ASPHALT CEMENT CONCRETE PAVEMENT RECYCLING
Cass and Montgomery Counties

Final Report
Iowa DOT Project HR-1018

Federal Highway Administration
Demonstration Project No. 39
Contract No. DOT-FH-15-336

October 1986

Highway Division
Iowa Department of Transportation

DISCLAIMER

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for
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Cass and Montgomery Counties

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ABSTRACT

This demonstration project consisted of three adjacent highway resurfacing projects using asphalt cement concrete removed from an Interstate highway which had become severely rutted.

The salvaged asphaltic concrete was later crushed and hauled to a plant site where it was combined with virgin materials to resurface the three projects. Only two of the projects were used for performance evaluation as the third project was in an interchange area including ramps and was otherwise too short.

It was concluded that recycling was cost effective and a high quality surface can be constructed using recycled asphalt cement concrete.

Recycling Asphalt Pavements
US 34 & US 71 - Cass and Montgomery Counties
FHWA Demonstration Project No. 39

INTRODUCTION

As the result of the increase in costs of paving materials, energy shortage, and our dwindling aggregate supplies, the concept of pavement recycling is being considered by the Highway community for the rehabilitation or reconstruction of bituminous pavements. In the future, as petroleum products become scarce and higher in price, the ability to build new asphalt roads will be reduced. A shortage of quality aggregates for road construction in selected areas has become a problem in some parts of the country. Even in Iowa we must at times haul aggregates 30 to 50 miles, which at todays fuel prices can be a very costly item. Recycling has a great potential, not only for preserving valuable resources, but also for controlling escalating costs.

There are three basic types of asphalt pavement recycling; hot mix recycling, cold mix recycling, and surface recycling. Hot mix recycling, the subject of this report, is a process where the major portion of an existing pavement structure, including in some cases the underlying treated base material, is removed and sized, then mixed hot with added asphalt cement and aggregate in a central plant. The finished product is termed recycled hot mix and has been used in Iowa for base, binder, and surface courses.

Iowa was involved in some of the first successful hot mix recycling projects in the country with work in Kossuth County, Iowa. In 1976

Kossuth County constructed the largest single recycling project in the United States using 80,000 tons of asphalt materials. To date, Kossuth County has recycled over 300,000 tons of asphaltic concrete material. The Kossuth County projects were designed to rip up the old asphaltic concrete pavement, haul it to the plant site for crushing and then lowering and widening the road bed prior to reconstruction of the pavement. Material was crushed to a maximum size of 2 inches. The new mix contained 50% salvaged and 50% new aggregate in 1976 and 1977 and then a 40-60 combination in 1978, and approximately 4% A.C. was added to the total mix. The mix was produced in a drum dryer operation, referred to as a drum within a drum. This material was hauled to the project and placed and compacted in a 4 and 2 inch lift in the conventional manner.

The Iowa Dept. of Transportation completed its first major hot mix recycling project in 1980. This project was on Iowa 44 in Guthrie County from Panora east, 15 miles. This 60,000 ton project used approximately 25,000 tons of salvaged material from Interstate I-80 in Adair County. These initial efforts have prompted the State to continue with hot mix recycling and in 1981 approximately 30 miles of recycling work in Cass and Montgomery Counties were let and completed and are the subject of this report.

Purpose and Scope:

The fundamental objective of this study is to evaluate the hot mix recycling process by collecting information pertaining to the following:

1. Pavement history and design criteria
2. Construction criteria
3. Recycling equipment
4. Mixture properties
5. Cost of alternative methods
6. Energy consumption
7. Environmental considerations
8. Post construction performance

Project Location and History:

This work consists of three projects in Cass and Montgomery Counties. Project No. FR-71-3(26)--2G-15 is on Iowa US 71 in Cass County from the Montgomery County line, north approximately 16 miles to just south of the City of Atlantic, project FR-71-2(17)--2G-69 in Montgomery County from the junction of US 34 northerly 12.5 miles to the Cass County line, and project FR-34-2(22)--2G-69 which is an interchange area.

A review of the old records and history of US 71 showed that the present pavement was constructed in 1971. It consisted of 6 inches of soil lime subbase and 9¼ inches of asphaltic concrete. The original pavement determination called for a future 3/4" surface course, but that lift had not been constructed. The pavement contained numerous transverse cracks which had dipped, areas of alligator cracking, and minor surface distortion.

The US 34 eastbound lane was a portland cement concrete pavement placed in 1965 and the westbound lane along with the interchange loops and ramps

consisted of the 6 inch soil lime subbase with 9½ inches of asphaltic concrete placed in 1971. The original full depth asphalt section had not received an overlay since construction, although the original design concept called for 3/4" in the future.

Cracks developed every 40 to 60 ft and deteriorated and dipped causing substantial loss of ride quality of the pavement. Investigation revealed significant asphalt stripping from the aggregate and debonding of lift courses at the cracks. For these reasons the project was implemented.

Through the years the Montgomery County section which was in another maintenance area had received some sealing of cracks using a cut-back material. The Cass County project had not been crack sealed. Therefore, the cracks were more deteriorated and depressed (dipped). On both US 71 projects extensive crack sealing was done in the Spring of 1980. This work involved pumping an ag-lime emulsion slurry into the wider cracks. These cracks were then leveled with the same ag-lime slurry. In the winter of 1980 the depression over each crack was leveled, using a coarser limestone emulsion slurry in two applications. At the time of construction the cracks were nearly 100% filled and for the most part level with the adjacent section. The pavement had areas of alligator or map cracking in the outside 6 ft. These areas had structural problems and required special treatment with reinforcing fabric.

PRELIMINARY INVESTIGATION

Traffic Volume:

The Montgomery section had an average daily traffic in 1978 of 1220 vehicles per day and a projected 1998 ADT of 1690. The Cass County section had 1978 ADT of 1684 vehicles per day with the 1998 ADT projection of 2331 vehicles per day. Trucks were 12% and 17% respectively.

Sufficiency Rating:

The Iowa Department of Transportation developed a sufficiency rating system based on "the tolerable standard approach". A tolerable standard is defined as the minimum prudent condition, geometric or structural, which can exist without being in need of upgrading.

There are three major categories which are broken down into specific rating items. The three major categories and maximum points are Structural Adequacy, 25 points; Safety, 40 points; Service, 35 points, giving a Maximum Sufficiency Rating of 100 points.

All rating items used are assigned approximately 1/2 the maximum points whenever a rating item equals the tolerable standard. Each rating item is assigned a maximum number of points, thus, using 100 points as a total for all rating items, a road section having a total rating below 50 points is considered to be in need of upgrading to eliminate the intolerable conditions (1).

The sufficiency ratings in 1980 for US 71 in Montgomery County between US 34 and the town of Grant was 89 and from Grant to the Cass County line was 92. The ratings in Cass County were 78 from Grant to the south junction of IA 92 and 82 from there to the north end of the project.

Present Serviceability Index Values:

The preliminary present serviceability index values were determined by using the IJK roadmeter. Results of these tests indicated ratings of 3.00 and 2.73 for two sections in Montgomery County and ratings of 3.08 and 2.80 on two sections in Cass County.

Friction Numbers:

US 71 was divided into four sections for test purposes. Preliminary friction tests were made at 40 mph in accordance with ASTM E-274. Tests were run at ½ mile intervals in both lanes in the inside wheel path. Average friction numbers at 40 mph with an ASTM E-501 ribbed tire ranged from 42 on one section in Montgomery County to 38 on one section in Cass County.

Cracking:

Crack surveys were made in December 1979 and February 1980. The cracks were classified as to Class 1, 2, 3, and 4 depending on depth of depression across the crack and method recommended for repair (Appendix A).

Table I shows the number of cracks by class from the two surveys.

TABLE I
CRACK SURVEY

Class	Dec. 79	Feb. 80
1	1896	2182
2	742	643
3	142	486
4	30	198
Map Cracking	3549 ft.^{2}	8248 ft.^{2}

There was some crack maintenance performed during the winter, causing some cracks to change in classification.

Reclaimed Material:

Approximately 40,000 tons of asphaltic concrete were removed from I-80 in Cass County between US 71 and the Adair County Interchange during the 1977 construction season. Some of the material had been heater planed and some had been resurfaced with a thin layer of hot sand surface course. No attempt was made to separate the salvaged material during the removal and stockpiling operations.

The salvaged 1½" thick binder course was produced and placed in 1973 and 1974. It was Type "A" 3/4" asphaltic concrete composed of 65% crushed limestone produced from the Argentine Geologic Formation; 35% locally produced sand and 5½% 85-100 penetration A.C. The salvaged 1½" thick surface course was also produced and placed in 1973 and 1974. It was Type "A" ½" asphaltic concrete composed of 65% crushed gravel produced from a glacial deposit near Auburn, 35% locally produced sand, and 5.25% 85-100 penetration A.C.

A combination of material characteristics, traffic volume and environmental conditions during the summer of 1974 resulted in severe ruts and corrugations. Following removal of this mix, tests were run on the material in conjunction with research project HR-1011, "Recycling of Asphalt Concrete From I-80 in Cass County" to determine the condition of the reclaimed material and to establish a job mix formula for a small test project to be constructed.

The original A.C. exhibited penetrations in the 85 to 100 range; the original absolute viscosity tests were in the 650 to 700 poise range. With the exception of one sample, the recovery tests indicated that little hardening occurred during the two to three years of service life. The low absolute viscosity and temperature susceptibility of the asphalt cement have been considered factors in the poor performance of the original resurfacing.

Approximately 40,000 tons of material had been removed from I-80 by milling and hauled to a sand production site about 3 miles north of the junction of US 71 and I-80. In January of 1979, a contract was let for crushing, hauling and stockpiling of the salvaged asphaltic concrete material from I-80. The removed material was crushed to pass a 1" sieve and stockpiled as a single product. No other gradation limits were specified. The contractor elected to crush at the original stockpile location and haul to the new site some 12 miles away.

The crushed material was to be stockpiled in such a manner as to minimize both consolidation and segregation of the stockpiled material and waste. Wheel and track equipment were prohibited from operating on the stockpile to minimize conglomeration of the salvaged material.

MIX DESIGN

The design of recycled asphalt mixtures consists of blending salvaged and crushed asphaltic concrete material with new aggregate to produce asphalt cement concrete. In this case it was a Type B recycled ½" mix (Appendix B).

Gradation tests were made on the salvaged asphaltic concrete as it was processed. Information on the average gradation of the reclaimed aggregate was given to the contractor. This gradation was to be used as a basis for determining the combined gradation of the aggregates for the new mix. Based on this gradation information and on previous experience, a blending ratio of equal parts of crushed, salvaged asphaltic concrete and new aggregate was selected. Since stripping was evident in the material salvaged from the I-80 project, hydrated lime was to be added to the salvaged material prior to heating. The hydrated lime content of the combined material was intended to be 1% by weight. The new aggregate was to be a combination of coarse and fine aggregates with the applicable quality requirements of Iowa DOT Specification 4126 (2), Aggregate for Type B, A.C.C.(Appendix C). The crushed particle needs of the mixture were satisfied by the use of the recycled asphaltic concrete. The gradation of the virgin aggregate was such that when combined with the recycled ag-

gregate the composite aggregate mixture met requirements of Iowa DOT Specification 4109 (1), Aggregate Gradations (Appendix D).

Asphalt cement selected for this project was the grade AC 2.5 - ASHTO M-226 Table 2. Basic additional A.C. content of the prescribed 50-50 mixture expressed by percent in the total mixture was 2.75%.

BID LETTING

The projects were let January 20, 1981. The bid range for FR-71-3(26)--2G-15 was $767,261.00 to $933,255.98; for FR-71-2(17)--2G-69 was $562,216.44 to $696,631.00; for FR-34-2(22)--2G-69 was $219,343.26 to $261,335.05. The bid sheets for each project are in Appendix E. The three projects were tied for bid letting.

