H.R. 522
Asphalt Cement Containing AC-13
Iowa D.O.T. Project FR-12-1(8)--2G-97
1984 Construction

by
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District Materials Engineer
September 1985

Iowa Department of Transportation
Highway Division
District 3 Office
Sioux City, Iowa 51102
712/276-0933

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I. Introduction

Stopping and turning maneuvers on high traffic volume asphalt cement concrete surfaced roads and streets often causes distortion of the pavement. Distortion may show up as excessive rutting in the wheel path, shoving of the pavement and/or rippling of the surface. Often times repeated corrective work such as cold milling or heater planing is required in these areas to maintain the pavement surface in a reasonable condition.

In recent years polymer additives have been developed for asphalt cement concrete paving mixes that show promise in improving the inplace stability of the pavements. AC-13 (Styrelf 13) available from Bitucote Products Company, St. Louis, Missouri is an asphalt cement that has been modified by an additive to exhibit characteristics of very high stability in asphalt mixes.

II. Research Objective

Research project HR-522 has been developed to evaluate AC-13 (Styrelf 13) in regard to the following characteristics:

1. Improved stability in the asphalt cement concrete mix.
2. Pavement surface distortion caused from stopping and turning movements when AC-13 is used in mixes.
3. Visual observation of cracking or raveling that might occur when AC-13 is used in an asphalt cement concrete pavement mixture.
4. Core evaluation for changes in the pavement characteristics

when in service.

The asphalt cement concrete mix characteristics were evaluated during the construction phase. Test results for gradation, void content, asphalt cement, penetration at 77°F and absolute viscosity at 140°F for the AC-13 are included in this report. Absolute Viscosity and penetration test results of the recovered asphalt cement (AC-13) in the asphalt cement concrete mixture are also included in this report.

Supplemental evaluation of the pavement area containing AC-13 asphalt cement concrete mixture will be made relating to future cracking, rutting, and shoving. Cores will be cut and tests on the recovered asphalt cement will be performed to determine changes that occur in the asphalt characteristics.

III. Conclusion

AC-13 is easily handled in conventional paving operations. This feature makes the product look very attractive for use in selected project locations where special material is needed to resist rutting and shoving.

Preliminary test results on the recovered asphalt cement from project mix samples show that the penetration values are what you would expect from an AC-10. The absolute viscosity of the recovered asphalt cement (13,000 poise) is consistant with results that might be obtained from an AC-30.

These preliminary results will be supplemented with a report of field evaluation of AC-13 performance after one

year, two years, and three years of service.

IV. Project Location

The urban project selected for the research is located on Iowa Primary Road 12 (Gordon Drive) in Sioux City. The project begins near the east City Limits of Sioux City and continues west 2.6 miles to near US 75. Traffic volumes range from 6,000 A.D.T. with 10% trucks near the east City Limits to 16,700 A.D.T. with 5% trucks near US 75. The route is a limited access four lane facility with turning lanes at service roads and intersections.

