

DENSITY – LIGHT WEIGHT DEFLECTOMETER (LWD)

General Description

Light Weight Deflectometer (LWD) is a light weight, portable tool used to determine the stiffness of unbound materials during construction by measuring the deflection under an applied load. This device is hand operated and takes measurements of the deflection of the compacted soil that is impacted by a falling weight. The device measures a deflection and estimates a modulus value based on the force required to generate a given deflection for that soil type. This is one of the new methods to measure in-place soil parameters such as stiffness and strength.



COLLECTION FREQUENCY

Procedure

TESTING CONSTRAINTS

1. Perform test at the time of compaction and immediately after corrective actions.
2. Complete testing in the operable temperature range of 0 to 50 degrees Celsius (32 to 120 degrees Fahrenheit).
3. Ensure soil is not frozen.
4. Execute test when the deflection measurements are greater than 0.2 mm (0.008 in).

SITE SELECTION AND PREPARTATION

1. Visually inspect the percentage of gravel in the soil. Ensure the percentage of gravel, larger than 38.1 mm (1.5 in), is less than 25 percent.
2. Create a relatively smooth and level spot that will allow the LWD guide rod to remain vertical and prevent translation of the loading plate during testing.
3. Ensure the test area incline is less than 4 percent.
4. Make sure that the test area represents the testing lot.
5. Prepare a test area that is at least 1.5 times larger than the diameter of the loading plate.
6. Remove loose, dried, cracked or uneven material prior to testing.
7. Perform tests at a uniform depth, representative of the compaction state. Ensure consistent test depths are used, throughout the project, for given material types. Use the following test depths:



Material Type	LWD Test Depth ¹
Granular Soils	≤ one-half lift thickness
Granular Base / Stabilization Layer	0 mm (compaction surface)
Non-Granular Soils Compacted with Padfoot Roller	Bottom of deepest indentation of the padfoot penetration.
Non-Granular Soils Compacted with Smooth-Drum Roller	Compaction Surface (0 mm)

Note 1— The influence depth is approximately 1 to 1.5 times the plate diameter, consequently, deflection measurements obtained for lifts less than this depth will be a composite deflection measurement.

Note 2— Complete test at compaction surface (0 mm) for cases where disturbance effects exist (i.e., deflection measurements increase, due to disturbance caused by the test, from that observed at the surface).

PROCESS

1. Position loading plate on test site. Do not drop loading plate on surface.
2. Turn loading plate left and right 45 degrees. (
3. Perform six falling weight load pulses.^{3,4} Use the following procedure for each load pulse:
 - a. Raise falling weight to preset drop height.
 - b. Snap falling weight into fix and release mechanism.
 - c. Adjust guide rod to vertical.
 - d. Release falling weight and allow it to freely fall.⁵
 - e. Catch falling weight after rebound when recommended by the manufacturer.
 - f. Snap weight into fix and release mechanism after rebound.⁶
4. Record resulting peak deflection values.
5. Record supporting information such as air temperature, surface temperature, location measurements, and identification data when needed.
6. Repeat deflection measurements at another location when conditions such as the following are present⁷:
 - a. The load plate tilts more than 4 percent.
 - b. The seating measurements differ by more than 10 percent.

Note 3— Use the first three drops for “seating” and the next three drops for analysis.

Note 4— Position the test device at a new test location when a faulty drop occurs. Testing cannot be repeated at the same location.

Note 5— Make sure the falling weight falls exactly from the calibration height (4).

Note 6— Ensure the following for LWD equipment constructed using a centering ball: (1) the guide rod is not removed from the centering ball and (2) the load plate is not displaced during testing. (3)

Note 7— Additional compaction may be necessary, or the material may be too wet when these conditions are present.

Calibrations/Formulas



Calibrate the force generation device and the deflection sensor as recommended by the manufacturer, when the deflection measurements are no longer repeatable, or after 10,000 measurements, whichever comes first.

Coordinate calibration through the Office of Material and Road Research.

Data Processing

Deflection Data is displayed and recorded on the data processing and storage system.



Electronic Output Device

For more information:

For more information about MnROAD and the Road Research program at Mn/DOT:

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MnROAD is a state of the art cold weather pavement and transportation testing facility located in Minnesota