



**Demonstration Projects Program
Technology Transfer
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DEMONSTRATION PROJECT NO. 39

RECYCLING ASPHALT PAVEMENTS

Ellendale, North Dakota

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**U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
REGION 15
DEMONSTRATION PROJECTS DIVISION
1000 NORTH GLEBE ROAD
ARLINGTON, VIRGINIA 22201**

Final Report on Construction

MILLING BITUMINOUS SURFACE

Project F-2-281(09)006

1978

Final Report

MILLING BITUMINOUS SURFACE

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Project Objective

The objectives of this project were three fold: (1) to eliminate the rutted condition of the surface; (2) to improve the skid resistance, and (3) to ease the transition from driving lane to shoulder. The process of milling off the top surface of the pavement and spreading and laying this material on the 12-foot shoulder was expected to accomplish all three objectives. Because the 1974 pavement mix had a lower than normal unit weight, the actual thickness placed was about 3.6 inches rather than the planned 2 inches. The structural capacity of the milled pavement was therefore considered to remain adequate.

Project Location

This project was located on U.S. 281 from Edgeley to Ellendale.

Project History

The pavement, which was completed in the spring of 1974, was severely rutted (1/2" average rut in outside wheel path with extreme rut depths measuring slightly over 1") was slippery because of a bleeding condition, and the transition from driving lane to shoulder was too abrupt.

The existing pavement was thoroughly evaluated by means of rut depth measurements and tests on the materials obtained from cores. It was concluded that the primary cause of the problem was that the mixture was over-asphalted. The air voids in the mix were excessively low

(less than 3%) which had caused some bleeding and the low air void content slowed the normal rate of asphalt hardening which compounded the problem. The average penetration of the recovered asphalt was 190. It was expected that because of the asphalt softness, the milled material would have a cohesive quality and would be compactible into a durable shoulder surfacing without adding any other material. The possibility existed, however, that the viscosity of the asphalt would still be too high to allow adequate compaction. A softening agent or cutter stock would then be required to be mixed in before laying. Tests were to be performed prior to construction to determine the most suitable additive. It was also expected that the surface texture resulting from the milling operation would be highly skid resistant, at least for a significant period of time.

Construction Notes

The contractor used one CMI Roto-Mill - nine foot wide, one distributor, one water truck, one broom, one blade, one front end loader, one dump truck, one rubber tire roller, and a steel vibratory roller.

Two passes were required in each lane by the Roto-Mill. The contractor started at the centerline with the first pass and then picked up the remaining portion of the lane with the second pass. At first they would do a half-mile portion of one lane and then switch lanes and catch up. Then they changed the operation to 4,000 feet in each pass. When they quit for the day, both lanes were even with a 100-foot transition out to prevent having a bump. They averaged one-mile/nine-hour day if no problems arose. Where the contractor started his transition out, note was taken of the crown rate and depth of cut so the next day the machine could be set for a smooth start. As the contractor progressed, instead of making the 100-foot transition at the end of the cut, they simply raised the machine up and allowed a bump to remain. The next day it was easier to set the machine and a better joint

resulted. The bump was small and was signed.

Cross-sections were taken every 500 feet at ten spots on each cross-section. These cross-sections were used to determine the crown rate the machine was set at. Cross-sections were also taken every 100 feet at the centerline and in each of the two outside ruts. These cross-sections were used to determine the depth of cut made by the machine.

Various travel speeds were tried and 40 feet/minute was found to be the best. The cutting teeth must be changed every mile at an approximate cost of \$1,000/time.

The contractor shot tack on the shoulders before milling the roadway. They then used a blade to lay the material and a rubber tire roller and steel vibratory roller to compact it. During warm weather, the steel vibratory roller was all that was used. Normally, the rubber tire roller was used to break it down and the vibratory was used to finish it.

If the contractor laid the shoulder the day after the material was milled, it looked and rode good. However, the contractor allowed the first three miles near Ellendale to lay for several weeks in a windrow before he tried to lay it down. A roto-tiller had to be brought in as the material had set up to the point where it was hard. No softening agent was needed in the mix before laying. The milled material was found to contain sufficient asphalt to make it workable.

Attached are the skid test data, the dynaflect deflection data, and the Mays Ride Meter data, both before and after milling (Figures 1, 2, and 3). The skid numbers improved greatly after milling. The ride improved somewhat although the pavement rode well before milling. Although our dynaflect data show a rather significant increase in the SCI for the west lane only, the structural capacity of the milled pavement is considered to remain adequate.

On days when the mat temperature was high, the aggregate appeared to pull out of the asphalt when the Roto-Mill made a pass. At a mat temperature of 95⁰F some

tackiness developed in the mat and at 110°F, the mat would tear when milled. The contractor added water in front of the milling machine at high mat temperatures to cool it. Attached are the mat temperatures taken during the milling operation (Figure 4).

After completion of the milling, cores were taken of the milled material on the shoulders and rut depth measurements in the roadway were taken. Samples of the loose milled material were also obtained and compacted with Marshall testing apparatus at ambient and also higher temperatures. The results are shown by stability, air voids, and flow measurements. The results are attached (Figures 5, 6, and 7). The results in Figure 5 indicate the material was laid at a temperature of approximately 80°F. This can be seen in a comparison of the unit weight and air voids in Figure 7.

The field personnel indicated that a full width machine would eliminate having to try and keep a constant slope when two passes are now made in each lane. However, this is not a necessity.

Attached is a copy of the bid proposal. The price of milling the surface and the cost of relaying the material is given on page three of the proposal.

Also attached is the savings due to the asphalt pavement recycling. This is based in part on the June 27, 1977 letter to Mr. Daniel Watt from Mr. George Seaworth on this subject (Figure 8).

A change order was used to use RC-250 in place of MC-250 Liquid Asphalt for sealing the shoulders. The change order is attached.

The job looks good overall and appears to have fulfilled the objectives of the project.

