Sampling & Testing Tips
Stark County, ND

Pre-Conference Graveling Workshop

Dickinson, ND

January 26, 2022

NORTH DAKOTA LOCAL TECHNICAL ASSISTANCE PROGRAM

INTRODUCTION

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HIGHLANDS ENGINEERING & SURVEYING, PLLC

CIVIL ENGINEERING & LAND SURVEYING

SOILS & CONCRETE LAB

STARK COUNTY GRAVEL TESTING

HIGHLANDS ENGINEERING

STARK COUNTY GRAVEL

SAMPLING PROCEDURES

- OBTAIN SAMPLE
- FISHER SAMPLING
- NDDOT SAMPLING
- NEXT DAY RESULTS

STARK COUNTY GRAVEL

Specifications		SIEVE SIZES AND PERCENTS PASSING										
		1"	3/4"	#4	#8	#30	#200		P.I.			
	Spec. Limit	100	70-100	38-75	22-62	12-45	7.0-18.0		3.0-6.0			
	Target Range											

STARK COUNTY GRAVEL

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			Spec. Limit	100	70-100	38-75	22-62	12-45	7.0-18.0		3.0-6.0							
			*Target Range															
TEST DATA	DATE/TIME SAMPLED	LOCATION SAMPLED	TEST NO.	PERCENTS PASSING														REMARKS
	10/14/20	Belt	20-SCG01	100	95	63	55	42	18.6		4.3							F #200
	10/15/20	Belt	20-SCG02	100	95	63	53	39	15.7		3.0							P
	10/19/20	Belt	20-SCG03	100	96	63	53	39	14.0		4.9							P
	10/20/20	Belt	20-SCG04	100	96	64	56	41	15.6		2.9							F - P.I.
	10/21/20	Belt	20-SCG05	100	95	57	50	38	16.6		3.4							P
	10/22/20	Belt	20-SCG06	100	95	53	43	30	11.0		4.1							P
	10/27/20	Belt	20-SCG07	100	96	58	48	35	14.7		3.0							P
	10/28/20	Belt	20-SCG08	100	96	58	49	35	14.8		2.6							F - P.I.
	10/29/20	Belt	20-SCG09	100	98	62	52	36	13.5		3.6							P
	10/30/20	Belt	20-SCG10	100	97	53	43	30	12.4		3.4							P
	11/02/20	Belt	20-SCG11	100	97	68	57	41	16.5		3.6							P
	11/03/20	Belt	20-SCG12	100	97	65	53	36	14.8		3.7							P
	11/04/20	Belt	20-SCG13	100	95	53	45	32	12.9		3.7							P
	11/05/20	Belt	20-SCG14	100	98	61	52	37	15.2		3.2							P
	11/06/20	Belt	20-SCG15	100	96	60	49	35	14.4		4.2							P
	11/09/20	Belt	20-SCG16	100	98	56	45	31	12.2		2.4							F - P.I.
	11/10/20	Belt	20-SCG17	100	96	54	46	33	14.0		4.0							P
	11/11/20	Belt	20-SCG18	100	96	60	51	39	16.9		3.8							P

STARK COUNTY GRAVEL

Project No.	Crushing and Stockpiling Gravel		PCN	Aggregate Class	13M
Specification Section Number	302	Title	Stark County Gravel	LA Abrasion	
Location	Miller-Bob Pit			Lab. Number	
Source of Aggregates	SW1/4 SEC 11, T139N, R93W Stark County, ND				

Specifications		SIEVE SIZES AND PERCENTS PASSING												
		1"	3/4"	#4	#8	#30	#200		P.I.					
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	*Target Range													

