. Investigations studying the changes in the compactive effort and its method of application, the changes in the size of soil particles used in the test, variations in the size of the mold, and variations in several other aspects of the test have been pursued. It is recognized that many factors can influence the values obtained from a moisture-density test.

One particular section of ASTM Test D698 reads:

> "Note 1 - This procedure has been found satisfactory in most cases. However, in instances where the soil material is fragile in character and will reduce significantly in grain size due to repeated compaction; and in cases where the soil is a heavy-textured clayey material into which it is difficult to incorporate water, a separate and new sample shall be used in each compaction test. In these cases, the separate samples shall be thoroughly mixed with amounts of water sufficient to cause the moisture contents of the samples to vary by approximately two percentage points. The moisture contents selected shall bracket the optimum moisture content, thus providing samples which, when compacted, will increase in weight to the maximum

> density and then decrease in weight. The soil-water mixtures should be placed in covered containers and allowed to stand for not less than 12 hours before making the moisture-density test." (2)

The foremost purpose of this paper's study is to determine if the special test procedures for clayey soils outlined in the just-quoted ASTM moisture-density test are necessary in the case of several Eastern Kansas clayey soils.