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FROM: Ron Horner
Materials and Research Engineer
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PROJECT: SNH-3-005(009)278
Major Rehabilitation

PCN: 18871

LOCATION: Langdon City – 4th Street to ND Highway 1

LENGTH: 0.2219 Miles

DATE: May 16, 2012

SUBJECT: Linear Soils Report and Recommendations

Attached is the Linear Soils Report and Recommendation for the above referenced project. If there are any changes made to the project after the report is issued that may require alteration to this recommendation or if you have any questions please contact Jeff Jirava at 328-6908 or jjirava@nd.gov.

SNH-3-005(009)278

Langdon City – 4th Street to ND Highway 1

CERTIFICATION

I hereby certify that this report was prepared by me or under my direct supervision and that I am a duly registered professional engineer under the laws of the State of North Dakota. This document was originally issued and sealed by Jeff Jirava, Registration number PE-5950 on 5/16/12 and the original document is stored at the North Dakota Department of Transportation.

REGISTERED PROFESSIONAL ENGINEER
JEFF JIRAVA
PE - 5950
DATE 5/16/12
NORTH DAKOTA

Jeff Jirava, P.E.

16 MAY 2012
Date

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Linear Soils Report and Recommendations

Project: SNH-3-005(009)278

PCN: 18871

Scope: Major Rehabilitation

Location: Langdon City – 4th Street to ND Highway 1

Length: 0.2219 Miles

Project Limits: Intersection of ND Highway 5 (RP 278.967) and ND Highway 1 (RP 213.926)

Date: May 16, 2012

Introduction

This report will provide recommendations for the major rehabilitation of the roadway. The major rehabilitation project will consist of a concrete pavement repair (CPR) on the roadway from 4th Street to the intersection of ND Highway 1 and reconstruction of the intersection of ND Highway 1 and ND Highway 5. Five borings were conducted to develop this recommendation. The borings extended to depths of up to 5.0 feet below the existing pavement surface. A total of 9 samples were taken from 5 borings from within the project limits. The project location is shown on Figure 1.

Figure 1 – Project Location Map

Existing Pavement Section

The existing driving lanes of the intersection are 8” Non Reinforced Portland Cement Concrete (PCC) Pavement on 8” of base. The boring locations were chosen in areas that would cause minimal traffic interference. These areas were not PCC pavement, rather they were asphalt adjacent to the PCC pavement. The boring locations are shown on Figure 2.

Maintenance Review

On 9/30/10, Jamie Naumann, Drill Crew Chief, spoke and met with Colin Fetcsch, Langdon Maintenance Section, to discuss any maintenance areas within the project limits. Colin indicated that the existing roadway was paved up to the intersection but not the intersection itself. The transition in all four directions was very rough at that time. However, at that time there were no specific maintenance areas within the project limits.

The soil borings were performed on 9/29/10 and 9/30/10 using a 6 inch solid flight auger. The boring that were conducted were at the intersection of Highway 5 and Highway 1.

Figure 2 - Boring Location Map

Summary of Soil Analysis

Soil Descriptions

All of the samples that were collected were classified as AASHTO A-7-6. The AASHTO A-7-6 soil is a silt-clay material. These soils have high liquid limits and may be elastic as well as subject to extremely high volume changes. The plasticity index in these soils is high in relation to liquid limit.

Moisture

The moisture contents provided in this report and summarized below have been obtained from samples taken on 9/29/10 and 9/30/10.

Table 1 - Summary of In-Place and Optimum Moisture Contents

Quantity	AASHTO Classification	In-Place Moisture Range (%)	In-Place Moisture Average (%)	T-180 Optimum Moisture Average (%)	Difference Between Average In-Place and T-180 Optimum Moistures (%)
9	A-7-6	29.4-43.0	33.1	19.5	13.6

Table 2 - Summary of In-Place versus Optimum Moisture Contents

In-Place Moisture vs. Optimum Moisture						
Quantity	**AASHTO Classification**	**Below Optimum**	**Optimum to Moderate** (0 to 6% over optimum)	**Moderate to High** (6 to 10% over optimum)	**High** (10 to 16% over optimum)	**Very High** (> 16% over optimum)
9	A-7-6	0%	0%	0%	78%	22%

Atterberg Limits

Table 3 - Summary of Atterberg Limits

AASHTO Classification	Liquid Limit Range (%)	Liquid Limit Average (%)	Plastic Limit Range (%)	Plastic Limit Average (%)	Plasticity Index Range (%)	Plasticity Index Average (%)
A-7-6	45-51	48	23-29	26	18-27	22

Swell Potential

The swell potential, which is based on the Plasticity Index (PI), is shown in the following table.

Table 4 - Swell Potential

Low (Plasticity Index < 25)	**Marginal** (25 ≤ Plasticity Index ≤ 35)	**High** (Plasticity Index > 35)
89%	11%	0%

Frost Susceptibility

Lab Number 990 was classified as an F4 soil. The F4 designation indicates that under the right conditions these soils have a higher probability of heaving during freeze/thaw cycles.