TABLES

- Table 1: Skid Test Results
- Table 2: Dynaflect Test Results
- Table 3: Mays Ride Meter Results
- Table 4: Milling Temperatures
- Table 5: Density Results
- Table 6: Density--Temperature Relationships
- Table 7: Rut Measurements
- Table 8: Cost, Energy, and Resource Savings

Table 1

SKID TEST RESULTS
At 40 MPH
US 281 Edgeley to Ellendale

Mile No.	<u>*6-13-77</u>	<u>9-13-77</u>	<u>*6-13-77</u>	<u>9-13-77</u>
	<u>South Bound Lane</u>		<u>North Bound Lane</u>	
	<u>Skid No. (SN)</u>		<u>Skid No. (SN)</u>	
30.5	23.1	48.1	13.7	52.8
30	15.6	49.2	10.5	55.0
29.5	10.8	51.2	12.9	54.1
29	9.9	48.8	13.7	54.8
28.5	11.7	49.4	10.2	55.6
28	13.0	50.9	12.6	57.8
27.5	7.7	52.9	14.7	57.3
27	8.8	52.6	8.9	56.1
26.5	11.2	50.1	16.9	55.1
26	11.4	50.8	11.9	56.7
25.5	12.2	46.9	15.3	52.5
25	13.4	51.0	17.0	52.9
24.5	9.3	52.8	14.5	52.8
24	11.6	53.6	16.4	53.1
23.5	29.5	47.1	32.8	48.5
23	36.0	47.5	19.8	49.1
22.5	11.7	47.4	10.1	47.0
22	6.0	48.2	8.9	46.6
21.5	14.4	43.7	16.2	43.7
21	13.3	41.5	14.6	42.9
20.5	10.6	48.6	14.3	48.5
20	13.0	44.0	14.9	45.3
19.5	13.2	38.3	18.3	43.7
19	12.9	38.1	10.3	44.2

US 281 Edgeley to Ellendale cont'd.

Table 1

18.5	12.9	29.9	11.5	37.6
18	11.3	35.4	10.1	37.9
17.5	10.1	34.1	8.3	30.1
17	11.2	33.1	15.6	47.8
16.5	10.2	31.3	10.2	42.2
16	11.4	32.1	9.3	43.1
15.5	9.3	33.5	10.1	38.7
15	9.5	40.8	10.9	40.2
14.5	7.7	35.0	10.4	34.8
14	11.8	41.1	14.7	43.0
13.5	10.7	36.2	20.1	39.3
13	10.5	--	23.5	47.6
12.5	12.4	43.0	26.1	39.3
12	11.8	36.7	23.2	40.0
11.5	12.4	42.0	20.5	37.0
11	7.0	32.0	10.6	41.2
10.5	7.9	34.4	14.1	40.4
10	19.5	32.9	16.1	34.2
9.5	9.8	24.5	8.9	23.9
9	7.2	20.6	8.7	43.9
8.5	8.9	24.1	9.2	27.7
8	16.7	32.0	29.6	27.6
7.5	8.1	25.2	11.7	30.1
7	7.7	22.0	11.0	31.7
6.5	8.1	26.7	9.0	25.8

TEST SECTIONS RUN BY DYNAPLECT

Location: US #281 - From Jct. ND #13 South to Jct. ND #11
(Edgeley to Ellendale)

Project: FLH-2-281(90) WEST LANE

<u>Date of Test:</u>		<u>6-14-77</u>	<u>9-21-77</u>
DMD	\bar{X}	1.75	2.00
	$\bar{X} + 2\sigma$	.27	.27
		2.29	2.54
SCI	\bar{X}	.33	.53
	$\bar{X} + 2\sigma$	.10	.10
		.53	.73
BCI	\bar{X}	.16	.13
	$\bar{X} + 2\sigma$	.06	.05
		.28	.23
W ₅	\bar{X}	.56	.54
	$\bar{X} + 2\sigma$	.09	.10
		.74	.74

TEST SECTIONS RUN BY DYNAFLECT

Location: US #281 - From Jct. ND #13 South to Jct. ND #11
(Edgeley to Ellendale)

Project: FLH-2-281(90) EAST LANE

<u>Date of Test:</u>		<u>6-14-77</u>	<u>9-21-77</u>
DMD	\bar{X}	1.84	1.90
	$\frac{b}{X}$	.31	.29
	$X + 2g$	2.46	2.48
SCI	\bar{X}	.41	.46
	$\frac{b}{X}$	.12	.10
	$X + 2g$	.65	.66
BCI	\bar{X}	.17	.14
	$\frac{b}{X}$	.07	.05
	$X + 2g$	.31	.24
W ₅	\bar{X}	.55	.54
	$\frac{b}{X}$	.10	.11
	$X + 2g$	.75	.76

Mays Ride Meter Results

Table 3

US 281 Edgeley to Ellendale

<u>Mile No.</u>	<u>*6-13-77</u>	<u>9-22-77</u>	<u>*6-13-77</u>	<u>9-22-77</u>
	<u>South Bound Lane</u> (inches/mile)		<u>North Bound Lane</u> (inches/mile)	
30	9.5	9.1	10.0	7.7
29	10.7	7.4	12.6	7.5
28	12.0	7.5	13.1	8.2
27	10.5	7.2	13.4	7.8
26	11.2	7.7	12.7	8.3
25	10.3	7.5	12.7	7.7
24	11.9	6.1	12.7	8.3
23	9.7	6.9	10.6	7.9
22	11.8	7.3	12.5	7.9
21	12.0	6.8	12.6	8.8
20	11.5	6.9	9.6	7.6
19	10.4	6.4	10.3	7.3
18	9.5	6.5	10.5	8.1
17	11.8	8.4	11.9	8.1
16	11.0	8.2	12.5	8.5
15	10.8	7.3	12.5	8.8
14	11.8	7.1	13.7	8.7
13	8.6	7.5	9.4	6.8
12	9.6	7.1	9.6	7.4
11	10.9	7.3	12.1	8.4
10	11.4	9.2	12.7	9.3
9	13.8	8.3	13.6	8.0
8	12.4	7.4	12.4	9.5
7	13.3	8.9	12.5	9.1
6	<u>13.3</u>	<u>10.0</u>	<u>11.8</u>	<u>11.7</u>
Average	11.2	7.6	11.9	8.3

