Field Evaluation of Cold In-Place Recycling of Asphalt Concrete

Construction Report for Highway Research Advisory Board Project HR-303

December 1990

Highway Division

Iowa Department of Transportation

Construction Report
for
Highway Research Advisory Board
Project HR-303

Field Evaluation of Cold In-Place Recycling of Asphalt Concrete

By
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and

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Office of Materials
Highway Division
Iowa Department of Transportation
Ames, Iowa 50010

December 1990

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DISCLAIMER

ABSTRACT

There are still many vintage portland cement concrete (PCC) pavements, 18 feet wide (5.4 meters (m)), dating back to pre-World War II era in use today. Successive overlays have been placed to cover joints and to improve rideability.

The average thickness of the existing asphalt cement concrete (ACC) along route E66 in Tama County was 6.13 inches (15.6 centimeters (cm)). The rehabilitation strategy called for widening the base using the top three inches (7.6 cm) of the existing ACC by a recycling process involving cold milling and mixing with additional emulsion/rejuvenator. The material was then placed into a widening trench and compacted to match the level of the milled surface

Research project HR-303, "Field Evaluation of Cold In-Place Recycling of Asphalt Concrete", has been undertaken to develop a rehabilitation methodology to widen these older pavements economically and to have a finished surface capable of carrying traffic with little or no additional work.

INTRODUCTION

There still exists in Iowa substantial mileage of 1920's and 1930's PCC pavement, 18 feet wide (5.4 m) with one, two or more ACC overlays dating from the 1950's to more recent times. The first overlays were placed to fill the curb sections, to cover joints and improve rideability. Successive overlays were placed to cover reflective cracks and to again improve the rideability.

To date, most of this mileage remains 18 feet wide and has its original horizontal and vertical alignment. These roads, now generally transferred to county jurisdiction, are increasingly more hazardous to drive (due to fewer and fewer motorists having significant driving experience on this type of road) and more difficult to maintain (especially along the edge of the pavement).

While there is agreement that these roads need to be improved, both from a safety and a maintenance perspective, there is no affordable, commonly accepted method available to accomplish the needed improvements. For example, Tama County has nearly 20 miles (32 kilometers (km)) of original (constructed in the 1920's) US 30. To do a reconstruction of this mileage (involving removal of existing pavement, corrective grading, and new paving) would use all of the county's Farm-to-Market money from now to well into the next century.

OBJECTIVE

The objective of this project is to search for an effective, affordable technique based on cold in-place recycling of ACC pavement to widen an existing road, 18 feet (5.4 m) in width, to 24 feet (7.2 m) and to have a finished surface capable of carrying traffic with little or no additional work.

Specific topics to be investigated were:

1. Structural adequacy of the milled and cold recycled rehabilitated pavement.

2. Smoothness measurements for the widening sections, the milled sections not overlayed, the ACC overlay sections and the recycled sections placed with an asphalt paver.

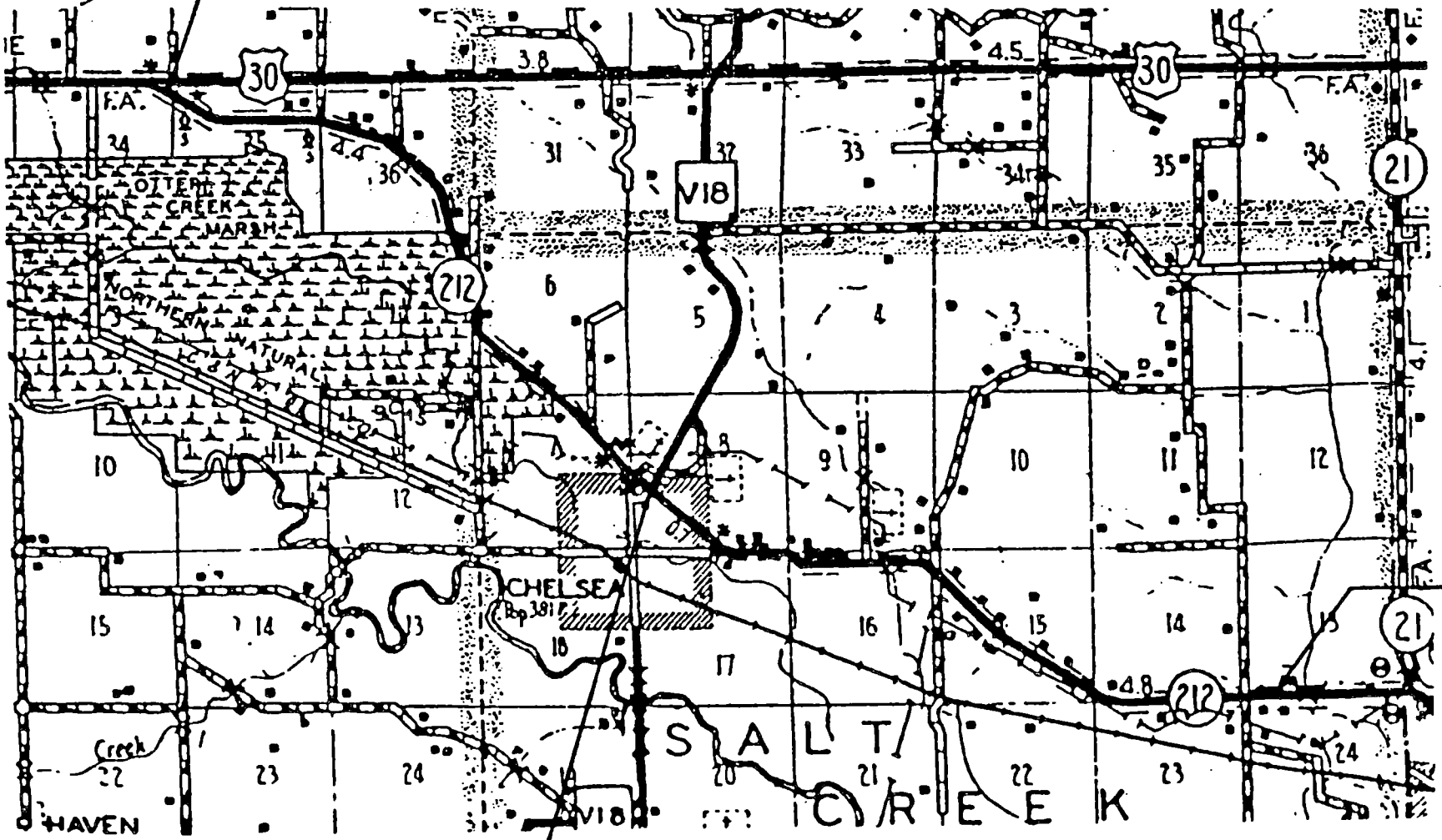
3. Density measurements to compare the density obtained in the several sections to the laboratory density of the recycled material.

PROJECT LOCATION AND DESCRIPTION

The proposed research is part of a project to improve a portion of Tama County Route E66 (formerly Iowa 212, formerly US 30) (see Figure 1) and involves:

PROJECT LOCATION

BEGINNING OF DIVISION 1
STA. 2307+75



END OF DIVISION 1
STA. 2546+97

Figure 1

1. Basic treatment: cold in-place recycling of three inches of the existing ACC surfacing to provide material for a widening strip, three feet (0.9 m) wide, to be placed along each side of the existing roadway,

2. Test sections applied to "Basic Treatment" sections:

   A. 400 feet (120 m) of aggregate seal coat only plus three engineering fabrics placed over the longitudinal joint.

   B. 400 feet (120 m) of slurry seal coat only plus three engineering fabrics placed over the longitudinal joint.

   C. 700 feet (210 m) of a 2 inch (5.1 cm) overlay of new hot mix ACC only plus three engineering fabrics placed over the longitudinal joint.

3. Test sections applied to 1500 feet (450 m) where three inches (7.6 cm) of ACC has been cold milled to provide material for the widening strip and an additional three inches (7.6 cm) of remaining ACC has been cold in-place recycled (placed by an asphalt paver):

   A. As in 2.

   B. As in 2.

   C. As in 2.

CONSTRUCTION

The research was part of a project to improve a 4.5 mile (7.2 km) portion of Tama County road E66 (formerly Iowa 212, formerly US 30). Three inches (7.6 cm) of the six inch ACC resurfacing on this PCC pavement was milled off to provide a three foot (.9 m) widening strip on both sides of the existing roadway. Fog seal treatment, bituminous seals or slurry seals were used to provide the wearing surface.

The contractors began the milling and trenching operations on June 14, 1989 and the entire project was completed August 17, 1989.

DAILY CONSTRUCTION RECORD

Wednesday, June 14, 1989

The milling procedure began at station 2315+50 in the right lane only. With the milling machine being 12 feet (3.6 m) wide and the road lane 9 feet (2.7 m) wide, the outside track of the machine would break off pieces of the ACC at the edge. The subcontractor began the trenching operation behind the milling machine and it soon proved inadequate in keeping pace with the milling operation. Consequently, the milled material was left in a windrow overnight to be compacted in the widening trench the following day. There was some discussion about obtaining an-

other trencher. In the meantime, the trench was bladed out 2 1/2 feet wide and 4 inches deep.

Thursday, June 15, 1989

Trenching began at station 2351+00 prior to milling to give it a head start. From station 2352+00 to 2355+75 a piece of concrete 15 inches wide (38.1 cm) at a depth of 4-6 inches (10-15 cm) was discovered. The milling operation ran smoothly until the machine ran out of asphalt emulsion. It again was running smoothly, but had to cease operating to allow the trencher to catch up. The second day's progress was over 6,700 feet (2 km).

