

# Construction Testing Issues and Reports

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Office of Geotechnical Division, INDOT

January 28, 2020

# Outlines

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- 203.24 , light Weight Deflectometer
- 203.23, Dynamic Cone Penetrometer
- Subgrade Treatments (207 and 215)
- Mixed Design guidelines
- Proofrolling, 203.26
- Resilient Modulus



# Compaction Requirements for Soil and Aggregate

## ATTACHMENT I

Material Types	Lab Testing	Field Testing					
		Maximum Density (ITM 512)	DCP (ITM 509)	Sand Cone (AASHTO T 191)	Moisture Test		LWD (ITM 508)
					ITM 506	AASHTO T 255	
Soil	AASHTO T 99 (Method A)	X	X	X	X	N/A	N/A
<b>Granular Soils</b> (Soils with aggregate retained on the 3/4 in., structural backfill sizes 2 in. and 1 1/2 in., and b borrow with a similar gradation)	AASHTO T 99 (Method A or C)	N/A	NA	X	X	N/A	X
<b>Granular Soils</b> (Soils with 100% passing 3/4 in., structural backfill Sizes 1 in., 1/2 in. No. 4, and No.30, and b borrow with a similar gradation)	AASHTO T 99 (Method A or C)	N/A	X	X	X	N/A	N/A
<b>Coarse Aggregates</b> (No. 43, 53, and 73)	AASHTO T 99 (Method A or C)	N/A	N/A	X	N/A	X	X
<b>Coarse Aggregates</b> (No. 5, 8, 9, 11, or 12)	Field testing is not required. Compaction shall be in accordance with the applicable specification.						
<b>Chemical Modified Soils</b>	AASHTO T 99 Performed by Contractor	N/A	X	N/A	X	N/A	X