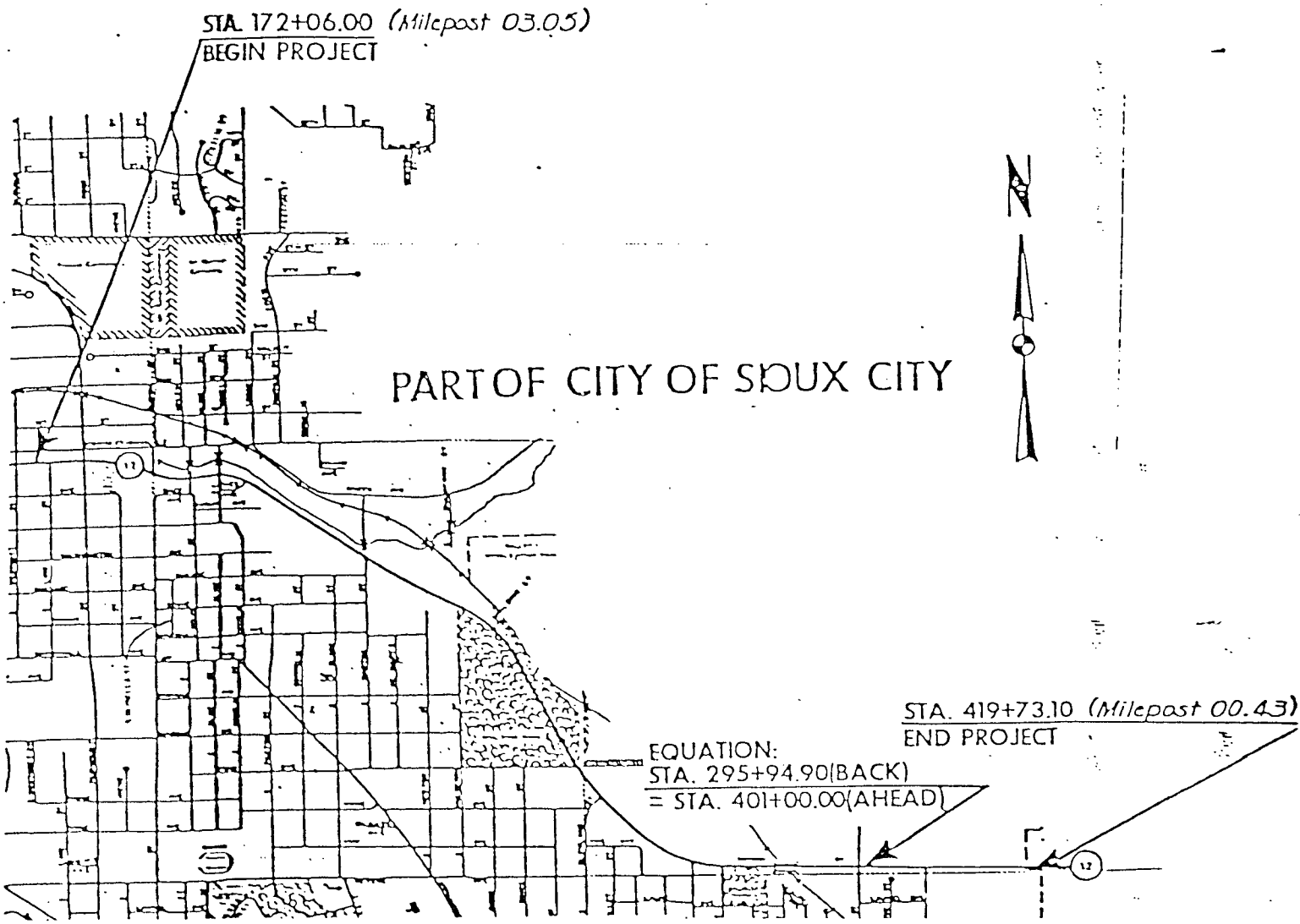


Figure 1

V. Evaluation Sections

Evaluation sections for AC-13 asphalt cement paving were constructed at four signalized intersections with a fifth section constructed on a four degree circular curve that is not super elevated. The curve is located in a 45 MPH speed zone where traffic speeds approach 50 M.P.H.

