

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**

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ASPHALT CEMENT CONCRETE
PAVEMENT RECYCLING
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 today's 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 $9\frac{1}{2}$ 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 $\frac{3}{4}$ " 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 $\frac{1}{2}$ 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

<u>Class</u>	<u>Dec. 79</u>	<u>Feb. 80</u>
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" ¾" 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 $\frac{1}{2}$ " 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
<u>Gas Data</u>			
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 ₂ O Vol %	22.6	19.7	22.1
ACFM	28,142	21,456	28,903
DSCFM	9,061	7,845	9,997
<u>Particulate Emissions</u>			
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 ₂ O 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 $\frac{1}{2}$ " 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 $\frac{1}{2}$ " 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		Leveling Course	
	Tons A.C.C.	\$ Ton	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

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.

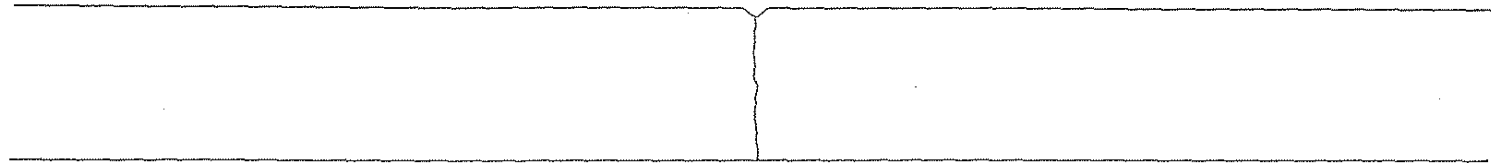
REFERENCES

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:

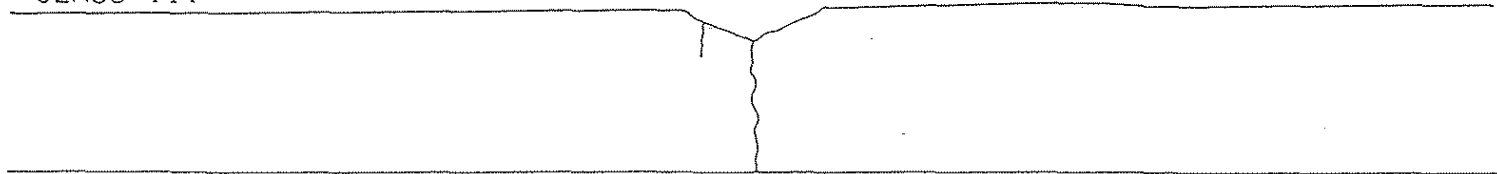
1. 0.25" to 0.50" average depression.

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. 074 DATE REPORTED 6/22/81
CASS SF-336 FR-71-3(26)--26-15
COUNTY MONTGOMERY PROJECT FR-34-2(22)--26-69
MONTGOMERY FR-71-2(17)--26-69
CONTRACTOR WESTERN

FROM MONTGOMERY LINE NORTH 14.3 MILES; FROM 0.5 MI. WEST OF
PROJ. LOCATION U.S. 71 INTERCHANGE EAST 1.2 MILES; FROM CASS CO. LINE SOUTH
12.6 MILES.

AGG. SOURCES 13/4" CR. LST. - ATLANTIC CR. - 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
75 BLOW MARSHALL DENSITY +0.3

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

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										Notes
	1 1/2	1	3/4	1/2	3/8	4	8	30	40	50	
1. 4110.	100	95-100		25-60	100	90-	70-	40-75		0-30	0-1.5
2. 4111.	100	50-90	30-100	20-75	5-55	0-10	95-		10-40		-1.5
3. 4112. (57, 2-8)	100	100	90-100		20-55	0-10	-5				-1.5
4. 4113. (2-8)											
5. 4115. (67, 2-8)											
6. 4115.08	100		100	97-100	40-90	5-30	60-75	20-40			0-1.5
7. 4117. (Cl.V)						80-92					0-30
8. 4117.03						90-	25-55				
9. 4120. (B Gr.)			100			50-75	25-70				
10. 4120. (C Gr.)			100			50-80					
11. 4120. (A, B Gr.S.)		100	95-100			55-	20-40	20-40			0-10
12. 4121.			100			60-	42-85				0-30
13. 4124.			100	97-	40-90	0-30	50-				-4
14. 4125. (1/4" Gr.S.)			100	93-	40-80	0-15	-7				-1.5
15. 4125. (1/2" Gr.)											
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	37-58	28-44	18-27			3-7
19. 4126. 7, 8, (3/4")		100	98-100		75-95	48-75	33-60	18-36			4-8
20. 4126. 7, (1/2")			100	98-100			35-60	18-36			5-9
21. 4126. 7, (3/8")				100	98-100	71-93	52-72	25-40			5-9
22. 4129.					35-55	90-100	75-95	25-55			0-9
23. 4130. (Gr.S.)	100	70-					30-45		10-		-5
24. 4130. (Gr.)	100										
25. 4132. (Gr.)	100										8-15
26. 4132. (L.S.)					95-	45-80					-30

1. Minimum percent passing 2 1/2-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:

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

TABULATION OF CONSTRUCTION AND MATERIAL BIDS
IOWA DEPARTMENT OF TRANSPORTATION



BID ORDER NO.