N/A – Not Applicable

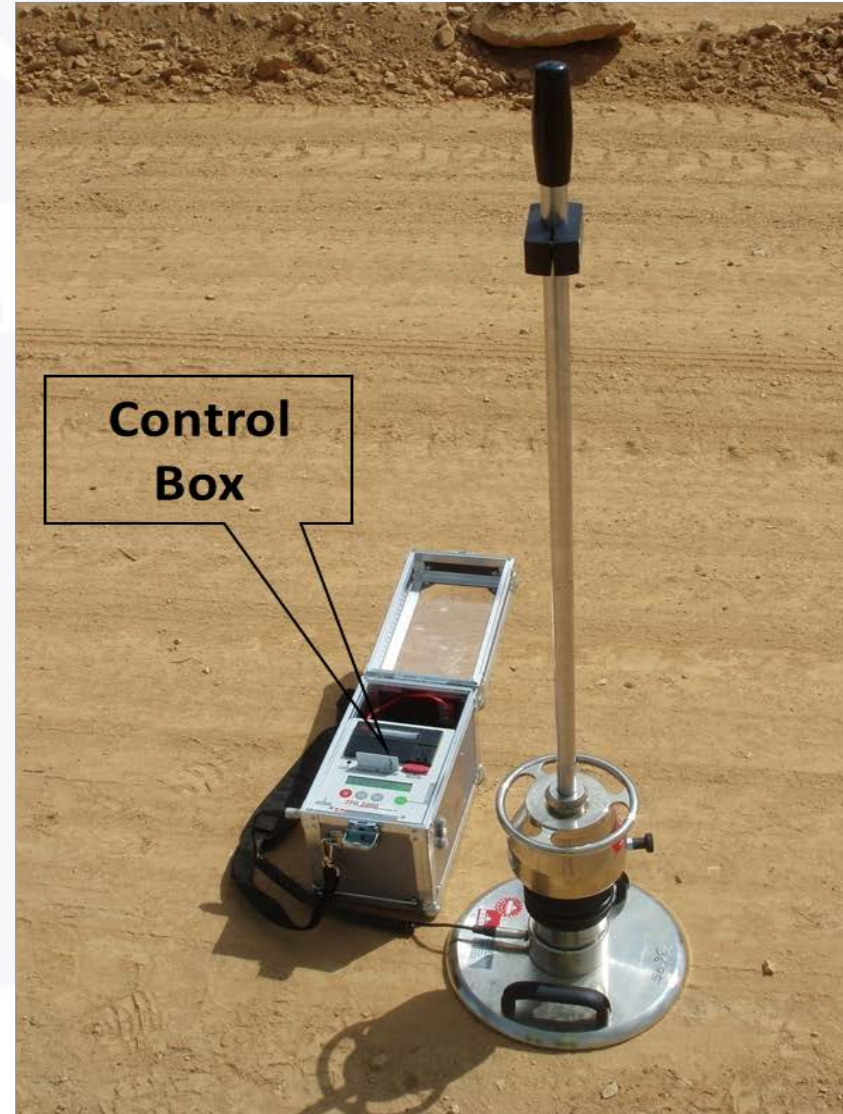
# LWD LIGHT WEIGHT DEFLECTOMETER

## LWD – Light Weight Deflectometer

**ITM 508**

**ASTM E 2835**

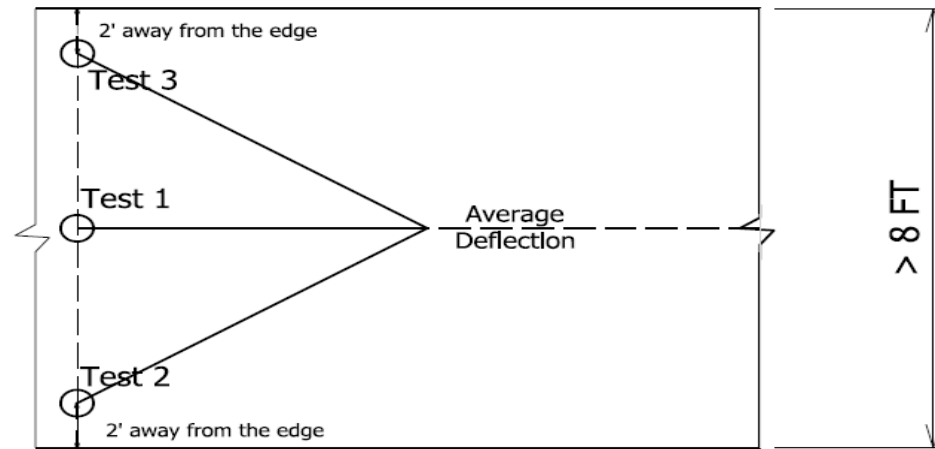
**ZORN model ONLY**



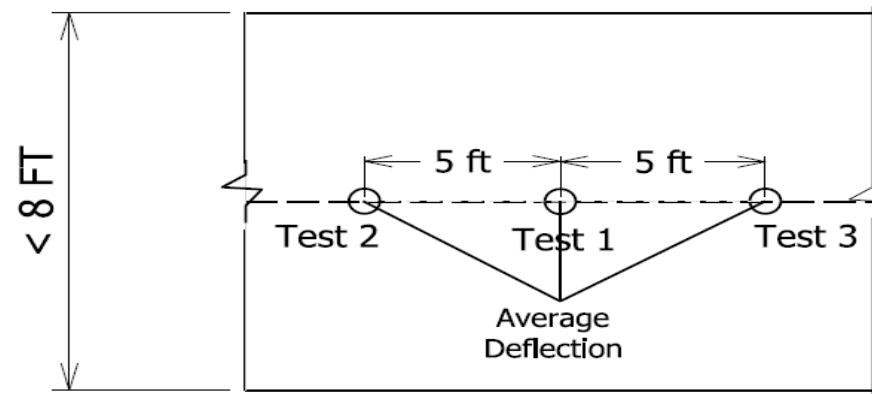
# SECTION 203.24, LWD TEST SETUP

## LWD Test Setup

For >8 ft Constructions



For <8 ft Constructions





# ALLOWABLE DEFLECTION

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Allowable Average Deflection and Maximum Deflection for Chemically Modified Soils and Aggregate over Chemically Modified Soils

Material Type	Allowable Average Deflection (mm)	Maximum Deflection at a Single Test Location (mm)
Lime Modified Soil	$\leq 0.30$	0.35
Cement Modified	$\leq 0.27$	0.31
Aggregate over Lime Modified Soil	$\leq 0.30$	0.35
Aggregate over Cement Modified Soil	$\leq 0.27$	0.31

# ALLOWABLE DEFLECTION

## Aggregate over Untreated Soils Where Proofrolling Can Be Performed

Material Thickness	Allowable Average Deflection (mm)	Maximum Deflection at a Single Test Location (mm)
6 in. Thick Coarse Aggregate No.53	≤ 0.51	0.57*
12 in. Thick Coarse Aggregate No.53	≤ 0.34	0.40**
18 in. Thick Coarse Aggregate No.53	≤ 0.31	0.35**

\* When deflection exceed this value, the area shall be recompacted or undercut as directed. The failed area shall be delineated prior to excavation. Deflection will be measured based on the top 6 in. thick coarse aggregate No. 53 layer material placed for undercut.

\*\* The Contractor shall recompact the coarse aggregate No.53 in accordance with 301.06 .

# ALLOWABLE DEFLECTION

## Aggregate over Untreated Soils: Where Proofrolling Cannot Be Performed

Material Thickness	Allowable Average Deflection (mm)	Maximum Deflection at a Single Test Location (mm)
6 in. Thick Coarse Aggregate No.53	$\leq 0.60$	0.65*
12 in. Thick Coarse Aggregate No.53	$\leq 0.47$	0.52**
18 in. Thick Coarse Aggregate No.53	$\leq 0.44$	0.49**

\* When deflection exceed this value, the area shall be recompacted or undercut as directed. The failed area shall be delineated prior to excavation. Deflection will be measured based on the top 6 in. thick coarse aggregate No. 53 layer material placed for undercut.