Section 1 South Fairmont Street Intersection

A. Posted speed limit 35 M.P.H.

B. Traffic Volume 16,700 A.D.T.

C. AC-13 evaluation areas (Figure 2)

1. Eastbound

a. Left turn lane Station 176+62-Station 178+90

b. Inside through lane Station 176+62 - Station 178+80

c. Outside through lane Station 176+62 - Station 178+62

d. Right turn lane Station 176+62 - Station 178+25±

2. Westbound

a. Left turn lane Station 178+00 - Station 180+42

b. Inside through lane Station 178+00 - Station 180+42

c. Outside through lane Station 177+40 - Station 180+42

d. Right turn lane Station 178+00± - Station 180+42

Figure 2 South Fairmont Street

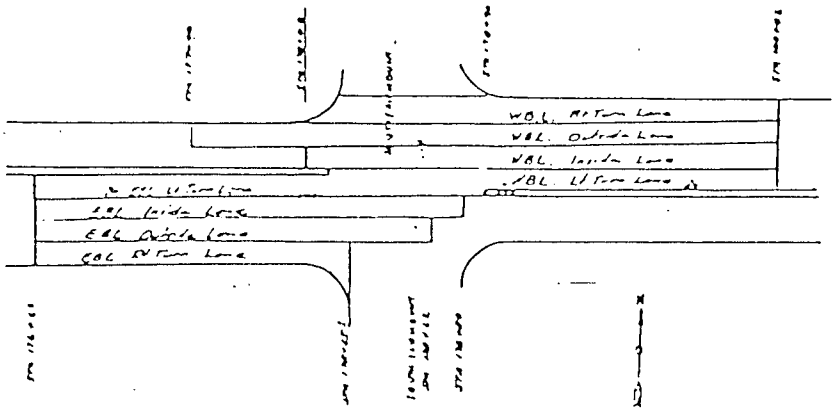


Figure 3 South Martha Street

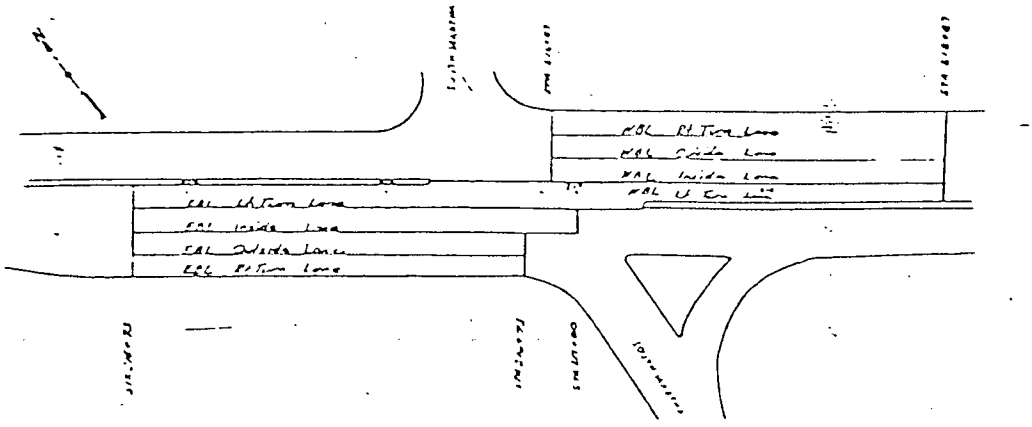
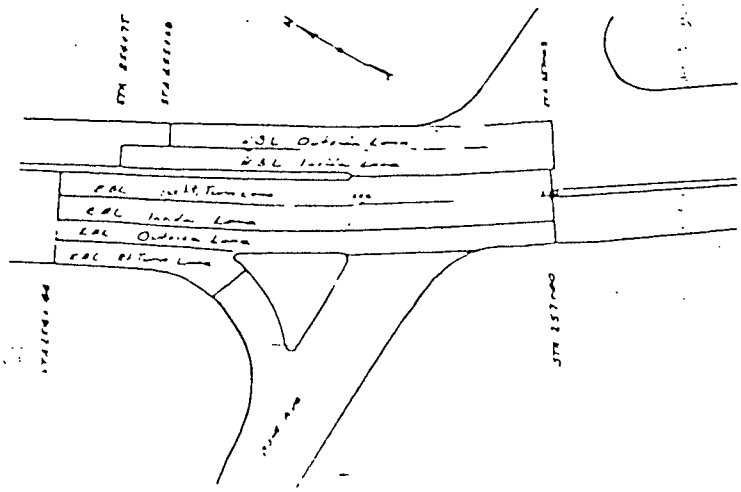


Figure 4 Stone Avenue



Section 2 South Martha Street Intersection

A. Posted speed limit 35 M.P.H.

B. Traffic volume 15,400 A.D.T.

C. AC-13 evaluation areas (Figure 3)

1. Eastbound

a. Left turn lane Station 214+73 - Station 217+35

b. Inside through lane Station 214+73 - Station 217+00

c. Outside through lane Station 214+73 - Station 216+73

d. Right turn lane Station 214+73 - Station 216+73

2. Westbound

a. Left turn lane Station 216+87 - Station 217+35

b. Inside through lane Station 216+87 - Station 218+87

c. Outside through lane Station 216+87 - Station 218+87

d. Right turn lane Station 216+87 - Station 218+87

Section 3 Stone Avenue Intersection

A. Posted speed limit 45 M.P.H.

B. Traffic volume 12,600 A.D.T.

C. AC-13 evaluation areas

1. Eastbound

a. Left turn lane Station 254+44 - Station 257+00

b. Inside through lane Station 254+44 - Station 257+00

c. Outside through lane Station 254+44 - Station 257+00

d. Right turn lane Station 254+44 - Station 255+44

2. Westbound

a. Inside through lane Station 254+75 - Station 257+03

b. Outside through lane Station 255+00 - Station 257+03

Section 4 Palmetto Street Intersection

A. Posted speed limit 45 M.P.H.

B. Traffic Volume 9,420 A.D.T.

C. AC-13 evaluation areas

1. Eastbound

a. Inside through lane Station 276+25 - Station 278+25

b. Outside through lane Station 276+25 - Station 278+50

Section 5 Four Degree Circular Curve With no Super Elevation Station 241+60 to Station 232+45