38

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

38A 16.337 MILES

COUNTY CASS				WESTERN ENGINEERING CO. INC. HARLAN, IOWA			GRAVES CONST CO INC MELVIN, IOWA & MIDWEST PAVING CO SIOUX CITY, IOWA			MANATTS, INC. BROOKLYN, IOWA		
TYPE OF WORK ASPH. CEMENT CONC. RESURF.												
PROJECT NO. FR-71-3(26)--26-15												
DATE OF LETTING JAN. 20, 1981												
NO.	ITEM	QUANTITY	UNIT	UNIT PRICE	AMOUNT	UNIT PRICE	AMOUNT	UNIT PRICE	AMOUNT			
1	BASE, CLEANING & PREPARATION OF	16.960	MILES	15000	2,544 00	40000	6,784 00	75000	12,720 00			
2	ASPH. CEM. CONC., TYPE B SURFACE											
	COURSE, MIXT. SIZE 1/2", RECYCLED	30534	TONS	662	202,135 08	763	232,974 42	870	265,645 80			
3	AGGREGATE, NEW	16439	TONS	867	142,526 13	836	137,430 04	775	127,402 25			
4	ASPHALT CEMENT	904	TONS	20000	180,800 00	20806	188,086 24	22200	200,688 00			
5	PRIMER OR TACK-COAT BITUMEN	13364	GALS.	100	13,368 00	100	13,368 00	100	13,368 00			
6	AGGREGATE FOR SPRINKLE TREATMENT	927	TONS	4750	44,032 50	10000	92,700 00	6000	55,620 00			
7	PATCHES, FULL DEPTH	134	SQ. YDS	6000	8,040 00	6000	8,040 00	7000	9,380 00			
8	PATCHES, ASPHALT CEMENT CONCRETE											
	SURFACE	30	TONS	5250	1,575 00	7000	2,100 00	6000	1,800 00			
9	SHOULDERS, GRANULAR SURFACING OF	11113	TONS	930	103,350 90	874	97,127 62	910	101,128 30			
10	SURFACING, GRANULAR, CLASS A											
	CRUSHED STONE - ON ROAD	943	TONS	930	8,769 90	874	8,241 82	848	7,996 64			
11	PAVEMENT MARKINGS	2421	STAS.	1250	30,262 50	1100	26,631 00	1200	29,052 00			
12	FABRIC REINFORCEMENT	2467	SQ. YDS	142500	3,515 47	150	3,700 50	200	4,934 00			
13	ASPH. CEM. CONC., TYPE B WEDGE,											
	LEVEL OR STRETH. COURSE, RECYCLED	2313	TONS	927	21,441 51	1163	26,900 19	1000	23,130 00			
14	FIELD LABORATORY	1	ONLY	450000	4,500 00	150000	1,500 00	100000	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)--26-69 FR-71-2(17)--26-69 & CASS COUNTY A.C.C. RESURFACING PROJECT FR-71-3(26)--26-15 ARE TIED												