Group Index

All of the samples were classified as A-7-6. The Group Indexes from the samples ranged from a low of 9 to a high of 16 with an average of 12. A group index of 20 or greater indicates a “very poor” subgrade material.

Design Recommendations

The analysis of the soils shows that the moisture contents were high and were, on average, 13.6% above the T-180 optimum moisture contents. Two samples had moisture contents 16% above optimum, and one sample was classified as an F4 soil. At the time of the borings there were no specific maintenance areas and the soils as a whole appear to have a low group index and a low swell potential.

The west leg of this intersection was subcut 48 inches when it was reconstructed in 1988. The south leg of this intersection had a 24 inch subcut.

Due to high moisture contents, presence of F4 soils and the adjacent 48 inch subcut on west leg of ND Highway 5 we recommend a 30 inch subcut to ensure that this intersection performs well and ties into the existing roadway sections without creating any significant differential movements.

Design Information

Depth = 30 inches

- The subcut should be cut to a depth of 30 inches below the top of the proposed subgrade elevation. The construction requirements are in 302.02 C.

Area = Entire Intersection

- The subcut should include the entire intersection.

Transitioning = 20:1

- This subcut will require a 20:1 transition until it ties into the subgrade on the adjacent legs of the intersection.

Plan Notes

None

The recommendations in this report are based on the Major Rehabilitation option. If the scope of work, vertical profile or horizontal alignment is changed, in either the conceptual phase or the design phase, Materials and Research must be notified as soon as possible to ensure that there is adequate geotechnical information addressing these areas.

APPENDIX A

SUMMARY OF SOIL ANALYSIS

								Low Swell	Below Opt.	Moisture Cont. Below PL				
	PROJECT NO. SNH-3-005(009)278					GI ≤ 20			0% to 6% Over Opt.					
	PCN 18871							Marginal Swell	6% to 10% Over Opt.	Moisture Cont. 0% to 5% Over PL				
	DESCRIPTION CPR - Intersection Improvements					GI > 20			10% to 16% Over Opt.					
								High Swell	More than 16% Over Opt.	Moisture Cont. More Than 5% Above PL				
Lab No.	STA	Offset	Depth of Sample (ft)	Plastic Limit (PL)	AASHTO	Group Index	Optimum Moisture	Swell Potential (PI)	Average In-Place Moisture Content of Sample Depth	Moisture Content @ Certain Depths				F4 Soil
										2 foot	3 foot	4 foot	5 foot	
990	278+5102	Rt 23 EB	0.5 - 3.5	29.1	A-7-6(13)	13	21.1	21	43.0	45.8	40.2	NA	NA	
991	278+5102	Rt 23 EB	3.5 - 5.0	26.8	A-7-6(11)	11	19.6	19	34.6	NA	NA	34.7	34.4	
992	278+5174	Rt 14 EB	0.7 - 2.8	25.5	A-7-6(15)	15	19.4	24	29.4	29.4	NA	NA	NA	
993	278+5174	Rt 14 EB	2.8 - 5.0	24.7	A-7-6(16)	16	19	27	29.8	NA	28.7	30.5	30.1	
994	278+5174	Lt 26 WB	0.8 - 5.0	25.8	A-7-6(10)	10	19.4	22	29.7	25.4	34.5	30.1	28.8	
995	278+5118	Lt 36 WB	0.5 - 3.8	22.7	A-7-6(14)	14	20.2	23	38.1	40.1	36.2	NA	NA	
996	278+5118	Lt 36 WB	3.8 - 5.0	26.4	A-7-6(9)	9	19.8	18	31.6	NA	NA	33.5	29.7	
997	278+5139	Rt 0 EB	0.8 - 3.8	27.3	A-7-6(10)	10	18.1	20	30.1	28.5	31.8	NA	NA	
998	278+5139	Rt 0 EB	3.8 - 5.0	23.2	A-7-6(12)	12	18.6	24	31.4	NA	NA	31.4	31.3	

APPENDIX B

LAB RESULTS

Linear Laboratory Analysis

Department of Transportation, Materials and Research Division
300 Airport Road, Bismarck ND 58504 (701) 328-6900

Report Number	SS-48-2010	**Date Reported**	12/2/2010	**District**	Devils Lake
County	CAVALIER	**Submitted By**	Naumann	**Project Number**	SNH-3-005(009)278
		AASHTO Test Method		**PCN**	18871

