Standard Test Method for Repetitive Static Plate Load Tests of Soils and Flexible Pavement Components, for Use in Evaluation and Design of Airport and Highway Pavements[1]

1. Scope

1.1 This test method covers a procedure for making repetitive static plate load tests on subgrade soils and compacted pavement components, in either the compact condition or the natural state, and provides data for use in the evaluation and design of rigid and flexible-type airport and highway pavements.

1.2 The values stated in inch-pound units are to be regarded as the standard.

1.3 *This standard does not purport to address all of the safety problems, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Terminology

2.1 *Definitions:*

2.1.1 *deflection*—the amount of downward vertical movement of a surface due to the application of a load to the surface.

2.1.2 *rebound deflection*—the amount of vertical rebound of a surface that occurs when a load is removed from the surface.

2.1.3 *residual deflection*—the difference between original and final elevations of a surface resulting from the application and removal of one or more loads to and from the surface.

3. Significance and Use

3.1 Field, in-place repetitive static plate load tests are used for the evaluation and design of pavement structures. Repetive static plate load tests are performed on soils and unbound base and subbase materials to determine a measure of the shear strength of pavement components.

4. Apparatus

4.1 *Loading Device*—A truck or trailer or a combination of both a tractor-trailer, an anchored frame, or other structure loaded with sufficient weight to produce the desired reaction on the surface under test. The supporting points (wheels in the case of a truck or trailer) shall be at least 8 ft (2.4 m) from the circumference of the largest diameter bearing plate being used.

4.2 *Hydraulic Jack Assembly*, with a spherical bearing attachment, capable of applying and releasing the load in increments. The jack shall have sufficient capacity for applying the maximum load required, and shall be equipped with an accurately calibrated gage that will indicate the magnitude of the applied load.

4.3 *Bearing Plates*—A set of circular steel bearing plates not less than 1 in. (25.4 mm) in thickness, machined so that they can be arranged in pyramid fashion to ensure rigidity, and having diameters ranging from 6 to 30 in. (152 to 762 mm). The diameters of adjacent plates in the pyramid arrangement shall not differ by more than 6 in.

NOTE 1—A minimum of four different plate sizes is recommended for pavement design or evaluation purposes. For evaluation purposes alone, a single plate may be used, provided that its area is equal to the tire-contact area corresponding to what may be considered as the most critical combination of conditions of wheel load and tire pressure. For the purpose of providing data indicative of bearing index (for example, the determination of relative subgrade support throughout a period of a year), a single plate of any selected size may be used.

4.4 *Dial Gages*, two or more, graduated in units of 0.001 in. (0.03 mm) and capable of recording a maximum deflection of 1 in. (25 mm) or other equivalent deflection-measuring devices.

4.5 *Deflection Beam*—A beam upon which the dial gages shall be mounted. The beam shall be a 2½-in. standard black pipe or a 3 by 3 by ¼-in. (76 by 76 by 6-mm) steel angle, or equivalent. It shall be at least 18 ft (5.5 m) long and shall rest on supports located at least 8 ft (2.4 m) from the circumference of the bearing plate or nearest wheel or supporting leg. The entire deflection measuring system shall be adequately shaded from direct rays of the sun.

4.6 *Miscellaneous Tools*, including a spirit level, for preparation of the surface to be tested and for operation of the equipment.

5. Procedure

5.1 Carefully center a bearing plate, of the selected diameter, under the jack assembly. Set the remaining plates of smaller diameter concentric with, and on top of, the bearing plate. Set the bearing plate level in a thin bed of a mixture of

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sand and plaster of Paris, of plaster of Paris alone, or of fine sand, using the least quantity of materials required for uniform bearing. To prevent loss of moisture from the subgrade during the load test, cover the exposed subgrade to a distance of 6 ft (1.8 m) from the circumference of the bearing plate with a tarpaulin or waterproof paper.

5.2 Where unconfined load tests are to be made at a depth below the surface, remove the surrounding material to provide a clearance equal to one and one-half plate diameters from the edge of the bearing plate. For confined tests, the diameter of the excavated circular area shall be just sufficient to accommodate the selected bearing plate.

