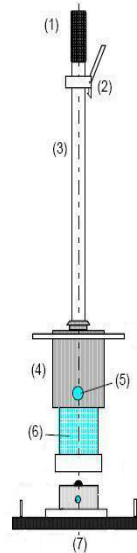


Light Weight Deflectometer (LWD)

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LIGHT WEIGHT DEFLECTOMETER ITM-508

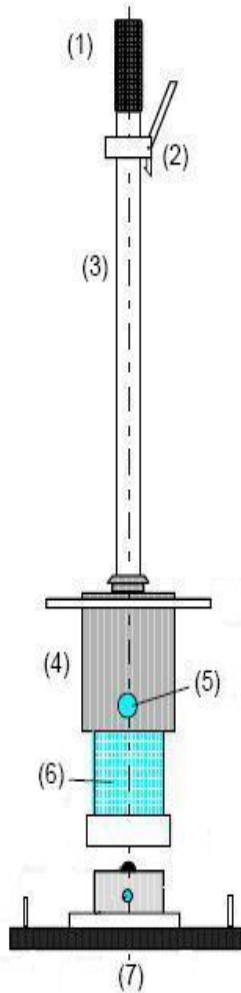


Outline

- LWD Equipment and Testing Procedure,
- ITM 508
- INDOT Standard Specs, 203.24,
- Test Section Construction, ITM 514
- LWD Repeatability, Maintenance and Storage
- LWD Limitations



LWD Setup



- (1) Grip
- (2) Top fix and release mechanism
- (3) Guide rod
- (4) 10 Kg –falling weight
- (5) Lock pin
- (6) Set of steel springs
- (7) Loading plate diameter

Boussinesq Half Space Equation

$$E_{LWD} = \frac{2(1 - \mu^2)q * R}{s}$$

Where q = applied stress, R = plate radius,
 μ = Poisson ratio, s = deflection

Three Major Elements:

- (a) Weight to induce the pulse
- (b) The loading plate
- (c) Accelerometer
(To determine the deflection)

Lightweight Deflectometer

INDOT permit LWD testing on the following materials:

- Aggregate No.53, No.73, structural backfill size 1 ,1.5 and 2 in
- Chemically Modified soils

ITM 508, LWD Testing Procedure

- Test method covers the determination of the plate deflection,
- Test surface shall be clean and smooth as possible with loose granular material,
- Load plate deflection should be equal to the surface deflection under the plate,
- Select site and set up LWD connection to its computational unit,
- Set the plate on a prepared surface and seat it by turning it left and right by 45 degrees. Do not drop the loading plate on the prepared surface.
- LWD plate should not translate laterally with each successive drop.

Con't.

- Perform 3 seating drops before collecting the data. If noticing excessive deflection.
- Material needs additional compaction.
- Following seating drops, perform three drops from a fixed height.
- Record the average of 4th, 5th and 6th drops.



Sec. 203.24

- Aggregate moisture shall be between 4 % and optimum moisture content when delivered to the project,
- Water shall not be added in aggregate at grade,
- Sample of the moisture content will be taken on the grade from the first truck of the day
- Frequency for the moisture shall be minimum one test per day,
- Test section shall be constructed for other materials when not included in the table,



Sec. 203.24, Con.t

- Acceptance test shall be obtained randomly in accordance with ITM 802,
- Frequency of LWD test will be three tests / 800 t of aggregates or 1400 cyd of chemically modified soils
- Location of 3 tests will be at two feet from the edge of the construction and at $\frac{1}{2}$ of the construction area

Maximum Allowable Deflection

The maximum allowable deflection for #53 will be in accordance with the following:

Material Type	Maximum Allowable Deflection (mm)
Lime Modified Soil	0.30
Cement Modified Soil	0.27
Aggregates over Lime Modified Soil	0.30
Aggregates over Cement Modified Soil	0.27

Materials not included in the table need a test pad.

LWD Data Recording Sheet

TD409 LWD Rev 12
6/10/2014

**INDIANA DEPARTMENT OF TRANSPORTATION
LWD AND MOISTURE ACCEPTANCE TESTS
AGGREGATES OVER SOILS**

ORIGINAL: PROJECT FILE
COPY TO: OFFICE OF GEOTECHNICAL ENGINEERING, Indiana

CONTRACT NO. PROJECT NO. ROAD NO. DATE WEATHER

FIELD TEST NO.					
SITEMANAGER TEST NO.					
SITEMANAGER SAMPLE I.D NO. (R+12 digits)					
Test Site Data	Station				
	Line No.				
	Ref. To Centerline				
	Elevation or Lift No.		Subgrade	Subgrade	Subgrade
	Compacted Depth of Lift (inches)				
Number of Passes with Compactor					
Comp. Agg. over Soils	<input checked="" type="radio"/> CA	LWD Assigned Test Number			
	<input type="radio"/> G	Test Deflection (S _m) (mm)			
	<input type="radio"/> S	Average Deflection (mm)			
Laboratory Data	Maximum Allowable Deflection (mm)				
	Material Name and Type				
	Lab. SM ID (R+12 digits)				
	Optimum Moisture Content (OMC) (%)				
Test Site Moisture	Determined Moisture (%)				
	Difference (Sp.Prov. -3% to OMC)		0	0	0
Comments	Comments 1				
	Comments 2				
PASS OR FAIL OR INFORMATION					