Western Engineering Co., Inc. of Harlan, Iowa, was the low bidder and was awarded the contracts.

CONSTRUCTION

Base Preparation

The thermal cracks in the base had been filled by injection of a lime slurry the winter prior to resurfacing. The crack depressions had been leveled with a slurry.

There was some alligator cracking in the outside six feet of the pavement. These areas were covered with an engineering fabric before resurfacing. Areas reported as base failures were leveled with hot mix before the fabric was placed.

Project FR-71-2(17)--2G-69 had 386.6 square yards of fabric placed and tack coated with 0.26 gallon of A.C. per square yard and project FR-71-3(26)--2G-15 had 5,542.64 square yards of fabric placed with 0.24 gallon of tack coat per square yard (Appendix F).

Surface preparation generally consisted of cleaning with a rotary broom and cleaning any open cracks with compressed air.

Plant Operation

The asphalt plant was a CMI Drum Mix Plant modified to mix recycled asphaltic concrete. The virgin aggregates were fed into the burner end of the drum and the recycled asphaltic concrete was fed into the drum through a collar at the center of the drum.

The virgin material was super heated and then combined with the recycled material at the center of the drum preventing the burning of the asphalt cement from the recycled asphalt cement concrete. Hydrated lime used as an anti-stripping agent (1% by weight) was pneumatically fed into the outlet end of the drum when the asphalt cement was added.

After some production, an auxiliary dryer was installed to pre-dry the recycled asphaltic concrete. The moisture content of the recycled material was reduced from 5.6% to 1.5%. Production could be increased by 60 tons per hour to about 275 tons per hour by pre-drying 50% of the recycled material going into the mix and combining it with the other 50% as taken from the stockpile before being fed into the drum mixer-drier.

Pollution Control

A baghouse was used initially for dust collection, but after two baghouse fires it was replaced with a wet scrubber.

Pollution testing for the auxiliary dryer and the baghouse system was conducted by a private testing firm. The summaries of the test results are in Tables II and III.

TABLE II
SUMMARY OF RESULTS
WESTERN ENGINEERING
PARTICULATE EMISSIONS - CMI PILOT
(Auxiliary Dryer)

Test Number	5	6	7
Test Date	9-16-81	9-17-81	9-17-81
Production TPH	100	75	83
Gas Data			
Temp°F	777	676	709
CO_2 Vol %	5.0	5.8	7.0
O_2 Vol %	15.0	15.0	12.5
Excess Air	245	254	143
H_2O Vol %	22.6	19.7	22.1
ACFM	28,142	21,456	28,903
DSCFM	9,061	7,845	9,997
Particulate Emissions			
gr/ACF	0.14	0.12	0.15
gr/DSCF	0.43	0.33	0.43
lb/hr	33.4	22.0	37.0
Isokinetic	114.0	99.4	99.2

TABLE III
WESTERN ENGINEERING
ATLANTIC, IOWA
SUMMARY OF PARTICULATE EMISSIONS
(Baghouse)
68°F STANDARD TEMPERATURE

Test #	1	2	3
Test Date	8-3-81	8-3-81	8-3-81
Stack Gas			
Temperature °F	362	339	346
ACFM	50,752	46,907	47,156
DSCFM	21,752	20,723	20,158
CO_2 Vol %	6.0	6.3	6.5
O_2 Vol %	13.5	13.0	12.7
H_2O Vol %	30.0	30.4	32.3
Excess Air	157.5	156.5	147.1
Emissions			
gr/DSCF	0.027	0.015	0.018
gr/ACF	0.012	0.006	0.008
lb/hr	5.1	2.6	3.1
Isokinetics	99.0	100.0	102.3

Placement

The asphaltic concrete was placed 2 inches thick by a Blaw Knox paver. Initial compaction was with a Hyster C615 single drum vibratory roller weighing 23,500 lbs including 2,500 lbs of water. Finish rolling was with a Cedar Rapids CR2-88 vibratory roller in the static mode weighing 32,500 lbs including 2,500 lbs of water. A Bros pneumatic roller weighing 31,000 lbs with 22 ply tires at 125 psi was on the project site but was not always used. Sprinkle treatment aggregate was applied with a Bristowes spreader.

During rolling operations, bumps appeared at crack locations in the underlying pavement. The bumps were from slippage over cracks which had been sealed and leveled with an asphalt emulsion slurry. The problem was remedied by placing loose mix over the area ahead of the paver and by modifying the rolling pattern.

COST COMPARISON

The average cost of ½" Type B surface course asphalt cement concrete in Iowa in 1981 was $13.10 per ton plus the asphalt cement which averaged $212 per ton. A ½" Type B surface course with 5.25% a.c. would cost $24.23 per ton.

This demonstration project included three construction projects. The asphaltic concrete tonnage and cost per ton for each project are listed in Table IV. The cost is based on the bid prices and pay quantities for asphalt cement concrete, new aggregate, asphalt cement, and crushing and stockpiling of the recycled asphaltic concrete.

TABLE IV
RECYCLED ASPHALTIC CONCRETE

Project	1/2" Type "B" Surface Tons A.C.C.	$ Ton	Leveling Course Tons A.C.C.	$ Ton
FR-71-3(26)--2G-15	28,848.42	20.30	2,406.32	22.95
FR-71-2(17)--2G-69	22,181.32	22.00	301.93	26.01
FR-34-2(22)--2G-69	6,105.00	24.22	61.83	33.30

The cost does not include the cost of removal of the recycled asphaltic concrete, as it would have been wasted if not recycled, or any savings which may be realized from not having to dispose of the material in a landfill.

It is impossible to determine cost benefits for the leveling course because of the small quantities involved. The savings based on the surface course for FR-71-3(26)--2G-15 were $113,374.29 ($3.93/ton), for FR-71-2(17)--2G-69 were $49,464.34 ($2.23/ton), and $61.05 ($0.01/ton) for FR-34-2(22)--2G-69 for a total savings of $162,899.68 for the three projects.

The plant site was located on the first project listed above and the last project listed was the farthest from the plant site. The first project also had the greatest tonnage with the last project being only 1.9 miles long and having the least tonnage of asphalt cement concrete.

ENERGY CONSERVATION

The three projects used 43,299.17 tons of recycled asphalt cement concrete. Assuming that the useable a.c. content was 2%, there would be 865.98 tons less of a.c., at 587,500 BTU/Ton, (3) manufactured conserving an equivalent 6.00 gal. of gas per ton. The total gasoline equivalent required to manufacture 865.98 tons of asphalt cement would be 5,195.35 gallons.

The recycled mix would contain 42,433.19 tons of aggregate. The crushed stone would require 56,000 BTU/Ton (2) to manufacture. This would be an equivalent 19,010.07 gallons of gasoline or 0.45 gallons of gasoline per ton of aggregate. A summary of energy consumption is in Appendix G.

CONSERVATION OF NATURAL RESOURCES

Iowa has no crude oil from which to obtain asphalt cement and sources of aggregate are becoming limited, therefore, natural resource conservation as well as energy conservation is very important. The conservation of 865 tons of asphalt cement and 42,433 tons of aggregate is especially important in southwest Iowa where aggregate is very scarce.

PERFORMANCE EVALUATION

The present serviceability index (PSI) has been determined biennially. Table V shows the crack and patch surveys, rut depth, friction numbers, and the PSI for half-mile test sections of US 71 in Montgomery and Cass Counties. Each half-mile test section is representative of the area listed by milepost for each section.

TABLE V
US 71 MONTGOMERY - CASS - RECYCLED A.C.

1/2 Mile Test Section							
	No. of cracks						
Date	Transverse	Longitudinal	Patch (Sq.ft.)	Mean Rut Depth	Average Fault	Friction No.	PSI
			Milepost 29.56 to 37.13				
1980						42	3.00
81-82	3.75	0	0	0.065	0.145	46	3.67
83-84	6	1	0	0.09	0.20		3.52
85-86	7	0	0	0.14	0.30	40	3.33
			Milepost 37.13 to 42.13				
1980						43	2.73
81-82	4.25	0	0	0.075	0.195	45	3.67
83-84	7	0	6	0.08	0.17		3.52
85-86	6	0	0	0.13	0.22	40	3.27
			Milepost 42.13 to 46.13				
1980						41	3.08
81-82	4.75	0	0	0.08	0.10	47	3.69
83-84	8	1	0	0.12	0.17		3.41
			Milepost 46.13 to 58.48				
79-80						38	2.80
81-82	4.08	0	0	0.10	0.13	45	3.69
83-84	3	0	0	0.12	0.12		3.41
85-86	5	0	0	0.15	0.12	49	3.37

Cores were drilled from three locations in March 1986. Some cores were tested for density and voids and others from the same locations were extracted for aggregate gradation and asphalt cement properties. The results of the tests are in Table VI.

TABLE VI
US 71 CASS - MONTGOMERY COUNTIES

RECYCLED ASPHALT CONCRETE MIX

	Sieve Analysis - % Passing								
	1/2	3/8	4	8	16	30	50	100	200
Montgomery Co. - Sta. 80									
Plant Report	96	86	71	59	48	32	13	6.1	4.2
Extracted March 1986	97	87	71	59	48	35	19	12	9.3
A.C. 5.69%; Pen. 58; Abs. Visc. 1480; Density 2.36; Voids 2.3%									
Cass Co. - Sta. 840									
Plant Report	Lt 95	86	71	57	46	30	13	6.5	4.8
Extracted March 1986	98	90	73	60	48	35	20	13	11
A.C. 5.52%; Pen. 63; Abs. Visc. 1210; Density 2.36; Voids 2.7%									
Cass Co. - Sta. 519									
Plant Report	95	84	67	54	43	28	14	6.6	4.8
Extracted March 1986	96	90	77	62	49	35	20	12	9.8
A.C. 5.39%; Pen. 43; ABs. Visc. 2190; Density 2.36; Voids 2.2%									

The highway has been visually inspected periodically. As indicated in Table V, there is slight rutting, which is no worse than if the asphaltic concrete were made using all new materials. The surface is in excellent condition, as there is no raveling or excessive asphalt cement.

The cracks that have reflected through the surface began to dip and have been sealed and any loss of ride quality has been restored. Any dipping of cracks was not related to the recycled asphalt cement concrete.

ENVIRONMENTAL CONSIDERATIONS

The recycling of the asphaltic concrete caused no environmental problems. On the other hand, environmental damage may have been prevented as the asphaltic concrete was placed back into a highway rather than in a landfill where water could possibly strip the asphalt cement from the aggregate polluting the ground water in the immediate area.

SUMMARY and CONCLUSIONS

This demonstration project consisted of three highway resurfacing projects using asphalt cement concrete removed from an Interstate highway which was resurfaced because of severe rutting. The removed asphaltic concrete was hauled and stored at a sand production site for later use.

The stockpiled material was later crushed to a one inch maximum size and hauled about 12 miles to a plant site where it was combined with virgin aggregate and asphalt cement for resurfacing the three projects.

The three projects were adjacent to each other, but the project on US 34 was a short project, including an interchange, so all of the post construction evaluation was conducted on the two adjacent projects on US 71.

From this demonstration project, it can be concluded that recycling asphalt cement concrete into another highway is a cost effective nonpolluting method of disposal.

A high quality highway surface can be constructed using recycled asphalt cement concrete.

Savings may be realized from the need for less asphalt cement and aggregate.

There is significant energy and natural resources conserved, especially in an area lacking aggregate and where all asphalt cement has to be imported.

Cost effectiveness is dependent upon the distance involved in processing and hauling the recycled asphaltic concrete.

ACKNOWLEDGEMENT

The Red Oak Construction Residency personnel are gratefully acknowledged for the complete diaries and records kept during the project. It would have been impossible to prepare the report without them.

The inspection personnel included John Tebrinke, Richard Blackburn, Larry Bruce, Robert Foster, Duane Heeren, Dennis Jones, Stephen Kling, and Perry Smith.