A. Posted speed limit 45 M.P.H.

B. Traffic volume 12,600 A.D.T.

C. Lane location

1. Westbound only

a. Inside through lane Station 232+25 - Station 242+00

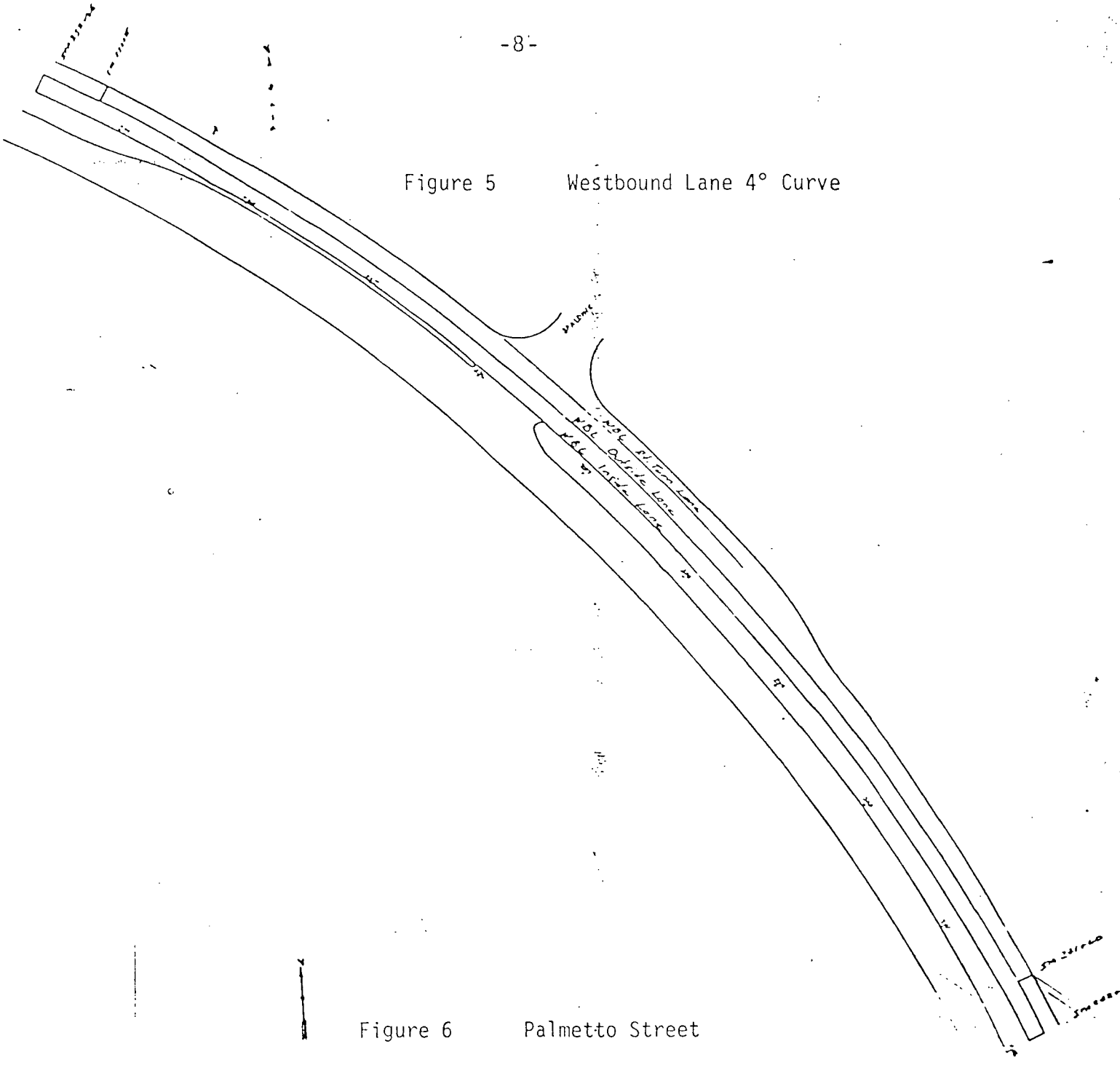


Figure 5 Westbound Lane 4° Curve

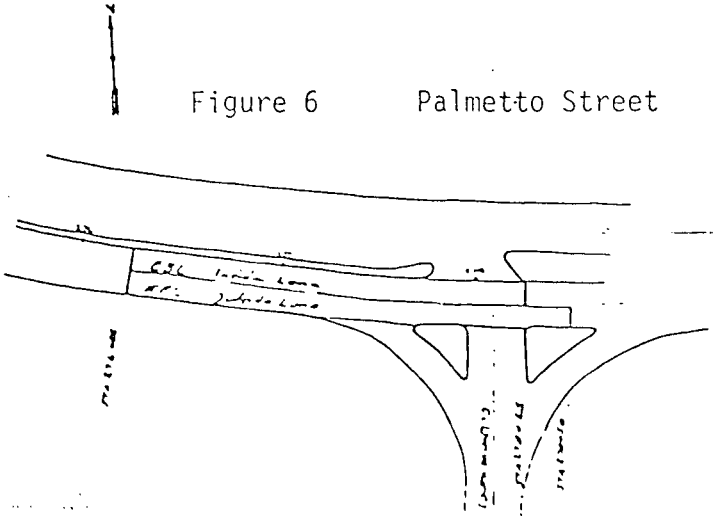


Figure 6 Palmetto Street

b. Outside through lane Station 232+75 - Station 241+60.

c. Right turn lane Station 237+00 - Station 239+00.

VI. Project Concept

The first step of the rehabilitation project involved removing the old asphalt cement concrete from the old PC concrete base. This was followed by base repair work. The longitudinal joints were covered with an engineering fabric prior to overlaying the base. The resurfacing of the old PC concrete base was then completed using two (1 1/2" thick) lifts of recycled asphalt cement concrete for all of the project except the special AC-13 research areas.

Virgin aggregate asphalt cement concrete containing AC-13 was placed in both the 1 1/2" thick binder and 1 1/2" thick surface lifts of five locations previously described in this report.

VII. Construction With AC-13

The AC-13 asphalt cement was handled and stored in a conventional manner in a separate storage tank at the asphalt plant. The temperature was maintained at a range of 290°F to 305°F.

A Barber Greene Batch plant was utilized for proportioning and mixing asphaltic concrete materials for the project. When the AC-13 mix was needed for the special areas the normal AC flow was cut off and the AC-13 was allowed to flow

to the batching equipment. The virgin aggregates were than batched along with the AC-13 to provide the special mix. This system worked well with minimum inconvenience to the contractor.

The temperature of the AC-13 mix was maintained near 300°F. Normally this would be in the range that conventional asphalt cement concrete mixes are produced. This characteristic of the AC-13 makes it convenient and practical to use in selected areas of a project.

The AC-13 mix was placed and rolled using conventional paving and rolling equipment. No paving gaps were needed for the switch from recycled mix to the AC-13 mix on the project. The average mat temperature at the time of placement was 284°F.