Thursday, June 29, 1989

Work proceeded eastward toward Chelsea and back westward over the last 2 weeks with the milling operation now working mostly in the left, westbound lane toward the research sections of the project (station 2333+00 to 2365+00). The new "Ditch Witch D-100" trencher did a significantly better job of keeping pace with the milling machine and with only a few minor repairs. Everything proceeded smoothly and the entire milling operation for the project was finally completed.

Tuesday, August 8, 1989

Work started on placing engineering fabrics on test sections using AC-10 asphalt cement. Trevira 1114 was placed from station 2345+00 to 2346+00, 1-Step Roadglas from station 2344+00-2345+00 on both sides and station 2351+00 to 2352+00, and Petromat from station 2343+00 to 2344+00. Other test sections utilized the same three engineering fabrics.

Wednesday, August 9, 1989

1-Step Roadglas was placed at station 2339+00 to 2340+00 using the heated binder and fiberglass on the rest of the 1-Step Roadglas areas as the 1-Step was discontinued due to lack of supply.

The slurry seal test sections at station 2337+00 to 2341+00 and 2355+00 to 2359+00 were to be done using a CSS-1H emulsion. It was determined that the asphalt emulsion on hand was inadequate to satisfactorily complete these sections, and more was received from Elf Asphalt in Des Moines.

Friday, August 11, 1989

A sample of chips from the spreader belt and a sample of CRS-2 emulsion were taken by a DOT representative for the chip seal test section done today.

Thursday, August 17, 1989

Brooming all the seal coat sections was the last thing done. All the research test sections are now completed.

PERFORMANCE

As of the writing of this report, the performance of the test sections of the road have been satisfactory. Although sections of the three foot (.9 m) widening strip show some areas of subsidence and cracking, the roadway has performed adequately in providing the public with customary wider driving lanes.

ACKNOWLEDGEMENTS

Research project HR-303 was sponsored by the Highway Research Advisory Board and Tama County. Funding for this project was from the Secondary Road Research Fund in the amount of $100,000.

The Tama County Secondary Road Department wishes to extend their appreciation to the Tama County Board of Supervisors, the Iowa Department of Transportation, the Asphalt Paving Association of Iowa, Nady Engineering Service and the employees of Koss Construction and Cessford Construction Company for the extra effort and cooperation that was put forth in the completion of this research project.

Appendix A
Contract Document

Iowa Department of Transportation
800 Lincoln Way, Ames, IA 50010 515/239-1414

MAY 31 1988

County Auditor:

We are enclosing one fully signed copy of the contract(s) awarded by your Board of Supervisors for the following project(s):

Tama County, SN-4875(1), ACC

Very truly yours,

Harvey H. Olson

Harvey H. Olson
Contracts Engineer
Highway Division

HHO:djw

Enclosure

cc: District 1 Engineer
Reilly Constr. Co., Inc.
Box 99
Ossian, IA 52161
Tama County Engineer

Form 650019 8-87 H-688

CONTRACT

NO. 28666

County TAMA Project No. SN-4875(1)--51-86
Type of Work GRADE & ACC PAVEMENT Miles 9.3200
Cost Center 801000 Object Code 860
ON SECONDARY ROAD E-66 FROM THE JUNCTION OF U.S. 30, SOUTHEASTERLY TO APPROXIMATELY 0.6 MILE WEST OF THE JUNCTION OF IOWA 21.

This agreement made and entered by and between the BOARD OF SUPERVISORS OF TAMA COUNTY, IOWA

Contracting Authority, and

REILLY CONSTRUCTION CO., INC. OF OSSIAN, IOWA

00037400 Contractor.

It is agreed that the notice and instructions to bidders, the proposal filed herein, the general specifications of the Iowa Department of Transportation for 1984, together with supplemental specifications and special provisions, together with the general and detailed plans, if any, for said project SN-4875(1)--51-86, together with Contractor's performance bond, are made a part hereof and together with this instrument constitute the contract. This contract contains all of the terms and conditions agreed upon by the parties hereto. A true copy of said plans and specifications is now on file in the office of the Contracting Authority under date of MAY 5, 1988.

Contractor, for and in consideration of $ **1,193,009.03, payable as set forth in the specifications constituting a part of this contract, agrees to construct various items of work and/or provide various materials or supplies in accordance with the plans and specifications therefor, and in the locations designated in the Notice to Bidders.

Contractor certifies by his signature on this contract, under pain of penalties for false certification, that he has complied with Iowa Code Section 324.17(8) (1985) as amended, if applicable.

In consideration of the foregoing, Contracting Authority hereby agrees to pay the Contractor promptly and according to the requirements of the specifications the amounts set forth, subject to the conditions as set forth in the specifications.

It is further understood and agreed that the above work shall be commenced or completed in accordance with the following schedule:

START. DATE	COMPL. DATE	WORK. DAYS
	06/30/89	120

Time is the essence of this contract.

To accomplish the purpose herein expressed, Contracting Authority and Contractor have signed this and four other identical instruments as of the 24 day of MAY, 1988.

BOARD OF SUPERVISORS OF TAMA COUNTY, IOWA

By _____
Contracting Authority

REILLY CONSTRUCTION CO., INC. OF OSSIAN, IOWA

By _____
Contractor

Approved:

_____ MAY 31 1988
Contracts Engineer Date
IOWA DEPT. OF TRANSPORTATION

Form 650031 8-87 H-668

CONTRACT PRICES

Proposal I.D. No. 880880 CONTRACT NO. 28666 Bid Order No. 157

Contractor's No. 13,7,4,0,01 County TAMA Page No. 1

Project No. SN-4875(1)--51-86 Type of Work GRADE & ACC PAVEMENT

Line No.	Item	Item Quantity and Units	Unit Price Dollars XXXX.XXX	Unit Price Cents XXXX	Amount Dollars XX,XXX.XXX	Amount Cents XX
0010	SURFACING, GRANULAR, CLASS A CRUSHED STONE - ON ROAD	60 TONS	15.0000		900.00	
0020	APRONS, CONCRETE PRECAST, 6' X 3'	6 ONLY	1800.0000		10,800.00	
0030	APRONS, CONCRETE PRECAST, 7' X 3'	2 ONLY	1900.0000		3,800.00	
0040	APRONS, CONCRETE PRECAST, 8' X 4'	2 ONLY	2050.0000		4,100.00	
0050	APRONS, CONCRETE, 36 IN. DIA.	6 ONLY	450.0000		2,700.00	
0060	APRONS, METAL, 21 IN. DIA.	9 ONLY	155.0000		1,395.00	
0070	APRONS, METAL, 24 IN. DIA.	4 ONLY	165.0000		660.00	
0080	APRONS, METAL, 36 IN. DIA.	2 ONLY	450.0000		900.00	
0090	APRONS, METAL, 66 IN. DIA.	2 ONLY	1225.0000		2,450.00	
0100	APRONS, METAL, 78 IN. DIA.	2 ONLY	1500.0000		3,000.00	
0110	APRONS, METAL, ARCH, 28 IN. X 20 IN.	4 ONLY	120.0000		480.00	
0120	APRONS, METAL, ARCH, 42 IN. X 29 IN.	6 ONLY	245.0000		1,470.00	
0130	CLEARING & GRUBBING	1 ACRES	2000.0000		2,000.00	
0140	CULVERT, CONCRETE ROADWAY PIPE, 36 IN. DIA.	245 LINEAR FT	65.0000		15,925.00	
0150	CULVERT, CORRUGATED METAL ARCH ROADWAY PIPE, 28 IN. X 20 IN.	27 LINEAR FT	42.0000		1,134.00	
0160	CULVERT, CORRUGATED METAL ARCH ROADWAY PIPE, 42 IN. X 29 IN.	108 LINEAR FT	47.5000		5,130.00	
0170	CULVERT, CORRUGATED METAL ARCH ROADWAY PIPE, 49 IN. X 33 IN.	120 LINEAR FT	60.0000		7,200.00	
0180	CULVERT, CORRUGATED METAL ROADWAY PIPE, 21 IN. DIA.	74 LINEAR FT	43.0000		3,182.00	
0190	CULVERT, CORRUGATED METAL ROADWAY PIPE, 24 IN. DIA.	118 LINEAR FT	21.0000		2,478.00	