The assistance of O. J. Lane, Jr., District Materials Engineer, and the late Charles Huisman, DOT Materials Engineer, for their assistance during the development and construction of the project is also acknowledged.

REFERENCES

1. Iowa Department of Transportation, "Iowa Primary Road Sufficiency Log".

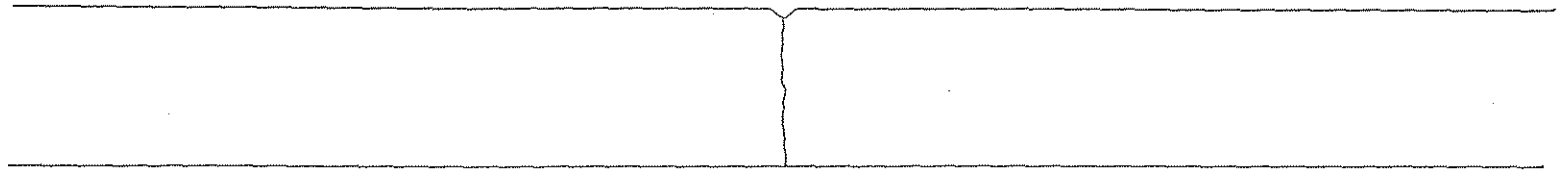
2. Iowa Department of Transportation, "Standard Specifications for Highway and Bridge Construction", Series 1977.

3. The Asphalt Institute, "Energy Requirements for Roadway Pavements", IS-173, November 1979

Appendix A

A.C. PAVEMENT SURFACE CRACKS

CLASS I



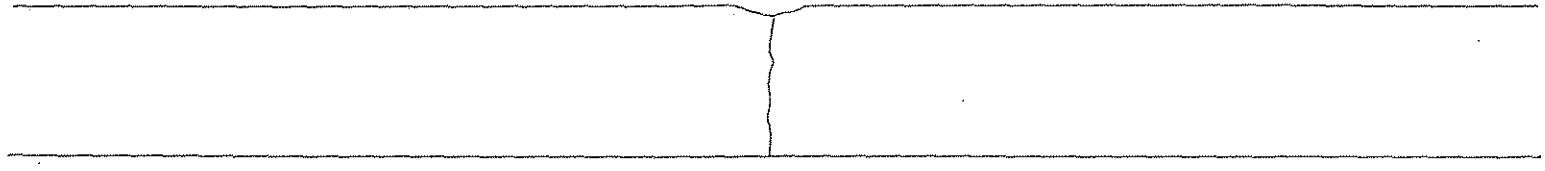
VISUAL CONDITIONS:

1. 0.0" to 0.25" average depression.

METHOD OF REPAIR:

1. Blow with compressed air to remove loose material
2. Seal crack with emulsified asphalt (CRS-2)

CLASS II



VISUAL CONDITIONS:

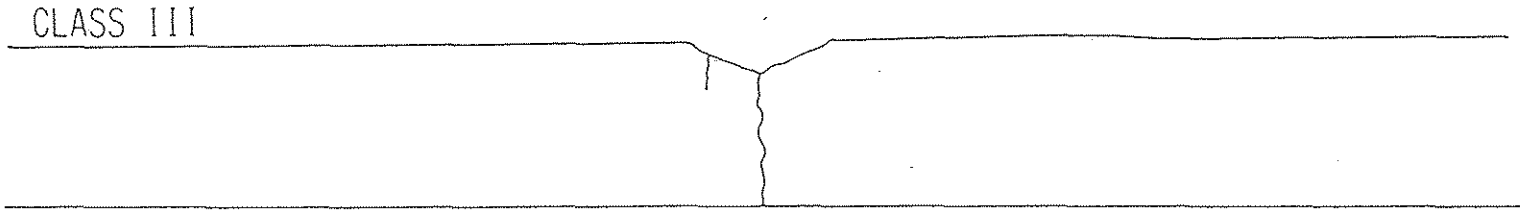
1. 0.25" to 0.50" average depression.

METHOD OF REPAIR:

1. Blow compressed air to remove loose material
2. Seal crack with emulsified asphalt (CRS-2)
3. 8" wide strip seal with 3/8" cover aggregate

A.C. PAVEMENT SURFACE CRACKS

CLASS III



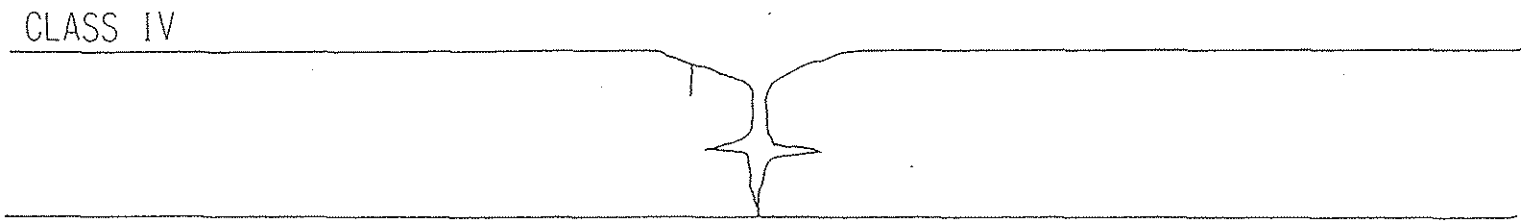
VISUAL CONDITIONS:

1. 0.50" to 1.0" average depression
2. Near straight line crack
3. Occasional secondary crack

METHOD OF REPAIR:

1. Saw 4" wide retracing crack line
2. Full depth patch - (tack, pre-mix or hot-mix & special compaction)

CLASS IV



VISUAL CONDITIONS:

1. 0.75" plus depression
2. Wide (3/4"+) crack
3. Secondary crack or breakup

METHOD OF REPAIR:

1. 12" wide removal
2. Full depth patch (per std. specs.)

Appendix B

IOWA DEPARTMENT OF TRANSPORTATION
OFFICE OF MATERIALS
ASPHALT CONCRETE MIX DESIGN
LAB LOCATION AMES

MIX, TYPE AND CLASS: RECYCLED TYPE B SURFACE LAB NO. ABD1-66

INTENDED USE:

SIZE 1/2" SPEC. NO. 874 SP-336 DATE REPORTED 6/22/81
CASS
COUNTY MONTGOMERY PROJECT FR-71-3(26)--2G-15
MONTGOMERY FR-34-2(22)--2G-69
CONTRACTOR WESTERN FR-71-2(17)--2G-69

PROJ. LOCATION FROM MONTGOMERY LINE NORTH 16.3 MILES; FROM 0.5 MI. WEST OF U.S. 71 INTERCHANGE EAST 1.9 MILES; FROM CASS CO. LINE SOUTH 12.6 MILES.

AGG. SOURCES 3/4" CR. LST.- ATLANTIC QR.- CASS CO.; SAND - LYMAN PIT - CASS CO.; SALVAGED ASPHALT CONCRETE CONTAINING 5.4% ASPHALT

JOB MIX FORMULA AGGREGATE PROPORTIONS: 20% AAT1-175; 30% AAT1-174; 50% ABC1-52; PLUS 1% HYDRATED LIME OF TOTAL MIX.

JOB MIX FORMULA - COMBINED GRADATION

1-1/2"	1"	3/4"	1/2"	3/8"	NO.4	NO.8	NO.16	NO.30	NO.50	NO.100	NO.200
		100	97	88	72	58	47	34	17	9.4	6.9
TOLERANCE:		95/100	7	7	6			5			-3.0 +0.3

75 BLOW MARSHALL DENSITY		2.30	
ASPHALT SOURCE AND APPROXIMATE VISCOSITY		SINCLAIR - 267 POISES	
XXXXXXXXXXXXXXXX	% ASPHALT ADDED	2.7	3.8	4.9
% TPH. IN MIX		5.25	6.25	7.25
NUMBER OF MARSHALL BLOWS		50	50	50
MARSHALL STABILITY - LBS.		3283	2512	1965
FLOW - 0.01 IN.		10	16	20
SP.GR. BY DISPLACEMENT(LAB DENS.)		2.37	2.38	2.36
BULK SP. GR. COMB. DRY AGG.		2.644	2.644	2.644
SP. GR. ASPH. @ 77 F.		1.018	1.018	1.018
CALC. SOLID SP.GR.		2.46	2.43	2.39
% VOIDS - CALC.		3.9	2.0	1.4
RICE SP. GR.		2.46	2.41	2.38
% VOIDS - RICE		3.5	1.2	1.0
% WATER ABSORPTION - AGGREGATE		0.93	0.93	0.93
% VOIDS IN THE MINERAL AGGREGATE		15.1	15.6	17.2
% V.M.A. FILLED WITH ASPHALT		74.3	87.1	91.8
CALCULATED ASPH.FILM THICKNESS(MICRONS)		6.8	8.3	9.9
FILLER/BITUMEN RATIO			1.3	

A CONTENT OF 5.50% ASPHALT IS RECOMMENDED TO START THE JOB, THIS IS AN ADDITION OF 3.0% ASPHALT.

COPIES:
ASPH. MIX DESIGN
PROJECTS LISTED ABOVE
V. R. SNYDER
W. G. BURGAN
R. SHELQUIST D. JORDISON
L. ZEARLEY C. JONES
WESTERN

THIS IS A BORDERLINE MIX DESIGN - VARIATIONS DUE TO THE SALVAGED MATERIAL WILL BE THE RESPONSIBILITY OF THE CONTRACTING AUTHORITY - VARIATIONS DUE TO THE VIRGIN AGGREGATE WILL BE THE CONTRACTORS RESPONSIBILITY.

SIGNED: BERNARD C. BROWN
TESTING ENGINEER

Appendix C

courses shall meet the following requirements for the material specified in the contract documents.

4122.02 MACADAM STONE BASE MATERIAL. This aggregate shall be the product of crushing limestone, dolomite, or quartzite and shall meet the following requirements:

A. Abrasion Loss. The percentage of wear, determined in accordance with AASHTO T 96, Grading A or B, shall not exceed 45.

B. Soundness. When subjected to the freezing-and-thawing test, Laboratory Test Method 211, Method C, the percentage loss shall not exceed 10.

C. Gradation. The aggregate for both base course and choke stone course shall be produced from the same source by an impact breaker primary crusher, both a product of that operation. The grates or breaker bars shall be adjusted to produce a nominal maximum size of 4 inches, and the product of the primary crusher shall be screened over a 1-inch screen. The aggregate retained on the 1-inch screen shall be furnished as the Macadam base course material.

The aggregate passing the 1-inch screen shall be furnished as the choke stone course material; however, additional restrictions may be placed on this material.

4122.03 AGGREGATE FOR STABILIZED SHOULDERS. Aggregate for stabilized shoulders shall meet requirements of 4120.04 or, when specifically designated, 4120.05. Since compaction is a specification requirement, the percent passing the No. 200 sieve shall be controlled as specified.

Section 4124. Granular Material for Soil-Aggregate Subbase

4124.01 GENERAL. Granular material to be added to the roadbed for construction of soil-aggregate subbase may be any mineral aggregate meeting these requirements.

The aggregate shall meet requirements of Section 4109 for gradation number 13.

The plasticity index shall not exceed 4 for gravels and 6 for crushed stone.

When the granular material is crushed limestone or dolomite, the portion of particles retained on the No. 4 sieve shall not have a percentage loss exceeding 15 when subjected to the freezing-and-thawing test, Laboratory Test Method 211, Method C.

When the contract includes work described in Sections 2202, 2203, 2204, or 2205, aggregate mixtures permitted for these items will be considered acceptable.

Section 4125. Cover Aggregate

4125.01 DESCRIPTION. Aggregate for bituminous seal coat, Section 2307, shall be composed of hard, durable rock, sand, or combinations thereof, washed and free from objectionable clay coatings, and shall meet the following requirements for the size designated in the contract documents.

Unless otherwise specified, the 1/2-inch size shall be used. The 1/2- and 3/8-inch sizes may be crushed stone, or gravel, or a mixture of these materials with sand.