TABULATION OF CONSTRUCTION AND MATERIAL BIDS
IOWA DEPARTMENT OF TRANSPORTATION



BID ORDER NO. 38

38B 16.337 MILES

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

COUNTY CASS TYPE OF WORK ASPH. CEMENT CONC. RESURF. PROJECT NO. FR-71-3(26)--26-15 DATE OF LETTING JAN. 20, 1981				HENNINGSEN CONSTR. INC. ATLANTIC, IOWA		ROHLIN CONSTR., CO., INC. ESTHERVILLE, IOWA		KOMATZ CONSTR., INC. ST. PETER, MINN.	
NO.	ITEM	QUANTITY	UNIT	UNIT PRICE	AMOUNT	UNIT PRICE	AMOUNT	UNIT PRICE	AMOUNT
1	BASE, CLEANING & PREPARATION OF	16960	MILES	25000	4,240 00	70000	11,872 00	50000	8,480 00
2	ASPH. CEM. CONC., TYPE B SURFACE								
	COURSE, MIXT. SIZE 1/2", RECYCLED	30534	TONS	975	297,706 50	978	304,729 32	1081	330,072 54
3	AGGREGATE, NEW	16439	TONS	668	109,812 52	669	109,976 91	790	129,868 10
4	ASPHALT CEMENT	904	TONS	21200	191,648 00	20806	188,086 24	21000	189,840 00
5	PRIMER OR TACK-COAT BITUMEN	13368	GALS.	100	13,368 00	122	16,308 96	90	12,031 20
6	AGGREGATE FOR SPRINKLE TREATMENT	927	TONS	5627	52,162 29	8900	82,503 00	7000	64,890 00
7	PATCHES, FULL DEPTH	134	SQ. YDS	7000	9,380 00	7000	9,380 00	7000	9,380 00
8	PATCHES, ASPHALT CEMENT CONCRETE								
	SURFACE	30	TONS	10000	3,000 00	10000	3,000 00	7000	2,100 00
9	SHOULDERS, GRANULAR SURFACING OF	11113	TONS	879	97,683 27	926	102,906 38	970	107,796 10
10	SURFACING, GRANULAR, CLASS A								
	CRUSHED STONE - ON ROAD	943	TONS	1019	9,609 17	900	8,487 00	960	9,052 80
11	PAVEMENT MARKINGS	2421	STAS.	1500	36,315 00	1100	26,631 00	1300	31,473 00
12	FABRIC REINFORCEMENT	2467	SQ. YDS	188	4,637 96	325	8,017 75	300	7,401 00
13	ASPH. CEM. CONC., TYPE B WEDGE,								
	LEVEL OF STRGTH. COURSE, RECYCLED	2313	TONS	1075	24,864 75	1325	30,647 25	1081	25,003 53
14	FIELD LABORATORY	1	ONLY	150000	1,500 00	150000	1,500 00	100000	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)--26-69 FR-71-2(17)--26-69 & CASS COUNTY A.C.C. RESURFACING PROJECT FR-71-3(26)--26-15 ARE TIED									

TABULATION OF CONSTRUCTION AND MATERIAL BIDS
IOWA DEPARTMENT OF TRANSPORTATION



BID ORDER NO.

38

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

38C 16.337 MILES

COUNTY CASS				CESSFORD CONSTR. CO.							
TYPE OF WORK ASPH. CEMENT CONC. RESURF.											
PROJECT NO. FR-71-3(26)--26-15				LE GRAND, IOWA.							
DATE OF LETTING JAN. 20, 1981											
NO.	ITEM	QUANTITY	UNIT	UNIT PRICE	AMOUNT	UNIT PRICE	AMOUNT	UNIT PRICE	AMOUNT	UNIT PRICE	AMOUNT
1	BASE, CLEANING & PREPARATION OF	16.960	MILES	25000	4,240 00						
2	ASPH. CEM. CONC., TYPE B SURFACE										
	COURSE, MIXT. SIZE 1/2", RECYCLED	30534	TONS	1078	329,156 52						
3	AGGREGATE, NEW	16439	TONS	669	109,976 91						
4	ASPHALT CEMENT	904	TONS	20306	188,086 24						
5	PRIMER OR TACK-COAT BITUMEN	13368	GALS.	125	16,710 00						
6	AGGREGATE FOR SPRINKLE TREATMENT	927	TONS	10100	93,627 00						
7	PATCHES, FULL DEPTH	134	SQ. YDS	7000	9,380 00						
8	PATCHES, ASPHALT CEMENT CONCRETE										
	SURFACE	30	TONS	5000	1,500 00						
9	SHOULDERS, GRANULAR SURFACING OF	11113	TONS	909	101,017 17						
10	SURFACING, GRANULAR, CLASS A										
	CRUSHED STONE - ON ROAD	943	TONS	898	8,468 14						
11	PAVEMENT MARKINGS	2421	STAS.	1210	29,294 10						
12	FABRIC REINFORCEMENT	2467	SQ. YDS	250	6,167 50						
13	ASPH. CEM. CONC., TYPE B WEDGE,										
	LEVEL OR STRGTH. COURSE, RECYCLED	2313	TONS	1480	34,232 40						
14	FIELD LABORATORY	1	ONLY	100000	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(21)--26-69 FR-71-2(17)--26-69 & CASS COUNTY A.C.C. RESURFACING PROJECT FR-71-3(26)--26-15 ARE TIED											