VIII. Materials

The material that is being evaluated on this project is the virgin asphalt cement concrete paving mix containing AC-13 asphalt cement. (Styrelf 13 produced and marketed by Bitucote Products Company of Des Moines, Iowa and St. Louis, Missouri.)

AC-13 has the unique characteristics of low penetration (77°F, 100 gm 5 sec; 60-90 range) and high absolute viscosity (140°F; 2500 poise minimum). A copy of the AC-13 specification is found in Appendix A-3.

The virgin aggregate AC-13 mix used in the special evaluation areas was composed of the following materials:

30% passing 5/8" sieve retained on #4 sieve, crushed quartzite - L.G. Everist, Dell Rapids, South Dakota.

10% passing 3/8" sieve retained on #8 sieve, crushed quartzite - L.G. Everist, Dell Rapids, South Dakota.

15% passing 3/16" sieve, crushed quartzite - L.G. Everist, Dell Rapids, South Dakota.

15% agrecultural limestone - Midwest Limestone, Gilmore City, Iowa.

30% concrete sand - L.G. Everist, Hawarden, Iowa.

5.15% AC-13 (Styrelf) - Bitucote Products Company.

The job mix formula is found in Appendix A-5.

The project control tests were very consistent for the aspahlt cement concrete containing the AC-13. Daily extraction gradation testing normally completed in the District Laboratory could not be accurately performed as the AC-13 plugged the extraction filter paper. Samples were submitted to the Ames Laboratory for extraction test results for aggregate gradation and asphalt cement content. These test results along with the Marshall stability 75 blow (4081 average), absolute viscosity of the extracted AC-13 (13,000 poise, average; 140°F 300 MMHG), penetration of extracted residue (77°F 100 gm 5 sec, 48 average), and filler-bitumen ratio (average 1.22) can be found in Appendix B-1.

Daily testing of the AC-13 for penetration and absolute viscosity was completed in the District Laboratory. The average absolute viscosity, 140°F 300 MMHG, was 3912 poise,

and the average penetration 77°F 100 gm 5 sec was 81. See Appendix B-3 for complete test results.

The average field percent of Marshall density (75 blow) was 97.8. The average field voids was 6.9%. Complete test results are found in Appendix B-3.