4125.02 ABRASION LOSS. The percentage of wear as determined by AASHTO T 96, Method C, shall not exceed 40.

4125.03 SOUNDNESS. When the particles retained on the No. 4 sieve in all sizes, except sand, are subjected to the freezing-and-thawing test, Laboratory Test Method 211, Method C, the loss shall not exceed 10 percent.

4125.04 SHALE. For 1/2- and 3/8-inch sizes, shale particles in the portion retained on the No. 4 sieve shall not exceed 5.0 percent of the particles retained on that sieve. Sand cover aggregate shall not contain more than 2.0 percent shale particles retained on the No. 16 sieve.

4125.05 GRADATION. Cover aggregate shall meet requirements of Section 4109 for the gradation number appropriate for the size designated or required and the aggregate furnished.

Size	Gradation Number
1/2 inch	
Crushed stone	14
Gravel	15
3/8 inch	
Crushed stone or gravel	16*
Sand	17†

*The 1/2-inch size may be used when the 3/8-inch size is specified if the percent passing the No. 200 sieve does not exceed 1.5 percent.
†Fine aggregate for concrete meeting the requirements of Section 4110 may be used for sand cover.

Section 4126. Aggregate for Cold-Laid Bituminous Concrete and Type B Asphalt Cement Concrete

4126.01 DESCRIPTION. The aggregate shall consist of gravel or crushed stone, or both, combined with sand and filler, and shall meet the following requirements.

4126.02 AGGREGATE. Aggregate shall consist of hard, durable rock or gravel and sand particles meeting the following additional requirements:

A. Abrasion Loss. Aggregate retained on the No. 4 sieve and crushed aggregate passing the No. 4 sieve shall be produced from sources which normally show an abrasion loss not exceeding 45, as determined in accordance with AASHTO T 96.

B. Freezing-and-Thawing Test. Aggregate retained on the No. 4 sieve and crushed aggregate passing the No. 4 sieve shall be produced from sources which normally show a freezing-and-thawing loss not exceeding 10 for Method C and 45 for Method A, when tested in accordance with Laboratory Test Method 211 using aggregate crushed or screened to 3/4-inch maximum size.

The engineer may waive these requirements for sand and gravel when the amount retained on the No. 4 sieve is less than 5 percent of the material.

4126.03 FILLER. Fine material added to the mixture without heating shall meet requirements for mineral filler in AASHTO M 17 except the gradation shall be determined in accordance with AASHTO T 11.

4126.04 COMPOSITE AGGREGATE. The composite aggregate shall be free from vegetable matter and from adherent films of clay or other matter which will prevent coating of particles with bitumen. Silt and clay naturally occurring in aggregate will not be considered objectionable provided they remain finely divided and uniformly distributed. All mixtures shall have at least 20 percent natural sand in the portion passing the No. 4 sieve. Natural sand required for wearing course mixtures shall be graded such that when sieved through the following numbered sieves—8, 16, 30, 50, and 100—not more than 50 percent shall pass one sieve and be retained on the next higher numbered sieve. The composite aggregate shall meet the following requirements for the class and mixture size specified.

A. Plasticity Index. The composite aggregate shall have a plasticity index not exceeding 4.

B. Gradation. The composite aggregate mixture for the job-mix formula aggregate shall meet requirements of Section 4109 for the gradation number appropriate for the class and mixture size specified.

Class and Mixture Size	Gradation Number
Class 1, 1 inch	18
Class 1 and 2, 3/4 inch	19
Class 1, 1/2 inch	20
Class 1, 3/8 inch	21

C. Crushed Particles. All mixtures required by Section 2304, and all Class 1 mixtures, shall have 30 percent crushed particles in the aggregate. The percentage of crushed particles shall be adjusted or controlled to meet requirements of the mix design.

Crushed particles may be obtained from crushed stone, mineral filler, or crushed sand or gravel. When crushed sand or gravel is furnished, it shall be produced as a separate operation by crushing sand or gravel particles to the extent that 90 percent or more will pass the sieve on which 90 percent or more was retained before crushing.

D. Production Limits. Production gradation limits for the various aggregates will be furnished as a guide to the contractor so that the combination of these aggregates in designated proportions should result in a gradation within the job-mix tolerances.

Section 4127. Aggregate for Type A Asphalt Cement Concrete

4127.01 DESCRIPTION. Aggregate for Type A asphalt cement concrete shall consist of a mixture of crushed stone, or gravel, combined with sand and filler. Particles retained on the No. 4 sieve shall be considered coarse aggregate, and particles passing the No. 4 sieve shall be considered fine aggregate. Aggregates shall comply with the following.

4127.02 MINERAL FILLER. Fine material added to the mixture without heating to secure the desired percentage passing the No. 200 sieve shall meet requirements of AASHTO M 17 except the gradation shall be determined in accordance with AASHTO T 11.

4127.03 FINE AGGREGATE. Fine aggregate shall consist of hard, durable grains of natural sand, crushed stone, or crushed gravel, free from injurious substances, including shale particles, in the portion retained on the No. 16 sieve, in excess of 2.0 percent.

Material from each separate source to be used as fine aggregate, before being delivered to the stockpile from which the mixing plant will be supplied, shall be screened and processed to the extent that it will contain no lumps, balls of clay, foreign material, or pebbles which will be retained on a 1 1/2-inch sieve.

4127.04 COARSE AGGREGATE. Coarse aggregate shall consist of crushed stone, gravel, or mixtures of crushed stone and gravel. When crushed gravel is used, it shall be produced as a separate operation by crushing gravel particles to the extent that 90 percent or more will pass the sieve on which 90 percent or more was retained before crushing. The screen size used to separate material prior to crushing shall be increased as necessary to compensate for screening efficiency and material variability.

Coarse aggregate shall be produced from sources which normally show an abrasion loss not exceeding 40, determined in accordance with AASHTO T 96, and a freezing-and-thawing loss not greater than 10 or when specifically required, not greater

Appendix D

of not more than 75 seconds and shall be of such consistency that they can be readily sprayed to a uniform coating at temperatures above 40 degrees F.

4105.03 MOISTURE RETENTION. When tested in accordance with Laboratory Test Method 901, the efficiency index of the material shall not be less than 95.0 percent, except that material showing moisture loss of less than 1.0 percent of the quantity of water remaining in the test specimen at the time the curing material is applied will be acceptable.

4105.04 SETTING. Liquid curing compounds shall set within 2 hours after application, to form a firm, water-impermeable film, adhering strongly to the concrete.

4105.05 WHITE-PIGMENTED COMPOUNDS. White-pigmented compounds shall consist of finely ground, white pigment and vehicle, ready-mixed for use without alteration. The pigment shall not settle badly or cake in the container, and the compound shall not thicken in storage so as to cause change in consistency which may result in a nonuniform spray. After the compound sprayed on a smooth surface has dried, it shall have an apparent daylight reflectance not less than 70.0 percent relative to magnesium oxide. The rate of application shall be not less than 0.067 gallon per square yard (15 square yards per gallon). The compound shall be stirred continuously during the time it is being applied.

4105.06 DARK-COLORED COMPOUNDS. Dark-colored compounds shall consist of asphalt emulsified or cut-back with a volatile solvent and shall contain not less than 50.0 percent asphalt. They shall set sufficiently 2 hours after application so that a whitewash coating will not be discolored. The rate of application shall be not less than 0.08 gallon per square yard (12.5 square yards per gallon).

4105.07 LINSEED OIL EMULSION. When linseed oil emulsion curing compound is specified, the following shall apply in lieu of other requirements of this section.

Linseed oil emulsion curing compound shall be a nonpigmented material that has been homogenized to produce a uniform mixture as set forth in United States Department of Agriculture patent application serial number 365,900, filed June 1, 1973. The material shall meet requirements of ASTM C 309 and C 156.

Section 4106. Paper and Plastic Film for Curing Concrete

4106.01 CURING PAPER. Paper to be used for curing

concrete shall meet requirements of ASTM C 171, except that, in lieu of the moisture loss limitation prescribed, the following shall apply: The moisture loss shall not be greater than 5.0 percent of the original mixing water used when the paper is tested in accordance with Laboratory Test Method 901, with the paper remaining in place for 24 hours.

The paper shall be prepared in sheets of sufficient width to cover the full width of concrete surface being placed without stretching and with normal allowance for shrinkage.

4106.02 PLASTIC FILM. Plastic film used for curing concrete shall be tough, pliable, moisture-proof, and sufficiently durable to retain its moisture-proof properties during the time it is in place on the surface of the concrete. It shall meet requirements of 4106.01 for retention of moisture in concrete and for size of sheets. The plastic film shall be white-pigmented material. The film shall be not less than 0.00085 inch thick, shall have not less than 70 percent daylight reflectance relative to the magnesium oxide when tested in accord with ASTM E 97, and shall be opaque. If the thickness of plastic film is less than 0.0034 inch, it shall not be used more than once for curing concrete.

Section 4107. Plastic Film for Subgrade Treatment

4107.01 GENERAL. Plastic film to be used for treating subgrade of concrete pavement shall be polyethylene film not less than 0.00085 inch thick, either clear or white-pigmented type. The width of strips used shall provide a lap not less than 12 inches between adjacent strips. Plastic film which has been used no more than once for curing concrete pavement and has been salvaged in usable condition may be used for treatment of subgrade.

Section 4109. Aggregate Gradations

4109.01 GENERAL. Gradations for various aggregates are shown in the gradation table on the following page, and each gradation is identified by number. When the aggregate is tested by means of laboratory sieves, the sieve analysis shall show a gradation within the range permitted for the gradation number specified for that aggregate.

Section 4110. Fine Aggregate for Concrete

4110.01 DESCRIPTION. Fine aggregate for concrete shall consist of clean, hard, durable, mineral aggregate particles free from injurious amount of silt, shale, coal, organic matter, or other

GRADATION TABLE

Gradation Number & Reference	Sieve Size 1½	1	3/4	1/2	3/8	4	8	30	40	50	100	200	Notes
1. 4110.					100	90-100	70-95	40-75		10-40	0-30	0-1.5	
2. 4112.												-3	
3. 4115. (57, 2-8)	100	95-100		25-60		0-10	-5					-1.5	
4. 4115. (2-8)	100	50-90	30-100	20-75	5-55	0-10	-5					-1.5	
5. 4115. (67, 2-8)		100	90-100		20-55	0-10	-5					-1.5	
6. 4115.08			100	97-100	40-90	5-30						0-1.5	
7. 4117.(Cl.V)	100					80-92	60-75	20-40					
8. 4117.03						90-						0-30	
9. 4120. (B Gr.)			100			50-75	25-55						
10. 4120. (C Gr.)			100			50-80	25-70						
11. 4120.(A, B Cr.S.)			100			-75	20-40						
12. 4121.		100	95-100			55-	42-85	20-40				0-10	
13. 4124.						60-	50-					0-30	1
14. 4125. (½"Cr.S.)			100	97-	40-90	0-30	-15					-4	
15. 4125. (½"Gr.)			100	95-	40-80	0-15	-7					-1.5	
16. 4125. (3/8")				100	90-	10-55	0-20	-7				-1.5	
17. 4125. (Sand)					100		60-90	0-40				-1.5	
18. 4126, 7, 8. (1")	100	98-100	79-97		54-76	37-68	28-44	13-27				3-7	2
19. 4126, 7, 8. (3/4")		100	98-100		65-95	48-75	35-60	18-36				4-8	2
20. 4126, 7. (1/2")			100	98-100	75-95	48-75	35-60	18-36				5-9	2
21. 4126, 7. (3/8")				100	98-100	71-93	52-72	25-40				5-9	2
22. 4129.					100	90-100	75-95	25-55				0-6	2
23. 4131.	100	70-			35-65		0-20					-5	
24. 4132. (Cr.S.)	100						30-45		10-				
25. 4132. (Gr.)	100					45-80						8-15	
26. 4132. (L.S.)					95-							-30	

1. Minimum percent passing 2½-inch sieve, 100. For gravel or sand, the maximum percent passing No. 200 sieve, 15.

2. Any operating tolerance allowed elsewhere in this specification does not apply to the largest sieve for which both a minimum and maximum are shown; the 2 percent is the tolerance.

deleterious material and shall comply with the following requirements. Fine aggregate for concrete floors, overlays, and pavements shall be natural sands. Natural sand is defined as fine aggregate resulting from disintegration of rock through glacial action. Manufactured sand produced from igneous or metamorphic rock may be used with approval of the engineer.