\*\* The Contractor shall recompact the coarse aggregate No.53 in accordance with 301.06 .

### Notes:

1. The Engineer will perform the moisture test on in-situ soils prior to placement of coarse aggregate . If the result of the moisture test is  $> 13\%$  the Engineer will contact the Geotechnical Section.

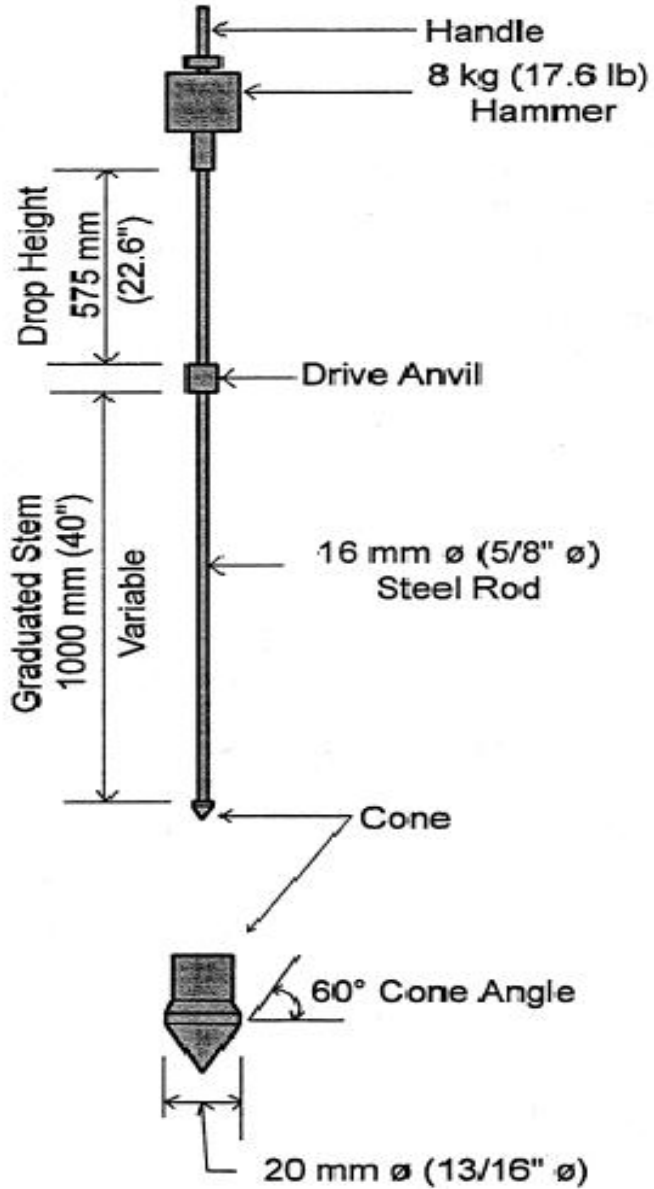


# Dynamic Cone Penetrometer

Nayyar Siddiki, M.S., P.E.

January 28, 2020

# DCP – DYNAMIC CONE PENETROMETER



# DYNAMIC CONE PENETROMETER (DCP)

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Disposable DCP Cone slides on end of attachment



# DYNAMIC CONE PENETROMETER (DCP)

The following laboratory tests are required:

<b>Laboratory Test</b>	<b>AASHTO Requirement</b>
Sieve Analysis	AASHTO T-88/or ASTM D-1140
Atterberg Limits	AASHTO T-90/or T-89
Moisture-Density	AASHTO T-99
Loss on Ignition	AASHTO T-267
Ca/Mg Carbonate	ITM 507*
*Not required unless shells or density <105 lbs. A representative soils sample (25 lbs) from project limits or borrow pit.	

CONT'D.