COST CENTER 611000 OBJECT 224

PROJ NO FR-12-3(8)--26-97 COUNTY LOCUST

PES ENGR RICHARD T. BOLTON ADDRESS SIOUX CITY

LETTING DATE MAY 05, 1984 LIQUIDATED DAMAGES $210.00

SPECIAL PROV 97--775 #FR-1273, 12/20/83 #941, 11,7,78 #839, 7/15/80 #868, 5/29/83 #920, 2/24/81 #220, 12/20/83 #943, 12/20/83 #945, 5/24/84 SP-567, 5/31/76 #900, 6/5/82 #935, 12/20/83 #940, 12/20/83 #939, 12/20/83 #941, 2/14/84 #952, 12/20/83 #942

DATE STARTED FIELD COMP CERT COMP

CONTRACT NO. 22738

TYPE OF WORK ASPH. CEMENT CONC. RESURF. PROJECT NO FR-12-3(8)--26-97

MILES 2.626 COST CENTER 611000 OBJECT 224

COUNTY LOCUST

ON IOWA 12 (OLD U.S. 20) IN SIOUX CITY FROM NEAR SOUTH LINN STREET EAST APPROX. 2.6 MILES TO C.C.L.

THIS AGREEMENT WAS NEGOTIATED BY AND ENTERED INTO BY THE IOWA DEPARTMENT OF TRANSPORTATION ROBERT R. RIGLER, DARREL KRASTAD, DENNIS VOY, DEL VAN HORN, MOLLY SCOTT, AUSTIN TURNER, & C ROGER FAIR PARTY OF THE FIRST PART AND BROWER CONSTRUCTION CO. OF SIOUX CITY, IOWA 04250

PARTY OF THE SECOND PART

WITNESSETH THAT THE PARTY OF THE SECOND PART FOR AND IN CONSIDERATION OF) $769,792.15 PAYABLE AS SET FORTH IN THE SPECIFICATIONS CONSTITUTING A PART OF THIS CONTRACT, HEREBY AGREES TO COMMENCE VARIOUS WORK AND TO SUPPLY VARIOUS MATERIALS OR SUPPLIES IN ACCORDANCE WITH THE PLANS AND SPECIFICATIONS THEREFOR AND IN THE LOCATIONS INDICATED IN THE NOTICE TO BIDDERS, AS FOLLOWS:

ITEM NO	ITEM	QUANTITY	UNIT	UNIT PRICE	AMOUNT
1	BASE, CLEANING & PREPARATION OF	2.626	MILES	3,200.00	8,403.20
28	PAVEMENT SCARIFICATION	12,800	TONS	11.85	151,680.00
3	PATCHES, ASPHALT CEMENT CONCRETE SURFACE	50	TONS	200.00	10,000.00
4	PATCHES, FULL DEPTH	330	SQ. YDS.	97.25	32,092.50
5	PATCHES, PARTIAL DEPTH	100	SQ. YDS.	82.45	8,245.00
6	PATCHES, BY COUNT	50	ONLY	100.00	5,000.00
7	PRIMER OR TACK-COAT BITUMEN	7,635	GALS.	1.25	9,543.75
88	ASPH. CEM. CONC., TYPE A WEDGE, LEVEL OR STRGTH. COURSE, RECYCLED	364	TONS	30.90	11,247.60
98	ASPH. CEM. CONC., TYPE A BINDER COURSE, MIXT. SIZE 3/4", RECYCLED	4,958	TONS	18.60	92,218.80
108	ASPH. CEM. CONC. TYPE A SURFACE COURSE, MIXT. SIZE 1/2", RECYCLED	6,283	TONS	18.25	114,664.75
11	ASPHALT CEMENT CONCRETE POLYMER MODIFIED (AC-13)	1,432	TONS	21.05	30,143.60
128	ASPHALT CEMENT	496	TONS	205.00	101,680.00
13	ASPHALT CEMENT (AC-13)	83	TONS	325.00	26,975.00
14	CURB REPAIR, AS PER PLAN	2,550	LIN. FT.	15.75	40,162.50
15	FABRIC REINFORCEMENT	19,111	SQ. YDS.	1.15	21,977.65
16	INTAKE, RA-4	1	ONLY	2,000.00	2,000.00
17	PAVEMENT MARKINGS, PREFORMED POLYMER LONGITUDINAL LINES	106.690	STAS.	175.00	18,670.75
18	PAVEMENT MARKINGS, PREFORMED POLYMER TRANSVERSE LINES, 24 IN.	3.250	STAS.	900.00	2,925.00
19	PAVEMENT MARKINGS	443.650	STAS.	17.00	7,542.05
20	SYMBOLS, AS PER PLAN	66	ONLY	40.00	2,640.00
21	TRAFFIC CONTROL		LUMP SUM		40,000.00
22	SAMPLES		LUMP SUM		2,500.00
23	JOINT, PRESSURE RELIEF	87	LIN. FT.	40.00	3,480.00
24	MOBILIZATION	100.00%			26,000.00
				GRAND TOTAL	$769,792.15