TABULATION OF CONSTRUCTION AND MATERIAL BIDS
IOWA DEPARTMENT OF TRANSPORTATION



BID ORDER NO. 43

43A 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

COUNTY MONTGOMERY				WESTERN ENGINEERING CO. INC. HARLAN, IOWA			HENNINGSEN CONSTR. INC. ATLANTIC, IOWA			ROHLIN CONSTR. CO., INC. ESTHERVILLE, IOWA		
TYPE OF WORK ASPH. CEMENT CONC. RESURF.												
PROJECT NO. FR-71-2(17)--26-69												
DATE OF LETTING JAN. 20, 1981												
NO.	ITEM	QUANTITY	UNIT	UNIT PRICE	AMOUNT	UNIT PRICE	AMOUNT	UNIT PRICE	AMOUNT	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	21729	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	604	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	88,360 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)--26-69 FR-71-2(17)--26-69 & CASS COUNTY A.C.C. RESURFACING PROJECT FR-71-3(26)--26-15 ARE TIED												

TABULATION OF CONSTRUCTION AND MATERIAL BIDS
IOWA DEPARTMENT OF TRANSPORTATION



BID ORDER NO. 43

43B 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

COUNTY MONTGOMERY				GRAVES CONST CO INC		MANATTS, INC.		CESSFORD CONSTR. CO.	
TYPE OF WORK ASPH. CEMENT CONC. RESURF.				MELVIN, IOWA &		BROOKLYN, IOWA		LE GRAND, IOWA.	
PROJECT NO. FR-71-2(17)--26-69				MIDWEST PAVING CO					
DATE OF LETTING JAN. 20, 1981				SIOUX CITY, IOWA					
NO.	ITEM	QUANTITY	UNIT	UNIT PRICE	AMOUNT	UNIT PRICE	AMOUNT	UNIT PRICE	AMOUNT
1	EASE, CLEANING & PREPARATION OF	13151	MILES	40000	5,260 40	75000	9,863 25	25000	3,287 75
2	ASPH. CEM. CONC., TYPE B SURFACE								
	COURSE, MIXT. SIZE 1/2", RECYCLED	21729	TONS	931	202,296 99	1000	217,290 00	1182	256,836 78
3	AGGREGATE, NEW	11013	TONS	836	92,068 68	800	88,104 00	669	73,676 97
4	ASPHALT CEMENT	606	TONS	20806	126,084 36	22200	134,532 00	20806	126,084 36
5	PRIMER OR TACK-COAT BITUMEN	9578	GALS.	100	9,578 00	100	9,578 00	125	11,972 50
6	SHOULDERS, GRANULAR SURFACING OF	8836	TONS	903	79,789 08	985	87,034 60	966	85,355 76
7	AGGREGATE FOR SPRINKLE TREATMENT	672	TONS	10000	67,200 00	6000	40,320 00	10100	67,872 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	7000	1,400 00	6000	1,200 00	5000	1,000 00
10	PAVEMENT MARKINGS	1722	STAS.	1100	18,942 00	1200	20,664 00	1200	20,836 20
11	SURFACING, GRANULAR, CLASS A								
	CRUSHED STONE - ON ROAD	579	TONS	903	5,228 37	900	5,211 00	954	5,523 66
12	FABRIC REINFORCEMENT	107	SQ. YDS	150	160 50	200	214 00	300	321 00
13	ASPH. CEM. CONC., TYPE B WEDGE,								
	LEVEL OR STRGTH. COURSE, RECYCLED	274	TONS	2500	6,900 00	1300	3,568 00	1582	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)--26-69 FR-71-2(17)--26-69 & CASS COUNTY A.C.C. RESURFACING PROJECT FR-71-3(26)--26-15 ARE TIED									

TABULATION OF CONSTRUCTION AND MATERIAL BIDS
IOWA DEPARTMENT OF TRANSPORTATION



BID ORDER NO. 43

43C 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

COUNTY MONTGOMERY				KOMATZ CONSTR., INC.					
TYPE OF WORK ASPH. CEMENT CONC. RESURF.				ST. PETER, MINN.					
PROJECT NO. FR-71-2(17)--2G-69									
DATE OF LETTING JAN. 20, 1981									
NO.	ITEM	QUANTITY	UNIT	UNIT PRICE	AMOUNT	UNIT PRICE	AMOUNT	UNIT PRICE	AMOUNT
1	BASE, CLEANING & PREPARATION OF	13151	MILES	50000	6,575 50				
2	ASPH. CEM. CONC., TYPE B SURFACE								
	COURSE, MIXT. SIZE 1/2", RECYCLED	21729	TONS	1350	293,341 50				
3	AGGREGATE, NEW	11013	TONS	790	87,002 70				
4	ASPHALT CEMENT	606	TONS	21000	127,260 00				
5	PRIMER OR TACK-COAT BITUMEN	9578	GALS.	90	8,620 20				
6	SHOULDERS, GRANULAR SURFACING OF	8836	TONS	1040	91,894 40				
7	AGGREGATE FOR SPRINKLE TREATMENT	672	TONS	7000	47,040 00				
8	PATCHES, FULL DEPTH	10	SQ. YDS	7000	700 00				
9	PATCHES, ASPHALT CEMENT CONCRETE								
	SURFACE	20	TONS	7000	1,400 00				
10	PAVEMENT MARKINGS	1722	STAS.	1300	22,386 00				
11	SURFACING, GRANULAR, CLASS A								
	CRUSHED STONE - ON ROAD	579	TONS	1030	5,963 70				
12	FABRIC REINFORCEMENT	107	SQ. YDS	300	321 00				
13	ASPH. CEM. CONC., TYPE B WEDGE,								
	LEVEL OR STRGTH. COURSE, RECYCLED	276	TONS	1350	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									