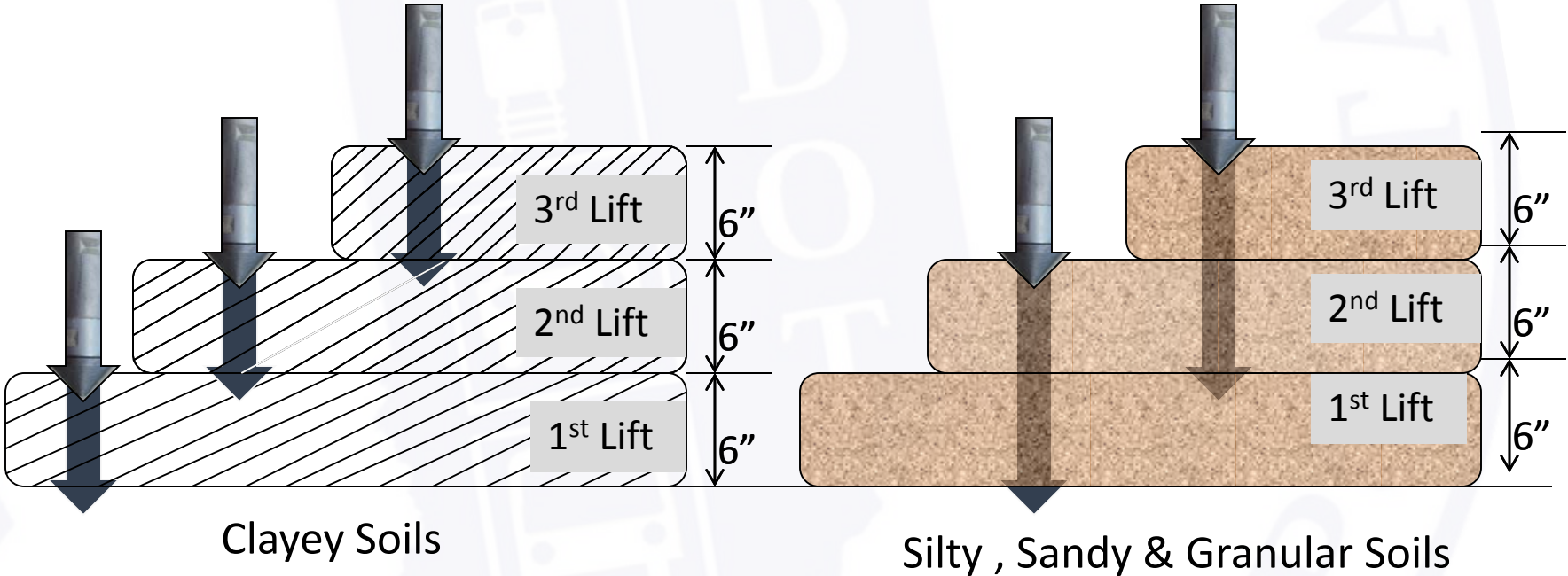
## 203.23, DCP Blow Counts Chart

Textural Classification	Maximum Dry Density (pcf)	Optimum Moisture Content Range (%)	Acceptable Minimum DCP value for 6 in. for 95% compaction	Acceptable Minimum DCP value for 12 in. for 95% compaction	Acceptable Minimum DCP value for 6 in or 12 in. for 100% compaction
<b>CLAY SOILS</b>					
Clay	< 105	19 - 24	6		*
Clay	105 - 110	16 - 18	7		*
Clay	111- 114	14 - 15	8		*
<b>SILTY SOILS</b>					
Silty	115 - 116	13 - 14		9	*
Silty	117 - 120			11	*
<b>SANDY SOILS</b>					
Sandy	121- 125	8 - 12		12	*
Sandy	> 125			15	*
<b>GRANULAR SOILS -STRUCTURE BACKFILL AND A-1, A-2, A-3 SOILS</b>					
No. 30				6	9
No. 4				7	10
1/2 in.				11	14
1 in.				16	19
<i>Note : * Test section required in accordance with ITM 514</i>					



# DYNAMIC CONE PENETROMETER (DCP)

## Dynamic Cone Penetrometer Testing



# DYNAMIC CONE PENETROMETER (DCP)

<b>Field Test</b>	<b>Test Method</b>
One Point Proctor for Cohesive Soils	ITM 512
Dynamic Cone Penetrometer	ITM 509
Field Determination of Moisture Content of Soils	ITM 506

# CONT'D.

## 203.23, Moisture Compaction ranges are as follows:

Soil Type	Moisture Compaction Range
Clay (<105 lb/cu ft)	-2 to + 2% of optimum moisture content
Clay (105-114 lb/cu ft)	-2 to + 1% of optimum moisture content
Silty and Sandy (>114 lb/cuft)	-3% of optimum moisture content and optimum
Granular	5 to 8%

Moisture tests will be performed every four hours for clayey soils once a day for Silty, sandy and granular soil types.



# SECTION 207 (REVISED)

Type	Subgrade Description
I	24 in. of soil compacted in accordance with 203.23
IA	[blank]
IB	
	* 14 in chemical modification using lime
	**14 in chemical soil modification using cement
IC	12 in. coarse aggregate No. 53 in accordance with 301
ID	12 in. coarse aggregate with Type 2B geotextile in accordance with 918.02(c)
II	6 in. coarse aggregate No. 53 in accordance with 301
HA	<del>8 in. chemical soil modification</del>
III	In-place compaction in accordance with 203.23
IV	12 in. coarse aggregate No. 53 with Type IB geogrid in accordance with 214
IVA	12 in. coarse aggregate with Geocell confining system in accordance with 214
V	3 in. of subgrade excavated and replaced with 3 in. coarse aggregate No. 53



# SECTION 215

## Revised Maximum Soil Properties for Chemical Modification

Soil Property	Test Method	Requirement
Maximum Dry Density	AASHTO T 99	$\geq 90$ pcf
Organic Material	AASHTO T 267	$\leq 6\%$
Sulfate Content	ITM 510	$\leq 1,000$ ppm

Table 1: Minimum Soil Properties for Chemical Modification

# SECTION 215

## Chemical Modification Allowable Average Deflection (*revised*)

### *Allowable Average Deflection for Chemically Modified Soil*

Material Type	Allowable Average Deflection (mm)	Maximum Deflection at a Single Test Location (mm)
Cement Modified Subgrade	0.27	0.31
Lime Modified Subgrade	0.30	0.35

# LWD AND DCP TESTING FREQUENCY

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The frequency of LWD and DCP testing will be three (3) tests for each 1,400 cyd of chemically modified soils.