	DATE/TIME SAMPLED	LOCATION SAMPLED	TEST NO.	PERCENTS PASSING												REMARKS
TEST DATA	10/27/21	Belt	21-SCG07	100	98	67	58	49	15.1		3.4					F - #30
	10/28/21	Belt	21-SCG08	100	98	66	57	48	14.4		3.3					F - #30
	10/29/21	Belt	21-SCG09	100	97	70	62	53	15.0		1.8					F - #30 & PI
	11/01/21	Belt	21-SCG10	100	97	68	60	49	13.7		NP					F - #30 & PI
	11/02/21	Belt	21-SCG11	100	99	69	61	53	15.7		2.7					F - #30 & PI
	11/03/21	Belt	21-SCG12	100	96	64	56	49	13.7		4.1					F - #30
	11/04/21	Belt	21-SCG13	100	97	69	63	54	14.5		4.1					F - #30 & #8
	11/05/21	Belt	21-SCG14	100	98	67	58	49	14.5		1.8					F - #30 & PI
	11/08/21	Belt	21-SCG15	100	97	68	61	52	12.8		2.7					F - #30 & PI
	11/09/21	Belt	21-SCG16	100	97	72	65	56	14.9		3.3					F - #30 & #8
	11/10/21	Belt	21-SCG17	100	99	71	61	52	14.9		3.0					F - #30
	11/11/21	Belt	21-SCG18	100	97	69	61	53	14.8		2.3					F - #30 & PI
	11/12/21	Belt	21-SCG19	100	95	68	61	53	15.3		3.7					F - #30
	11/15/21	Belt	21-SCG20	100	98	74	65	55	15.5		3.2					F - #30 & #8
	11/16/21	Belt	21-SCG21	100	97	64	56	48	13.5		3.9					F - #30
	11/17/21	Belt	21-SCG22	100	97	66	58	49	13.4		3.7					F - #30
	11/18/21	Belt	21-SCG23	100	96	69	61	52	15.0		3.7					F - #30
	11/22/21	Belt	21-SCG24	100	98	70	61	52	14.5		5.2					F - #30

If the PI and LL are required, these should also be shown. Sieve size percentages and physical property results shall be reported to the required specification. Include all tests conducted, both passing and failing and circle all failing percentages. Indicate under "Remarks" the action taken to correct the situation causing failing tests. As each item of the project is completed, submit the original copies of these reports to the district materials coordinator for correction and review. When the district materials coordinator

Submitted by Project Engineer Name

Mike Njos, Highlands Engineering

Reviewed by District Materials Coordinator Name

Date

Legend - Test Type

V - Verification

P - Progress Record

I - Independent Assurance

STARK COUNTY GRAVEL

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TEST DATA	DATE/TIME SAMPLED	LOCATION SAMPLED	TEST NO.	PERCENTS PASSING												REMARKS
	11/23/21	Belt	21-SCG25	100	95	67	59	50	14.7		3.1					F - #30
	11/29/21	Belt	21-SCG26	100	97	71	63	53	15.7		3.3					F - #30 & #8
	11/30/21	Belt	21-SCG27	100	99	70	60	51	13.9		2.2					F - #30 & PI
	12/1/21	Belt	21-SCG28	100	99	69	60	52	14.8		3.4					F - #30
	12/2/21	Belt	21-SCG29	100	100	72	64	54	13.9		2.4					F - #30, #8 & PI
	12/3/21	Belt	21-SCG30	100	97	74	66	57	15.2		3.3					F - #30 & #8
	12/7/21	Belt	21-SCG31	100	97	74	67	59	14.8		3.3					F - #30 & #8
	12/8/21	Belt	21-SCG32	100	99	74	65	56	15.6		3.1					F - #30 & #8

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STARK COUNTY GRAVEL

PREPARING SAMPLES & GRADATION PROCESS

- **SPLIT SAMPLES**
- **OVEN DRY OVERNIGHT**
- **GRADATIONS**
  - ***COARSE AGGREGATE***
  - ***MINUS NO. 200 BY WASHING***
  - ***FINE AGGREGATE***

ATTERBERG LIMITS PROCEDURES

PLASTICITY INDEX, PI: The numerical difference between the liquid limit and the plastic limit. It is the moisture content at which the soil is in a plastic state.