REMARKS: CA = Crushed Stone, G= Gravel, S= Slag	REQUIREMENTS:				
	ITM 506 DATA				
	Test Number				
	Station				
	Tested on Material Passing (No. 4 or 3/4" Sieve)				
	1. Wt. of Pan & Wet Material (W1)(lb) or (g)				
	2. Wt. of Pan & Dry Material (W2)(lb) or (g)				
	3. Wt. of Moisture (lb) Line 1 - Line 2	0.0	0.0	0.0	
	4. Wt. of Pan (W3)(lb) or (g)				
	5. Wt. of Dry Material Line 2 - Line 4	0.0	0.0	0.0	
% Moisture (0.1%) (Line 3 / Line 5) x 100					
LWD SD Card#					
Compactor:					

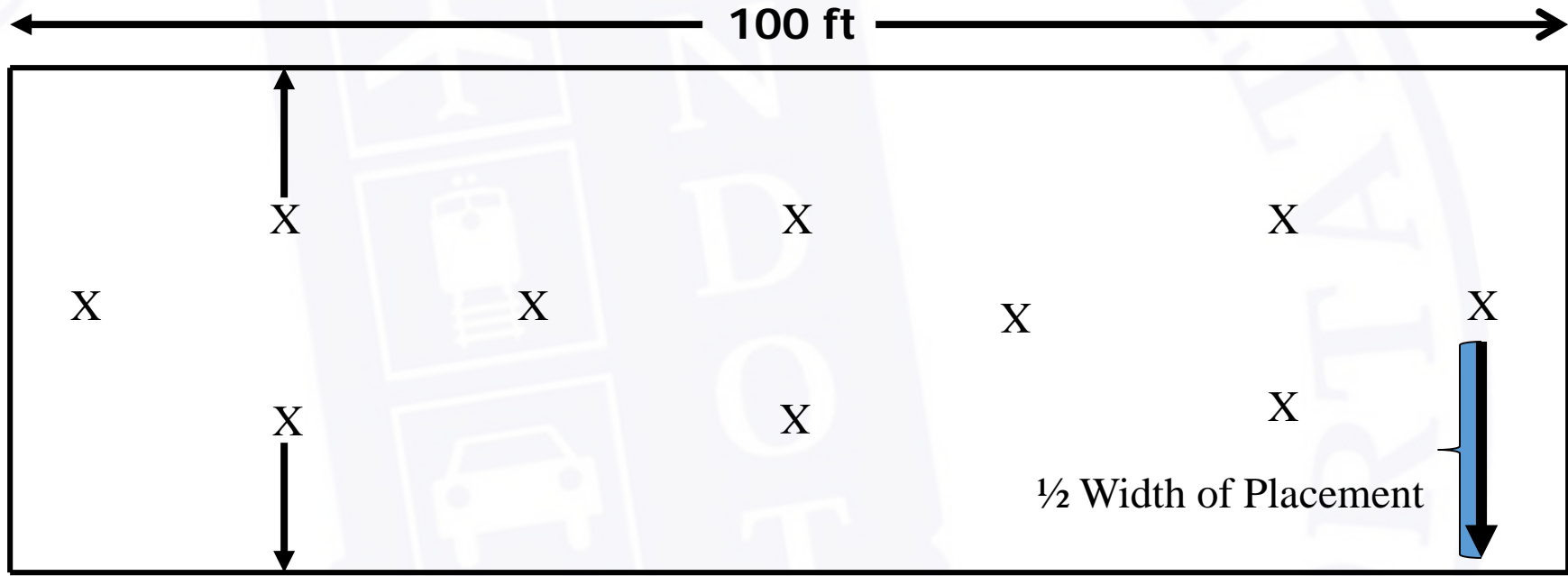
LWD Serial Number RECORDED IN SITE-MANAGER: Qualified Technician:

Test Pad Construction

Test section requirements:

1. AASHTO T-11, T-27, and T-99.
2. Subgrade shall be proof-rolled.
3. Test Pad area is 100 ft. by 20 ft. (part of the roadway).
4. One moisture test is based on AASHTO T-255. Moisture shall be between 4 % and OMC. Perform moisture on aggregates before placing on grade.
5. Shall be 4 roller passes in vibratory mode and one with static on the aggregates.
6. 10 randomly selected LWD Tests (Deflection) based on ITM-802 and take average of 10 tests.