The chemically modified soil lift shall meet the following requirements for compaction:

The average DCP blow count will not be less than 17 for the top 6 in. of a 14 in. lift.

The average DCP blow count will not be less than 16 for the bottom 8 in of a 14 in. lift.

Moisture tests for chemically modified soils mixture shall be performed in accordance with ITM 506 at every 4 h during chemical and soils mixing.

One gradation test shall be performed for each 2,500 ft cyd of chemically modified soil in accordance with 215.08 and ITM 516.

# Sec 203.26, PROOFROLLING

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- When specified, the work shall be performed with dump truck with a minimum tire pressure of 90 psi.
- Proofrolling for embankment construction shall be performed using a 15t dump truck . Proofrolling for subgrade shall be performed using 33 t.
- Proofrolled surfaces shall be covered completely with a single pass.
- Operating speed of the truck shall not exceed 2 mph.
- Deflection or rutting in excess of 1/2 in. shall require remediation of the subgrade surface as directed.
- Deflection or rutting in excess of 3 in. shall require corrective remediation measures and the Office of Geotechnical Services will be contacted.
- Proofrolling shall be performed after remediation measures on embankment or subgrade prior to the placement of additional material.
- Failures shall be corrected.

# DESIGN PROCEDURES FOR SOIL MODIFICATION OR STABILIZATION



## **Design Procedures for Soil Modification or Stabilization**

**Division of Engineering and Asset Management  
Office of Geotechnical Services  
120 South Shortridge Road  
Indianapolis, Indiana 46219  
January 5, 2020**



# CHEMICAL SOIL MODIFICATION

## 3.0 Design Procedures

### 3.1 Suggested Criteria for Chemical Selection

When the chemical stabilization or modification of subgrade soil is considered the most feasible alternative, the following criteria shall be considered for chemical selection based on the index properties of the soils.

#### 1. Chemical Selection for Stabilization.

- a. Lime<sup>1</sup>: Clay content >30 % and PI > 20.
- b. Cement: Clay content  $\leq$ 30% and PI  $\leq$  20.

#### 2. Chemical Selection for Modification

- a. Lime: Clay content > 30% and PI >20.
- b. Cement: Clay content  $\leq$  30% and PI  $\leq$  20.

Note 1. Lime shall be quick or hydrated lime only and lime shall have a soluble sulfate content < 5%.

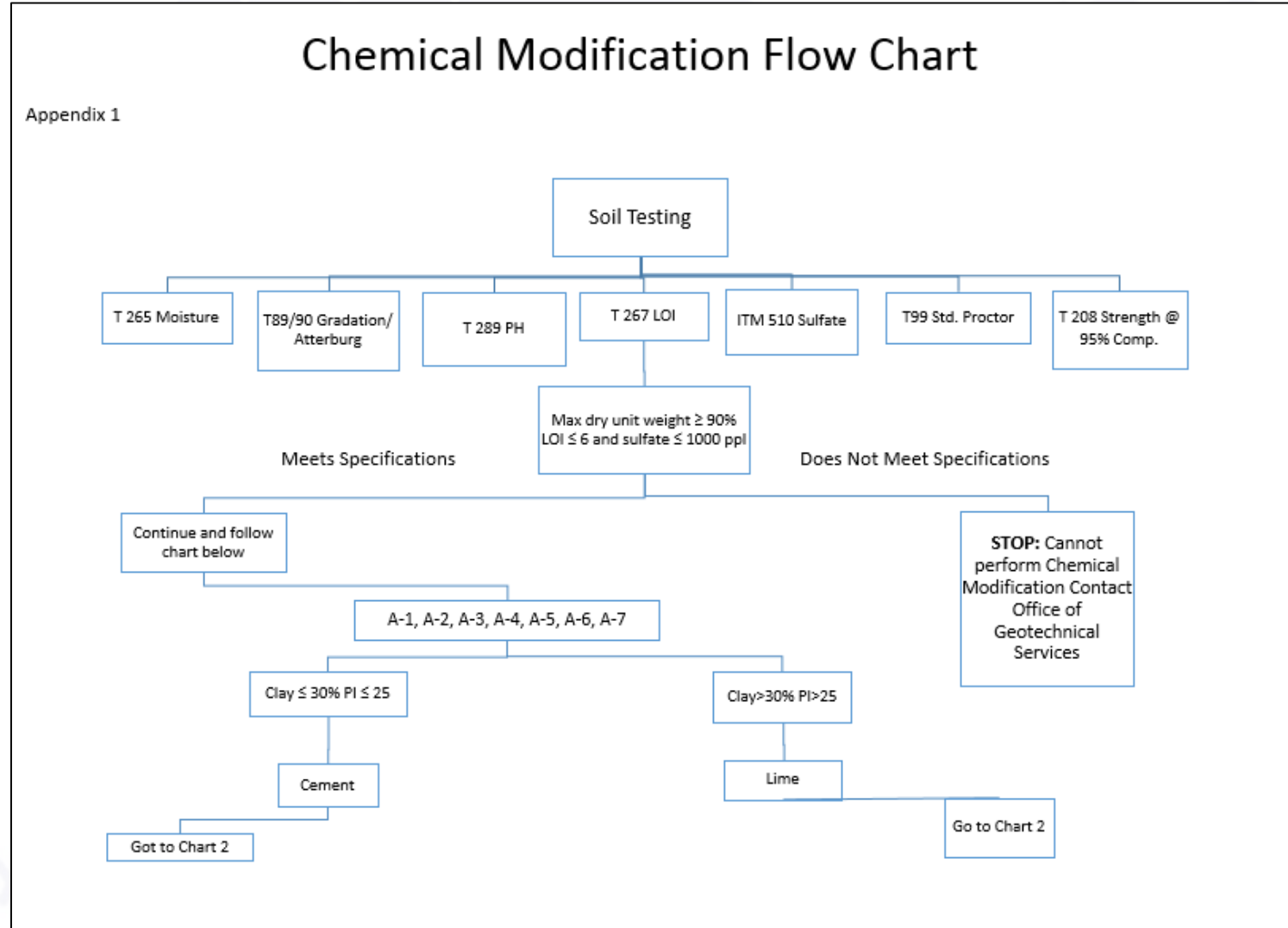
Note 2. In lieu of lime class C fly ash with a soluble sulfate content < 5% may be used.