CONTRACT PRICES

Proposal I.D. No. 880880 | CONTRACT NO. 28666 | Bid Order No. 157

Contractor's No. 13 7 41 01 01 | County TAMA | Page No. 3

Project No. SN-4875(1)--51-86 | Type of Work GRADE & ACC PAVEMENT

Line No.	Item	Item Quantity and Units	Unit Price Dollars X,XXX,XXX	Unit Price Cents XXXX	Amount Dollars XX,XXX,XXX	Amount Cents XX
	(CONTINUED)					
0420	FLAGGERS	10 DAYS	100.0000		1,000.00	
0430	APRONS, CONCRETE PRECAST, 12' X 5'	2 ONLY	5050.0000		10,100.00	
0440	APRONS, CONCRETE PRECAST, 8' X 4'	2 ONLY	2050.0000		4,100.00	
0450	APRONS, CONCRETE, 48 IN. DIA.	1 ONLY	685.0000		685.00	
0460	APRONS, METAL, 21 IN. DIA.	7 ONLY	155.0000		1,085.00	
0470	APRONS, METAL, 30 IN. DIA.	1 ONLY	250.0000		250.00	
0480	APRONS, METAL, ARCH, 49 IN. X 33 IN.	2 ONLY	400.0000		800.00	
0490	APRONS, METAL, ARCH, 42 IN. X 29 IN.	2 ONLY	245.0000		490.00	
0500	CLEARING & GRUBBING	2 ACRES	2000.0000		4,000.00	
0510	CONCRETE, STRUCTURAL	32.6 CUBIC YDS	350.0000		11,410.00	
0520	CULVERT, CONCRETE ROADWAY PIPE, 48 IN. DIA.	81 LINEAR FT	85.0000		6,885.00	
0530	CULVERT, CORRUGATED METAL ARCH ROADWAY PIPE, 49 IN. X 33 IN.	25 LINEAR FT	60.0000		1,500.00	
0540	CULVERT, CORRUGATED METAL ARCH ROADWAY PIPE, 64 IN. X 43 IN.	40 LINEAR FT	125.0000		5,000.00	
0550	CULVERT, CORRUGATED METAL ENTRANCE PIPE, 18 IN. DIA.	165 LINEAR FT	16.0000		2,640.00	
0560	CULVERT, CORRUGATED METAL ENTRANCE PIPE, 24 IN. DIA.	28 LINEAR FT	22.0000		616.00	
0570	CULVERT, CORRUGATED METAL ROADWAY PIPE, 21 IN. DIA.	113 LINEAR FT	43.0000		4,859.00	
0580	CULVERT, CORRUGATED METAL ROADWAY PIPE, 66 IN. DIA.	33 LINEAR FT	125.0000		4,125.00	
0590	CULVERT, CORRUGATED METAL ROADWAY PIPE, 30 IN. DIA.	43 LINEAR FT	62.0000		2,666.00	
0600	CULVERT, CORRUGATED METAL ROADWAY PIPE, 54 IN. DIA.	124 LINEAR FT	75.0000		9,300.00	

Line No.	Item	Item Quantity and Units	Unit Price Dollars X,XXX.XXX	Unit Price Cents XXXX	Amount Dollars XX,XXX.XXX	Amount Cent XX
	(CONTINUED)					
0200	CULVERT, CORRUGATED METAL ROADWAY PIPE, 36 IN. DIA.	24 LINEAR FT	62.0000		1,488.00	
0210	CULVERT, CORRUGATED METAL ROADWAY PIPE, 78 IN. DIA.	102 LINEAR FT	90.0000		9,180.00	
0220	CULVERT, PRECAST CONCRETE BOX, 6' X 3'	36 LINEAR FT	450.0000		16,200.00	
0230	CULVERT, PRECAST CONCRETE BOX, 7' X 3'	18 LINEAR FT	510.0000		9,180.00	
0240	CULVERT, PRECAST CONCRETE BOX, 8' X 4'	12 LINEAR FT	560.0000		6,720.00	
0250	ELBOWS, CONCRETE PIPE, 36 IN. DIA.	1 ONLY	240.0000		240.00	
0260	ELBOWS, CORRUGATED METAL ARCH ROADWAY PIPE, 42 IN. X 29 IN.	4 ONLY	280.0000		1,120.00	
0270	ELBOWS, CORRUGATED METAL ARCH ROADWAY PIPE, 49 IN. X 33 IN.	4 ONLY	320.0000		1,280.00	
0280	ELBOWS, CORRUGATED METAL PIPE, 21 IN. DIA.	2 ONLY	160.0000		320.00	
0290	ELBOWS, CORRUGATED METAL PIPE, 36 IN. DIA.	2 ONLY	280.0000		560.00	
0300	EXCAVATION, CLASS 10, ROADWAY & BORROW	25752 CUBIC YDS	2.9000		74,680.80	
0310	EXCAVATION, CLASS 20	276 CUBIC YDS	20.0000		5,520.00	
0320	GRANULAR MATERIAL	32 TONS	20.0000		640.00	
0330	MOBILIZATION	LUMP SUM			44,000.00	
0340	MORTAR, FLOWABLE	220 CUBIC YDS	70.0000		15,400.00	
0350	OVERHAUL	315261 STA. YDS.	0.0200		6,305.22	
0360	REMOVAL OF EXISTING STRUCTURES	LUMP SUM			5,000.00	
0370	REMOVAL OF PAVEMENT	2753 SQ. YDS.	3.5000		9,635.50	
0380	STABILIZING CROP - SEEDING AND FERTILIZING	21 ACRES	200.0000		4,200.00	
0390	SUBDRAIN, PLASTIC PIPE, 6 IN.	95 LINEAR FT	15.0000		1,425.00	
0400	TOPSOIL, STRIP, SALVAGE AND SPREADING	8470 CUBIC YDS	3.5000		29,645.00	
0410	TRAFFIC CONTROL	LUMP SUM			7,000.00	

Line No.	Item	Item Quantity and Units	Unit Price Dollars X,XXX,XXX	Unit Price Cents XXXX	Amount Dollars XX,XXX,XXX	Amount Cents XX
	(CONTINUED)					
0820	SUBDRAIN, TILE, 6 IN. DIA.	995 LINEAR FT	7.0000		6,965.00	
0830	TOPSOIL, STRIP, SALVAGE AND SPREADING	4961 CUBIC YDS	3.5000		17,363.50	
0840	TRAFFIC CONTROL	LUMP SUM			7,000.00	
0850	FLAGGERS	10 DAYS	100.0000		1,000.00	
0860	CULVERT, CORRUGATED METAL ROADWAY PIPE, 66 IN. DIA.	28 LINEAR FT	100.0000		2,800.00	
0870	CULVERT, CORRUGATED METAL ROADWAY PIPE, 48 IN. DIA.	104 LINEAR FT	85.0000		8,840.00	
0880	ASPHALT PAVEMENT, IN-PLACE COLD RECYCLED	48880 SQ. YDS.	1.7700		86,517.60	
0890	ASPHALT REJUVENATING AGENT	43991 GALLONS	0.8500		37,392.35	
0900	EXCAVATION, CLASS 13, FOR WIDENING	8095 CUBIC YDS	2.5900		20,966.05	
0910	SHOULDERS, GRANULAR, TYPE B	2815 TONS	8.9000		25,053.50	
0920	BASE, TYPE B CLASS 1 ASPHALT CEMENT CONCRETE	2271 TONS	19.4500		44,170.95	
0930	ASPHALT CEMENT	136 TONS	144.1400		19,603.04	
0940	PRIMER OR TACK-COAT BITUMEN	3727 GALLONS	0.8300		3,093.41	
0950	SHOULDER CONSTRUCTION, EARTH	28 STAS.	125.0000		3,500.00	
0960	ASPHALT EMULSION FOR FOG SEAL	15356 GALLONS	1.2400		19,041.44	
0970	ASPHALT EMULSION FOR SLURRY SEAL	746 GALLONS	1.8200		1,357.72	
0980	AGGREGATE FOR SLURRY SEAL	26 TONS	180.4000		4,690.40	
0990	AGGREGATE, ROADWAY COVER, 3/8 IN.	26 TONS	26.5400		690.04	
1000	BINDER BITUMEN, FURNISH & APPLY CRS-2S	640 GALLONS	4.2000		2,688.00	
1010	FABRIC REINFORCEMENT	533 SQ. YDS.	6.4100		3,416.53	
1020	ASPHALT PAVEMENT, IN-PLACE COLD RECYCLED	46905 SQ. YDS.	1.7700		83,021.85	
1030	ASPHALT REJUVENATING AGENT	42215 GALLONS	0.8500		35,882.75	

Line No.	Item	Item Quantity and Units	Unit Price		Amount	
			Dollars X,XXX,XXX	Cents XXXX	Dollars XX,XXX,XXX	Cents XX
	(CONTINUED)					
0610	CULVERT, CORRUGATED METAL ARCH ROADWAY PIPE, 42 IN. X 29 IN.	14 LINEAR FT		47.5000		665.00
0620	CULVERT, PRECAST CONCRETE BOX, 12' X 5'	26 LINEAR FT		525.0000		13,650.00
0630	CULVERT, PRECAST CONCRETE BOX, 8' X 4'	14 LINEAR FT		560.0000		7,840.00
0640	ELBOWS, CONCRETE PIPE, 48 IN. DIA.	1 ONLY		325.0000		325.00
0650	ELBOWS, CORRUGATED METAL ARCH ROADWAY PIPE, 49 IN. X 33 IN.	2 ONLY		250.0000		500.00
0660	ELBOWS, CORRUGATED METAL PIPE, 21 IN. DIA.	2 ONLY		110.0000		220.00
0670	ELBOWS, CORRUGATED METAL PIPE, 30 IN. DIA.	2 ONLY		175.0000		350.00
0680	EXCAVATION, CLASS 10, CHANNEL	1328 CUBIC YDS		4.0000		5,312.00
0690	EXCAVATION, CLASS 10, ROADWAY & BORROW	35215 CUBIC YDS		2.9000		102,123.50
0700	EXCAVATION, CLASS 20, FOR ROADWAY PIPE CULVERT	185 CUBIC YDS		20.0000		3,700.00
0710	SURFACING, GRANULAR, CLASS A CRUSHED STONE - ON ROAD	10 TONS		15.0000		150.00
0720	GUARDRAIL, END ANCHORAGES, BEAM, RE-52	14 ONLY		400.0000		5,600.00
0730	GUARDRAIL, FORMED STEEL BEAM	1293.75 LINEAR FT		10.0000		12,937.50
0740	GUARDRAIL, POSTS, BEAM	202 ONLY		50.0000		10,100.00
0750	MOBILIZATION	LUMP SUM				44,000.00
0760	OVERHAUL	606273 STA. YDS.		0.0200		12,125.46
0770	REMOVAL OF EXISTING STRUCTURES	LUMP SUM				4,000.00
0780	REMOVAL OF PAVEMENT	2300 SQ. YDS.		3.5000		8,050.00
0790	STABILIZING CROP - SEEDING AND FERTILIZING	16 ACRES		200.0000		3,200.00
0800	STEEL, REINFORCING	5810 POUNDS		1.0000		5,810.00
0810	SUBDRAIN OUTLET, CORRUGATED METAL PIPE, 6 IN. DIA.	36 ONLY		100.0000		3,600.00