4110.02 SHALE. Shale and coal particles retained on a No. 16 sieve shall not exceed 2.0 percent.

4110.03 GRADATION. Fine aggregate for concrete shall meet requirements of Section 4109 for gradation number 1. In addition, when the fine aggregate is sieved through the following numbered sieves—4, 8, 16, 30, 50, and 100—not more than 40 percent shall pass one sieve and be retained on the sieve with the next higher number.

4110.04 MORTAR STRENGTH. The mortar strength of fine aggregate shall be determined according to Laboratory Test Method 212. The strength of the mortar tested at 7 days, shall not be less than 1.5 times the strength of mortar in which standard sand is used. More restrictive limits for deleterious substances or size of particles may be set, if necessary, to insure a continuously satisfactory mortar strength.

Section 4112. Fine Aggregate for Mortar

4112.01 DESCRIPTION. Fine aggregate for mortar shall consist of natural sand as defined in 4110.01, unless otherwise permitted or specified. It shall comply with the following provisions.

4112.02 DELETERIOUS SUBSTANCES. Deleterious substances shall not exceed the following:

A. Shale and coal particles retained on a No. 16 sieve, not more than 2.0 percent.

B. Organic matter, other than coal, not more than indicated by the standard reference color when tested according to ASTM C 40.

4112.03 GRADATION. Fine aggregate for mortar shall meet requirements of Section 4109 for gradation number 2. When mortar joints are 1/4 inch or less in thickness, 100 percent of the particles shall pass the No. 8 sieve.

4112.04 MORTAR STRENGTH. When tested as prescribed in 4110.04, the mortar strength of the aggregate shall not be less than 0.9 times the strength of mortar made from graded standard sand.

Appendix E

FORM 650016
8-78 H 15478

TABULATION OF CONSTRUCTION AND MATERIAL BIDS
IOWA DEPARTMENT OF TRANSPORTATION

38A 16.337 MILES

LOCATION ON U S 71 FROM THE MONTGOMERY COUNTY LINE NORTH
AFFROXIMATELY 16.3 MILES

BID ORDER NO. 38

COUNTY CASS
TYPE OF WORK ASPH. CEMENT CONC. RESURF.
PROJECT NO. FR-71-3(26)--2G-15
DATE OF LETTING JAN. 20, 1981

NO.	ITEM	QUANTITY	UNIT	WESTERN ENGINEERING CO. INC. HARLAN, IOWA UNIT PRICE	AMOUNT	GRAVES CONST CO INC MELVIN, IOWA & MIDWEST PAVING CO SIOUX CITY, IOWA UNIT PRICE	AMOUNT	MANATTS, INC. BROOKLYN, IOWA UNIT PRICE	AMOUNT
1	BASE, CLEANING & PREPARATION OF	16960	MILES	150.00	2,544.00	400.00	6,784.00	750.00	12,720.00
2	ASPH. CEM. CONC., TYPE B SURFACE COURSE, MIXT. SIZE 1/2", RECYCLED	30534	TONS	6.62	202,135.08	7.63	232,974.42	8.70	265,645.80
3	AGGREGATE, NEW	16439	TONS	8.67	142,526.13	8.36	137,430.04	7.75	127,402.25
4	ASPHALT CEMENT	904	TONS	200.00	180,800.00	208.06	188,086.24	222.00	200,688.00
5	PRIMER OR TACK-COAT BITUMEN	13368	GALS.	1.00	13,368.00	1.00	13,368.00	1.00	13,368.00
6	AGGREGATE FOR SPRINKLE TREATMENT	927	TONS	47.50	44,032.50	100.00	92,700.00	60.00	55,620.00
7	PATCHES, FULL DEPTH	134	SQ. YDS	60.00	8,040.00	60.00	8,040.00	70.00	9,380.00
8	PATCHES, ASPHALT CEMENT CONCRETE SURFACE	30	TONS	52.50	1,575.00	70.00	2,100.00	60.00	1,800.00
9	SHOULDERS, GRANULAR SURFACING OF	11113	TONS	9.30	103,350.90	8.74	97,127.62	9.10	101,128.30
10	SURFACING, GRANULAR, CLASS A CRUSHED STONE - ON ROAD	943	TONS	9.30	8,769.90	8.74	8,241.82	8.48	7,996.64
11	PAVEMENT MARKINGS	2421	STAS.	12.50	30,262.50	11.00	26,631.00	12.00	29,052.00
12	FABRIC REINFORCEMENT	2467	SQ. YDS	1.42500	3,515.47	1.50	3,700.50	2.00	4,934.00
13	ASPH. CEM. CONC., TYPE B WEDGE, LEVEL OR STRGTH. COURSE, RECYCLED	2313	TONS	9.27	21,441.51	11.63	26,900.19	10.00	23,130.00
14	FIELD LABORATORY	1	ONLY	4500.00	4,500.00	1500.00	1,500.00	1000.00	1,000.00
15	TRAINEE REIMBURSEMENT	500	HOURS	80	400.00	80	400.00	80	400.00
	TOTAL				$767,261.00		$845,983.83		$854,264.99

MONTGOMERY COUNTY A.C.C. RESURFACING PROJECTS FR-34-2(22)--2G-69
FR-71-2(17)--2G-69 & CASS COUNTY A.C.C. RESURFACING PROJECT
FR-71-3(26)--2G-15 ARE TIED

FORM 650016
6-78 H 15478

TABULATION OF CONSTRUCTION AND MATERIAL BIDS
IOWA DEPARTMENT OF TRANSPORTATION

38B 16.337 MILES

LOCATION ON U S 71 FROM THE MONTGOMERY COUNTY LINE NORTH
APPROXIMATELY 16.3 MILES

BID ORDER NO. 38

COUNTY CASS
TYPE OF WORK ASPH. CEMENT CONC. RESURF.
PROJECT NO. FR-71-3(26)--2G-15
DATE OF LETTING JAN. 20, 1981

NO.	ITEM	QUANTITY	UNIT	HENNINGSEN CONSTR. INC. ATLANTIC, IOWA UNIT PRICE	AMOUNT	ROHLIN CONSTR., CO., INC. ESTHERVILLE, IOWA UNIT PRICE	AMOUNT	KOMATZ CONSTR., INC. ST. PETER, MINN. UNIT PRICE	AMOUNT
1	BASE, CLEANING & PREPARATION OF	16960	MILES	250.00	4,240.00	700.00	11,872.00	500.00	8,480.00
2	ASPH. CEM. CONC., TYPE B SURFACE COURSE, MIXT. SIZE 1/2", RECYCLED	30534	TONS	9.75	297,706.50	9.98	304,729.32	10.81	330,072.54
3	AGGREGATE, NEW	16439	TONS	6.68	109,812.52	6.69	109,976.91	7.90	129,868.10
4	ASPHALT CEMENT	904	TONS	212.00	191,648.00	208.06	188,086.24	210.00	189,840.00
5	PRIMER OR TACK-COAT BITUMEN	13368	GALS.	1.00	13,368.00	1.22	16,308.96	.90	12,031.20
6	AGGREGATE FOR SPRINKLE TREATMENT	927	TONS	56.27	52,162.29	89.00	82,503.00	70.00	64,890.00
7	PATCHES, FULL DEPTH	134	SQ. YDS	70.00	9,380.00	70.00	9,380.00	70.00	9,380.00
8	PATCHES, ASPHALT CEMENT CONCRETE SURFACE	30	TONS	100.00	3,000.00	100.00	3,000.00	70.00	2,100.00
9	SHOULDERS, GRANULAR SURFACING OF	11113	TONS	8.79	97,683.27	9.26	102,906.38	9.70	107,796.10
10	SURFACING, GRANULAR, CLASS A CRUSHED STONE - ON ROAD	943	TONS	10.19	9,609.17	9.00	8,487.00	9.60	9,052.80
11	PAVEMENT MARKINGS	2421	STAS.	15.00	36,315.00	11.00	26,631.00	13.00	31,473.00
12	FABRIC REINFORCEMENT	2467	SQ. YDS	1.88	4,637.96	3.25	8,017.75	3.00	7,401.00
13	ASPH. CEM. CONC., TYPE B WEDGE, LEVEL OR STRGTH. COURSE, RECYCLED	2313	TONS	10.75	24,864.75	13.25	30,647.25	10.81	25,003.53
14	FIELD LABORATORY	1	ONLY	1500.00	1,500.00	1500.00	1,500.00	1000.00	1,000.00
15	TRAINEE REIMBURSEMENT	500	HOURS	80	400.00	80	400.00	80	400.00
	TOTAL				$856,327.46		$904,445.81		$928,768.27

MONTGOMERY COUNTY A.C.C. RESURFACING PROJECTS FR-34-2(22)--2G-69
FR-71-2(17)--2G-69 & CASS COUNTY A.C.C. RESURFACING PROJECT
FR-71-3(26)--2G-15 ARE TIED

FORM 650016
6-78 H 15478

TABULATION OF CONSTRUCTION AND MATERIAL BIDS
IOWA DEPARTMENT OF TRANSPORTATION

38C 16.337 MILES

LOCATION ON U S 71 FROM THE MONTGOMERY COUNTY LINE NORTH APPROXIMATELY 16.3 MILES

BID ORDER NO. 38

COUNTY CASS
TYPE OF WORK ASPH. CEMENT CONC. RESURF.
PROJECT NO. FR-71-3(26)--2G-15
DATE OF LETTING JAN. 20, 1981

NO.	ITEM	QUANTITY	UNIT	CESSFORD CONSTR. CO. LE GRAND, IOWA. UNIT PRICE	AMOUNT		UNIT PRICE	AMOUNT		UNIT PRICE	AMOUNT	
1	BASE, CLEANING & PREPARATION OF	16960	MILES	25 00	4,240	00						
2	ASPH. CEM. CONC., TYPE B SURFACE COURSE, MIXT. SIZE 1/2", RECYCLED	30534	TONS	10 78	329,156	52						
3	AGGREGATE, NEW	16439	TONS	6 69	109,976	91						
4	ASPHALT CEMENT	904	TONS	208 06	188,086	24						
5	PRIMER OR TACK-COAT BITUMEN	13368	GALS.	1 25	16,710	00						
6	AGGREGATE FOR SPRINKLE TREATMENT	927	TONS	101 00	93,627	00						
7	PATCHES, FULL DEPTH	134	SQ. YDS	70 00	9,380	00						
8	PATCHES, ASPHALT CEMENT CONCRETE SURFACE	30	TONS	50 00	1,500	00						
9	SHOULDERS, GRANULAR SURFACING OF	11113	TONS	9 09	101,017	17						
10	SURFACING, GRANULAR, CLASS A CRUSHED STONE - ON ROAD	943	TONS	8 98	8,468	14						
11	PAVEMENT MARKINGS	2421	STAS.	12 10	29,294	10						
12	FABRIC REINFORCEMENT	2467	SQ. YDS	2 50	6,167	50						
13	ASPH. CEM. CONC., TYPE B WEDGE, LEVEL OR STRGTH. COURSE, RECYCLED	2313	TONS	14 80	34,232	40						
14	FIELD LABORATORY	1	ONLY	1000 00	1,000	00						
15	TRAINEE REIMBURSEMENT	500	HOURS	80	400	00						
	TOTAL	. . . . .	. . . . .	. . . . .	$933,255	98						