PI = LIQUID LIMIT – PLASTIC LIMIT, OR

PI = LL - PL

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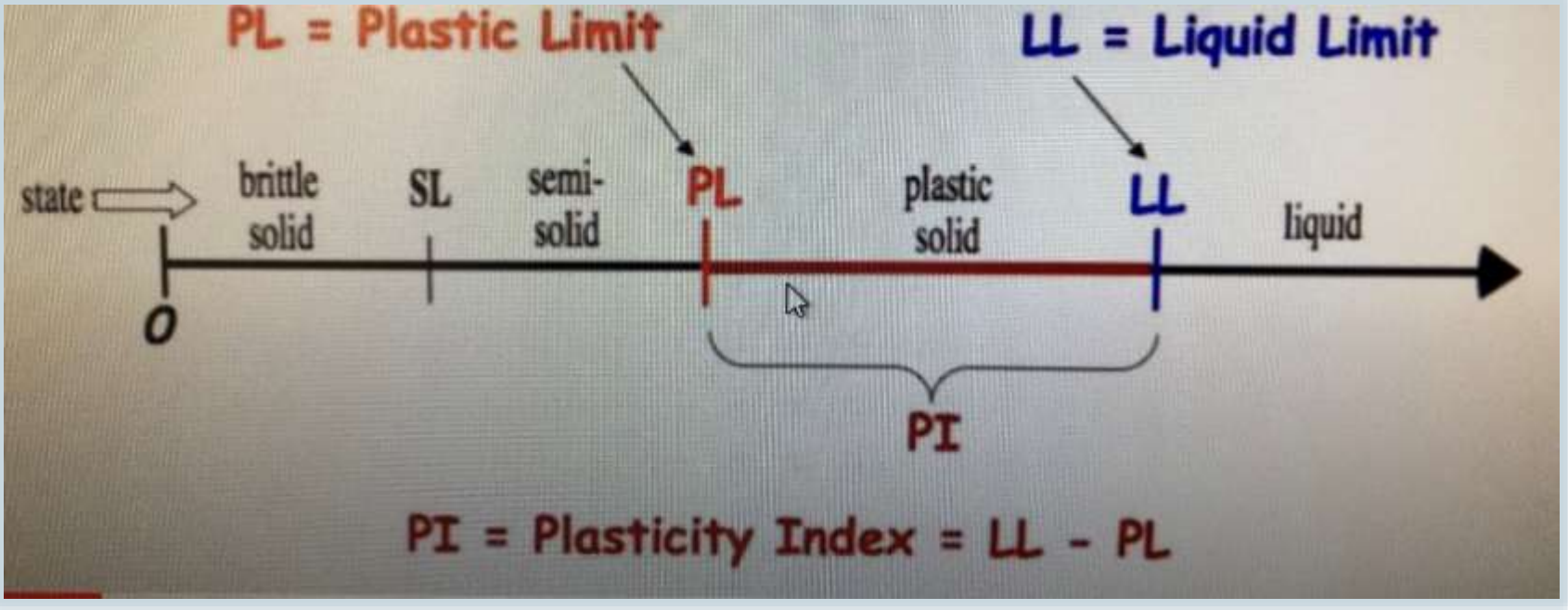
ATTERBERG LIMITS PROCEDURES



ATTERBERG LIMITS PROCEDURES

LIQUID LIMIT, LL: The liquid limit of a soil is the moisture content at which the soil passes from a plastic to a liquid state.