rm 650031 8-87 H-688

CONTRACT PRICES

oposal I.D. No. 880820 CONTRACT NO. 28666 Bid Order No. 157

ontractor's No. 3 7 4 0 1 01 County TAMA Page No. 6

oject No. SN-4875(1)--51-86 Type of Work GRADE & ACC PAVEMENT

Line No.	Item	Item Quantity and Units	Unit Price Dollars X,XXX,XXX	Unit Price Cents XXXX	Amount Dollars XX,XXX,XXX	Amount Cents XX
	(CONTINUED)					
1040	EXCAVATION, CLASS 13, FOR WIDENING	8638 CUBIC YDS	2.5900		22,372.42	
1050	SHOULDERS, GRANULAR, TYPE B	3010 TONS	9.3800		28,233.80	
1060	BASE, TYPE B CLASS 1 ASPHALT CEMENT CONCRETE	1532 TONS	20.3500		31,176.20	
1070	ASPHALT CEMENT	92 TONS	144.1400		13,260.88	
1080	PRIMER OR TACK-COAT BITUMEN	1878 GALLONS	0.8300		1,558.74	
1090	SHOULDER CONSTRUCTION, EARTH	23 STAS.	125.0000		2,875.00	
1100	ASPHALT EMULSION FOR FOG SEAL	18762 GALLONS	1.2400		23,264.88	

TOTAL $1,193,009.03

LAST PAGE

IOWA DEPARTMENT OF TRANSPORTATION

AMES, IOWA

SPECIAL PROVISION

FOR

COLD IN-PLACE ASPHALT RECYCLING

February 23, 1988

ll applicable provisions of the Iowa Department of Transportation's Standard pecifications for Highway and Bridge Construction, 1984, shall apply in addition to the following.

186.01 DESCRIPTION. This work shall consist of the in-place recycling of an existing pavement by pulverizing to the depth as shown on the plans, and by adding emulsified asphalt and water (if required) with the pulverized bituminous surfacing, then placing and compacting said mixture as shown on the plans and as provided herein unless otherwise directed by the Engineer.

The contractor shall furnish all equipment, tools, labor and material (except the pulverized bituminous material), and any other appurtenances necessary to complete the work.

186.02 EQUIPMENT. Equipment used for the tilling or milling shall be subject to the approval of the engineer.

The Contractor shall furnish a self-propelled machine capable of cutting and removing the bituminous pavement, in one pass, to the depth shown on the plans. The cutting machine shall have automatic controls capable of maintaining a uniform grade and cross slope. The existing asphalt pavement shall be pulverized to 98-100% passing the 1 1/4" sieve.

Provisions shall be made for continuous weight measurement of the pulverized pavement material, interlocked with the additive metering device in order that the desired additive content will be maintained. Positive means shall be provided for calibrating the weight measurement device and the additive metering device.

The additive shall be applied in a mixing chamber which is capable of mixing the pulverized pavement material and additive to a homogeneous mixture. The additive pump shall automatically shut off when delivery of pulverized material to the mixing chamber is stopped. The additive system shall maintain the binder amount within plus or minus 0.2 percent of the desired rate. The mixture shall be placed in a windrow in such a manner that segregation does not occur.

1.) Rollers - Shall comply with Sec. 2001.05 Standard Specifications 1984.

Tama County
SN 4875(1)--51-86
ACC Resurfacing
Page 2 of 2

Iowa Department of Transportation
Special Provision for Cold In-Place Asphalt Recycling

186.03 Materials - The Asphalt Emulsion shall be a grade as specified by the Engineer and shall meet the the requirements of Sec. 4140 Standard Specifications 1984.

187.04 GENERAL CONDITIONS AND SPECIFICATIONS. Except in specific cases when permitted by the Engineer, the work shall be done only between May 1 and October 1. Bituminous materials shall be applied and bituminous mixtures shall be placed only when air temperature in the shade is above 60° F.

A. Cleaning and Preparation. Prior to initiating any recycling operation or other inherent work, the contractor shall clear, grub, and remove all vegetation and debris within the width of pavement to be recycled. Disposal of said vegetation and debris shall be as directed by the Engineer.

B. Mixing. If there is insufficient moisture for proper mixing or optimum moisture, water in the amount specified by the Engineer shall be added. A place for adding water shall be provided.

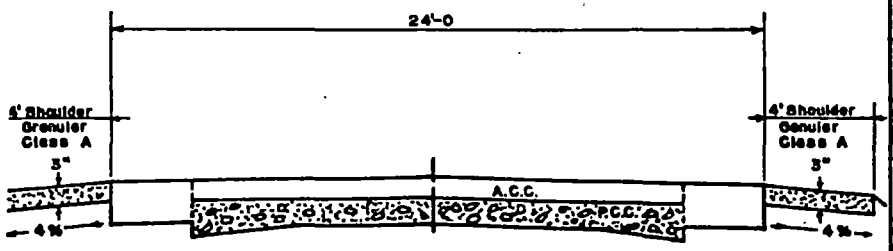
C. Compaction. After the mixture has been spread and it will bear the weight of the roller without excess laterial movement, as determined by the Engineer, it shall be rolled longitudinally. Initial rolling shall be performed with the pneumatic roller(s) and continue until no displacement is discerned or until the pneumatic rollers have "walked out." Final rolling to eliminate pneumatic tire marks and achieve density shall be done by steel wheel roller(s) either in static or vibratory mode, as required, to achieve required density.

Rollers shall not be started or stopped on uncompacted recycled material. Rolling shall be established so that starting and stopping will be on previously compacted recycled material or on existing asphalt mat.

E. Density. The field density shall be a minimum of 92% of laboratory density based on the dry weight of compacted material. Five tests per days run will be required at locations as determined by the Engineer. A nuclear tester may be used to determine density.

F. Basis of Payment. This work will be paid for at the Contract Unit Prices per gallon for Asphalt Rejuvenating Agent and square yards for Asphalt Pavement, in place Cold recycled which shall include all preparation, tilling or milling, mixing, shaping, and compaction.

(L)



GRANULAR CLASS "A" SHOULDER SECTION

DIV. 1 STA. 2307+75 – STA. 2546+97

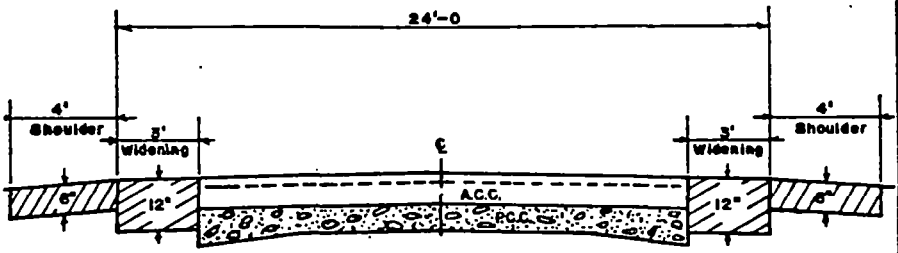
DIV. 2 STA. 2546+97 – STA. 2814+97

DIV. 3
-418 L.F. LT. INTRS.
-358 L.F. RT. INTRS.

DIV. 4
-44 L.F. LT. INTRS.
-298 L.F. RT. INTRS.
-63 L.F. BRIDGE

EQUATIONS:
DIV. 3 – 78.98
DIV. 4 – 1465.79'

(M)



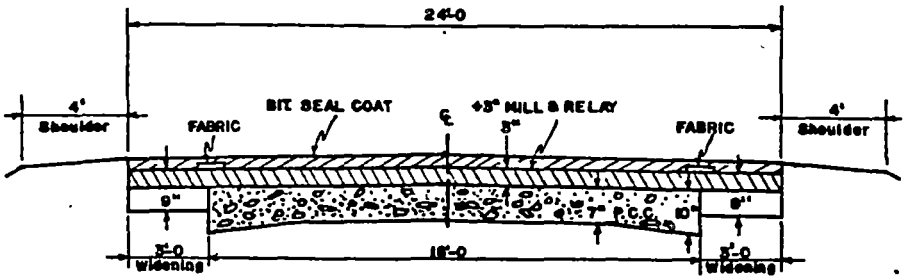
EXCAVATION, CLASS 13 SECTION

DIV. 3	DIV. 4
STA. 2307+75 – STA. 2388+00 (1)	◘ STA. 2546+97 – STA. 2656+78.5 (3,4)
STA. 2391+50 – STA. 2417+60	▪ STA. 2669+50 – STA. 2706+55 (5)
STA. 2418+00 – STA. 2452+50	STA. 2707+90 – STA. 2749+00
▲ STA. 2465+30 – STA. 2546+97 (2)	STA. 2753+75 – STA. 2814+97 (6)

( ) EQUATIONS:
DIV. 3 – 78.98'
DIV. 4 – 1465.79'

▲ NO EXCAV. : LT. 418' RT. 358' (L.F.)
▪ NO WIDENING: LT. 88' RT. 207' (L.F.) ◘ NO EXCAV. : LT 44' RT. 298' (L.F.)