MONTGOMERY COUNTY A.C.C. RESURFACING PROJECTS FR-34-2(22)--2G-69
FR-71-2(17)--2G-69 & CASS COUNTY A.C.C. RESURFACING PROJECT
FR-71-3(26)--2G-15 ARE TIED

FORM 650016
6-78 M 15478

TABULATION OF CONSTRUCTION AND MATERIAL BIDS
IOWA DEPARTMENT OF TRANSPORTATION

43 A 12.573 MILES

LOCATION ON U S 71 FROM THE CASS COUNTY LINE SOUTH APPROX. 12.6 MILES TO JUST SOUTH OF JCT. U S 34

BID ORDER NO. 43

COUNTY MONTGOMERY
TYPE OF WORK ASPH. CEMENT CONC. RESURF.
PROJECT NO. FR-71-2(17)--2G-69
DATE OF LETTING JAN. 20, 1981

NO.	ITEM	QUANTITY	UNIT	WESTERN ENGINEERING CO. INC. HARLAN, IOWA UNIT PRICE	AMOUNT	HENNINGSEN CONSTR. INC. ATLANTIC, IOWA UNIT PRICE	AMOUNT	ROHLIN CONSTR., CO., INC. ESTHERVILLE, IOWA UNIT PRICE	AMOUNT
1	BASE, CLEANING & PREPARATION OF	13151	MILES	15000	1,972 65	25000	3,287 75	70000	9,205 70
2	ASPH. CEM. CONC., TYPE B SURFACE COURSE, MIXT. SIZE 1/2", RECYCLED	21725	TONS	832	180,785 28	975	211,857 75	998	216,855 42
3	AGGREGATE, NEW	11013	TONS	867	95,482 71	668	73,566 84	669	73,676 97
4	ASPHALT CEMENT	606	TONS	20000	121,200 00	21200	128,472 00	20806	126,084 36
5	PRIMER OR TACK-COAT BITUMEN	9578	GALS.	100	9,578 00	100	9,578 00	122	11,685 16
6	SHOULDERS, GRANULAR SURFACING OF	8836	TONS	1000	86,360 00	935	82,616 60	982	86,769 52
7	AGGREGATE FOR SPRINKLE TREATMENT	672	TONS	4750	31,920 00	5627	37,813 44	8900	59,808 00
8	PATCHES, FULL DEPTH	10	SQ. YDS	6000	600 00	7000	700 00	7000	700 00
9	PATCHES, ASPHALT CEMENT CONCRETE SURFACE	20	TONS	5250	1,050 00	10000	2,000 00	10000	2,000 00
10	PAVEMENT MARKINGS	1722	STAS.	1250	21,525 00	1500	25,830 00	1100	18,942 00
11	SURFACING, GRANULAR, CLASS A CRUSHED STONE - ON ROAD	579	TONS	1000	5,790 00	1075	6,224 25	950	5,500 50
12	FABRIC REINFORCEMENT	107	SQ. YDS	142500	152 47	188	201 16	325	347 75
13	ASPH. CEM. CONC., TYPE B WEDGE, LEVEL OR STRGTH. COURSE, RECYCLED	276	TONS	1232	3,400 32	1075	2,967 00	1325	3,657 00
14	TRAINEE REIMBURSEMENT	500	HOURS	80	400 00	80	400 00	80	400 00
	TOTAL				$562,216 44		$585,514 79		$615,632 38

MONTGOMERY COUNTY A.C.C. RESURFACING PROJECTS FR-34-2(22)--2G-69
FR-71-2(17)--2G-69 & CASS COUNTY A.C.C. RESURFACING PROJECT
FR-71-3(26)--2G-15 ARE TIED

FORM 650016
6-78 H 15478

TABULATION OF CONSTRUCTION AND MATERIAL BIDS
IOWA DEPARTMENT OF TRANSPORTATION

43 B 12.573 MILES

LOCATION ON U S 71 FROM THE CASS COUNTY LINE SOUTH APPROX. 12.6 MILES TO JUST SOUTH OF JCT. U S 34

BID ORDER NO. 43

COUNTY MONTGOMERY
TYPE OF WORK ASPH. CEMENT CONC. RESURF.
PROJECT NO. FR-71-2(17)--2G-69
DATE OF LETTING JAN. 20, 1981

NO.	ITEM	QUANTITY	UNIT	GRAVES CONST CO INC MELVIN, IOWA & MIDWEST PAVING CO SIOUX CITY, IOWA UNIT PRICE	AMOUNT	MANATTS, INC. BROOKLYN, IOWA UNIT PRICE	AMOUNT	CESSFORD CONSTR. CO. LE GRAND, IOWA. UNIT PRICE	AMOUNT
1	BASE, CLEANING & PREPARATION OF	13151	MILES	40.00	5,260 40	75.00	9,863 25	25.00	3,287 75
2	ASPH. CEM. CONC., TYPE B SURFACE COURSE, MIXT. SIZE 1/2", RECYCLED	21729	TONS	9.31	202,296 99	10.00	217,290 00	11.82	256,836 78
3	AGGREGATE, NEW	11013	TONS	8.36	92,068 68	8.00	88,104 00	6.69	73,676 97
4	ASPHALT CEMENT	606	TONS	208.06	126,084 36	222.00	134,532 00	208.06	126,084 36
5	PRIMER OR TACK-COAT BITUMEN	9578	GALS.	1.00	9,578 00	1.00	9,578 00	1.25	11,972 50
6	SHOULDERS, GRANULAR SURFACING OF	8836	TONS	9.03	79,789 08	9.85	87,034 60	9.66	85,355 76
7	AGGREGATE FOR SPRINKLE TREATMENT	672	TONS	100.00	67,200 00	60.00	40,320 00	101.00	67,872 00
8	PATCHES, FULL DEPTH	10	SQ. YDS	60.00	600 00	70.00	700 00	70.00	700 00
9	PATCHES, ASPHALT CEMENT CONCRETE SURFACE	20	TONS	70.00	1,400 00	60.00	1,200 00	50.00	1,000 00
10	PAVEMENT MARKINGS	1722	STAS.	11.00	18,942 00	12.00	20,664 00	12.10	20,836 20
11	SURFACING, GRANULAR, CLASS A CRUSHED STONE - ON ROAD	579	TONS	9.03	5,228 37	9.00	5,211 00	9.54	5,523 66
12	FABRIC REINFORCEMENT	107	SQ. YDS	1.50	160 50	2.00	214 00	3.00	321 00
13	ASPH. CEM. CONC., TYPE B WEDGE, LEVEL OR STRGTH. COURSE, RECYCLED	276	TONS	25.00	6,900 00	13.00	3,588 00	15.82	4,366 32
14	TRAINEE REIMBURSEMENT	500	HOURS	80	400 00	80	400 00	80	400 00
	TOTAL	. . . . .		. . . . .	$615,908 38		$618,698 85		$658,233 30

MONTGOMERY COUNTY A.C.C. RESURFACING PROJECTS FR-34-2(22)--2G-69
FR-71-2(17)--2G-69 & CASS COUNTY A.C.C. RESURFACING PROJECT
FR-71-3(26)--2G-15 ARE TIED

FORM 650016
6-78 H 15478

TABULATION OF CONSTRUCTION AND MATERIAL BIDS
IOWA DEPARTMENT OF TRANSPORTATION

43 C 12.573 MILES

LOCATION ON U S 71 FROM THE CASS COUNTY LINE SOUTH APPROX. 12.6 MILES TO JUST SOUTH OF JCT. U S 34

BID ORDER NO. 43

COUNTY MONTGOMERY
TYPE OF WORK ASPH. CEMENT CONC. RESURF.
PROJECT NO. FR-71-2(17)--2G-69
DATE OF LETTING JAN. 20, 1981

NO.	ITEM	QUANTITY	UNIT	KOMATZ CONSTR., INC. ST. PETER, MINN. UNIT PRICE	AMOUNT	UNIT PRICE	AMOUNT	UNIT PRICE	AMOUNT
1	BASE, CLEANING & PREPARATION OF	13151	MILES	500 00	6,575 50				
2	ASPH. CEM. CONC., TYPE B SURFACE COURSE, MIXT. SIZE 1/2", RECYCLED	21729	TONS	13 50	293,341 50				
3	AGGREGATE, NEW	11013	TONS	7 90	87,002 70				
4	ASPHALT CEMENT	606	TONS	210 00	127,260 00				
5	PRIMER OR TACK-COAT BITUMEN	9578	GALS.	90	8,620 20				
6	SHOULDERS, GRANULAR SURFACING OF	8836	TONS	10 40	91,894 40				
7	AGGREGATE FOR SPRINKLE TREATMENT	672	TONS	70 00	47,040 00				
8	PATCHES, FULL DEPTH	10	SQ. YDS	70 00	700 00				
9	PATCHES, ASPHALT CEMENT CONCRETE SURFACE	20	TONS	70 00	1,400 00				
10	PAVEMENT MARKINGS	1722	STAS.	13 00	22,386 00				
11	SURFACING, GRANULAR, CLASS A CRUSHED STONE - ON ROAD	579	TONS	10 30	5,963 70				
12	FABRIC REINFORCEMENT	107	SQ. YDS	3 00	321 00				
13	ASPH. CEM. CONC., TYPE B WEDGE, LEVEL OR STRGTH. COURSE, RECYCLED	276	TONS	13 50	3,726 00				
14	TRAINEE REIMBURSEMENT	500	HOURS	80	400 00				
	TOTAL	. . . . .	. . . . .	. . . . .	$696,631 00				

MONTGOMERY COUNTY A.C.C. RESURFACING PROJECTS FR-34-2(22)--2G-69
FR-71-2(17)--2G-69 & CASS COUNTY A.C.C. RESURFACING PROJECT
FR-71-3(26)--2G-15 ARE TIED