- LIQUID LIMIT APPARATUS

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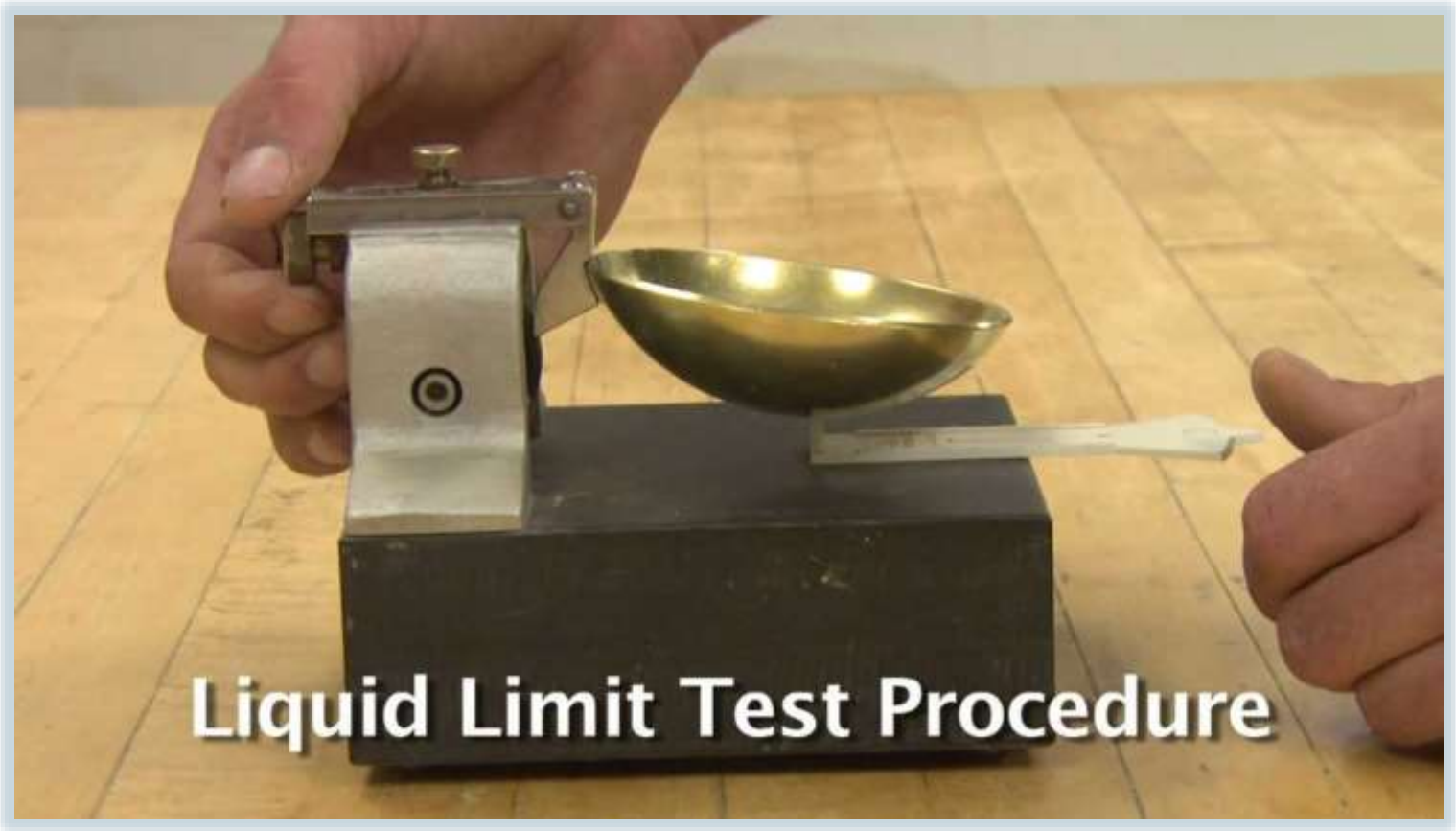
ATTERBERG LIMITS PROCEDURES



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ATTERBERG LIMITS PROCEDURES

LIQUID LIMIT

- **GROOVE SAMPLE**
- **22-28 BLOWS TO ½" CLOSURE**
- ***DRY SAMPLE & CALC MOISTURE CONTENT***

STARK COUNTY GRAVEL

ATTERBERG LIMITS PROCEDURES

LIQUID LIMIT		PLASTIC LIMIT
Tin #	1	2
M_T = Mass of tin, (g)	12.1	12.1
M_{MST} = Mass of tin and moist soil (g)	27.2	20.6
M_{DST} = Mass of tin and dry soil (g)	24.7	19.4
M_s = Mass of soil solids (g)	12.6	7.3
M_w = Mass of water (g)	2.5	1.2
w = Water content, (%)	19.8	16.4
No. of Drops (N)	22	

# of Blows, N	*k*
22	0.985
23	0.990
24	0.995
25	1.000
26	1.005
27	1.009
28	1.014

One Point Liquid Limit Calculation:

$LL = k * w_N$

$k =$ 0.985

Liquid Limit	**19.5**
Plastic Limit	**16.4**
Plastic Index	**3.1**

STARK COUNTY GRAVEL

ATTERBERG LIMITS PROCEDURES

PLASTIC LIMIT, PL:

- **The plastic limit of a soil is the lowest water content at which the soil remains plastic.**
- **The minimum water content that allows a soil sample, after which further removal of moisture, causes the sample to crumble.**
- **It is the transition between moisture contents in the plastic and the semi-solid state of the soil.**

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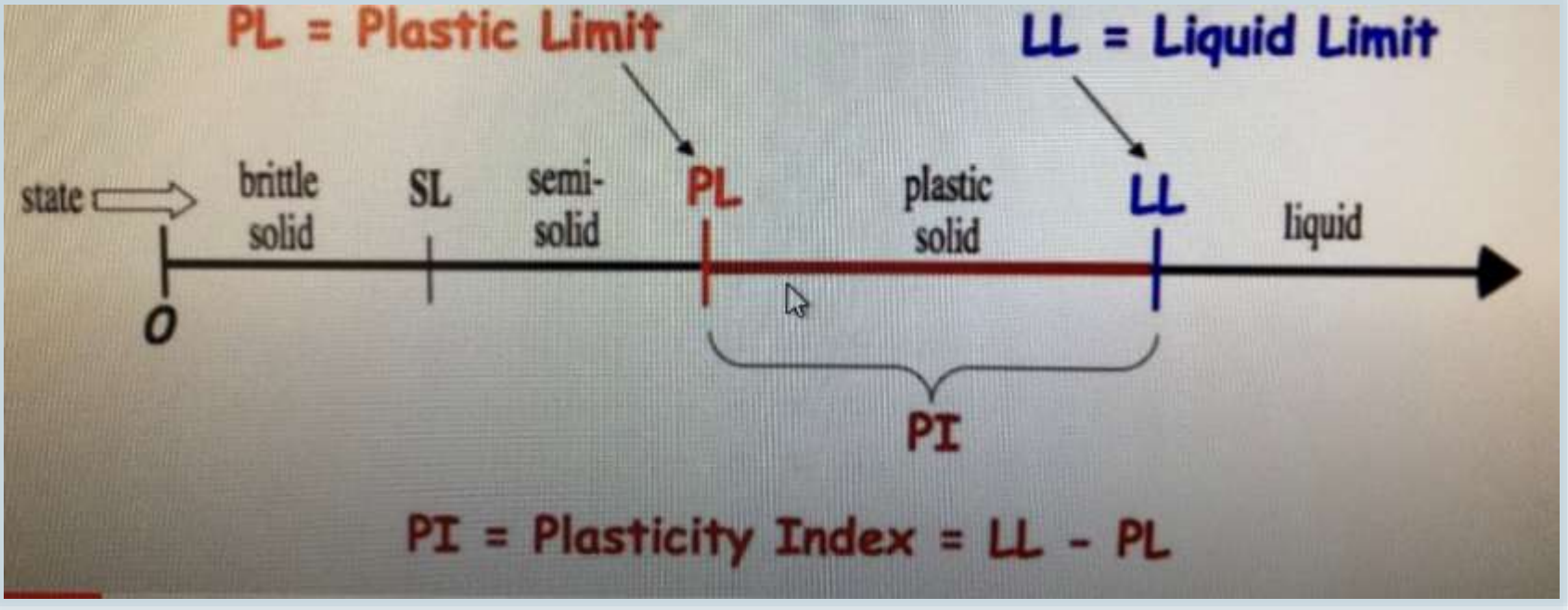
ATTERBERG LIMITS PROCEDURES



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ATTERBERG LIMITS PROCEDURES

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Liquid Limit	**19.5**
Plastic Limit	**16.4**
Plastic Index	**3.1**

CONCLUSION

Recommendations:

Establish an efficient sampling & testing procedure.

Spec a PI that works best for their situation.

A higher PI indicates more binder and will hold together well but may become soft and rut with a lot of moisture.

A low PI indicates less binder, will not hold together well in dry conditions, will have loose gravel, but will not rut and become soft.

HIGHLANDS ENGINEERING

QUESTIONS?

NORTH DAKOTA LOCAL TECHNICAL ASSISTANCE PROGRAM

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