TABULATION OF CONSTRUCTION AND MATERIAL BIDS
IOWA DEPARTMENT OF TRANSPORTATION



BID ORDER NO. 44

44A 1.893 MILES

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

COUNTY MONTGOMERY				WESTERN ENGINEERING CO. INC.		MANATTS, INC.		CESSFORD CONSTR. CO.	
TYPE OF WORK ASPH. CEMENT CONC. RESURF.				CO. INC.		BROOKLYN, IOWA		LE GRAND, IOWA.	
PROJECT NO. FR-34-2(22)--26-69				HARLAN, IOWA					
DATE OF LETTING JAN. 20, 1981									
NO.	ITEM	QUANTITY	UNIT	UNIT PRICE	AMOUNT	UNIT PRICE	AMOUNT	UNIT PRICE	AMOUNT
1	EASE, CLEANING & PREPARATION OF	3054	MILES	15000	458 10	75000	2,290 50	25000	763 50
2	PATCHES, FULL DEPTH	269	SQ. YDS	6000	16,140 00	7000	18,830 00	4000	10,760 00
3	FABRIC REINFORCEMENT	373	SQ. YDS	142500	531 52	200	746 00	250	932 50
4	AGGREGATE, NEW	3120	TONS	867	27,050 40	800	24,960 00	669	20,872 80
5	PATCHES, ASPHALT CEMENT CONCRETE SURFACE	100	TONS	5250	5,250 00	6000	6,000 00	5000	5,000 00
6	ASPHALT CEMENT	173	TONS	20000	34,600 00	22200	38,406 00	20876	35,994 36
7	ASPH. CEM. CONC. TYPE B SURFACE COURSE, MIXT. SIZE 1/2", RECYCLED	6087	TONS	1022	62,209 14	1100	66,957 00	1266	77,061 42
8	PRIMER OR TACK-COAT BITUMEN	2670	GALS.	100	2,670 00	100	2,670 00	125	3,337 50
9	PAVEMENT MARKINGS	391	STAS.	1250	4,887 50	1200	4,692 00	1210	4,731 10
10	SHOULDERS, GRANULAR SURFACING OF	1293	TONS	1010	13,059 30	1000	12,930 00	965	12,477 45
11	CULVERT, JACKED CONCRETE RDWY. PIPE, 24 IN. DIA.	148	LIN. FT	10500	15,540 00	1500	2,220 00	10500	15,540 00
12	APRONS, CONCRETE, 24 IN. DIA.	4	ONLY	15000	600 00	25000	1,000 00	15100	604 00
13	GUARD, PIPE APRON, 24 IN.	2	ONLY	19500	390 00	20000	400 00	20000	400 00
14	REMOVAL OF FORMED STEEL BEAM GUARDRAIL	562500	LIN. FT	306	1,721 25	400	2,250 00	330	1,856 25
15	GUARDRAIL, FORMED STEEL BEAM	762500	LIN. FT	968	7,381 00	950	7,243 75	1025	7,815 62
16	GUARDRAIL, POSTS, BEAM	112	ONLY	5100	5,712 00	5000	5,600 00	5500	6,160 00
17	EXCAVATION, CLASS 1C, ROADWAY & BORROW	935	CU. YDS	600	5,610 00	700	6,545 00	600	5,610 00
18	DELINEATORS, SINGLE WHITE	7	ONLY	1733	121 31	1700	119 00	1850	129 50
19	DELINEATOR, TRIPLE AMBER VERTICAL	6	ONLY	1835	110 10	1800	108 00	1980	118 80
20	OBJECT MARKER, TYPE 3	5	ONLY	5100	255 00	5000	250 00	5500	275 00
21	GUARDRAIL, END ANCHORAGES, BEAM BRIDGE, RE-28	2	ONLY	68800	1,376 00	67500	1,350 00	73000	1,460 00
22	GUARDRAIL, END ANCHORAGES, BEAM RE-33	1	ONLY	33100	331 00	32500	325 00	35500	355 00
23	GUARDRAIL, END ANCHORAGES, BEAM RE-52	3	ONLY	40800	1,224 00	40000	1,200 00	44000	1,320 00
24	GUARDRAIL, END ANCHORAGES, BEAM RE-53	4	ONLY	53000	2,120 00	52000	2,080 00	57000	2,280 00
25	AGGREGATE FOR SPRINKLE TREATMENT	40	TONS	4750	4,275 00	6000	5,400 00	10100	9,090 00