FORM 650016
6-78 H 15478

TABULATION OF CONSTRUCTION AND MATERIAL BIDS
IOWA DEPARTMENT OF TRANSPORTATION

44A 1.893 MILES

LOCATION ON U S 34 FROM 0.5 MILE WEST OF U S 71 INTERCHANGE
EASTERLY APPROX. 1.9 MILES

BID ORDER NO. 44

COUNTY MONTGOMERY
TYPE OF WORK ASPH. CEMENT CONC. RESURF.
PROJECT NO. FR-34-2(22)--2G-69
DATE OF LETTING JAN. 20, 1981

NO.	ITEM	QUANTITY	UNIT	WESTERN ENGINEERING CO. INC. HARLAN, IOWA UNIT PRICE	AMOUNT	MANATTS, INC. BROOKLYN, IOWA UNIT PRICE	AMOUNT	CESSFORD CONSTR. CO. LE GRAND, IOWA. UNIT PRICE	AMOUNT
1	BASE, CLEANING & PREPARATION OF	3054	MILES	150.00	458.10	750.00	2,290.50	250.00	763.50
2	PATCHES, FULL DEPTH	269	SQ. YDS	60.00	16,140.00	70.00	18,830.00	40.00	10,760.00
3	FABRIC REINFORCEMENT	373	SQ. YDS	1.42500	531.52	2.00	746.00	2.50	932.50
4	AGGREGATE, NEW	3120	TONS	8.67	27,050.40	8.00	24,960.00	6.69	20,872.80
5	PATCHES, ASPHALT CEMENT CONCRETE SURFACE	100	TONS	52.50	5,250.00	60.00	6,000.00	50.00	5,000.00
6	ASPHALT CEMENT	173	TONS	200.00	34,600.00	222.00	38,406.00	208.06	35,994.38
7	ASPH. CEM. CONC., TYPE B SURFACE COURSE, MIXT. SIZE 1/2", RECYCLED	6087	TONS	10.22	62,209.14	11.00	66,957.00	12.66	77,061.42
8	PRIMER OR TACK-COAT BITUMEN	2670	GALS.	1.00	2,670.00	1.00	2,670.00	1.25	3,337.50
9	PAVEMENT MARKINGS	391	STAS.	12.50	4,887.50	12.00	4,692.00	12.10	4,731.10
10	SHOULDERS, GRANULAR SURFACING OF	1293	TONS	10.10	13,059.30	10.00	12,930.00	9.65	12,477.45
11	CULVERT, JACKED CONCRETE RDWY. PIPE, 24 IN. DIA.	148	LIN. FT	105.00	15,540.00	15.00	2,220.00	105.00	15,540.00
12	APRONS, CONCRETE, 24 IN. DIA.	4	ONLY	150.00	600.00	250.00	1,000.00	151.00	604.00
13	GUARD, PIPE APRON, 24 IN.	2	ONLY	195.00	390.00	200.00	400.00	200.00	400.00
14	REMOVAL OF FORMED STEEL BEAM GUARDRAIL	562.500	LIN. FT	3.06	1,721.25	4.00	2,250.00	3.30	1,856.25
15	GUARDRAIL, FORMED STEEL BEAM	762.500	LIN. FT	9.68	7,381.00	9.50	7,243.75	10.25	7,815.62
16	GUARDRAIL, POSTS, BEAM	112	ONLY	51.00	5,712.00	50.00	5,600.00	55.00	6,160.00
17	EXCAVATION, CLASS 10, ROADWAY & BORROW	935	CU. YDS	6.00	5,610.00	7.00	6,545.00	6.00	5,610.00
18	DELINEATORS, SINGLE WHITE	7	ONLY	17.33	121.31	17.00	119.00	18.50	129.50
19	DELINEATOR, TRIPLE AMBER VERTICAL	6	ONLY	18.35	110.10	18.00	108.00	19.80	118.80
20	OBJECT MARKER, TYPE 3	5	ONLY	51.00	255.00	50.00	250.00	55.00	275.00
21	GUARDRAIL, END ANCHORAGES, BEAM BRIDGE, RE-28	2	ONLY	688.00	1,376.00	675.00	1,350.00	730.00	1,460.00
22	GUARDRAIL, END ANCHORAGES, BEAM RE-33	1	ONLY	331.00	331.00	325.00	325.00	355.00	355.00
23	GUARDRAIL, END ANCHORAGES, BEAM RE-52	3	ONLY	408.00	1,224.00	400.00	1,200.00	440.00	1,320.00
24	GUARDRAIL, END ANCHORAGES, BEAM RE-53	4	ONLY	530.00	2,120.00	520.00	2,080.00	570.00	2,280.00
25	AGGREGATE FOR SPRINKLE TREATMENT	90	TONS	47.50	4,275.00	60.00	5,400.00	101.00	9,090.00

FORM 650016
6-76 H 15478

TABULATION OF CONSTRUCTION AND MATERIAL BIDS
IOWA DEPARTMENT OF TRANSPORTATION

44 B 1.893 MILES

LOCATION ON U S 34 FROM 0.5 MILE WEST OF U S 71 INTERCHANGE EASTERLY APPROX. 1.9 MILES

BID ORDER NO. 44

COUNTY MONTGOMERY
TYPE OF WORK ASPH. CEMENT CONC. RESURF.
PROJECT NO. FR-34-2(22)--2G-69
DATE OF LETTING JAN. 20, 1981

NO.	ITEM	QUANTITY	UNIT	WESTERN ENGINEERING CO. INC. HARLAN, IOWA UNIT PRICE	AMOUNT	MANATTS, INC. BROOKLYN, IOWA UNIT PRICE	AMOUNT	CESSFORD CONSTR. CO. LE GRAND, IOWA. UNIT PRICE	AMOUNT
26	REMOVE & REINSTALL FORMED STEEL BEAM GUARDRAIL	275	LIN. FT	10.20	2,805.00	10.00	2,750.00	11.00	3,025.00
27	REMOVAL OF POSTS	75	ONLY	3.06	229.50	3.00	225.00	3.30	247.50
28	POSTS, REMOVE AND REINSTALL	75	ONLY	16.30	1,222.50	16.00	1,200.00	17.60	1,320.00
29	REMOVAL OF GUARDRAIL END ANCHORAGE	6	ONLY	76.50	459.00	75.00	450.00	82.00	492.00
30	ASPH. CEM. CONC., TYPE B WEDGE, LEVEL OR STRGTH. COURSE, RECYCLED	52	TONS	19.32	1,004.64	20.00	1,040.00	22.50	1,170.00
	TOTAL	. . . . .	. . . . .	. . . . .	$219,343.26		$220,237.25		$231,199.32

MONTGOMERY COUNTY A.C.C. RESURFACING PROJECTS FR-34-2(22)--2G-69
FR-71-2(17)--2G-69 & CASS COUNTY A.C.C. RESURFACING PROJECT
FR-71-3(26)--2G-15 ARE TIED

FORM 650016
6-78 H 15478

TABULATION OF CONSTRUCTION AND MATERIAL BIDS
IOWA DEPARTMENT OF TRANSPORTATION

LOCATION ON U S 34 FROM 0.5 MILE WEST OF U S 71 INTERCHANGE
EASTERLY APPROX. 1.9 MILES

44C 1.893 MILES

BID ORDER NO. 44

COUNTY MONTGOMERY
TYPE OF WORK ASPH. CEMENT CONC. RESURF.
PROJECT NO. FR-34-2(22)--26-69
DATE OF LETTING JAN. 20, 1981

NO.	ITEM	QUANTITY	UNIT	GRAVES CONST CO INC MELVIN, IOWA & MIDWEST PAVING CO SIOUX CITY, IOWA UNIT PRICE	AMOUNT	HENNINGSEN CONSTR. INC. ATLANTIC, IOWA UNIT PRICE	AMOUNT	ROHLIN CONSTR., CO., INC. ESTHERVILLE, IOWA UNIT PRICE	AMOUNT
1	BASE, CLEANING & PREPARATION OF	3054	MILES	400.00	1,221.60	1000.00	3,054.00	800.00	2,443.20
2	PATCHES, FULL DEPTH	269	SQ. YDS	60.00	16,140.00	70.00	18,830.00	80.00	21,520.00
3	FABRIC REINFORCEMENT	373	SQ. YDS	1.50	559.50	1.88	701.24	3.25	1,212.25
4	AGGREGATE, NEW	3120	TONS	8.36	26,083.20	6.68	20,841.60	6.69	20,872.80
5	PATCHES, ASPHALT CEMENT CONCRETE SURFACE	100	TONS	60.00	6,000.00	75.00	7,500.00	80.00	8,000.00
6	ASPHALT CEMENT	173	TONS	208.06	35,994.38	212.00	36,676.00	208.06	35,994.38
7	ASPH. CEM. CONC., TYPE B SURFACE COURSE, MIXT. SIZE 1/2", RECYCLED	6087	TONS	10.03	61,052.61	10.75	65,435.25	12.85	78,217.95
8	PRIMER OR TACK-COAT BITUMEN	2670	GALS.	1.00	2,670.00	1.00	2,670.00	1.27	3,390.90
9	PAVEMENT MARKINGS	391	STAS.	11.00	4,301.00	15.00	5,865.00	11.00	4,301.00
10	SHOULDERS, GRANULAR SURFACING OF	1293	TONS	9.03	11,675.79	10.00	12,930.00	9.82	12,697.26
11	CULVERT, JACKED CONCRETE RDWY. PIPE, 24 IN. DIA.	148	LIN. FT	134.00	19,832.00	110.00	16,280.00	110.00	16,280.00
12	APRONS, CONCRETE, 24 IN. DIA.	4	ONLY	165.00	660.00	160.00	640.00	142.50	570.00
13	GUARD, PIPE APRON, 24 IN.	2	ONLY	120.00	240.00	200.00	400.00	180.00	360.00
14	REMOVAL OF FORMED STEEL BEAM GUARDRAIL	562.500	LIN. FT	3.85	2,165.62	4.05	2,278.12	3.00	1,687.50
15	GUARDRAIL, FORMED STEEL BEAM	762.500	LIN. FT	10.50	8,006.25	11.00	8,387.50	9.50	7,243.75
16	GUARDRAIL, POSTS, BEAM	112	ONLY	64.66	7,241.92	68.00	7,616.00	50.00	5,600.00
17	EXCAVATION, CLASS 10, ROADWAY & BORROW	935	CU. YDS	7.00	6,545.00	8.40	7,854.00	6.75	6,311.25
18	DELINEATORS, SINGLE WHITE	7	ONLY	20.00	140.00	28.90	202.30	17.00	119.00
19	DELINEATOR, TRIPLE AMBER VERTICAL	6	ONLY	25.00	150.00	30.00	180.00	18.00	108.00
20	OBJECT MARKER, TYPE 3	5	ONLY	55.00	275.00	52.50	262.50	50.00	250.00
21	GUARDRAIL, END ANCHORAGES, BEAM BRIDGE, RE-28	2	ONLY	800.00	1,600.00	830.00	1,660.00	675.00	1,350.00
22	GUARDRAIL, END ANCHORAGES, BEAM RE-33	1	ONLY	500.00	500.00	520.00	520.00	325.00	325.00
23	GUARDRAIL, END ANCHORAGES, BEAM RE-52	3	ONLY	500.00	1,500.00	520.00	1,560.00	400.00	1,200.00
24	GUARDRAIL, END ANCHORAGES, BEAM RE-53	4	ONLY	562.00	2,248.00	590.00	2,360.00	520.00	2,080.00
25	AGGREGATE FOR SPRINKLE TREATMENT	90	TONS	100.00	9,000.00	56.27	5,064.30	89.00	8,010.00

FORM 650016
6-76 H 15478

TABULATION OF CONSTRUCTION AND MATERIAL BIDS
IOWA DEPARTMENT OF TRANSPORTATION

44D 1.893 MILES

LOCATION ON U S 34 FROM 0.5 MILE WEST OF U S 71 INTERCHANGE
EASTERLY APPROX. 1.9 MILES

BID ORDER NO. 44

COUNTY MONTGOMERY
TYPE OF WORK ASPH. CEMENT CONC. RESURF.
PROJECT NO. FR-34-2(22)--2G-69
DATE OF LETTING JAN. 20, 1981

NO.	ITEM	QUANTITY	UNIT	GRAVES CONST CO INC MELVIN, IOWA & MIDWEST PAVING CO SIOUX CITY, IOWA UNIT PRICE	AMOUNT	HENNINGSEN CONSTR. INC. ATLANTIC, IOWA UNIT PRICE	AMOUNT	ROHLIN CONSTR., CO., INC. ESTHERVILLE, IOWA UNIT PRICE	AMOUNT
26	REMOVE & REINSTALL FORMED STEEL BEAM GUARDRAIL	275	LIN. FT	9.04	2,486.00	9.50	2,612.50	10.00	2,750.00
27	REMOVAL OF POSTS	75	ONLY	7.44	558.00	7.80	585.00	3.00	225.00
28	POSTS, REMOVE AND REINSTALL	75	ONLY	34.23	2,567.25	35.50	2,662.50	16.00	1,200.00
29	REMOVAL OF GUARDRAIL END ANCHORAGE	6	ONLY	125.00	750.00	130.00	780.00	75.00	450.00
30	ASPH. CEM. CONC., TYPE B WEDGE, LEVEL OR STRGTH. COURSE, RECYCLED	52	TONS	25.00	1,300.00	12.75	663.00	16.00	832.00
	TOTAL				$233,463.12		$237,070.81		$245,601.24

MONTGOMERY COUNTY A.C.C. RESURFACING PROJECTS FR-34-2(22)--2G-69
FR-71-2(17)--2G-69 & CASS COUNTY A.C.C. RESURFACING PROJECT
FR-71-3(26)--2G-15 ARE TIED