Comments

Lab Number	990	991	995	996
Reference Pt + Feet	278+5102	278+5102	278+5118	278+5118
Distance From CenterLine (Ft.)	Rt 23 EB	Rt 23 EB	Lt 36 WB	Lt 36 WB
Depth, Ft.	0.5 - 3.5	3.5 - 5.0	0.5 - 3.8	3.8 - 5.0
Field Sample No.	990	991	995	996
% Pass. 3/8" Sieve	100	100	100	100
% Pass. No. 4 Sieve	98	99	98	99
% Pass. No. 10 Sieve	95	98	97	96
% Coarse Sand (-No. 10 + No. 40)	11	10	9	13
% Fine Sand (-No. 40 + No. 200)	21	26	20	24
% Silt (0.074 - 0.005 mm)	30	29	35	32
% Clay (-0.005 mm)	34	34	33	27
Liquid Limit (-No. 40)	51	46	46	45
Plasticity Index (-No. 40)	21	19	23	18
Plastic Limit	29	27	23	26
Soil Color	BLK	GRY	BLK	BRN
Textural Class	CLY	CLY	CLY	CLY LM
Soil Class (AASHTO M-145)	A-7-6(13)	A-7-6(11)	A-7-6(14)	A-7-6(9)
Frost Class	F4	F3	F3	F3
Optimum Moisture (%)	21.1	19.6	20.2	19.8
Maximum Dry Density (pcf)	99.6	103.2	100.9	102.6
% Organic Content				
Depth (Ft.) | Moisture (%)	2 | 45.8	4 | 34.7	2 | 40.1	4 | 33.5
	3 | 40.2	5 | 34.4	3 | 36.2	5 | 29.7
Avg. Moisture of Sample Depth	43.0	34.6	38.1	31.6

Scott W. Wutzke, Testing Lab Supervisor
Date Printed: 4/23/2012

Linear Laboratory Analysis

Department of Transportation, Materials and Research Division
300 Airport Road, Bismarck ND 58504 (701) 328-6900

Report Number	SS-48-2010	**Date Reported**	12/2/2010	**District**	Devils Lake
County	CAVALIER	**Submitted By**	Naumann	**Project Number**	SNH-3-005(009)278
		AASHTO Test Method		**PCN**	18871

Comments

Lab Number	997	998	992	993
Reference Pt + Feet	278+5139	278+5139	278+5174	278+5174
Distance From CenterLine (Ft.)	Rt 0 EB	Rt 0 EB	Rt 14 EB	Rt 14 EB
Depth, Ft.	0.8 - 3.8	3.8 - 5.0	0.7 - 2.8	2.8 - 5.0
Field Sample No.	997	998	992	993
% Pass. 3/8" Sieve	100	100	100	100
% Pass. No. 4 Sieve	97	97	100	99
% Pass. No. 10 Sieve	94	95	99	96
% Coarse Sand (-No. 10 + No. 40)	12	11	7	11
% Fine Sand (-No. 40 + No. 200)	24	24	25	21
% Silt (0.074 - 0.005 mm)	26	29	29	30
% Clay (-0.005 mm)	32	32	38	35
Liquid Limit (-No. 40)	48	47	49	51
Plasticity Index (-No. 40)	20	24	24	27
Plastic Limit	27	23	26	25
Soil Color	BRN/GRY/BLK	BRN/TAN	DRK BRN	BRN/GRY
Textural Class	CLY	CLY	CLY	CLY
Soil Class (AASHTO M-145)	A-7-6(10)	A-7-6(12)	A-7-6(15)	A-7-6(16)
Frost Class	F3	F3	F3	F3
Optimum Moisture (%)	18.1	18.6	19.4	19.0
Maximum Dry Density (pcf)	107.1	105.9	103.2	105.2
% Organic Content				
Depth (Ft.) | Moisture (%)	2 | 28.5	4 | 31.4	2 | 29.4	3 | 28.7
	3 | 31.8	5 | 31.3		4 | 30.5
				5 | 30.1
Avg. Moisture of Sample Depth	30.1	31.4	29.4	29.8

Scott W. Wutzke, Testing Lab Supervisor
Date Printed: 4/23/2012

Linear Laboratory Analysis

Department of Transportation, Materials and Research Division
300 Airport Road, Bismarck ND 58504 (701) 328-6900

Report Number	SS-48-2010	**Date Reported**	12/2/2010	**District**	Devils Lake
County	CAVALIER	**Submitted By**	Naumann	**Project Number**	SNH-3-005(009)278
		AASHTO Test Method		**PCN**	18871

Comments

Lab Number	994
Reference Pt + Feet	278+5174
Distance From CenterLine (Ft.)	Lt 26 WB
Depth, Ft.	0.8 - 5.0
Field Sample No.	994
% Pass. 3/8" Sieve	100
% Pass. No. 4 Sieve	96
% Pass. No. 10 Sieve	91
% Coarse Sand (-No. 10 + No. 40)	12
% Fine Sand (-No. 40 + No. 200)	22
% Silt (0.074 - 0.005 mm)	31
% Clay (-0.005 mm)	26
Liquid Limit (-No. 40)	48
Plasticity Index (-No. 40)	22
Plastic Limit	26
Soil Color	BRN/GRY/BLK
Textural Class	CLY LM
Soil Class (AASHTO M-145)	A-7-6(10)
Frost Class	F3
Optimum Moisture (%)	19.4
Maximum Dry Density (pcf)	104.3
% Organic Content	

Depth (Ft.)	**Moisture (%)**
2	25.4
3	34.5
4	30.1
5	28.8

Avg. Moisture of Sample Depth	29.7

Scott W. Wutzke, Testing Lab Supervisor
Date Printed: 4/23/2012