Table 4

Milling Temperatures

<u>Date</u>	<u>Time</u>	<u>Air Temp.</u>	<u>Mat Temp.</u>	
7-14-77	4:15 PM	75°	110°	1114 to 1160 (two outside passes)
	5:20 PM	75°	110°	
7-15-77	7:10 AM	65°	70°	Milling time - mainline 7:30 AM to 11:20 AM 1114 to 1160 (two center passes)
	9:35 AM	68°	75°	
	10:20 AM	70°	98°	
7-18-77	11:15 AM	85°	105°	1087+40 to 1114 complete roadway
	2:15 PM	95°	120°	
7-19-77	9:15 AM	80°	90°	1039 to 1087+40 (2 center passes and one outside pass)
	11:20 AM	88°	105°	
	2:00 PM	95°	125°	
	3:00 PM	103°	128°	
7-20-77	9:45 AM	65°	30°	990 to 1039 (two center passes)
	2:45 PM	75°	90°	
7-22-77	11:30 AM	74°	100°	965 to 990 (center passes) 990 to 1039 (two outside passes)
7-25-77	8:30 AM	58°	70°	900 to 965 (one center pass)
	12:00 PM	65°	103°	
7-26-77	7:15 AM	65°	80°	900 to 965 (2nd center pass) (870 to 900 two center passes)
7-27-77	10:30 AM	75°	95°	870 to 965 (last pass) 810 to 870 (one center pass)
7-28-77	8:50 AM	68°	85°	810 to 870 (one center pass and two outside passes)
	10:45 AM	78°	98°	
	12:00 PM	85°	110°	
7-29-77	9:50 AM	68°	85°	778 to 810 (complete roadway)
	4:15 PM	83°	115°	
8-4-77	1:30 PM	79°	105°	656 to 701 (2nd center pass)
	3:00 PM	81°	110°	
8-5-77	8:30 AM	60°	73°	656 to 701 (two outside passes)
8-11-77	2:00 PM	70°	105°	581 to 630 (two center passes)

<u>Date</u>	<u>Time</u>	<u>Air Temp.</u>	<u>Mat Temp.</u>	
8-22-77	2:00 PM	65 ^o	75 ^o	370 to 424 (two center passes - one outside pass)
8-23-77	2:00 PM	66 ^o	85 ^o	370 to 424 (one outside pass) 317 to 370 (two center - one outside pass)
8-24-77	1:30 PM	68 ^o	95 ^o	317 to 370 (one outside pass) 260 to 317 (two center passes)
8-25-77	4:30 PM	75 ^o	95 ^o	260 to 317 (two outside passes) 200 to 260 (two center passes)

Table 5

REPORT ON DENSITIES
ON RECYCLED ASPHALT PAVEMENT

PROJECT : F-2-281(09)006
LOCATION: Edgeley to Ellendale
DATE : November 16, 1977

Core Number	Mile Marker	Bulk Sp.Gr.	Unit Weight	Measured Maximum Sp.Gr.	Air Voids
1-2-3-4	29	1.914	119.4	2.329	17.8
5-6-7-8	23	1.857	115.9	2.302	19.3
9-10-11-12	18	1.956	122.1	2.316	15.5
13-14-15-16	14	2.000	124.8	2.368	15.5
17-18-19-20	9	2.082	129.9	2.277	8.6

Note: All cores were too unstable to get a stability measurement.

HOT MIX DESIGN DATA WORKSHEET

Project F-2-281(09)006 Date 11-15-77

Specimen No.	Mix Moisture Content	Weight in Air	Weight in Water	Surface Dry Weight	Volume*	Bulk Specific Gravity			Moisture Corrected Bulk Specific Gravity	Stability		Flow
						C	F	G		Dial Reading	Converted to Pounds	
A	B	C	D	E	E-D	F	G	H	I	J	K	L
1		520.0	258.9	530.8	271.9	1.912						
2		353.4	180.0	364.0	184.0	1.921						
3		507.0	253.5	514.6	261.1	1.942						
4		489.2	250.0	501.1	251.1	1.948						
	0.9					1.931		1.914	119.4			
5												
6		351.7	163.3	360.0	196.7	1.788						
7		290.0	147.6	296.7	149.1	1.945						
8		384.8	191.6	398.0	206.4	1.864						
	0.5					1.866		1.857	115.9			
9		465.9	237.6	472.2	234.4	1.988						
10		426.4	215.5	432.7	217.2	1.963						
11		441.9	224.5	448.5	224.0	1.973						
12		520.7	263.0	530.5	267.5	1.947						
	0.6					1.968		1.956	122.1			
13		562.3	291.1	568.7	277.6	2.026						
14		619.3	322.6	628.7	306.1	2.023						
15		602.6	310.0	610.0	300.0	2.009						
16		623.8	319.8	633.1	313.3	1.991						
	0.6					2.012		2.000	124.8			
17		340.7	182.1	342.5	160.4	2.124						
18		267.9	141.3	269.4	128.1	2.091						
19		253.2	134.6	255.0	120.4	2.103						
20		261.0	137.4	263.1	125.7	2.076						
	0.8					2.099		2.082	129.9			

Station:

* 504.525 ml. is tolerance corresponding to specimen height of 2.50 ± 0.05 inches.

DENSITY TEMPERATURE RELATION

Project: RF-2-281(04)005

Location: Edgeley to Ellendale

Date: 10-18-77

Molding Temp.	Unit Wt.	Air Voids	Stability	Flow
80°F	125.7	13.9		
100°F	127.9	12.4	82	13½
120°F	135.3	7.2	127	17½
200°F	143.7	1.5	405	50+

(50 blow Marshall test used)

Edgeley to Ellendale
HOT MIX DESIGN DATA
WORKSHEET

Project RF-2-281(04)005

Date 10-10-77

Molding Temp.	Specimen No.	Mix Moisture Content	Weight in Air	Weight in Water	Surface Dry Weight	Volume*	Bulk Specific Gravity	Moisture Corrected Bulk Specific Gravity	Stability		Flow	
									Dial Reading	Converted to Pounds		
	A	B	C	D	E	E-D F	C F G	$\frac{G}{100+B}$ H	I	J	K	L
80°F	1	0.4	1046.6	560.3	1078.0	517.7	2.022	2.014				
	2	0.4	890.0	473.6	913.8	440.2	2.022	2.014	125.7			
100°F	3	0.4	1005.4	529.7	1018.5	488.8	2.057	2.049		7	87	14
	4	0.4	1008.3	532.2	1022.3	490.1	2.057	2.049		6	76	13
								2.049	127.9		82	13½
120°F	5	0.4	1085.6	596.2	1092.9	496.7	2.186	2.177		11	114	19
	6	0.4	1096.0	596.3	1101.3	505.0	2.170	2.161		15	140	16
								2.169	135.3		127	17½
200°F	7	0.4	1165.5	663.8	1165.9	502.1	2.321	2.312		45	400	50+
	8	0.4	1160.0	656.6	1160.2	503.6	2.303	2.294		47	410	50+
								2.303	143.7		405	50+

* 504-525 ml. is tolerance corresponding to specimen height of 2.50 ± 0.05 inches.