(I)

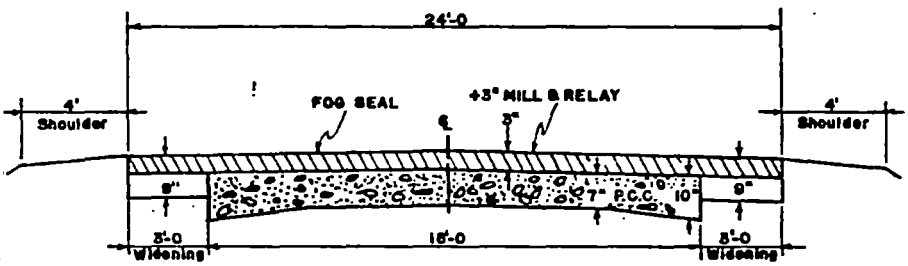


DIV. 3

ADDITIONAL 3" MILL & RELAY WITH BIT. SEAL COAT SECTION

	STA. 2359+00	–	STA. 2363+00
PETROMAT (18")	STA. 2360+00	–	STA. 2361+00
ROAD GLASS (12")	STA. 2361+00	–	STA. 2362+00
TREVIRA 1114 (18")	STA. 2362+00	–	STA. 2363+00

(J)

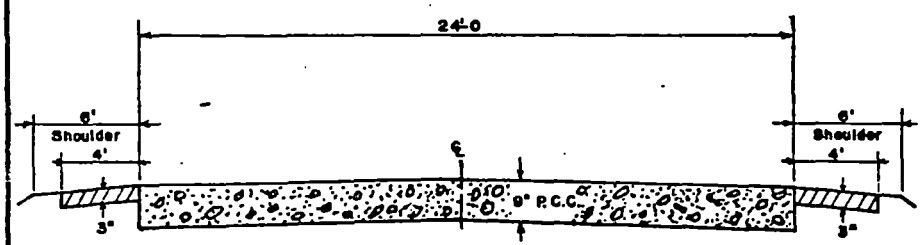


DIV. 3

ADDITIONAL 3" MILL & RELAY WITH FOG SEAL SECTION

STA. 2363+00 – STA. 2365+00

(K)



EXCAVATION, CLASS 13 P.C.C. SHOULDER SECTION

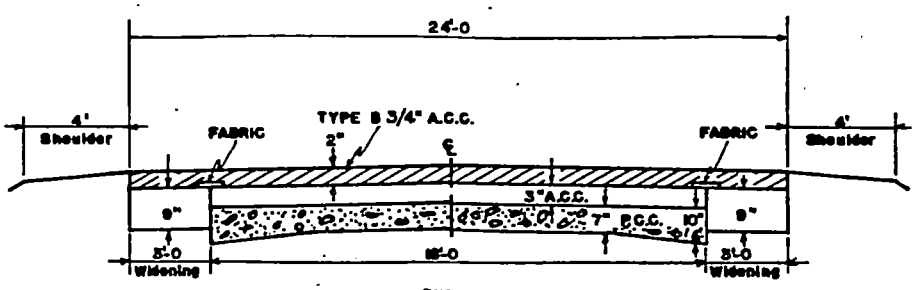
DIV. 3	STA. 2388+00	–	STA. 2391+50
DIV. 4	* STA. 2656+78.5	–	STA. 2662+75
"	STA. 2706+55	–	STA. 2707+80

* –83 L.F. BRIDGE

BRUNING 44-131-65300

LDOT 8000-31820

(F)

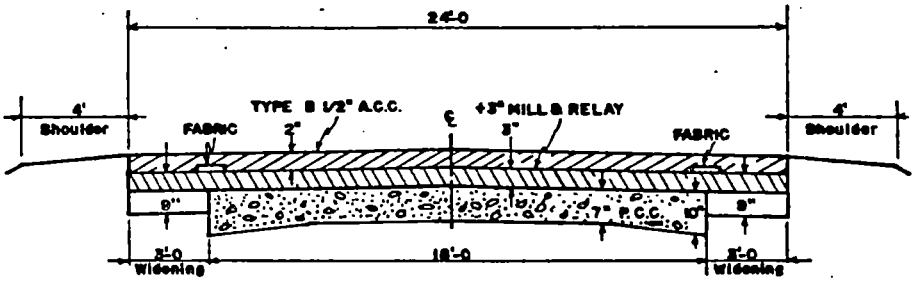


DIV. 3

2" A.C.C. TYPE "B" SECTION

	STA. 2341+00	—	STA. 2348+00
PETROMAT (18")	STA. 2343+00	—	STA. 2344+22.5
ROAD GLASS (12")	STA. 2344+22.5	—	STA. 2345+22.5
TREVIRA 1114 (18")	STA. 2345+22.5	—	STA. 2346+22.5

(G)

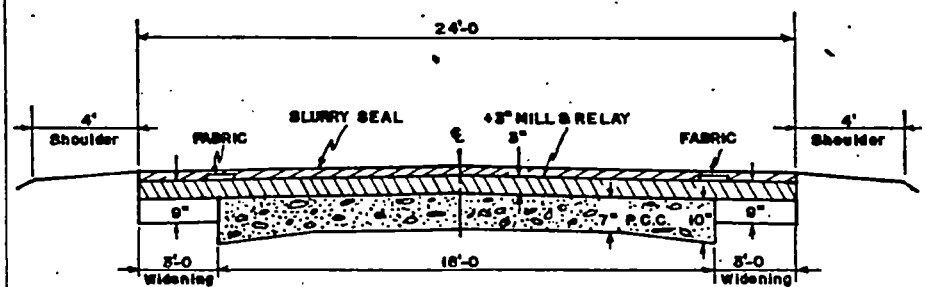


DIV. 3

ADDITIONAL 3" MILL & RELAY WITH 2" A.C.C. SURFACE SECTION

	STA. 2348+00	—	STA. 2355+00
PETROMAT (18")	STA. 2350+00	—	STA. 2351+00
ROAD GLASS (12")	STA. 2351+00	—	STA. 2352+00
TREVIRA 1114 (18")	STA. 2352+00	—	STA. 2353+00

(H)

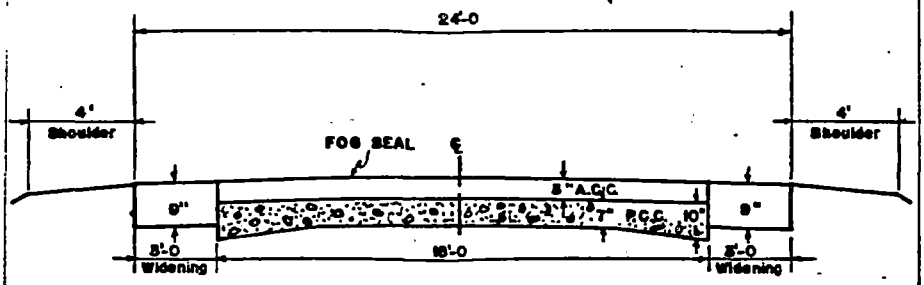


DIV. 3

ADDITIONAL 3" MILL & RELAY WITH SLURRY SEAL SECTION

	STA. 2355+00	—	STA. 2359+00
PETROMAT (18")	STA. 2356+00	—	STA. 2357+00
ROAD GLASS (12")	STA. 2357+00	—	STA. 2358+00
TREVIRA 1114 (18")	STA. 2358+00	—	STA. 2359+00

Ⓒ

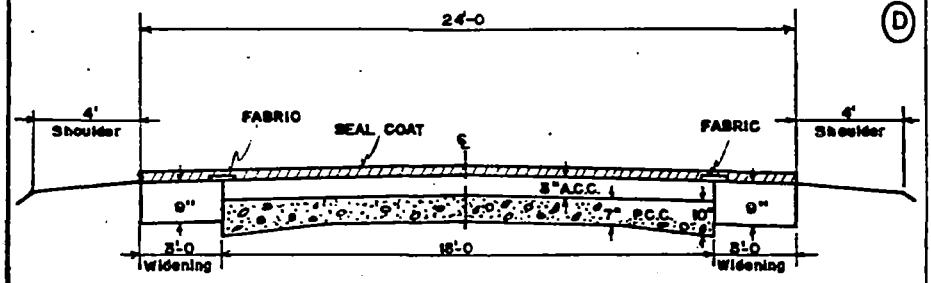


FOG COAT SECTION

DIV. 3		DIV. 4	
STA. 2307+75	– STA. 2333+00	STA. 2546+97	– STA. 2656+78.5 (3,4)
STA. 2365+00	– STA. 2388+00		
STA. 2391+50	– STA. 2417+60	STA. 2669+50	– STA. 2706+55 (5)
STA. 2418+00	– STA. 2452+50	STA. 2707+90	– STA. 2749+00
STA. 2465+30	– STA. 2546+97 (2)	STA. 2753+75	– STA. 2814+97 (6)

EQUATIONS:
(2) – 56.46' (3,4) – 1447.4' – 0.73' (5) – 12.53' (6) – 5.13'

Ⓓ

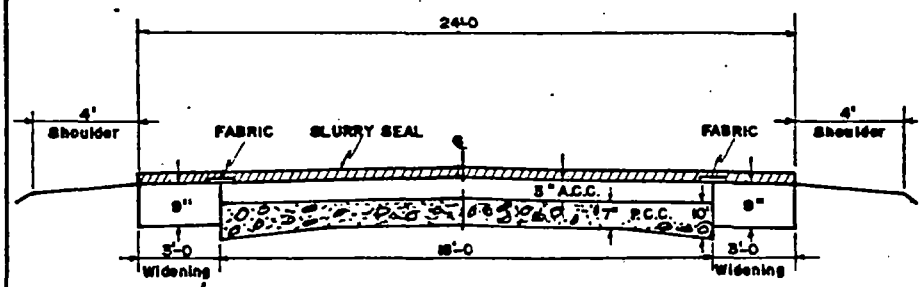


DIV. 3

BITUMINOUS SEAL COAT SECTION

		STA. 2333+00	–	STA. 2337+00
PETROMAT	(18")	STA. 2334+00	–	STA. 2335+00
ROAD GLASS	(12")	STA. 2335+00	–	STA. 2336+00
TREVIRA 1114	(18")	STA. 2336+00	–	STA. 2337+00