TABULATION OF CONSTRUCTION AND MATERIAL BIDS
IOWA DEPARTMENT OF TRANSPORTATION



BID ORDER NO.

44

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

COUNTY MONTGOMERY TYPE OF WORK ASPH. CEMENT CONC. RESURF. PROJECT NO. FR-34-2(22)--26-65 DATE OF LETTING JAN. 20, 1981				WESTERN ENGINEERING CO. INC. HARLAN, IOWA		MANATTS, INC. BROOKLYN, IOWA		CESSFORD CONSTR. CO. LE GRAND, IOWA.	
NO.	ITEM	QUANTITY	UNIT	UNIT PRICE	AMOUNT	UNIT PRICE	AMOUNT	UNIT PRICE	AMOUNT
26	REMOVE & REINSTALL FORMED STEEL BEAM GUARDRAIL	275	LIN. FT	1020	2,805 00	1000	2,750 00	1100	3,025 00
27	REMOVAL OF POSTS	75	ONLY	306	229 50	300	225 00	330	247 50
28	POSTS, REMOVE AND REINSTALL	75	ONLY	1630	1,222 50	1600	1,200 00	1760	1,320 00
29	REMOVAL OF GUARDRAIL END ANCHORAGE	6	ONLY	7650	459 00	7500	450 00	8200	492 00
30	ASPH. CEM. CONC., TYPE B WEDGE, LEVEL OR STRGTH. COURSE, RECYCLED	52	TONS	1932	1,004 64	2000	1,040 00	2250	1,170 00
TOTAL					\$219,343 26		\$220,237 25		\$231,199 32
MONTGOMERY COUNTY A.C.C. RESURFACING PROJECTS FR-34-2(22)--26-65 FR-71-2(17)--26-65 & CASS COUNTY A.C.C. RESURFACING PROJECT FR-71-3(26)--26-15 ARE TIED									