Note 3. When fly ash class C is substituted in lieu of lime, a minimum corresponding strength of 50 psi gain should be obtained.

Note 4. Use of fly ash is not permitted between October 15 and April 15. Appropriate tests showing the improvements in the strength gain and the swell reduction are essential for the exceptions listed above.

Note 5. Lime treated soils may not provide immediate stability due to presence of high-moisture. Geotechnical consultants may recommend cement as modifier for faster strength gain in these conditions.

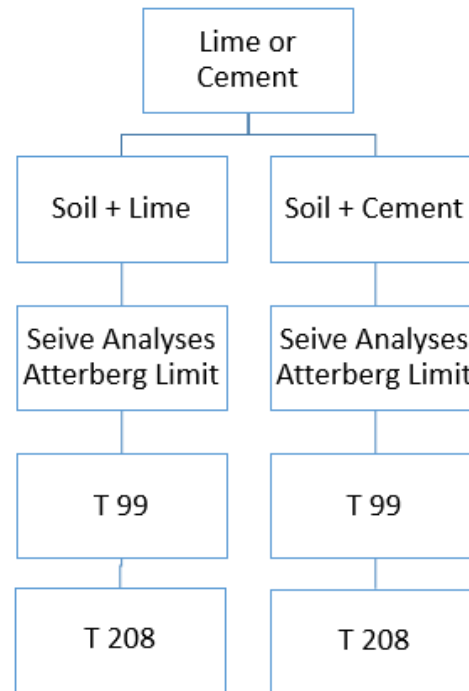
# CHEMICAL SOIL MODIFICATION GUIDELINES



# CHEMICAL SOIL MODIFICATION GUIDELINES

## Chemical Modification Flow Chart

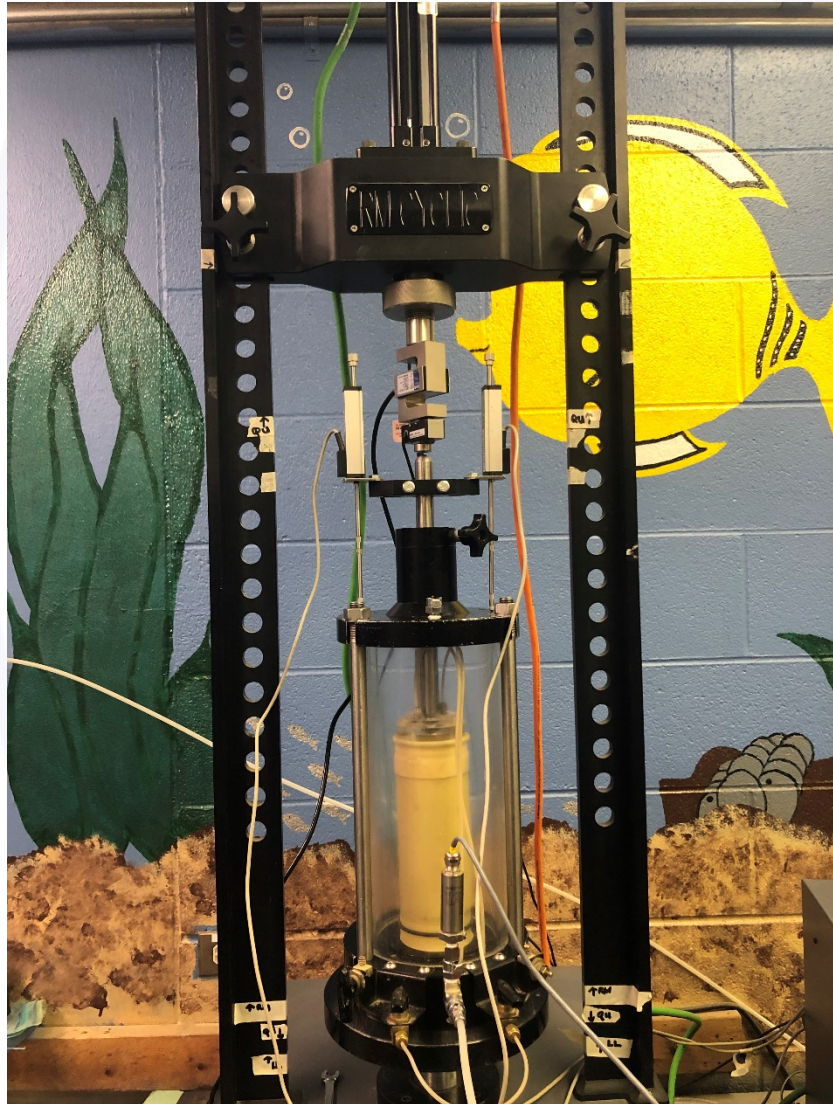
Appendix 2





# RESILIENT MODULUS MACHINE

Testing on Soil and Aggregate



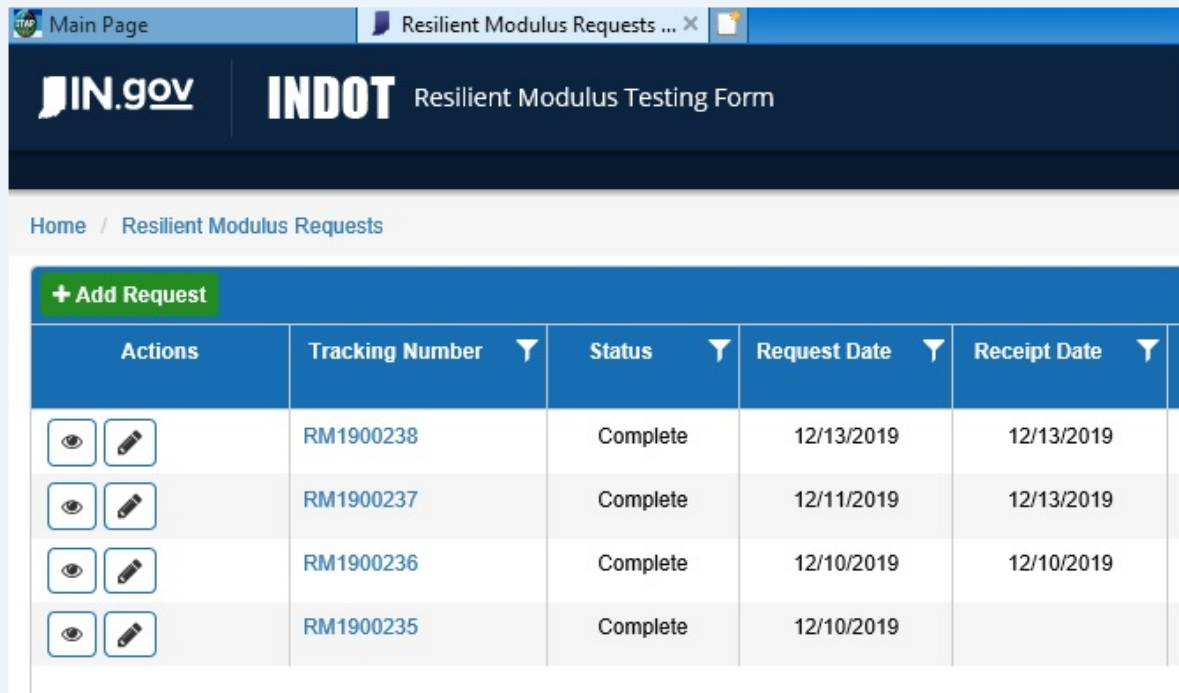
3 in  
sample  
Cell



6 in  
sample  
Cell

# RESILIENT MODULUS REQUEST INFORMATION

## M<sub>R</sub> Test Request by Consultant



Main Page Resilient Modulus Requests ...