Ⓔ

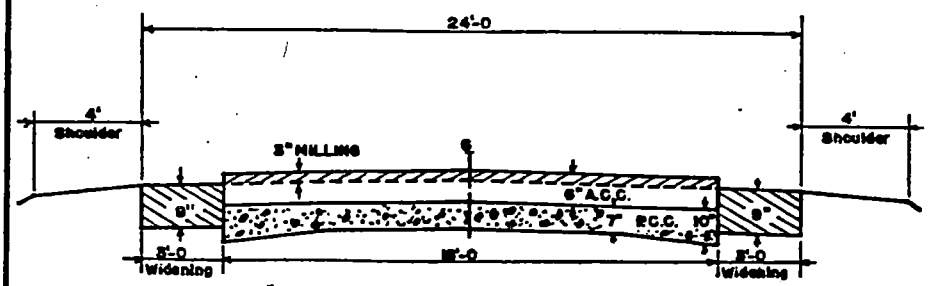


DIV. 3

SLURRY SEAL SECTION

		STA. 2337+00	–	STA. 2341+00
PETROMAT	(18")	STA. 2338+00	–	STA. 2339+00
ROAD GLASS	(12")	STA. 2339+00	–	STA. 2340+00
TREVIRA 1114	(18")	STA. 2340+00	–	STA. 2341+00

(A)



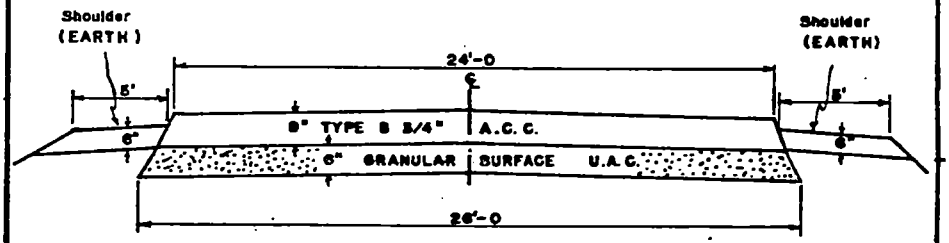
3" MILLING & WIDENING SECTION

DIV. 3	STA. 2307+75	—	STA. 2388+00
"	STA. 2391+50	—	STA. 2417+60
"	STA. 2418+00	—	STA. 2452+50
"	STA. 2465+30	—	STA. 2546+97
DIV. 4	STA. 2546+97	—	STA. 2656+78.5
"	STA. 2669+50	—	STA. 2706+55
"	STA. 2707+90	—	STA. 2749+00
"	STA. 2753+75	—	STA. 2814+97

EQUATIONS:

1 Sta.	2343+80.9	= 2344+03.4	(-22.5')	4 Sta.	2620+10.6	= 2620+11.33	(- 0.73')
2 Sta.	2465+69.72	= 2466+46.2	(-56.48')	5 Sta.	2669+97.68	= 2670+10.22	(- 12.53')
3 Sta.	2577+06.9	= 2591+54.3	(-1447.4')	6 Sta.	2754+67.19	= 2754+72.52	(- 5.13')

(B)



9" A.C.C. TYPE "B" & EARTH SHOULDER SECTION

DIV. 3	STA. 2417+60	STA. 2418+80
"	STA. 2452+50	STA. 2465+30
DIV. 4	STA. 2662+75	STA. 2669+50
"	STA. 2749+00	STA. 2753+75

Core Number	Location	Core Density	Laboratory Density	Core as % of Lab	Core Unit Weight, pcf
1	2384+60 Rt	2.242	2.161	103.7	139.9
2	2414+08 Lt	2.199	2.186	100.6	137.2
3	2447+24 Rt	2.216	2.067	107.2	138.3
4	2478+40 Lt	2.197	2.121	103.6	137.1
5	2509+56 Rt	2.234	2.073	107.8	139.4
6	2532+47 Lt	2.189	2.119	103.3	136.6
7	2594+81 Rt	2.239	2.147	104.3	139.7
8	2641+61 Lt	2.206	2.153	102.5	137.7
9	2687+35 Rt	2.193	2.152	101.9	136.8
10	2743+38 Lt	2.187	2.135	102.4	136.5
11	2785+17 Rt	2.196	2.128	103.2	137.0
12	2806+40 Lt	2.158	2.111	101.8	134.7

Core Densities of Cold Recycled Mixture

ASPH. CONC. COR
R. Monroe
V. Marks

Form 820257
6-83

FORM 257
20M 4-71

Iowa Department of Transportation

Materials Department

AMES LABORATORY

TEST REPORT — BITUMINOUS MATERIALS

Material Cold Recycled Asphalt Mix **Laboratory No.** ABEO-27

Intended Use Lane Widening

Project No. HR-303 **County** Tama

Contractor

Producer

Plant

Unit of Material 6 Cores taken from Rt. E-66

Sampled by G. Harris **Sender's No.**

Date Sampled 10/05/90 **Date Rec'd** 10/08/90 **Date Reported** 10/12/90

SIEVE ANALYSIS — PER CENT PASSING

	1½"	1"	3/4"	1/2"	3/8"	No. 4	No.8	No. 16	No. 30	No. 50	No. 100	No. 200
CORE #1				100	98	82	64	51	40	25	19	16
CORE #6			100	99	93	71	55	44	33	19	14	12

	Core #1	Core #6
% Aggregate - By Extraction	92.62	92.89
% Bitumen - By Extraction	7.38	7.11
% Water		
% Volatile	Specific Gravity 2.393 @ 275 °F	

For cores 2 and 4 the Rice samples were only heated long enough to break into small pieces. Dry weight was calculated from moisture samples. Several particles were larger than permissible 1/4 inch size. Samples contained several uncoated particles caused by the coring and sawing processe

Density #		Density
#1-2.212	2 Top =	2.203
#2-2.181	2 Cent. =	2.165
#3-2.168	2 Bottom =	2.165
#4-2.131	Avg.	2.178
#5-2.124	4 Top =	2.135
#6-2.106	4 Cent. =	2.113
	4 Bottom =	2.124
	Avg.	2.124

MISCELLANEOUS TESTS

Rice Sp. Gr. #2	2.435
Rice Sp. Gr. #4	2.432
Rice Voids #2	10.6
Rice Voids #4	12.7
Rice-Mixed @ 275 °F	2.399
Voids Mixed @ 275 °F	0.3

