Designation: D 1194 – 94

Standard Test Method for Bearing Capacity of Soil for Static Load and Spread Footings[1]

This standard is issued under the fixed designation D 1194; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

This standard has been approved for use by agencies of the Department of Defense.

1. Scope

1.1 This test method covers estimation of the bearing capacity of soil in place by means of field loading tests. This test method can be used as part of a procedure for soil investigation for foundation design. It gives information on the soil only to a depth equal to about two diameters of the bearing plate, and takes into account only part of the effect of time.

1.2 The values stated in inch-pound units are to be regarded as the standard. The SI units given in parentheses are for information only.

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. Significance and Use

2.1 This test method is used to estimate the bearing capacity of a soil under field loading conditions for a specific loading plate and depth of embedment. The bearing capacity of a soil is not simply a soil strength parameter, but it also depends on the magnitude and distribution of the load, dimension, and geometry of the loading plate and depth of embedment (or elevation of testing). This bearing capacity can be used in soil investigations and for the design of foundations.

3. Apparatus

3.1 *Loading Platforms or Bins* of sufficient size and strength to supply the estimated total load required or equivalent means of supplying the total load reaction anticipated.

3.2 *Hydraulic or Mechanical Jack Assembly* of sufficient capacity to provide and maintain the maximum estimated load for the specific soil conditions involved, but not less than 50 tons (440 kN) in any case, and at least one device, such as a pressure gage, electronic load cell, or proving ring, for measuring the force exerted by the jack. The force-measuring devices should be capable of recording the load with an error not exceeding ±2 % of the load increment used.

3.3 *Bearing Plates*—Three circular steel bearing plates, not less than 1 in. (25 mm) in thickness and varying in diameter from 12 to 30 in. (305 to 762 mm), including the minimum and maximum diameter specified or square steel bearing plates of equivalent area. As an alternative, three small concrete footings of the size mentioned or larger can be cast *in-situ*. Such footings must have a depth of not less than two thirds of their width.

3.4 *Settlement-Recording Devices*, such as dial gages, capable of measuring settlement of the test plates to an accuracy of at least 0.01 in. (0.25 mm).

3.5 *Miscellaneous Apparatus*, including loading columns, steel shims, and other construction tools and equipment required for preparation of the test pits and loading apparatus.

NOTE 1—Testing assemblies may vary widely, depending on job conditions, testing requirements, and equipment available. The testing assembly and program should be planned in advance and approved by the supervising engineer, and in general can permit considerable latitude in details within the specific requirements noted above and outlined in the following test procedure. A typical assembly for conducting load tests is illustrated in Fig. 1.

4. Procedure

4.1 *Selection of Test Areas*—Base the selection of representative test areas for bearing tests on the results of exploratory borings and on the design requirements of the structure. Unless otherwise specified, make the load test at the elevation of the proposed footings and under the same conditions to which the proposed footings will be subjected. At the selected elevation place the bearing plates at the same relative depths (depths expressed in plate diameters) as the actual footing.

NOTE 2—For footings placed under permanently excavated basements the depth of the actual footing is construed as the depth from the basement level or depth over which the surcharge is permanently acting, rather than the depth from the ground surface.

NOTE 3—If the mentioned condition of equal relative depth cannot be met for practical reasons, the test results must be interpreted by using an

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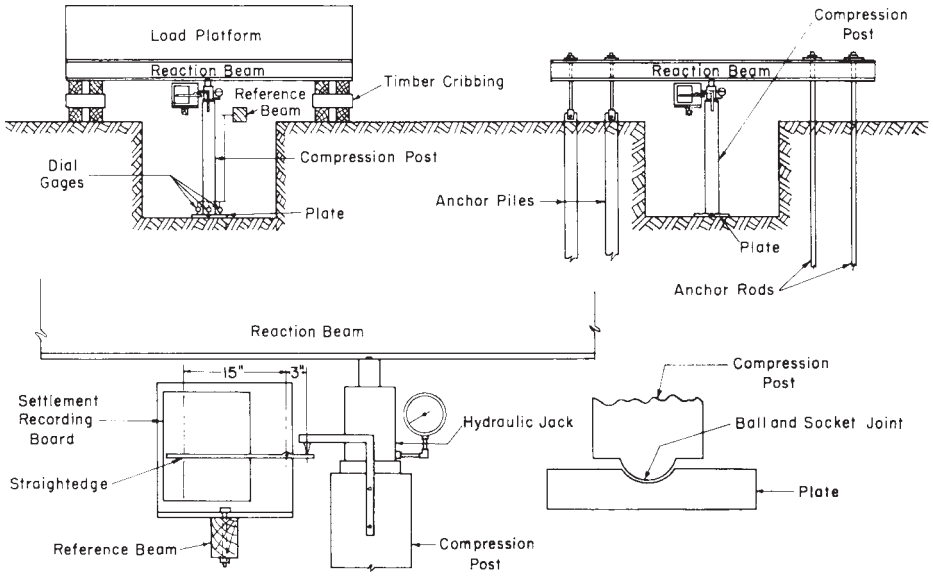