PARTY OF THE SECOND PART CERTIFIES BY HIS SIGNATURE ON THIS CONTRACT UNDER PAIN OF PENALTIES FOR FALSE CERTIFICATION THAT HE HAS COMPLIED WITH SECTION 19A.160 CODE OF IOWA AS AMENDED IF APPLICABLE, AND THAT THE PLANS AND SPECIFICATIONS AND PLANS ARE HEREBY MADE A PART OF AND THE BASIS OF THIS AGREEMENT, AND A TRUE COPY OF SAID PLANS AND SPECIFICATIONS IS NOW ON FILE IN THE OFFICE OF THE PARTY OF THE FIRST PART UNDER DATE OF MAY 04, 1984

THAT IN CONSIDERATION OF THE FOREGOING, THE PARTY OF THE FIRST PART HEREBY AGREES TO PAY THE PARTY OF THE SECOND PART PROMPTLY AND ACCORDING TO THE REQUIREMENTS OF THE SPECIFICATIONS THE AMOUNTS SET FORTH SUBJECT TO THE CONDITIONS AS SET FORTH IN THE SPECIFICATIONS.

THE PARTIES HERETO AGREE THAT THE NOTICE AND INSTRUCTIONS TO BIDDERS, THE PROPOSAL FILED HEREIN, THE GENERAL SPECIFICATIONS OF THE IOWA DEPARTMENT OF TRANSPORTATION EDITION OF 1977 TOGETHER WITH SPECIAL PROVISIONS ATTACHED TOGETHER WITH THE GENERAL AND DETAILED PLANS IF ANY FOR SAID PROJECT FR-12-3(8)--26-97 TOGETHER WITH SECOND PARTY'S PERFORMANCE BOND ARE MADE A PART HEREOF, AND TOGETHER WITH THIS INSTRUMENT CONSTITUTE THE CONTRACT BETWEEN THE PARTIES HERETO.

THAT IT IS FURTHER UNDERSTOOD AND AGREED BY THE PARTIES OF THIS CONTRACT THAT THE ABOVE WORK SHALL BE COMMENCED OR COMPLETED IN ACCORDANCE WITH THE FOLLOWING SCHEDULE

APPROX. OR SPECIFIED STARTING DATE OR NUMBER OF WORKING DAYS	SPECIFIED COMPLETION DATE OR NUMBER OF WORKING DAYS
70 WORKING DAYS	SEPT. 28, 1984

AND THAT IT IS THE ESSENCE OF THIS CONTRACT AND THAT SAID CONTRACT CONTAINS ALL OF THE TERMS AND CONDITIONS AGREED UPON BY THE PARTIES HERETO AND IN WITNESS WHEREOF, THE PARTIES HERETO HAVE SET THEIR HANDS FOR THE PURPOSE HEREIN EXPRESSED TO THIS AND THREE OTHER IDENTICAL INSTRUMENTS AS OF THE _____ DAY OF _____ A.D. _____

IOWA DEPARTMENT OF TRANSPORTATION

BY _____ PARTY OF THE FIRST PART

BROWER CONSTRUCTION CO. OF SIOUX CITY, IOWA

BY _____ PARTY OF THE SECOND PART

Iowa Department of Transportation

SUPPLEMENTAL SPECIFICATION
for
ASPHALT CEMENT AC-13

December 20, 1983

942.01 **DESCRIPTION.** This material is a polymerized asphalt cement intended to be used in asphalt cement concrete mixtures where high stability requirements are necessary.

The contracting authority believes this to be a proprietary product. It is available as Styrelf 13 from Biticote Products Company, St. Louis, Missouri, and Des Moines, Iowa. Bidders should contact this supplier for information concerning this material.

Other sources of a similar material may also be approved. Specific approval will be required. Approval will be based on the manufacturer's proposed method of polymerization, as well as compliance with the test requirements specified.

