Florida Method of Test
for
NONREPETITIVE STATIC PLATE LOAD TEST OF SOILS AND FLEXIBLE PAVEMENT COMPONENTS

Designation: FM 5-527
Modified AASHTO T-222-78

1. SCOPE

1.1 This method covers the making of nonrepetitive static plate load test on subgrade soils (compacted or the natural state), base materials and flexible pavement components.

2. APPLICABLE DOCUMENTS

2.1 AASHTO Standards
T-222-78 - Standard Method for Nonrepetitive Static Plate Load Test of Soils and Flexible Pavement Components, for use in Evaluation and Design of Airport and Highway Pavements.

2.2 Florida Research Report 68-B, Field Procedure for Performing Plate Bearing Test

3. DEFINITIONS

3.1 Deflection - The amount of downward vertical movement of a surface due to the application of a load to the surface.

3.2 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.

3.3 Rebound Deflection - The amount of vertical rebound of a surface that occurs when a load is removed from the surface.

4. APPARATUS

4.1 Field Test Apparatus - The required field test apparatus, part of which is shown in Figure 1, is as follows:

4.1.1 Loading Device - A truck or trailer, a tractor trailer, an anchored frame, or other structure loaded with sufficient mass 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 used. Florida commonly uses a tanker with a total load of at least 60,000 lbs. (27.216 kg).

4.1.2 Hydraulic Jack Assembly - With a spherical bearing attachment, capable of applying and releasing the load increments. The jack shall have sufficient capacity for applying the maximum load required, and shall be equipped with an accurately calibrated gauge, or proving ring, that will indicate the magnitude of the applied load.

4.1.3 Bearing Plate - A set of circular steel 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 have diameters ranging from 6 in. to 30 in. (152 to 762 mm). The diameters of adjacent plates in the pyramid arrangement shall not differ by more than 6 in. (152 mm). Aluminum alloy No. 24 ST plates 1-1/2 in. (38 mm) thick may be used in lieu of steel plates.

4.1.4 Dial Gauges - Two graduated in units of 0.001 in. (0.02 mm) and capable of recording an accumulated deflection of at least 1 in. (25.4 mm), or other equivalent deflection measuring devices such as LVDT's.

4.1.5 Deflection Beam - Upon which the dial gauges shall be mounted. The beam shall be a 2-1/2 in. (63.5 mm) standard black pipe or a 3 by 3 in. by 1/4 in. (76 x 76 x 6 mm) steel angle, or equivalent. It shall rest on supports located at least 4 ft. (1.2 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.

4.1.6 Miscellaneous Tools - Including a spirit level, for preparation of the surface to be tested for operation of the equipment.

5. PROCEDURE

5.1 Where unconfined load tests are to be made, strip or remove the material lying above the elevation of the material to be tested. The stripped area should be at least twice the diameter of the largest plate to eliminate surcharge or confining effects. Clear the area to be tested of any loose materials and make it level. Extreme care should be taken not to disturb the soil in the test area, especially in granular material. For confined tests, the diameter of the excavated circular area shall be just sufficient to accommodate the selected bearing plate.

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 plates. Set the bearing plate level in a thin bed of a mixture of sand and plaster of paris, or plaster of paris alone, or of fine sand, using the least quantity of materials required for uniform bearing. If additional testing is to be conducted it is necessary to cover the exposed soil material to a distance of 6 ft. (1.8 m) from the circumference of the bearing plate with a tarpaulin or proof paper to prevent loss of moisture from the soil during the load test.

Note: For routine evaluations, Florida uses a 12 in. (305 mm) unconfined load test. Leveling of the bearing plate is accomplished with plaster of paris alone.

5.2 Seat the selected bearing plate on the sand or plaster of paris. Turning or working the plate back and forth will help to provide uniform seating of the plate. Center the remaining plates of smaller diameter concentric with, and on top of, the bearing plate. Center the hydraulic jack on the smallest diameter plate.