Table 7

RUT MEASUREMENTS
Milling Project
F-2-281(09)006

Date 10-26-77

Mile Marker	Core Numbers	Shoulder Lt. or Rt.	West Lane		East Lane	
			OWP*	IWP*	IWP*	OWP*
29	1,2,3&4	Rt.	0.010	0.010	0.080	0.070
23	5,6,7&8	Lt.	0.215	0.240	0.130	0.130
18	9,10,11&12	Rt.	0.230	0.130	0.150	0.070
14	13,14,15&16	Lt.	0.230	0.240	0.200	0.240
9	17,18,19&20	Rt.	0.130	0.140	0.100	0.050
* OWP = Outside Wheel Path IWP = Inside Wheel Path						
Note: Measurement of ruts could vary 0.020 or more because of rough milled surface. This was more apparent on the North end of project.						

SAVINGS DUE TO RECYCLING

Savings due to asphalt pavement recycling will be compared to a "shoulder build-up" with a one-inch overlay on the surface as Alternate No. 1 and a "shoulder build-up" with a one-inch leveling course and an inch and a half wearing course as Alternate No. 2. The actual amount of fuel and asphalt used on the project will be compared to the estimated amount needed for the alternates.

Actual Project

- (1) Mill an average of 1 3/4" of bituminous surface from 49.128 (12') lane miles of pavement.
- (2) Lay tailings from milling operation on the existing 12' shoulders (49.128 shoulder lane miles) raising elevation 1 3/4".

Alternate No. 1

- (1) Raise shoulders (49.128 shoulder lane miles) by 3".
- (2) Overlay the surface (49.128 lane miles) with 1" to improve skid resistance and rideability.

Alternate No. 2

- (1) Raise shoulders (49.128 shoulder lane miles) by 3".
- (2) Overlay the surface (49.128 lane miles) and shoulders (49.128 shoulder miles) with 1" to improve skid resistance and rideability.
- (3) Overlay the surface (49.128 lane miles) with 1 1/2" wearing course to improve the rideability.

A comparison of these two alternatives with the actual project shows the savings to be equivalent to 49.128 (12') lane miles of 2 1/4" asphaltic mat for Alternate No. 1 and a savings equivalent to 49.128 (12') lane miles of 3 3/4" asphaltic mat for Alternate No. 2, less additional asphalt and fuel used when laying the milled surface tailings:

Savings Assumptions

1. Asphalt: AC 120-150, 235 gals/ton
2. Mix density: 140 lbs/ft³ (6 1/2% asphalt)

- 2 -

3. Asphaltic concrete cost: \$11.50/ton in place
4. Diesel Fuel in place: 3.06 gal/ton
5. Gas in place: 0.86 gal/ton

Savings - Alternate No. 1

1. Asphalt: Total mat volume = $2 \frac{1}{4}'' \times 12' \times 49.128 \text{ miles}$
Total mat volume = 583,641 ft³

Mat weight = (140 pcf) 583,641 ft³
Mat weight = $8.17 \times 10^7 \text{ lb}$

Asphalt = $6 \frac{1}{2}\% \times 8.17 \times 10^7 \text{ lb}$
Asphalt = 2,655 ton x 235 (gal/ton)
Asphalt = 623,925 gal (See No. 4)
2. Aggregate: 93 1/2% of mat weight
 $93.5\% \times 8.17 \times 10^7 \text{ lbs}$
38,195 tons
3. Cost: Mat weight x \$11.50/ton
40,850 ton x \$11.50/ton
\$469,775 (See No. 4)

Savings - Alternate No. 2

1. Asphalt: Total mat volume = $3 \frac{3}{4}'' \times 12' \times 49.128 \text{ miles}$
Total mat volume = 972,734 ft³

Mat weight = (140 pcf) 972,734 ft³
Mat weight = $1.36 \times 10^8 \text{ lb}$

Asphalt = $6 \frac{1}{2}\% \times 1.36 \times 10^8 \text{ lbs}$
Asphalt = 4,420 ton x 235 (gal/ton)
Asphalt = 1,038,700 gal (See No. 4)
2. Aggregate: 93 1/2% of mat weight
 $93.5\% \times 1.36 \times 10^8 \text{ lbs}$
63,580 tons
3. Cost: Mat weight x \$11.50/ton
68,000 ton x \$11.50/ton
\$782,000 (See No. 4)
4. Savings need to be adjusted for additional asphalt required to seal the shoulders. It took 13,206 gallons of MC-250 for tack on the shoulders but this would have been used on the alternates also.

79,240 gallons of RC-250 were used to seal the shoulders at a unit cost of \$.56/gal. This would reduce asphalt savings to 544,685 gallons and cost savings to \$425,400.60 for Alternate No. 1. For Alternate No. 2, the asphalt savings would be reduced to 959,460 gallons and cost savings reduced to \$737,625.60.

5. Equally as important as the money saved is the amount of energy saved. On an average asphalt paving job with this quantity of mix, it would have required 125,001 gallons of diesel fuel and 35,131 gallons of gasoline for Alternate No. 1. It would have required 208,080 gallons of diesel fuel and 58,480 gallons of gasoline for Alternate No. 2. With this recycling milling project, it took 12,000 gallons of diesel fuel and 8,000 gallons of gasoline. This is a savings of 140,132 gallons of fuel for Alternate No. 1 and a savings of 246,560 gallons of fuel for Alternate No. 2.