FIG. 1 Typical Setup for Conducting Static Load Tests

appropriate theory of bearing capacity. Also make corrections for the effects of the shape and size of the footing and the effects of the water table as appropriate.

4.2 *Test Pits*—At least three test locations are required, and the distance between test locations shall not be less than five times the diameter of the largest plate used in the tests. Carefully level and clean the areas to be loaded by the test plates or footings so that the loads are transmitted over the entire contact areas on undisturbed soil. Prior to loading, protect test pits and areas against moisture changes in the soil unless it is expected that wetting of the soil will occur at some future time, as in the case of hydraulic structures. In this case, prewet the soil in the area to the desired extent to a depth not less than twice the diameter of the largest bearing plate.

4.3 *Loading Platforms*—Support the loading platforms or bins by cribbing or other suitable means, at points as far removed from the test area as practicable, and preferably not less than 8 ft (2.4 m). The total load required for the test shall be available at the site before the test is started.

4.4 *Dead Load*—Weigh and record as dead weight all equipment used, such as steel plates, loading column and jack, etc., that are to be placed on the test area prior to the application of the load increments.

4.5 *Reference Beam*—Independently support the beam supporting dial gages or other settlement-recording devices as far as practicable, but not less than 8 ft (2.4 m) from the center of the loaded area.

4.6 *Load Increments*—Apply the load to the soil in cumulative equal increments of not more than 1.0 ton/ft^2 (95 kPa), or of not more than one tenth of the estimated bearing capacity of the area being tested. Accurately measure each load, and apply it in such a manner that all of the load reaches the soil as a static load, without impact, fluctuation, or eccentricity.

4.7 *Time Interval of Loading*—After the application of each load increment, maintain the cumulative load for a selected time interval of not less than 15 min.

NOTE 4—Longer time intervals may be determined by maintaining the load until the settlement has ceased or the rate of settlement becomes uniform. However, maintain any type of time interval so selected for each load increment in all tests of any series.

4.8 *Measurement of Settlement*—Keep a continuous record of all settlements. Make settlement measurements as soon as possible before and after the application of each load increment, and at such equal time intervals, while the load is being held constant, as will provide not less than six settlement measurements between load applications.

4.9 *Termination of Tests*—Continue each test until a peak load is reached or until the ratio of load increment to settlement increment reaches a minimum, steady magnitude. If sufficient load is available, continue the test until the total settlement reaches at least 10 % of the plate diameter, unless a well-defined failure load is observed. After completion of observations for the last load increment, release this applied load in three approximately equal decrements. Continue recording rebound deflections until the deformation ceases or for a period not smaller than the time interval of loading.

NOTE 5—The following alternative loading procedure is also permissible: Apply the load to the soil in increments corresponding to settlement increments of approximately 0.5 % of the plate diameter. After the application of each settlement increment, measure the load at some fixed time intervals, for example, 30 s, 1 min, 2 min, 4 min, 8 min, and 15 min, after load application, until the variation of the load ceases or until the rate of variation of the load, on a load *versus* logarithm-of-time scale becomes linear. Continue loading in selected settlement increments. Termination of tests and unloading are made in the same manner as in 4.9.

5. Report

5.1 In addition to the continuous listing of all time, load, and settlement data for each test, as prescribed in Section 3, report all associated conditions and observations pertaining to the test, including the following:

5.1.1 Date,

5.1.2 List of personnel,

5.1.3 Weather conditions,

5.1.4 Air temperature at time of load increments, and

5.1.5 Irregularity in routine procedure.

6. Precision and Bias

6.1 The precision and bias of this test method for determining the bearing capacity of soil in place by means of a field loading test has not been determined. No available methods provide absolute values for the bearing capacity of soil in place against which this method can be compared. The variability of the soil and the resulting disturbance of the soil under the loading plate do not allow for the repetitive duplication of test results required to obtain a meaningful statistical evaluation. The subcommittee is seeking pertinent data from users of this method which may be used to develop meaningful statements of precision and bias.

7. Keywords

7.1 bearing capacity; bearing plate; deflection; settlement