If shimming is needed, shim between the hydraulic jack and loading device but use a ball joint between the shim and loading device. If a proving ring is being used to measure load, it should be placed on top of the hydraulic jack and the ball joint used between the proving ring and loading device. For safety reasons, shims should not be used between the ball joint and loading device. The loading device must be long enough so that its supports (wheels in the case of a truck or trailer) will be at least 8 ft. (2.4 m) from the bearing plate. Two dial gauges shall be used to measure deformation of the soil under load. Place these dial gauges so that the stems rest on the bearing plate not more than 3/4 in. (19 mm) from the outer edge, spaced 180 degrees apart. Fasten the dial gauges to a frame whose supports are at least 4 ft. (1.2 m) from the edge of the bearing plate and loading device supports (wheels in the case of truck or trailer).

5.3 Use the following procedures:

5.3.1 Seating Procedures - Seat the loading system and bearing plate by applying three seating loads. Each seating load shall produce an average total deflection of 0.030 in. (0.76 mm). Each of the three seating loads shall be applied in five uniform increments (minimum). After each increment of load has been applied, allow its action to continue until a rate of deflection, not more than 0.001 in. (0.02 mm) per minute, has been maintained for three consecutive minutes. Record load and deflection readings for each load increment (See Table 1). When the average total deflection of 0.030 in. (0.76 mm) or the capacity of the loading device has been reached, record the total deflection, after which release the load, and maintain zero load until the rate of recovery does not exceed 0.001 in. (0.02 mm) for three consecutive minutes. Record the rebound deflection (See Table 1.) and then reset each dial indicator accurately at its zero mark. Repeat the above sequence for the second and third seating loads.

5.3.2 Load Application - Apply load in uniform increments. The magnitude of each load increment shall be such as to permit the recording of a sufficient number of load-deflection points to produce an accurate load-deflection curve (not less than five). 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. (0.02 mm) per minute has been maintained for three consecutive minutes. Record load and deflection readings for each load increment. Continue this procedure until the average total deflection [0.050 in. (1.27 mm) plus average rebound deflection from third seating load] 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. (0.02 mm) for three consecutive minutes record the total final deflection. Each individual set of readings will be averaged, and this value is recorded as the average deflection reading.

6. RECORD THE TESTS

6.1 In addition to the continuous listing of all load, deflection and temperature data, as prescribed in Section 5, a record shall also be made of all associated conditions and observations pertaining to the test, including the following: (See Table 1 for example.)

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.

6.1.7.1 Any unusual observations made during the test.

7. CALCULATION AND PLOTTING OF LOAD DEFLECTION RELATIONSHIPS

7.1 Plot Load - Deflection Curve - Select appropriate scale for load and deflection values encountered during testing (See Figure 2). Plot only final load, it is not necessary to plot seating loads. Only the average deflection corresponding to each load increment will be plotted (See Figure 2).

7.2 Total Load Determination - Determine the residual deflection by connecting the straight portion of the load-deflection curve with a straight line that intersects the "x" coordinate. The intercept deflection value is the corrected deflection value. This value is added to the selected total deflection, 0.050 in. (1.27 mm) and the total load (stress at 0.050 in., 1.27 mm, deflection) is determined from the deflections point of intercept on the load-deflection curve (See Figure 2).

7.3 Pounds Per Square Inch (PSI) Determination - Total load (stress at 0.050 in., 1.27 mm) expressed in pounds shall be divided by the area of the selected bearing plate expressed in square inches.

The equations would take the following form:

$$A = \quad R^2$$

$$PSI = \frac{P}{A}$$

where: A = Area of selected bearing plate
= 3.14159
R = Radius of selected bearing plate
P = Stress at 0.050 (1.27 mm)

7.4 Modulus Determination - Shall be determined using Burmister's theory for rigid circular plates. Burmister extended Boussinesq's theory of deflections at the center of a flexible circular plate to rigid plates. Florida's equation takes the following form:

$$E = \frac{1.18\ (PSI)\ (R)}{0.050}$$

$$K = \frac{E}{1.18 \times R}$$

where: E = Modulus of elasticity
1.18 = Constant for rigid plate

P = Stress at 0.050 in. (1.27 mm)
A = Area of selected bearing plate
K = Soil reaction
R = Radius of selected bearing plate