TABULATION OF CONSTRUCTION AND MATERIAL BIDS
IOWA DEPARTMENT OF TRANSPORTATION



BID ORDER NO. 44

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

1.893 MILES

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

GRAVES CONST CO INC
MELVIN, IOWA 8
MIDWEST PAVING CO
SIOUX CITY, IOWA

HENNINGSEN CONSTR.
INC.
ATLANTIC, IOWA

ROHLIN CONSTR. CO.,
INC.
ESTHERVILLE, IOWA

NO.	ITEM	QUANTITY	UNIT	UNIT PRICE	AMOUNT	UNIT PRICE	AMOUNT	UNIT PRICE	AMOUNT
1	BASE, CLEANING & PREPARATION OF	3654	MILES	40000	1,221 60	100000	3,054 00	80000	2,443 20
2	PATCHES, FULL DEPTH	269	SQ. YDS	6000	16,140 00	7000	18,830 00	8000	21,520 00
3	FABRIC REINFORCEMENT	373	SQ. YDS	150	559 50	188	701 24	325	1,212 25
4	AGGREGATE, NEW	3120	TONS	836	26,083 20	668	20,841 60	669	20,872 80
5	PATCHES, ASPHALT CEMENT CONCRETE SURFACE	100	TONS	6000	6,000 00	7500	7,500 00	8000	8,000 00
6	ASPHALT CEMENT	173	TONS	20806	35,994 38	21200	36,676 00	20806	35,994 38
7	ASPH. CEM. CONC., TYPE B SURFACE COURSE, MIXT. SIZE 1/2", RECYCLED	6087	TONS	1003	61,052 61	1075	65,435 25	1285	78,217 95
8	PRIMER OR TACK-COAT BITUMEN	2670	GALS.	100	2,670 00	100	2,670 00	127	3,390 90
9	PAVEMENT MARKINGS	391	STAS.	1100	4,301 00	1500	5,865 00	1100	4,301 00
10	SHOULDERS, GRANULAR SURFACING OF	1293	TONS	903	11,675 79	1000	12,930 00	982	12,697 26
11	CULVERT, JACKED CONCRETE RDWY. PIPE, 24 IN. DIA.	146	LIN. FT	13400	19,832 00	11000	16,280 00	11000	16,280 00
12	APRONS, CONCRETE, 24 IN. DIA.	4	ONLY	16500	660 00	16000	640 00	14250	570 00
13	GUARD, PIPE APRON, 24 IN.	2	ONLY	12000	240 00	20000	400 00	18000	360 00
14	REMOVAL OF FORMED STEEL BEAM GUARDRAIL	562500	LIN. FT	385	2,165 62	405	2,278 12	300	1,687 50
15	GUARDRAIL, FORMED STEEL BEAM	762500	LIN. FT	1050	8,006 25	1100	8,387 50	950	7,243 75
16	GUARDRAIL, POSTS, BEAM	112	ONLY	6466	7,241 92	6800	7,616 00	5000	5,600 00
17	EXCAVATION, CLASS 10, ROADWAY & BORROW	935	CU. YDS	700	6,545 00	840	7,854 00	675	6,311 25
18	DELINEATORS, SINGLE WHITE	7	ONLY	2000	140 00	2890	202 30	1700	119 00
19	DELINEATOR, TRIPLE AMBER VERTICAL	6	ONLY	2500	150 00	3000	180 00	1800	108 00
20	OBJECT MARKER, TYPE E	5	ONLY	5500	275 00	5250	262 50	5000	250 00
21	GUARDRAIL, END ANCHORAGES, BEAM BRIDGE, RE-28	2	ONLY	80000	1,600 00	83000	1,660 00	67500	1,350 00
22	GUARDRAIL, END ANCHORAGES, BEAM RE-33	1	ONLY	50000	500 00	52000	520 00	32500	325 00
23	GUARDRAIL, END ANCHORAGES, BEAM RE-52	3	ONLY	50000	1,500 00	52000	1,560 00	40000	1,200 00
24	GUARDRAIL, END ANCHORAGES, BEAM RE-53	4	ONLY	56200	2,248 00	59000	2,360 00	52000	2,080 00
25	AGGREGATE FOR SPRINKLE TREATMENT	90	TONS	10000	9,000 00	5627	5,064 30	8900	8,010 00

TABULATION OF CONSTRUCTION AND MATERIAL BIDS
IOWA DEPARTMENT OF TRANSPORTATION



BID ORDER NO.

44

44 D

1.893 MILES

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

COUNTY MONTGOMERY				GRAVES CONST CO INC				HENNINGSEN CONSTR.				ROHLIN CONSTR., CO.,			
TYPE OF WORK ASPH. CEMENT CONC. RESURF.				MELVIN, IOWA &				INC.				INC.			
PROJECT NO. FR-34-2(22)--26-69				MIDWEST PAVING CO				ATLANTIC, IOWA				ESTHERVILLE, IOWA			
DATE OF LETTING JAN. 20, 1981				SIOUX CITY, IOWA											
NO.	ITEM	QUANTITY	UNIT	UNIT PRICE	AMOUNT		UNIT PRICE	AMOUNT		UNIT PRICE	AMOUNT				
26	REMOVE & REINSTALL FORMED STEEL BEAM GUARDRAIL	275	LIN. FT	9.04	2,486	00	9.50	2,612	50	1.000	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)--26-69 FR-71-2(17)--26-69 & CASS COUNTY A.C.C. RESURFACING PROJECT FR-71-3(26)--26-15 ARE TIED															

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TABULATION OF CONSTRUCTION AND MATERIAL BIDS
IOWA DEPARTMENT OF TRANSPORTATION



BID ORDER NO.