A Test Section Layout



Test Pad Construction - Con.t

7. Perform an additional passes in vib. and static mode each.
8. Retest the previous 10 test locations and take the average.
9. Subtract the average deflection of step 8 from step 6.
10. If difference is 0.02 mm or below, test section is complete.
11. The average deflection of step 8 is the maximum allowable deflection and would be used for the remaining project.
12. If the difference is greater than .02 mm, additional roller passes in vibratory and static are required prior to LWD test.

Test Pad Worksheet

TD409 LWD/Rev 12
6/10/2014

INDIANA DEPARTMENT OF TRANSPORTATION
LWD TEST SECTION FOR AGGREGATE OVER SOILS

ORIGINAL: PROJECT FILE
COPY TO: OFFICE OF GEOTECHNICAL ENGINEERING, Indianapolis

CONTRACT NO. _____ PROJECT NO. _____ ROAD NO. _____ DATE _____ WEATHER _____

FIELD TEST NO.													
SITEMANAGER TEST NO.													
SITEMANAGER SAMPLE I.D. NO. (R+12 digits)													
Test Section Site Data	Station												
	Line No.												
	Ref. To Centerline												
	Elevation or Lift No.												
	Compacted Depth of Lift (inches)												
Test Section Position Number		Average	1	2	3	4	5	6	7	8	9	10	
Subgrade LWD Info	Type	Cohesive or Granular (Fill or Cut)											
	WD Assigned Test Number												
Avg. Test Deflection (S _m) (mm)													
LWD Test Section Data	Passes	WD Assigned Test Number	4V+1S										
	Avg.	Test Deflection (S _m) (mm)	0.379	0.387	0.375	0.388	0.375	0.392	0.389	0.394	0.372	0.354	0.365
	Passes	WD Assigned Test Number	5V+2S										
	Avg.	Test Deflection (S _m) (mm)	0.273	0.269	0.278	0.278	0.273	0.269	0.275	0.265	0.279	0.270	0.274
	Passes	WD Assigned Test Number	6V+3S										
	Avg.	Test Deflection (S _m) (mm)	0.267	0.266	0.267	0.275	0.298	0.268	0.272	0.269	0.256	0.244	0.255
	Passes	WD Assigned Test Number											
	Avg.	Test Deflection (S _m) (mm)											
	Passes	WD Assigned Test Number											
	Avg.	Test Deflection (S _m) (mm)											
	Passes	WD Assigned Test Number											
	Avg.	Test Deflection (S _m) (mm)											
	Passes	WD Assigned Test Number											
	Avg.	Test Deflection (S _m) (mm)											
Test Site	Maximum Allowable Deflection (mm)		0.267										
Laboratory Report Data	Material Name and Type			Test Number	111								
	Lab. SM ID (R+7 digits)			Station	112+05								
	Lab. SM ID (Last 5 digits)			Tested on Material Passing (No. 4 or 3/4" Sieve)	3/4								
	Optimum Moisture Content (OMC) (%)			1. Wt. of Pan & Wet Material (W1)(lb) or (g)	2370.0								
Test Site Moisture	Determined Moisture (%)			2. Wt. of Pan & Dry Material (W2)(lb) or (g)	2188.7								
	Difference (Sp.Prov. -3% to OMC)	0		3. Wt. of Moisture (lb) Line 1 - Line 2	181.2								
Comments	Comments 1			4. Wt. of Pan (W3)(lb) or (g)	100.0								
	Comments 2			5. Wt. of Dry Material Line 2 - Line 4	2088.7								
					% Moisture (0.1%) (Line 3 / Line 5) x 100	8.7							
REMARKS:	This procedure will continue until the difference of the average of the 10 LWD test between consecutive roller passes is equal to or less than 0.02 mm.												
V – VIBRATORY S - STATIC													
LWD SD Card#													
Compactor:													

LWD Serial Number _____

RECORDED IN SITE-MANAGER: _____

Qualified Technician: _____

INDOT Repeatability Procedure

Repeatability will comply with ASTM E 2835

Office of Materials Management is in process of developing an Indiana Test Method, ITM

Recommend the repeatability as follows

- Immediately upon receipt of a newly purchased device,
- Immediately after full calibration
- After significant repairs
- Annually
- When Measurements are no longer repeatable or are questionable

LWD Care, Storage & Maintenance Procedure

Office of Geotechnical and Materials Management is in the process of developing “INDOT LWD Care, Storage, and Maintenance procedure”

The documents will include the following

- Care and storage guidelines
- Maintenance and Repair guides
- LWD testing on Chemically Modified soils or in pH environment
- Troubleshooting Notes

Limitations:

- The aggregates larger than 1.5 in. shall not be over 15% in testing location.
- The testing location shall not exceed 5% inclination.
- The testing location shall not be frozen.
- Measurement shall not be executed when deflection measurements are less than 0.2 mm.
- LWD test is questionable in case of shallow ground water (2 feet) or soil with high moisture content.

Any Questions?