PLATE BEARING TEST
STATIC LOADING

Project No.:______________________

Station or Lab No.:______________________

Layer Tested:______________________

Thickness:______________________

Description:______________________

Beginning Time:______________________

Time Completed:______________________

Test No.:______________________

Plate Diameter:______________________

Degree Saturation:______________________

Weather (°F):______________________

Date:______________________

Tested By:______________________

Comments:______________________

Max. Density
(AASHTO T-__________)

Optimum Moisture
(AASHTO T-__________)

__________%

LBR
At Optimum __________

Soaked__________

Dry Density @ test:

__________ pcf

Moisture @ test:

__________%

p = Stress @ 0.05"
Deflection __________psi

a = Radius of Plate

__________ in.

$E = \frac{1.18\ pa}{0.05} =$ __________

Applied Load (lbs.)	Duration (Min.)	Actual Deflection		Avg. Dial Reading (in.)
		Dial # 1	Dial # 2	

(6 of 10)

PLATE BEARING TEST
STATIC LOADING

Project No.: 31010
Station or Lab No.: Trench No. 4
Layer Tested: Base
Thickness: 8"
Description: Limerock
Beginning Time: ______
Time Completed: ______

Test No.: Base
Plate Diameter: 12"
Degree Saturation: As Constructed
Weather (°F): ______
Date: 4-28-81
Tested By: R. B. Schaub & W. Thomas
Comments: ______

Max. Density (AASHTO T-______)

Optimum Moisture (AASHTO T-______)

______ %

LBR
At Optimum ______
Soaked ______

Dry Density @ test: ______ pcf

Moisture @ test: ______ %

p = Stress @ 0.05" Deflection ______ psi

a = Radius of Plate ______ in.

$E = \frac{1.18\ pa}{0.05}$ = ______

Applied Load (lbs.)	Duration (Min.)	Actual Deflection Dial # 1	Actual Deflection Dial # 2	Avg. Dial Reading (in.)
0	Seating			0
1000	Load 1	.009	.016	.013
2000		.012	.020	.016
3000		.018	.026	.022
4000		.020	.028	.024
5000		.023	.032	.028
6000		.028	.036	.032
0	Rebound			
0	Seating	0	0	0
2000	Load 2	.009	.011	.010
4000		.014	.016	.015
6000		.021	.022	.022
8000		.026	.028	.027
10000		.034	.035	.035
0	Rebound			

PLATE BEARING TEST
STATIC LOADING

Pro,
Sta
Lay
Thi
Des
Beg
Tim

Max.
(AAS

Opti
(AAS

LBR
At
Soa

Dry

Mois

p =
Defl
a =

E =

ial
ng
)