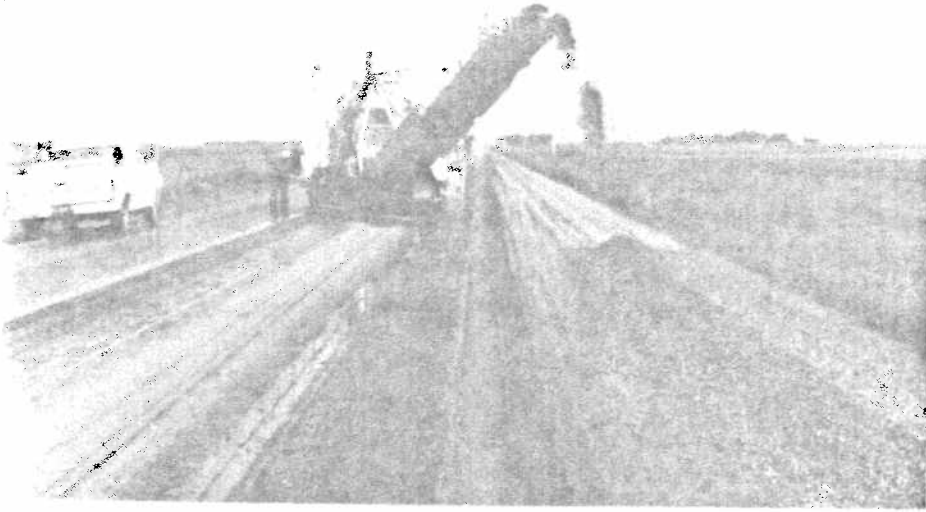


Figure 1: Milling machine making first pass.

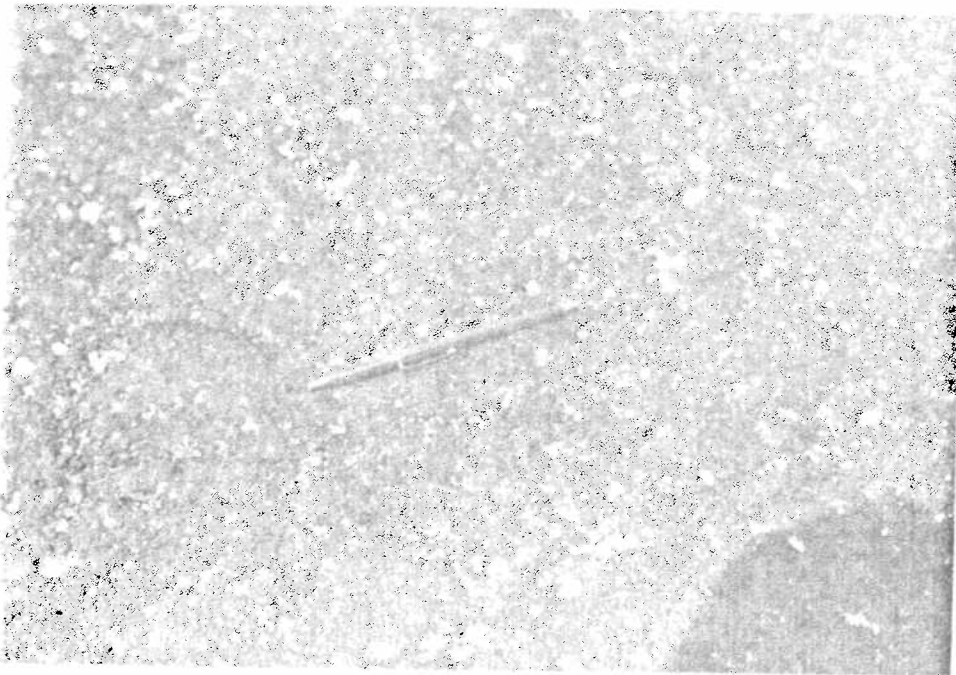


Figure 2: Close up view of laid shoulder material.



Figure 3: Finished roadway and shoulders.

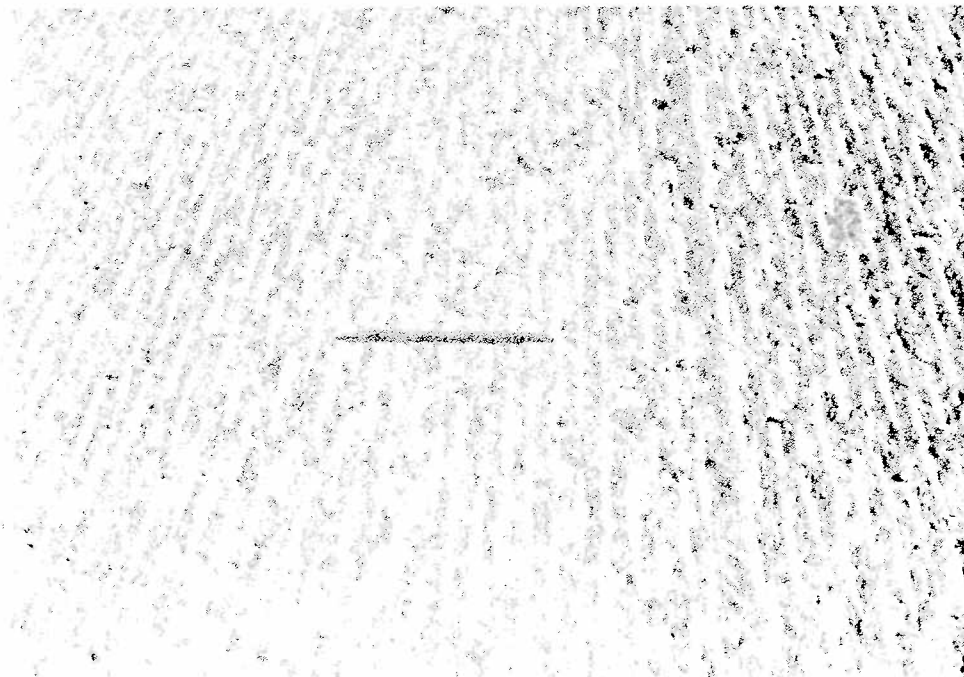


Figure 4: Close up view of milled roadway.

