Standard Test Method for Nonrepetitive 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 the making of nonrepetitive static plate load tests on subgrade soils and pavement components, in either the compacted 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 concerns, 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 nonrepetitive static load tests are used for the evaluation and design of pavement structures. Nonrepetitive static plate load tests are performed on soils and unbound base and subbase materials to determine the modulus of subgrade reaction or 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. (25.4 mm) or other equivalent deflection-measuring devices.

4.5 *Deflection 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

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the bearing plate level in a thin bed of a mixture of 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 bearing 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 deflection 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, with all of the dead load (jack, plates, etc.) acting, seat the 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 dials. When the dial needles come to rest following 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 then again come to rest, set each dial accurately at its zero mark.

5.5 Apply loads at a moderately rapid rate in uniform increments. The magnitude of each load increment shall be small enough to permit the recording of a sufficient number of load-deflection points to produce an accurate load-deflection curve (not less than six). After each increment of load has been applied, allow its action to continue until a rate of deflection of not more than 0.001 in. (0.03 mm)/min has been maintained for three consecutive minutes. Record load and deflection readings for each load increment. Continue this procedure until the selected total deflection has been obtained, or until the load capacity of the apparatus has been reached, whichever occurs first. At this point, maintain the load until an increased deflection of not more than 0.001 in./min for three consecutive minutes occurs. Record the total deflection, after which release the load to load at which the dial gages were set at zero, and maintain this zero-setting load until the rate of recovery does not exceed 0.001 in. for three consecutive minutes. Record the deflection at the zero-setting load.

5.6 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 From the data obtained by the procedure described under 4.5, plot the total or unit load in pounds-force (or newtons) for each increment against the corresponding settlement in inches. Also plot the recovery after full release of load. Correction should be made for the zero deflection point, taking into account the dead weight of the equipment and the seating load. From this graph, the relation of load and total deflection for that load, and the relation of rebound and residual deflection for the maximum load used, may be obtained.

8. Precision and Bias

8.1 The precision and bias of this test method for making nonrepetitive 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 nonrepetitive 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 test method which may be used to develop meaningful statements of precision and bias.

9. Keywords

9.1 bearing plate; deflection; pavements