FORM 650016
6-78 H 15478

TABULATION OF CONSTRUCTION AND MATERIAL BIDS
IOWA DEPARTMENT OF TRANSPORTATION

LOCATION ON U S 34 FROM 0.5 MILE WEST OF U S 71 INTERCHANGE
EASTERLY APPROX. 1.9 MILES

44E 1.893 MILES

BID ORDER NO. 44

COUNTY MONTGOMERY
TYPE OF WORK ASPH. CEMENT CONC. RESURF.
PROJECT NO. FR-34-2(22)--26-69
DATE OF LETTING JAN. 20, 1981

NO.	ITEM	QUANTITY	UNIT	KOMATZ CONSTR., INC. ST. PETER, MINN. UNIT PRICE	AMOUNT	UNIT PRICE	AMOUNT	UNIT PRICE	AMOUNT
1	BASE, CLEANING & PREPARATION OF	3054	MILES	500.00	1,527.00				
2	PATCHES, FULL DEPTH	269	SQ. YDS	70.00	18,830.00				
3	FABRIC REINFORCEMENT	373	SQ. YDS	3.00	1,119.00				
4	AGGREGATE, NEW	3120	TONS	7.90	24,648.00				
5	PATCHES, ASPHALT CEMENT CONCRETE SURFACE	100	TONS	70.00	7,000.00				
6	ASPHALT CEMENT	173	TONS	210.00	36,330.00				
7	ASPH. CEM. CONC., TYPE B SURFACE COURSE, MIXT. SIZE 1/2", RECYCLED	6087	TONS	15.40	93,739.80				
8	PRIMER OR TACK-COAT BITUMEN	2670	GALS.	.90	2,403.00				
9	PAVEMENT MARKINGS	391	STAS.	13.00	5,083.00				
10	SHOULDERS, GRANULAR SURFACING OF	1293	TONS	10.40	13,447.20				
11	CULVERT, JACKED CONCRETE RDWY. PIPE, 24 IN. DIA.	148	LIN. FT	100.00	14,800.00				
12	APRONS, CONCRETE, 24 IN. DIA.	4	ONLY	250.00	1,000.00				
13	GUARD, PIPE APRON, 24 IN.	2	ONLY	500.00	1,000.00				
14	REMOVAL OF FORMED STEEL BEAM GUARDRAIL	562.500	LIN. FT	3.50	1,968.75				
15	GUARDRAIL, FORMED STEEL BEAM	762.500	LIN. FT	11.00	8,387.50				
16	GUARDRAIL, POSTS, BEAM	112	ONLY	60.00	6,720.00				
17	EXCAVATION, CLASS 10, ROADWAY & BORROW	935	CU. YDS	5.00	4,675.00				
18	DELINEATORS, SINGLE WHITE	7	ONLY	20.00	140.00				
19	DELINEATOR, TRIPLE AMBER VERTICAL	6	ONLY	21.00	126.00				
20	OBJECT MARKER, TYPE 3	5	ONLY	60.00	300.00				
21	GUARDRAIL, END ANCHORAGES, BEAM BRIDGE, RE-28	2	ONLY	700.00	1,400.00				
22	GUARDRAIL, END ANCHORAGES, BEAM RE-33	1	ONLY	350.00	350.00				
23	GUARDRAIL, END ANCHORAGES, BEAM RE-52	3	ONLY	450.00	1,350.00				
24	GUARDRAIL, END ANCHORAGES, BEAM RE-53	4	ONLY	600.00	2,400.00				
25	AGGREGATE FOR SPRINKLE TREATMENT	90	TONS	70.00	6,300.00				

FORM 650016
6-78 H 15478

TABULATION OF CONSTRUCTION AND MATERIAL BIDS
IOWA DEPARTMENT OF TRANSPORTATION

44F 1.893 MILES

LOCATION ON U S 34 FROM 0.5 MILE WEST OF U S 71 INTERCHANGE EASTERLY APPROX. 1.9 MILES

BID ORDER NO. 44

COUNTY MONTGOMERY
TYPE OF WORK ASPH. CEMENT CONC. RESURF.
PROJECT NO. FR-34-2(22)--2G-69
DATE OF LETTING JAN. 20, 1981

NO.	ITEM	QUANTITY	UNIT	KOMATZ CONSTR., INC. ST. PETER, MINN. UNIT PRICE	AMOUNT	UNIT PRICE	AMOUNT	UNIT PRICE	AMOUNT
26	REMOVE & REINSTALL FORMED STEEL BEAM GUARDRAIL	275	LIN. FT	12.00	3,300 00				
27	REMOVAL OF POSTS	75	ONLY	4.00	300 00				
28	POSTS, REMOVE AND REINSTALL	75	ONLY	18.00	1,350 00				
29	REMOVAL OF GUARDRAIL END ANCHORAGE	6	ONLY	90.00	540 00				
30	ASPH. CEM. CONC., TYPE B WEDGE, LEVEL OR STRGTH. COURSE, RECYCLED	52	TONS	15.40	800 80				
	TOTAL				$261,335 05				

MONTGOMERY COUNTY A.C.C. RESURFACING PROJECTS FR-34-2(22)--2G-69
FR-71-2(17)--2G-69 & CASS COUNTY A.C.C. RESURFACING PROJECT
FR-71-3(26)--2G-15 ARE TIED

Appendix F

APPENDIX

Engineering Fabric

Project FR-71-2(17)--2G-69

Station to Station	Station to Station
488+65 to 488+95	532+37 to 532+70
490+78 to 490+98	543+85 to 544+25
517+50 to 518+22	544+71 to 545+00
518+00 to 518+36	544+46 to 545+06
227+7 to 528+20	553+69 to 554+19

Project FR-71-3(26)--2G-15

Left Lane

Station to Station	Station to Station
739+52 to 740+09	805+45 to 805+88
741+00 to 748+10	812+73 to 812+97
750+20 to 750+62	829+58 to 830+36
759+18 to 760+80	832+73 to 833+00
762+00 to 765+85	834+35 to 836+77
767+22 to 768+00	840+39 to 841+34
768+55 to 768+75	860+97 to 860+97
770+85 to 781+80	866+65 to 867+25
783+00 to 783+25	869+90 to 870+11
785+15 to 785+60	871+23 to 871+68
803+07 to 803+57	874+20 to 877+37
804+64 to 805+00	879+08 to 880+05

Right Lane

885+98 to 886+17	829+61 to 830+33
885+27 to 885+51	826+22 to 826+39
882+20 to 882+02	825+35 to 825+50
877+13 to 877+31	802+00 to 802+20
874+38 to 876+32	785+15 to 785+60
872+50 to 872+77	784+00 to 784+25
871+65 to 871+80	783+35 to 783+60
866+03 to 866+20	778+74 to 782+42
855+63 to 860+29	759+18 to 765+50
850+54 to 854+44	753+74 to 753+94
846+80 to 847+76	752+60 to 752+84
840+48 to 841+76	749+06 to 749+34
834+55 to 835+33	750+23 to 750+53
831+50 to 831+11	

Appendix G

Form 000020
2-75 H-15078

IOWA DEPARTMENT OF TRANSPORTATION

To Office: Construction Department

Date: December 14, 1981

Attention: Don Jordison

Ref. No.
FR-71-3(26)--2G-15
Cass Co.
FR-71-2(17)--2G-69
FR-34-2(22)--2G-69
Montgomery County
ASph. Conc. Resurfacing

From: John Tebrinke
for W. G. Burgan

Office: Red Oak Construction

Subject: Asphalt Concrete Pavement Recycling
Fuel Consumption.

Find listed below the summaries of energy consumption for projects FR-71-3(26)--2G-15, FR-71-2(17)--2G-69 and FR-34-2(22)--2G-69.

Gallons of fuel used is shown in equivalent gallons of gasoline at 125,000 BTU./gallon.

No. 2 diesel was used in the plant generator, secondary dryer and trucks that hauled the hot mix, new aggregate and hydrated lime. No. 5 fuel oil was used in the primary dryer.

The secondary dryer was used on eleven days and production was increased approximately 45 tons per hour when it was in operation.

Moisture content of the salvaged asphaltic concrete prior to induction into the secondary dryer was 4.6% to 6.2% as determined from samples run by the District Materials lab. Moisture content of the salvaged material sampled at the outlet end of the secondary dryer was approximately 2.5%.

For comparison, the moisture content was 2.1% in the asphaltic concrete that was milled on I-80 from Stuart to Greenfield this past season.

Moisture content of the new aggregate was approximately 2.5% in the coarse aggregate and 7.0% in the fine aggregate.

SUMMARY OF ENERGY CONSUMPTION - Project FR-71-3(26)--2G-15:

Tons mix used on road:

Surface course	=	28,848.42 tons
Strengthening course	=	2,406.32 tons
Full depth patches	=	219.54 tons
Surface patch	=	8.13 tons
Total tons used	=	31,482.41

Equivalent gallons of gasoline used:

Plant generator	=	2,582.1 gals.
Primary dryer	=	72,323.9 gals.
Secondary dryer	=	982.8 gals.
Hot mis haul	=	7,276.5 gals.
New aggregate haul	=	3,699.0 gals
Hydrated lime haul	=	2,018.0 gals

(continued next page)

Equivalent gallons of gasoline per ton of mix used:

Plant generator	=	$\frac{2582.1}{31482.41}$	= 0.082
Primary dryer	=	$\frac{72323.9}{31482.41}$	= 2.297
Secondary dryer	=	$\frac{982.8}{31482.41}$	= 0.031
Hot mix haul	=	$\frac{7276.5}{31482.41}$	= 0.231
New aggregate haul	=	$\frac{3699.0}{31482.41}$	= 0.117
Hydrated lime haul	=	$\frac{2018.0}{31482.41}$	= 0.064
Total gals/ton			= 2.822

SUMMARY OF ENERGY CONSUMPTION - Project Fr-34-2(22)--2G-69

Tons of mix used on road:

Surface course	=	6105.00
Leveling course	=	61.83
Full depth patch	=	223.09
Surface patch	=	1.00
Total tons used	=	6390.92

Equivalent gallons of gasoline used:

Plant generator	=	655.1 gals
Primary dryer	=	14790.3 gals
Secondary dryer	=	827.9 gals
Hot mix haul	=	3732.7 gals
New aggregate haul	=	751.0 gals
Hydrated lime haul	=	404.0 gals

Equivalent gallons of gasoline used per ton of mix:

Plant generator	=	$\frac{655.1}{6390.92}$	= 0.102
Primary dryer	=	$\frac{14790.3}{6390.92}$	= 2.314
Secondary dryer	=	$\frac{827.9}{6390.92}$	= 0.130
Hot mix haul	=	$\frac{3732.7}{6390.92}$	= 0.584
New aggregate haul	=	$\frac{751.0}{6390.92}$	= 0.118
Hydrated lime haul	=	$\frac{404.0}{6390.92}$	= 0.063
Total gals per ton			= 3.311

(continued next page)

Don Jordison
page 3 of 3

December 14, 1981

SUMMARY OF ENERGY CONSUMPTION - Project FR-71-2(17)--2G-69

Ton of mix used on road:

Surface course	=	22181.32 tons
Leveling course	=	301.93 tons
Surface patch	=	4.00 tons
Total tons used	=	22487.25

Equivalent gallons of gasoline used:

Plant generator	=	1523.6 gals.
Primary dryer	=	45487.3 gals.
Secondary dryer	=	12923.2 gals.
Hot mix haul	=	7176.5 gals.
New aggregate haul	=	2642.0 gals.
Hydrated lime haul	=	1346.0 gals.

Equivalent gallons of gasoline per ton of mix used:

Plant generator $= \frac{1523.6}{22487.25} = 0.068$

Primary dryer $= \frac{45487.3}{22487.25} = 2.023$

Secondary dryer $= \frac{12923.2}{22487.25} = 0.575$

Hot mix haul $= \frac{7176.5}{22487.25} = 0.319$

New aggregate haul $= \frac{2642.0}{22487.25} = 0.117$

Hydrated lime haul $= \frac{1346.0}{22487.25} = 0.060$

Total gals. per ton $= 3.162$

WGB:JDT:jg
cc: J. Lane, Dist. Materials Engr., D.O.T., Atlantic
RC file