44

44E

1.893 MILES

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

COUNTY MONTGOMERY				KOMATZ CONSTR., INC.							
TYPE OF WORK ASPH. CEMENT CONC. RESURF.											
PROJECT NO. FR-34-2(22)--2G-69				ST. PETER, MINN.							
DATE OF LETTING JAN. 20, 1981											
NO.	ITEM	QUANTITY	UNIT	UNIT PRICE	AMOUNT	UNIT PRICE	AMOUNT	UNIT PRICE	AMOUNT	UNIT PRICE	AMOUNT
1	BASE, CLEANING & PREPARATION OF	3054	MILES	50000	1,527 00						
2	PATCHES, FULL DEPTH	269	SQ. YDS	7000	18,830 00						
3	FABRIC REINFORCEMENT	373	SQ. YDS	300	1,119 00						
4	AGGREGATE, NEW	3120	TONS	790	24,648 00						
5	PATCHES, ASPHALT CEMENT CONCRETE SURFACE	100	TONS	7000	7,000 00						
6	ASPHALT CEMENT	173	TONS	21000	36,330 00						
7	ASPH. CEM. CONC., TYPE B SURFACE COURSE, MIXT. SIZE 1 1/2", RECYCLED	6087	TONS	1540	93,739 80						
8	PRIMER OR TACK-COAT BITUMEN	2670	GALS.	90	2,403 00						
9	PAVEMENT MARKINGS	391	STAS.	1300	5,083 00						
10	SHOULDERS, GRANULAR SURFACING OF	1293	TONS	1040	13,447 20						
11	CULVERT, JACKED CONCRETE RDWY. PIPE, 24 IN. DIA.	148	LIN. FT	10000	14,800 00						
12	APRONS, CONCRETE, 24 IN. DIA.	4	ONLY	25000	1,000 00						
13	GUARD, PIPE APRON, 24 IN.	2	ONLY	50000	1,000 00						
14	REMOVAL OF FORMED STEEL BEAM GUARDRAIL	562500	LIN. FT	350	1,968 75						
15	GUARDRAIL, FORMED STEEL BEAM	762500	LIN. FT	1100	8,387 50						
16	GUARDRAIL, POSTS, BEAM	112	ONLY	6000	6,720 00						
17	EXCAVATION, CLASS 1G, ROADWAY & BORROW	939	CU. YDS	500	4,675 00						
18	DELINEATORS, SINGLE WHITE	7	ONLY	2000	140 00						
19	DELINEATOR, TRIPLE AMBER VERTICAL	6	ONLY	2100	126 00						
20	OBJECT MARKER, TYPE 3	5	ONLY	6000	300 00						
21	GUARDRAIL, END ANCHORAGES, BEAM BRIDGE, RE-28	2	ONLY	70000	1,400 00						
22	GUARDRAIL, END ANCHORAGES, BEAM RE-33	1	ONLY	35000	350 00						
23	GUARDRAIL, END ANCHORAGES, BEAM RE-52	3	ONLY	45000	1,350 00						
24	GUARDRAIL, END ANCHORAGES, BEAM RE-53	4	ONLY	60000	2,400 00						
25	AGGREGATE FOR SPRINKLE TREATMENT	90	TONS	7000	6,300 00						

TABULATION OF CONSTRUCTION AND MATERIAL BIDS
IOWA DEPARTMENT OF TRANSPORTATION



BID ORDER NO.

44

44F

1.893 MILES

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

COUNTY MONTGOMERY				KOMATZ CONSTR., INC.							
TYPE OF WORK ASPH. CEMENT CONC. RESURF.				ST. PETER, MINN.							
PROJECT NO. FR-34-2(22)--26-69											
DATE OF LETTING JAN. 20, 1981											
NO.	ITEM	QUANTITY	UNIT	UNIT PRICE	AMOUNT	UNIT PRICE	AMOUNT	UNIT PRICE	AMOUNT	UNIT PRICE	AMOUNT
26	REMOVE & REINSTALL FORMED STEEL BEAM GUARDRAIL	275	LIN. FT	1200	3,300 00						
27	REMOVAL OF POSTS	75	ONLY	400	300 00						
28	POSTS, REMOVE AND REINSTALL	75	ONLY	1800	1,350 00						
29	REMOVAL OF GUARDRAIL END ANCHORAGE	4	ONLY	5000	540 00						
30	ASPH. CEM. CONC., TYPE B WEDGE, LEVEL OR STRGTH. COURSE, RECYCLED	52	TONS	1540	800 80						
	TOTAL				\$261,335 05						
MONTGOMERY COUNTY A.C.C. RESURFACING PROJECTS FR-34-2(22)--26-69 FR-71-2(17)--26-69 & CASS COUNTY A.C.C. RESURFACING PROJECT FR-71-3(26)--26-15 ARE TIED											

Appendix F

APPENDIX

Engineering Fabric

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

<u>Station to Station</u>	<u>Station to Station</u>
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

<u>Station to Station</u>	<u>Station to Station</u>
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

IOWA DEPARTMENT OF TRANSPORTATION

To Office Construction Department

Date December 14, 1981

Attention Don Jordison

Ref. No.

From John Tebrinke
for W. G. Burgan
Office Red Oak Construction

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

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	=	<u>31,482.41</u>

Equivalent gallons of gasoline used:

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

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			=	<u>2.822</u>

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	=	<u>1.00</u>
Total tons used	=	<u>6390.92</u>

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			=	<u>3.311</u>

(continued next page)

Don Jordison
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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	=	<u>22487.25</u>

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	=		=	<u>3.162</u>

WGB:JDT:jg

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