Signed Orin J. Lane

Testing Engineer

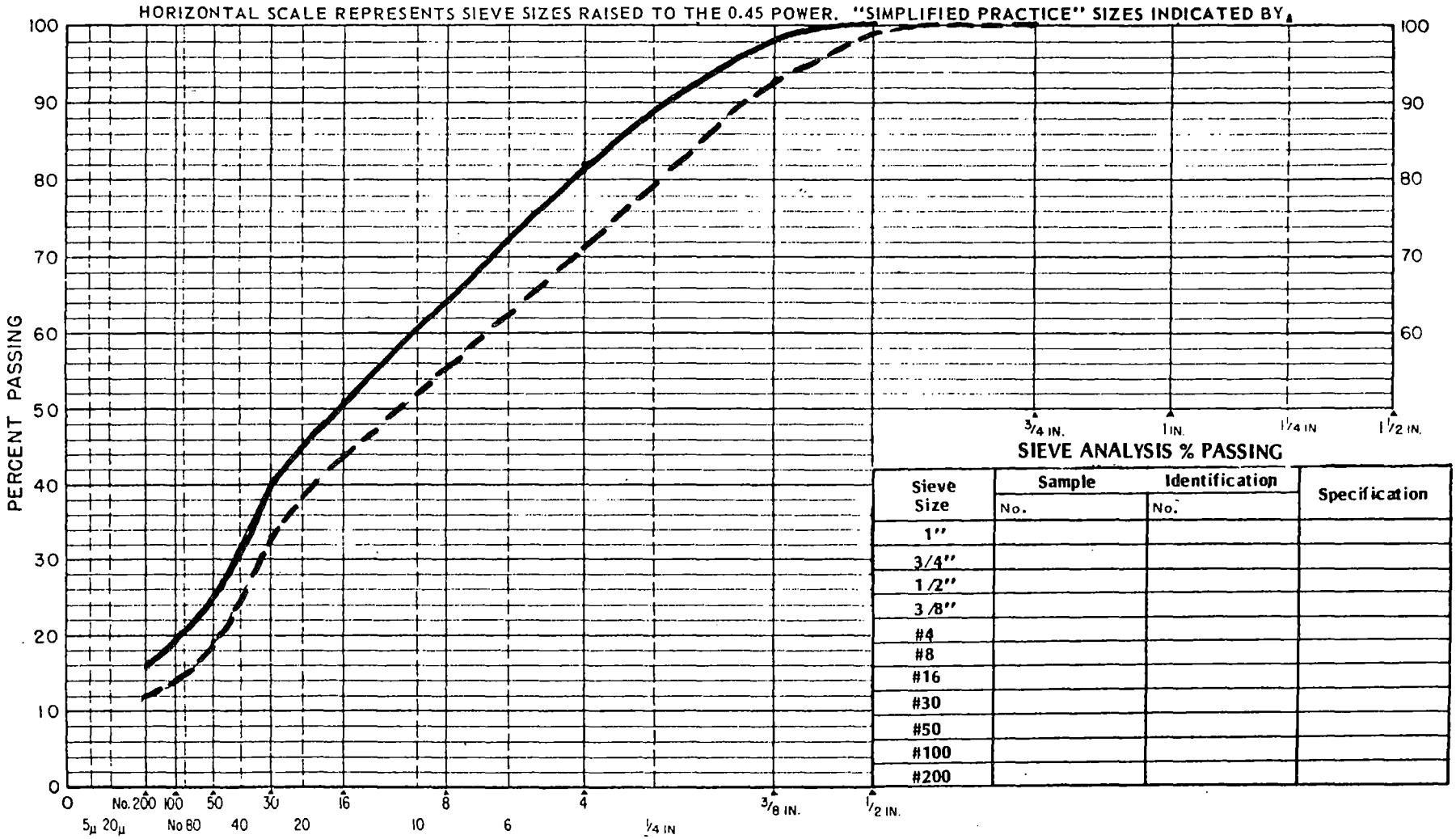
Core #1 ——————

Core #6 — — —

FORM 820925
8-75

IOWA DEPARTMENT OF TRANSPORTATION

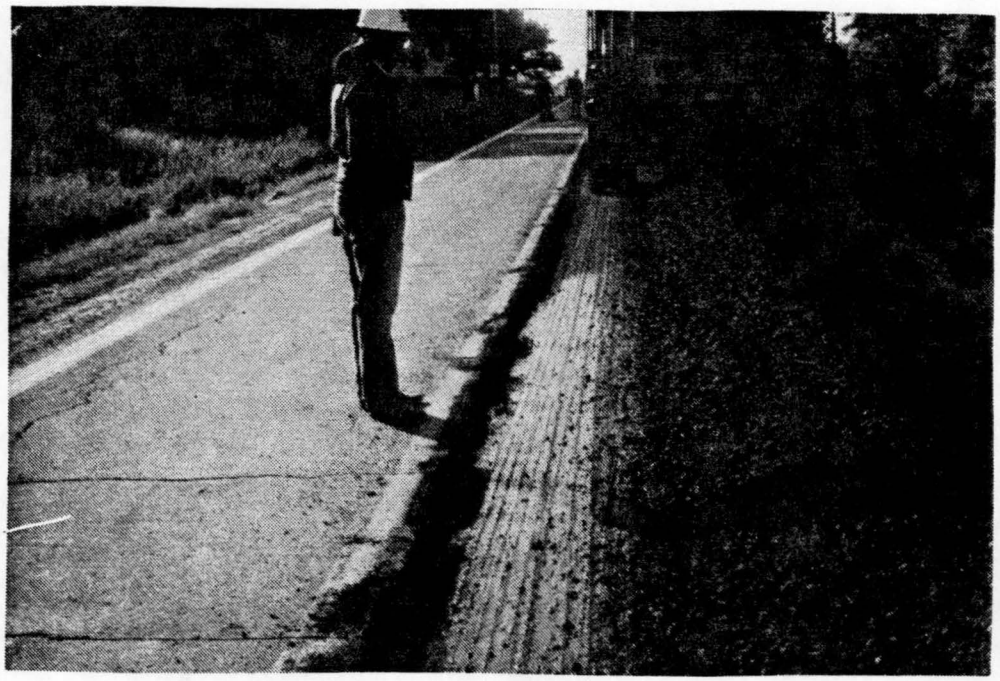
GRADATION CHART



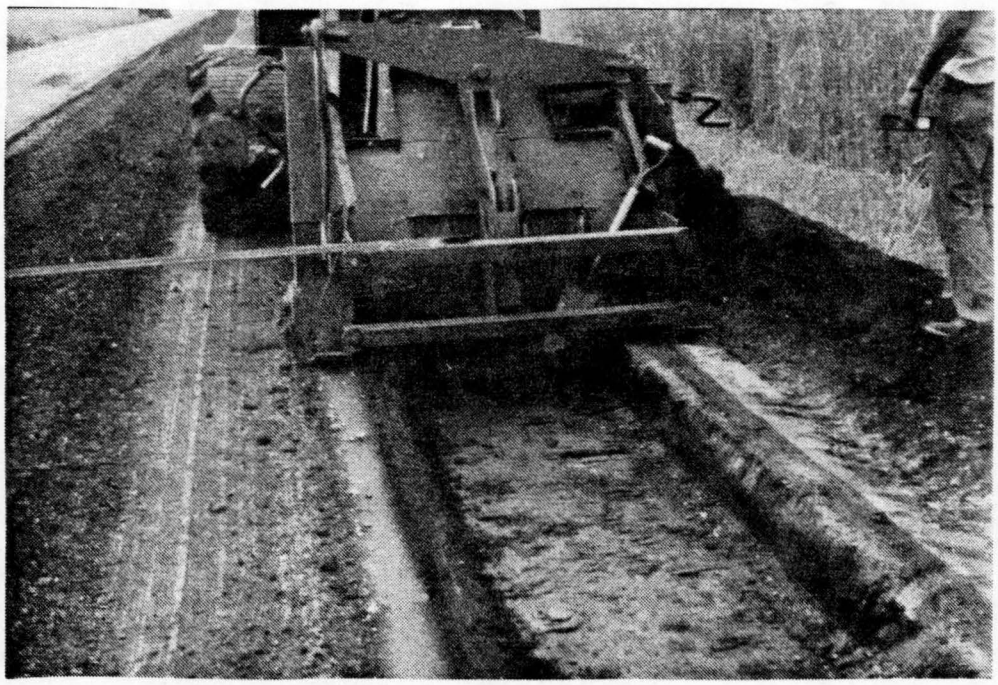
SIEVE ANALYSIS % PASSING

Sieve Size	Sample No.	Identification No.	Specification
1"			
3/4"			
1/2"			
3/8"			
#4			
#8			
#16			
#30			
#50			
#100			
#200			

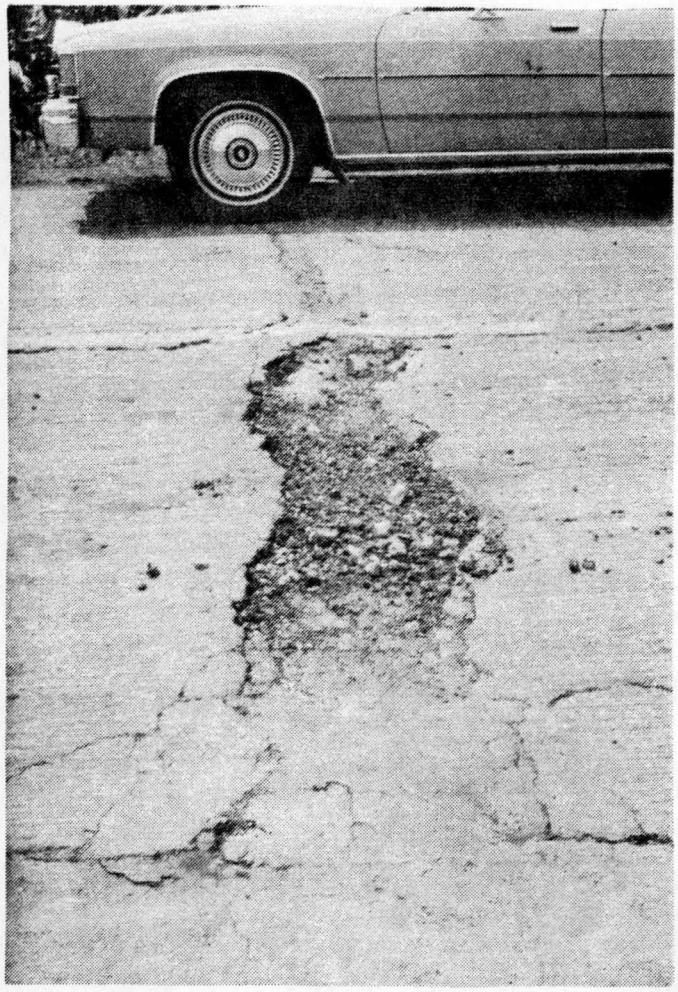
Aggregate Gradation on a 0.45 Power Chart