NORTH DAKOTA STATE HIGHWAY DEPARTMENT
PROPOSAL

Contract No. _____

Note: The envelope containing this proposal should be marked: Proposal for Federal-aid

Project No. F-2-281(09)006

Milling Bituminous Surface & Incidental Items, in LaMoure and Dickey Counties

(Proposal of - Name) _____

(Address) _____

to furnish and deliver all materials and to do and perform all work, in accordance with the Standard Specifications, adopted by the North Dakota State Highway Department October, 1976 and approved by the Federal Highway Administration on December 17, 1976, and other Contract Provisions submitted herewith.

of the North Dakota State Highway Department except as specifically stated otherwise in the "Special Provisions" contained therein, for the improvement of a certain section of State Highway in LaMoure and Dickey

Counties State of North Dakota, on which proposals will be received until 9:30

o'clock A M., on the 20th day of May 1977, this highway being known as Federal-aid Project No. F-2-281(09)006

. Said project being situated as follows: Beginning at Station 0+00 a point at the NW Cor. of Sec. 11, Twp. 133 N., Rge. 64 W.

and extending to Station 1296+84.7 a point at the SE Cor. of Sec. 35, Twp. 130 N., Rge. 63 W.

being approximately 24.564

miles in length, as indicated on the plans approved March 11 19 77

NOTE: The Federal District Manager for Reemployment is:
To the State Highway Commissioner, Richard E. Coddington
Bismarck, North Dakota 429 2nd Street SW
Jamestown, ND 58401

Sir:
In accordance with the advertisement and Notice to Contractors of the State Highway Department, inviting proposals for the improvements of the section of highway hereinbefore named, and in conformity with the plans and specifications, on file in the office of the State Highway Department and in that of the County Auditor of the above County, I/we hereby certify that I am/we are the only person or persons interested in this proposal as principals; that it is made without collusion with any person, firm or corporation; that an examination has been made of the specifications and Contract Form, including "Special Provisions" contained therein, also the Plans, and the site of the work, and propose to furnish all necessary machinery, equipment, tools, labor and other means of construction, and to furnish all materials specified, in the manner and at the time prescribed and understand that the quantities of work as shown herein are approximate only and are subject to increase or decrease, and further understand that all quantities of work, whether increased or decreased, are to be performed at the following unit prices (except as provided in said specifications):

MILLING BITUMINOUS SURFACE & INCIDENTAL
LAURE & DICKEY COUNTIES
PROPOSAL

SPEC. NO.	ITEM NO.	APPROXIMATE QUANTITIES	ITEMS AND UNIT PRICES BID	UNIT PRICES		AMOUNT	
				\$	¢	\$	c
106 01	1	48,100.	GAL MC250 LIQUID ASPHALT				
			FOR <i>Fifty six Cents</i> AND 100 DOLLARS PER GAL				
						56	26,936 00
01 401	2	1,200.	TON BLOTTER MATERIAL CL.				
			44				
			FOR <i>Eight</i> AND 100 DOLLARS PER TON				
						8 00	9,600 00
10 705	3	1.	MOBILIZATION				
			FOR <i>Thirty five hundred</i> AND 100 DOLLARS LUMP SUM				
							3,500 00
01 705	4	600.	M HR FLAGGING				
			FOR FOUR AND				
			100 DOLLARS PER M HR			4 000	2,400 00
01 762	5	1.	MILE PROTECTION OF TRAFFIC				
			FOR <i>Ten thousand</i> AND 100 DOLLARS LUMP SUM				
							10,000 00
01 770	6	24.560	MILE TEMPORARY STRIPING				
			FOR <i>One hundred</i> AND 100 DOLLARS PER MILE				
						100 00	2,456 00

PAGE 3 OF A
MILLING BITUMINOUS SURFACE & INCIDENTAL
LAMORE & DICKEY COUNTIES
 PROPOSAL

112-111(09)000

REQ. NO.	ITEM NO.	APPROXIMATE QUANTITIES	ITEMS AND UNIT PRICES BID	UNIT PRICES		AMOUNT	
				\$	¢	\$	¢
✓	7	374,380.	50 YD MILLING BITUMINOUS SURFACE FOR <i>thirty seven Cents</i> AND /100 DOLLARS PER 50 YD			37	138,520 60
	8	24.560	MILE. RELAYING SALVAGED MATERIAL FOR <i>Fifteen hundred</i> AND <i>no</i> /100 DOLLARS PER MILE			1500	00 36,840 00
			TOTAL AMT BID				230,252 60

NORTH DAKOTA STATE HIGHWAY DEPARTMENT

PROPOSAL

Page 4 of 4

It is further proposed that this bidder will:

Do all "Extra Work" which may be required to complete the work contemplated at unit prices or lump sums, to be agreed upon in writing prior to starting such extra work, or if such price or sums cannot be agreed upon, to perform such work on a "Force Account" basis, as provided for in the specifications.

Obtain all required license and authority as may be required by law of foreign corporations prior to executing the contract and agrees that failure to do so shall constitute a default and grounds for forfeiture of proposal guarantee.

Execute the contract form and furnish a contract bond within ten calendar days, after having received notice of award of contract, in an amount equal to the gross sum bid as a guarantee of the completion of all work in accordance with plans and specifications.

Begin work within ten calendar days from the date of the "Notice to Proceed" and to prosecute said work so as to complete the roadway and its appurtenances on or before September 1, 1977.

Comply with the requirements of Title 65, North Dakota Century Code, as amended, known as the Workmen's Compensation Act.

Industrial Builders Inc
Contractor

By James J. Hess
Title W. Pres.

Dated May 20, 1977

Change 1-Project
Order No. 1-Contract

Project F-2-281(09)006
County LaMoure & Dickey

For Milling Bituminous Surface

Contractor Original Contract Amount

To Industrial Builders Inc.
 Fargo,

North Dakota \$ 230,252.60

No.	Item of Work	Unit	Original + or - Previous Chg. Quantity	Quantity + or -	Unit Price	Increase Amount	Decrease Amount
1	MC-250 Liquid Asphalt	Gal.	48,100	- 33,700	.56		18,872.0
	<u>ADDED CONTRACT ITEM - PARTICIPATING</u>						
1	RC-250 Liquid Asphalt	Gal.	0	+ 79,240	.56	44,374.40	
Totals						44,374.40	18,872.0
Non-Participating							
Net Increase or Decrease to Date \$ 25,502.40							
Final Contract Increase or Decrease \$							

EXPLANATION OF CHANGE IN PLAN RECOMMENDED

MC-250 Liquid Asphalt: Eliminating the prime coat quantity from this item.
ADDED CONTRACT ITEM PARTICIPATING

RC-250 Liquid Asphalt: Due to the excess amount of liquid asphalt in the milled material, it was felt that changing the MC-250 liquid asphalt for prime coat which was provided for to RC-250 would be of a more beneficial value. There was an error in plan amount for this item which accounts for the increased quantity.