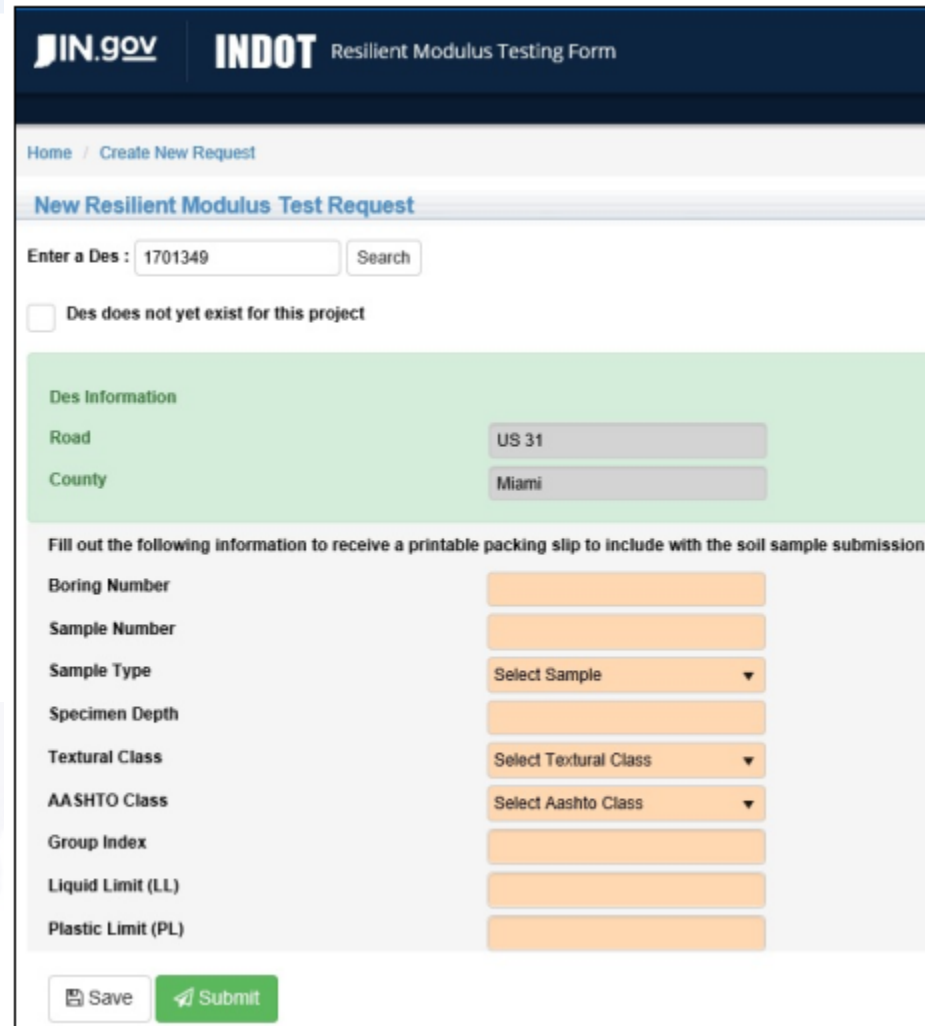
**IN.gov** **INDOT** Resilient Modulus Testing Form

Home / Resilient Modulus Requests

[+ Add Request](#)

Actions	Tracking Number	Status	Request Date	Receipt Date
	RM1900238	Complete	12/13/2019	12/13/2019
	RM1900237	Complete	12/11/2019	12/13/2019
	RM1900236	Complete	12/10/2019	12/10/2019
	RM1900235	Complete	12/10/2019	

## M<sub>R</sub> Test Request by Consultant Submittal



**IN.gov** **INDOT** Resilient Modulus Testing Form

Home / Create New Request

### New Resilient Modulus Test Request

Enter a Des :

Des does not yet exist for this project

**Des Information**

Road

County

Fill out the following information to receive a printable packing slip to include with the soil sample submission.

Boring Number

Sample Number

Sample Type

Specimen Depth

Textural Class

AAASHTO Class

Group Index

Liquid Limit (LL)

Plastic Limit (PL)



# RESILIENT MODULUS ONLINE SUBMITTAL

## M<sub>R</sub> Test Request Submittal

**Successfully Requested**

You have successfully submitted the resilient modulus test request. Print the page and submit it with the soil sample.

[Print](#)

**Tracking Number:** RM2000246

**Des:**  
**Road:**  
**County:**  
**Boring:** RB-1  
**Sample Number:** ST-1  
**Sample Type:** Shelby Tube  
**Specimen Depth:** 2-4  
**Textural Class:** Clay Loam  
**AASHTO Class:** A-6  
**Liquid Limit (LL):** 38  
**Plastic Limit (PL):** 18  
**Request Date:** 1/21/2020 8:21:39 AM  
**Requested By:** Kamran Ghani  
**Company:** IN Dept of Transportation

## Soils Laboratory Print Output

Successfully Requested - Resilient Modulus Test Request Form Page 1 of 1

**Successfully Requested**

You have successfully submitted the resilient modulus test request. Print the page and submit it with the soil sample.

**Tracking Number:** RM2000246

**Des:**  
**Road:**  
**County:**  
**Boring:** RB-1  
**Sample Number:** ST-1  
**Sample Type:** Shelby Tube  
**Specimen Depth:** 2-4  
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# Questions

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