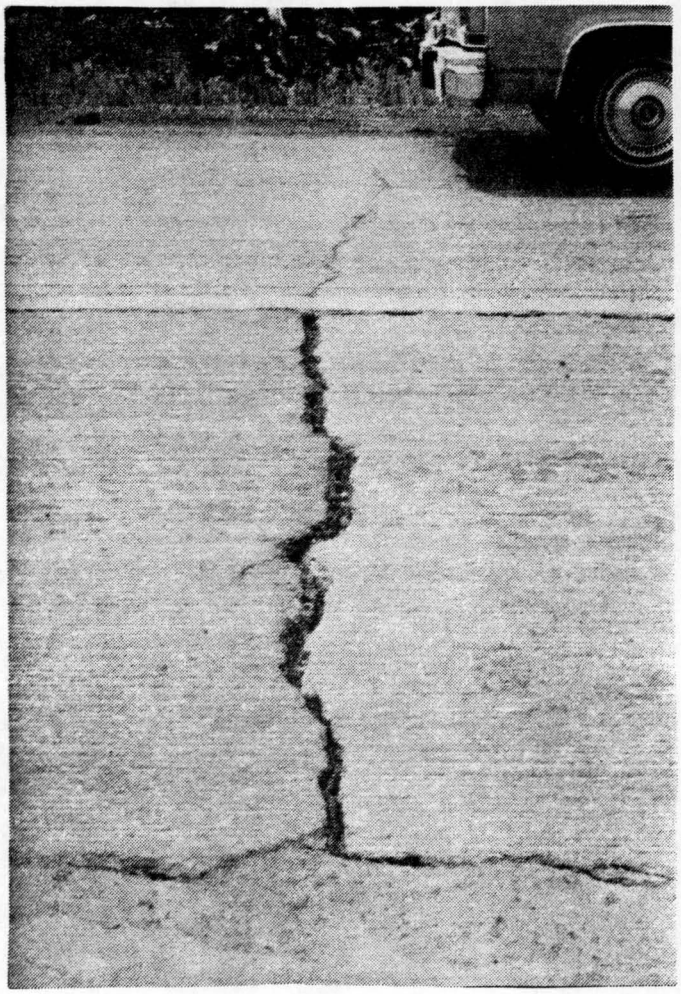
Material From Milling Machine Train



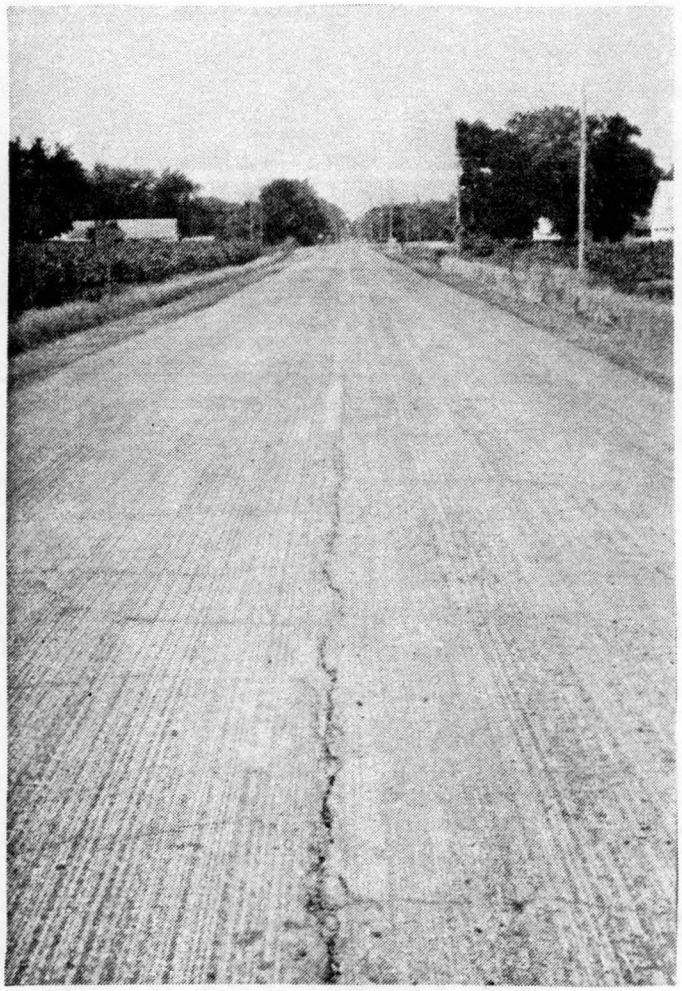
Trencher



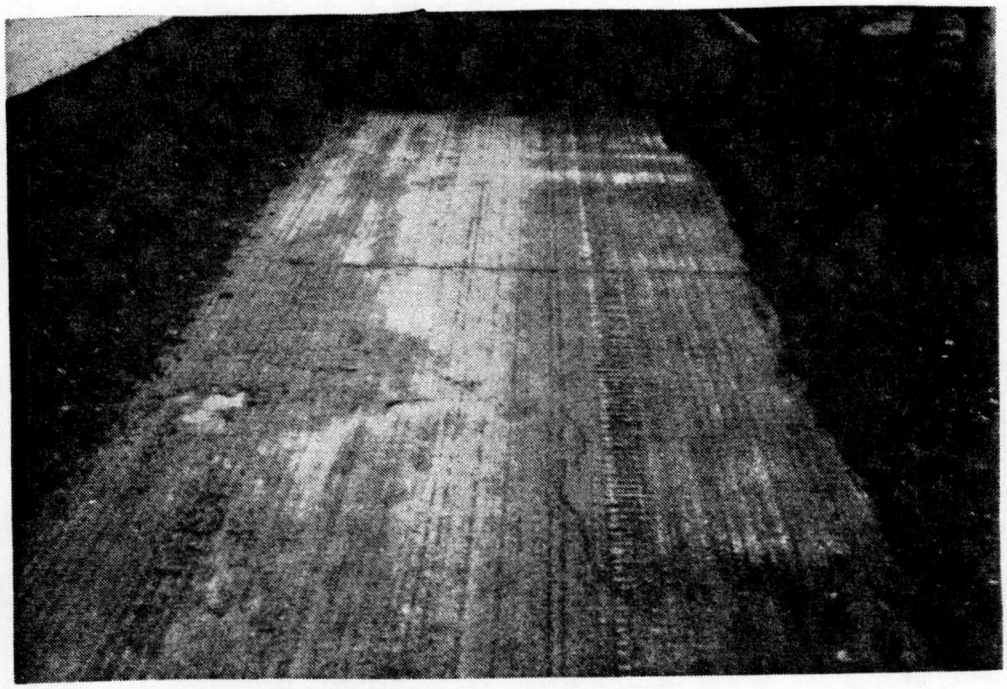
Slippage Crack Replaced



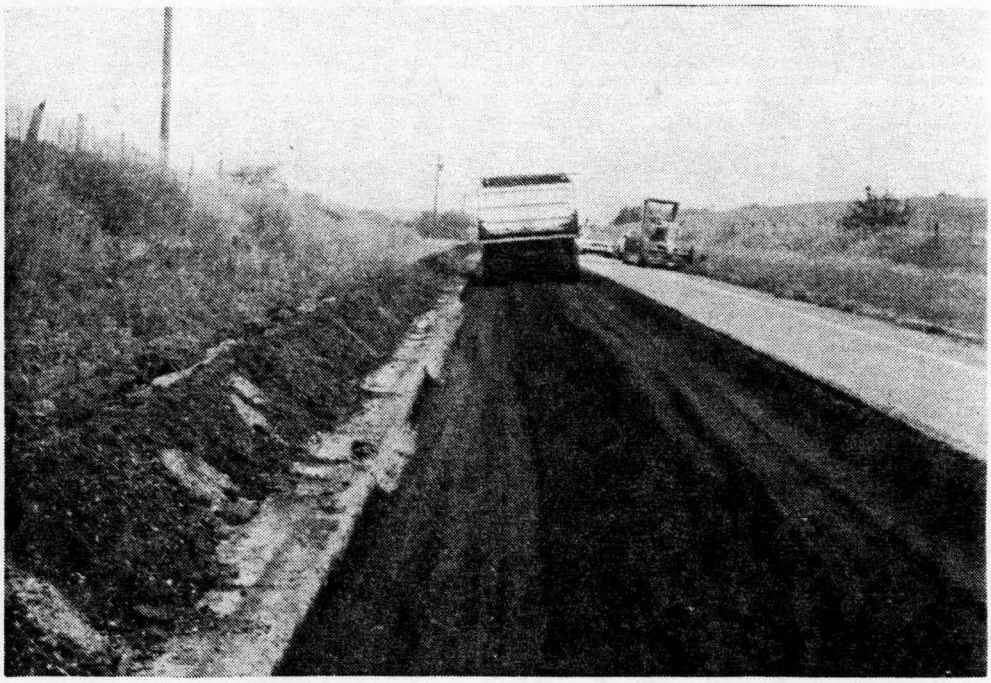
Slippage Crack Removed
and Replaced



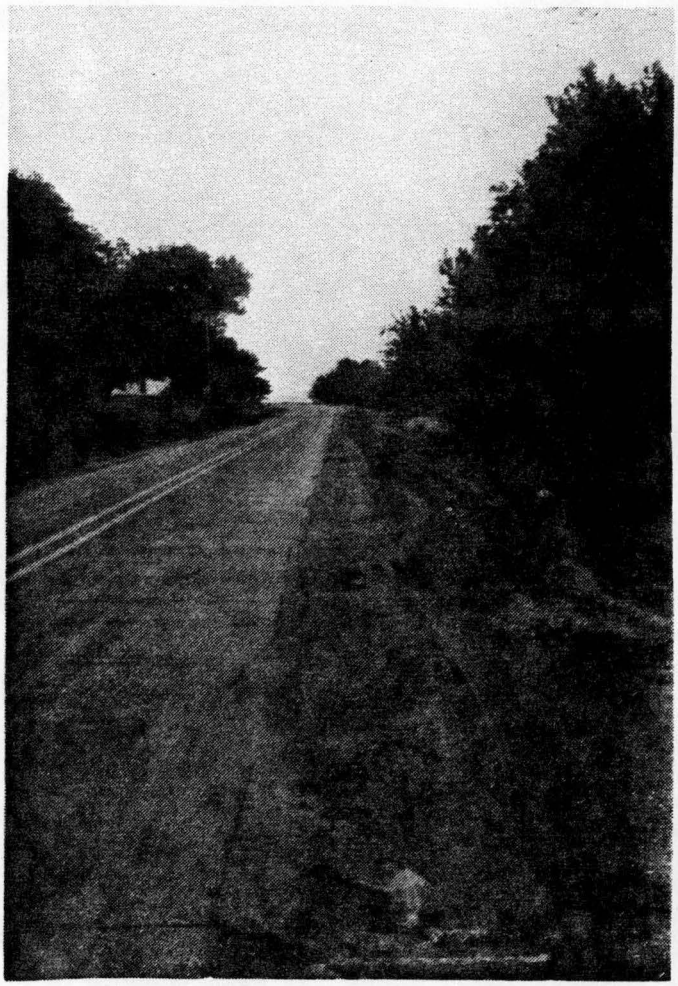
Milled Surface



Trench After Cleaning



Rolling Lower Lift



Subsidence in First Day's Run