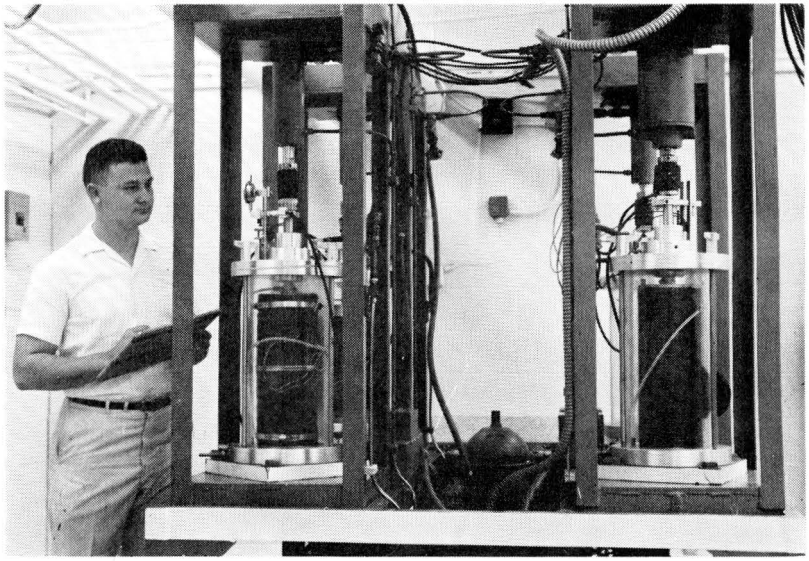
SUMMARY REPORT 27-4(S)

DEFORMATION CHARACTERISTICS OF GRANULAR MATERIALS SUBJECTED TO RAPID, REPETITIVE LOADING

SUMMARY REPORT
of
Research Report Number 27-4
Study 2-8-62-27



Cooperative Research Program of the
Texas Transportation Institute and the Texas Highway Department
In Cooperation with the
U. S. Department of Commerce, Bureau of Public Roads

November, 1966

TEXAS TRANSPORTATION INSTITUTE
Texas A&M University
College Station, Texas

Deformation Characteristics of Granular Materials Subjected to Rapid, Repetitive Loading

by

Wayne A. Dunlap

Assistant Research Engineer

The engineering behavior of soils and aggregates is a function of their basic properties and the environment to which they are subjected. In pavement design the effect of repeated loading is an important environmental condition which has received little attention, especially for granular materials. This report presents results showing the influence of repetitive triaxial stressing on the deformation of granular (flexible base course) materials. The materials examined were (1) hard rounded material (gravel), (2) hard angular material manufactured by crushing oversized pieces of the gravel, and (3) a soft crushed limestone. Each material—except the soft—was tested at three separate gradations representing the coarse, medium and fine ranges allowed by Texas Highway Department specifications for such materials.

The total strain characteristics of the materials were quantitatively related to the applied stresses and number of stress repetitions. It was shown that the behavior under repetitive stresses was not closely related to static shear strengths as determined by the Texas triaxial method. Rebound strains could only be expressed qualitatively.

Under repetitive stressing the rounded material, which ranked lowest in static shear tests, was at least equivalent to the angular material for the stress range expected in roadways; both were superior to the soft material. It is believed that the relative densities of the respective materials influenced their behavior more than particle shape or hardness.

Several recommendations were made for improving equipment and testing procedures which should simplify analysis of

results and reduce experimental error in future investigations. The principal recommendations made are as follows:

1. Major improvements are needed in the method of measuring specimen strain. With the present arrangement, it is difficult to separate strain occurring in the triaxial cell from the measured strain to obtain the specimen strain. Optical tracking devices are available which appear to be capable of performing this function.

2. Improvements are needed in the loading apparatus to make it capable of consistently applying accurate and reproductible load patterns and especially it must be capable of doing this during the initial load phases regardless of the deformation characteristics of the specimen. Commercial loading devices now available can do this.

3. A better method of fabricating test specimens should be developed. The impact method (the Texas Highway Department compaction method modified for 6-inch diameter by 12-inch high specimens) was not suitable for producing replicate specimens. It is felt that observed differences between replicate specimens resulted primarily from the hand finishing operation needed to level the compacted surface of the specimen. Possibly some type of gyratory compaction apparatus could be developed that would be more suitable.

4. Volume change devices are not adequate substitutes for measurement of the pore air and pore water pressures. At best, they give qualitative information from which unit weight and degree of saturation can be estimated. This is certainly helpful in explaining some aspects of material behavior, but to actually understand how the material reacts to load, the effective stresses must be known. Measurement of pore pressures during dynamic load applications will certainly be a difficult problem to solve for partly saturated specimens, but it must be accomplished to determine the effective stresses.