APPROVED

AUG 25 1977

FEDERAL HIGHWAY
ADMINISTRATION

David A. Whetstone 8/17/77
Resident - County Engineer Date

John W. ... 8-17-77
District Engineer Date

Estley ... 8-19-77
Bridge-Construction/Secondary Road Engineer Date

APPROVED
[Signature] 8-23-77
Chief Engineer Date

Asst.

DESIGN DATA

Traffic
 Average Daily
 Current Traffic (1977) 1050 Pass. 200 Trucks 1250 Total 180
 Traffic Forecast (1997) 1680 Pass. 320 Trucks 2000 Total 290
 Design Speed 70 MPH
 Traffic Classification "M"
 Minimum Sight Distance (Stopping) 600'
 Minimum Sight Distance (Safe Passing) 3200'
 Minimum Passing Sight Distance for Marking 1200'
 Bridges

**NORTH DAKOTA
 STATE HIGHWAY DEPARTMENT**

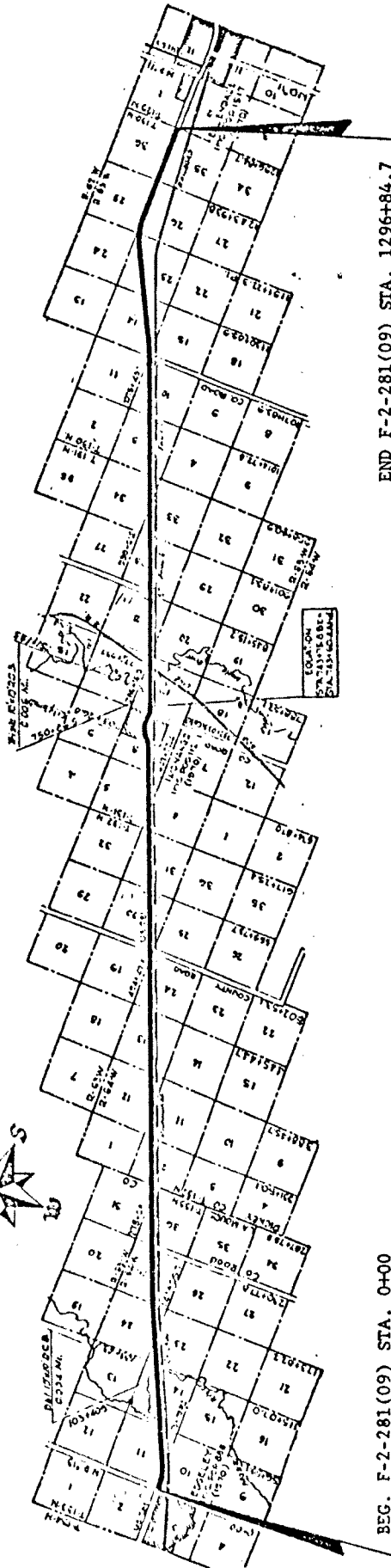
MILLING BITUMINOUS SURFACE
 IN LAMORE AND DICKEY COUNTIES
 FEDERAL AID PROJECT NO. F-2-281(09)006

GOVERNING SPECIFICATIONS:

Standard Specifications adopted by the North Dakota State Highway Department, Oct. 1976, and approved by the Federal Highway Administration on December 17, 1976, and other Contract Provisions submitted herewith.

LENGTH OF PROJECT

Project F-2-281(09) Miles-Gross 24,564
 Miles-Net 24,564

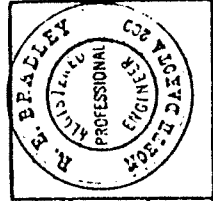


BEG. F-2-281(09) STA. 0+00
 A POINT AT THE N.W. COR. OF SEC. 11,
 TWP. 133 N., RGE. 64 W.

END F-2-281(09) STA. 1296+84.7
 A POINT AT THE S.E. COR. OF SEC. 35,
 TWP. 130 N., RGE. 63 W.

STATE REGION	STATE	PROJECT	SHEET NO.
8	N.D.	F-2-281(09)	1

APPROVED DATE 3-11-77
R. Bradley
 CHIEF ENGINEER
 NORTH DAKOTA
 STATE HIGHWAY DEPARTMENT



U.S. DEPARTMENT OF TRANSPORTATION
 FEDERAL HIGHWAY ADMINISTRATION
 APPROVED
 DIVISION ENGINEER
 DATE

TABLE OF CONTENTS

<u>Sheet No.</u>	<u>Description</u>
1	Title Sheet
2	This Sheet
3	Quantities, Basis of Estimate & Notes
4	Typical Sections
5	Construction Signing Layout
6	D-742-1, Striping for Flared Intersections
7	D-743-1, Striping for Railroad Crossing
8 thru 15	D-754-1, 2, 3, 4, 5, 8 & 10, Construction Sign & Barricade Details
16	D-754-14, Windrow Markers

LIST OF PROVISIONS

<u>No.</u>	<u>Name</u>
SP-102-1	Bidding Requirements & Conditions
SS-107-1	Legal Relations & Responsibility to Public
SP-107-2	Legal Relations & Responsibility to Public
SS-109-1	Measurement & Payment
SP	Milling Bituminous Surface

ESTIMATED QUANTITIES

<u>Sec. No.</u>	<u>Code No.</u>	<u>Item</u>	<u>Unit</u>	<u>Quantity</u>
	8581	Milling Bituminous Surface	S. Y. Mile	374, 380
401	8582	Relaying Salvaged Material	Mile	24, 56
401	0106	MC-250 Liquid Asphalt	Gal.	48, 100
705	0160	Blotter Material-Cl. 44	Ton	1, 200
762	0100	Mobilization	LSum	1
746	3299	Maintenance & Protection of Traffic	LSum	1
776	0100	Flagging	M. Hrs.	600
776	0100	Temporary Striping	Mile	24, 56
743	0102	*Pvm't. Marking-Drop On Beads-Type II	L. F.	353, 300

NOTES:

- PAVEMENT MARKING (ITEM 743): Pavement marking is not a bid item on this contract. This work is to be done by State Forces under a separate agreement.
- The quantity shown for milling bituminous surface is based on a width of 25 feet for the entire length of the project, plus the square yardage for approaches and intersections as shown on Sheet No. 4.
- The depths of the existing ruts were determined from 25 random cross sections plus 15 additional cross sections that were taken at select locations containing the worst rutting conditions. In addition to these measurements, 45 cores were taken from the existing pavement section. Based on these measurements, it was determined that approximately 1 1/2 inches of material shall be removed at the centerline and the finished transverse crown maintained at 0.021 ft./ft. The thickness removed at other transverse location will vary depending upon the rut depths with the average throughout the project approximately 1 3/4 inches. The depth of removal will generally vary from approximately 1/2 inch to 4 inch.
- The Contractor shall be required to furnish R. R. Protection Insurance for this project in accordance with Sections 107-8.2 and 107-8.3 of the Standard Specifications.
- Pneumatic rollers shall be used to compact the milled material placed on the shoulders.
- WORK SCHEDULE: Work on this project can not start before June 15, 1977 and shall be completed by September 1, 1977.

BASIS OF ESTIMATE (SURFACING)

<u>Quantity Per S.Y.</u>	<u>Unit</u>	<u>Description</u>
0.05	Gal.	MC-250 Liq. Asph. for Tack Coat @ 0.05 Gal/S. Y. (Shldr.)
0.25	Gal.	MC-250, Liq. Asph. for Prime Coat @ 0.25 Gal./S. Y. (Shldr.)
0.0075	Ton	Blotter Material-Cl. 44 @ 15 Lbs./S. Y. (Shldr.)

BASIS OF ESTIMATE (STRIPING)

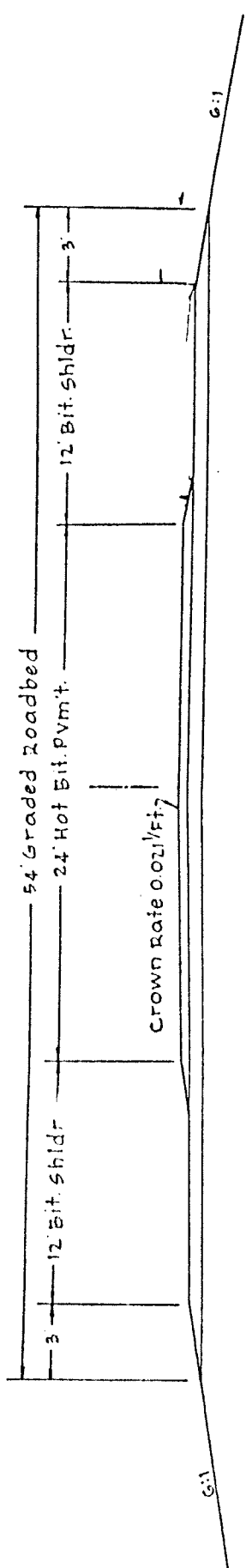
Centerline = 1980 L. F. per Mile of Broken Stripes
 Barrier Line = Estimate 1485 L. F. per Mile (75% of Broken Stripes)
 R.R. Crossing = 1200 L. F.
 Flared Intersections (6) = 1265 L. F. per Intersection
 Edge Lines = 10, 650 L. F. per Mile

MAXIMUM SIZE OF AGGREGATE

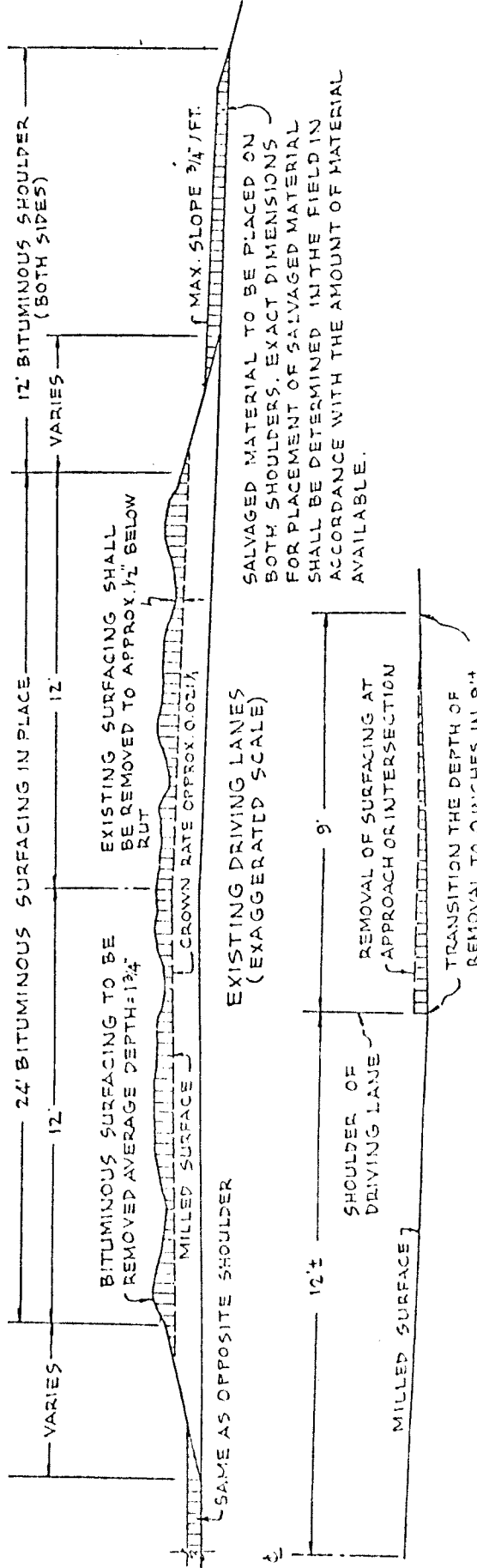
<u>Description</u>	<u>Type of Aggregate</u>	<u>Max. Size</u>
Blotter Material, Cl. 44	Screened	5/8"

8	ND	5-2-79:(09)	3
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SECTION	DATE	BY	NO.	DATE
8	ND	5-2-28	1000	1



EXISTING SECTION



SECTION AT APPROACHES AND INTERSECTIONS