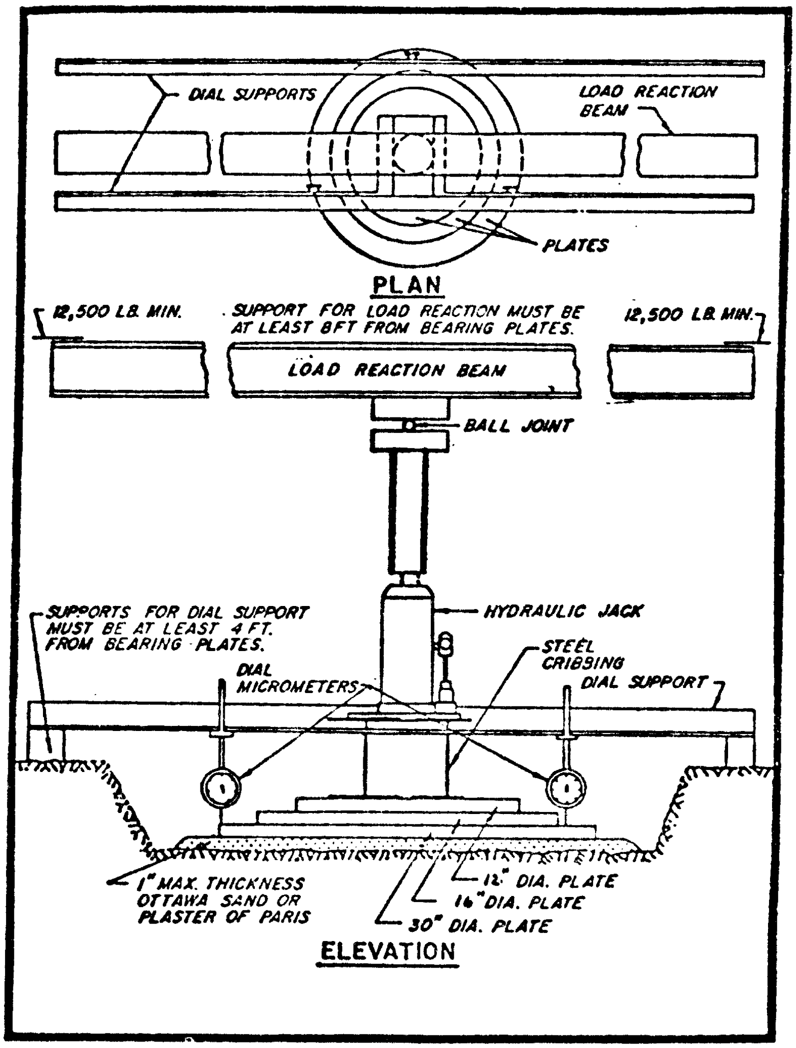
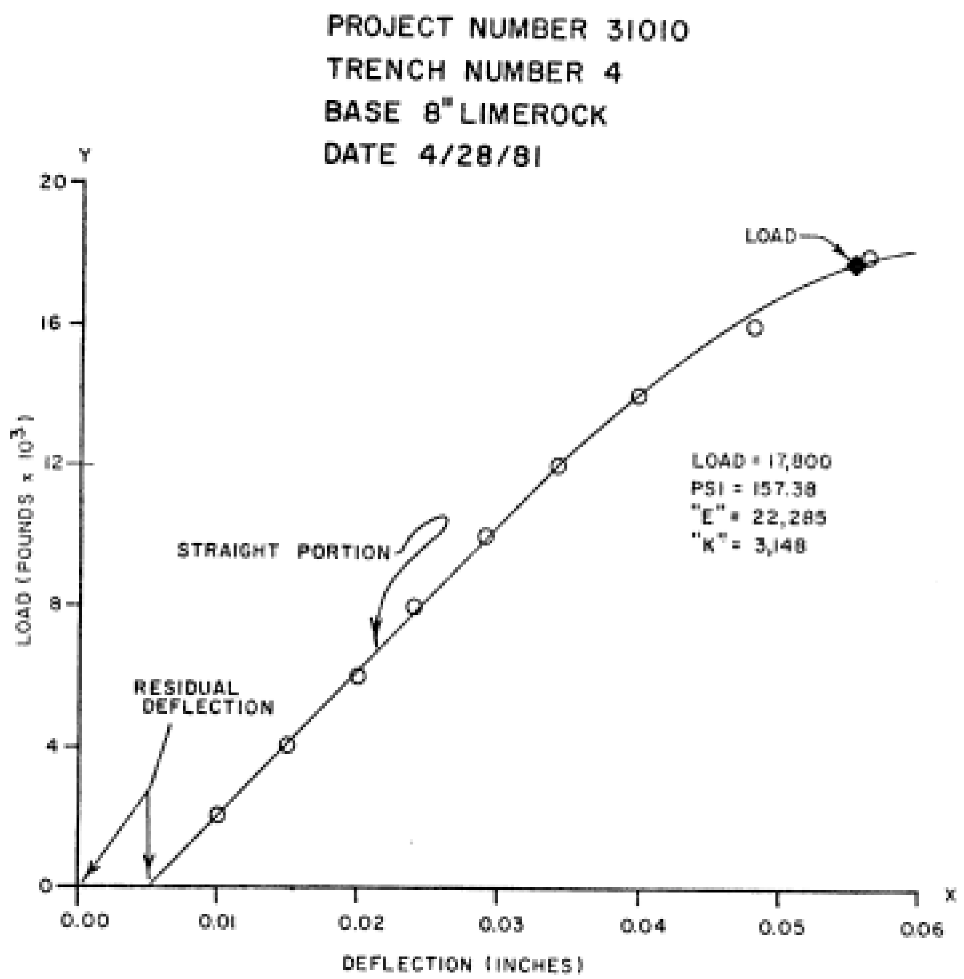


Figure I. *Plate-bearing test equipment.*



12 INCH PLATE BEARING TEST

FIGURE 2