5.3 Use a sufficient number of dial gages, so located and fixed in position as to indicate the average vertical movement of the bearing plate. When using two dial gages, they shall be set near each extremity of a diameter of the bearing plate, 1 in. (25.4 mm) from the circumference. When three gages are employed, they shall be set at an angle of 120° from each other, and equidistant from the circumference of the bearing plate. Each individual set of readings shall be averaged, and this value is recorded as the average settlement reading.

5.4 After the equipment has been properly arranged, and with all of the dead load (jack, plates, etc.) acting, seat and bearing plate and assembly by the quick application and release of a load sufficient to produce a deflection of not less than 0.01 in. (0.25 mm) nor more than 0.02 in. (0.51 mm) as indicated by the dial gages. When the dial needles come to rest following the release of this load, reseat the plate by applying one half of the recorded load producing the 0.01 to 0.02-in. deflection. When the dial needles have again come to rest, set each dial accurately at its zero mark.

NOTE 2—The use of additional dial gages, placed on the surface of the material being tested at one half, one, and one and one-half, etc., bearing-plate diameters from the edge of the bearing plate, is optional.

5.5 Apply a load giving a deflection of about 0.04 in. (1.0 mm), start a stop watch, and maintain the same load constantly until the rate of deflection is 0.001 in. (0.03 mm) per min or less for three successive minutes. Then completely release the load, and observe the rebound until the rate of recovery is 0.001 in. per min or less, for three successive minutes. Apply and release the same load in this manner six times. Record the readings of the dial gages resting on the bearing plate at the end of each minute; record the readings of the dial gages set beyond the perimeter of the bearing plate just before the application, and just before the release of load, for each repetition. To ensure good contact between the gages and the bearing plate or other surface on which they are resting, briefly buzz an electric bell attached to the deflection beam, 10 s before the dial gages are to be read.

5.6 Increase the load to give a deflection of about 0.2 in. (5.1 mm), and proceed as directed in 4.5.

5.7 Increase the load to give a deflection of about 0.4 in. (10.2 mm), and proceed as directed in 4.5.

5.8 In all cases the standard end point shall be a rate of 0.001 in. (0.03 mm)/min or less for three successive minutes.

5.9 From a thermometer suspended near the bearing plate, read and record the air temperature at half-hour intervals.

6. Record of Tests

6.1 In addition to the continuous listing of all load, deflection, and temperature data, as prescribed in Section 4, a record shall also be made of all associated conditions and observations pertaining to the test, including the following:

6.1.1 Date,

6.1.2 Time of beginning and completion of test,

6.1.3 List of personnel,

6.1.4 Weather conditions,

6.1.5 Any irregularity in routine procedure,

6.1.6 Any unusual conditions observed at the test site, and

6.1.7 Any unusual observations made during the test.

7. Calculation and Plotting of Load-Deflection Relationships

7.1 For each repetition of each load, determine the deflection at which the rate of deflection is exactly 0.001 in. (0.03 mm)/min. This is termed end point deflection and can be determined with sufficient accuracy from visual inspection of the deflection data for each repetition of load recorded.

7.2 Correct the recorded loads, as read from the pressure gage of each hydraulic jack employed, by means of the calibration curve for each jack and pressure gage used.

7.3 Determine graphically the zero point corrections for both applied load and deflection. This requires taking into account the weight of the hydraulic jack, that of the pyramid of bearing plates, etc., and that of the corrected jack loads at which the dial gages were set to zero at the beginning of the test.

7.4 Plot the corrected deflection at which the rate of deflection is exactly 0.001 in. (0.03 mm)/min *versus* the number of repetitions of each corrected load. Similar graphs may be prepared in which corrected residual deflection and rebound deflection are plotted *versus* the number of repetitions of each corrected load.

8. Precision and Bias

8.1 The precision and bias of this test method for making repetitive static plate load tests on subgrade soils and flexible pavement components has not been determined. Soils and flexible pavement components at the same location may exhibit significantly different load-deflection relationships. No method presently exists to evaluate the precision of a group of repetitive plate load tests on soils and flexible pavement components due to the variability of these materials. The subcommittee is seeking pertinent data from users of this method which may be used to develop meaningful statements of precision and bias.

9. Keywords

9.1 bearing plate; deflection; pavements