942.02 **MATERIAL.** Asphalt cement AC-13 shall meet requirements of AASHTO M 226, Table 1, for grade AC-40, except as follows:

Penetration, 25°C (77°F), 100 g, 5 sec; 60-90.
Viscosity, 60°C (140°F), poises; 2,500 min.
Tensile Stress, ASTM D 412, @ 800%
elongation of the sample, 20°C (68°F),
500 mm/min, kg/cm^2; 0.50 min.

The contractor shall furnish certified test results for each load of this material furnished to the project.

942.03 **CONSTRUCTION.** Asphalt Cement AC-13 shall be incorporated in the ACC mixture to be placed in the locations designated on the plans, in lieu of the asphalt cement specified for other mixtures specified for the project. The mixture shall be prepared and placed according to requirements of the Standard Specifications.

The contractor shall furnish facilities and use a procedure that keeps this material separate from other asphalt cement used on the project during storage and incorporation into the mixture.

942.04 **MEASUREMENT AND PAYMENT.** Asphalt cement AC-13 will be separately measured and paid for in accord with 2303.19B and 2303.20B. The quantity shall be for mixture in the areas designated on the plans and such additional mixture as was necessary to cover the designated areas using full truck loads of mixture. This payment shall be full compensation for furnishing and incorporating this material into the mixture and for the special facilities and procedures necessary to accomplish this.

The quantity of ACC mixture with asphalt cement AC-13, furnished and placed as designated, will be included with the other quantities of ACC mixture and will be paid for accordingly.

Iowa Department of Transportation

SPECIAL PROVISION
for
ASPHALT CEMENT CONCRETE

FN-75-1(39)--21-97, Woodbury County
FR-12-1(8)--2G-97, Woodbury County

May 9, 1984

This work shall consist of removal by scarification and salvage of the asphaltic pavement surface. Incorporation of the salvaged material into a recycled asphalt cement concrete for the projects is a bidding alternate. Only one group of alternates for each project is to be bid, and the contracts will be awarded on the basis of the alternates bid.

Scarification

Scarification shall be in accord with the plans and Supplemental Specification 940.

Asphalt Cement Concrete, Type A.

When Type A asphalt cement concrete is furnished with virgin aggregates, the mixture shall meet requirements of the Standard Specifications, with the following modifications.

1. The asphalt cement shall meet requirements of Section 4137, grade AC-20.
2. Coarse aggregates for surface course mixtures shall be Type 3 skid-resistant aggregate, as classified in Materials I.M. T-203, dated 1983.

AC-13 Polymer Modified Asphalt Cement Concrete.

This mixture shall be furnished and placed in accord with Supplemental Specification 942. A virgin aggregate mixture is required for all courses, using the aggregate mixture designated herein for the surface course. For lower lifts, the contractor may substitute a virgin aggregate mixture designated for the binder course.

The quantity of this mixture required will be separately identified as an item on the proposal.

Asphalt Cement Concrete, Type A, Recycled.

When the recycled mixture is to be furnished, the following provisions shall apply.

These mixtures shall be furnished, mixed, and placed in accord with Supplemental Specification 939.

Asphalt cement for the recycled mixture shall meet requirements of Section 4137, grade AC-2.5, AC-5 or AC-10. The exact grade will be determined at the time of job-mix approval.

The salvaged material to be used for both projects shall be that which is removed by scarification from the roadway of project FR-12-1(8)--2G-97. The existing surface is a 3/8-inch Type A surface mixture on a 3/4-inch Type A binder course mixture. For the purpose of computing crushed particles, it can be assumed that the material salvaged contains 70 percent crushed particles, and the remainder is natural sand.

The aggregate to be used shall be a mixture of 40 or more percent salvaged asphaltic material, combined with new aggregate. It is expected that the material removed from the designated project will be sufficient to provide at least enough salvaged material for the quantity of mixture shown on the plans for both projects. The amount of salvaged asphaltic material in one of the recycled mixtures may be less than the percentage specified, if the percentage in the other mixtures is increased sufficiently to provide for a minimum total usage of salvaged material equivalent to that specified.

New coarse aggregate furnished for recycled surface course mixture shall be Type 3 skid-resistant aggregate, as classified in materials I.M. T-203, dated 1983.

For the 1/2-inch mixture, the required percent passing the 1/2-inch sieve will be modified to 95-100 percent.

For the contractor's information, the average job-mix gradations for the existing surface on the FR-12-1(8)--2G-97 project are as follows:

Sieve Size	3/4-inch Binder Course	3/8-inch Surface Course
3/4 inch	100	
1/2 inch	95	
3/8 inch	75	100
No. 4	57	85
No. 8	51	62
No. 30	26	33
No. 200	6	6

There is a significant difference between the binder and surface courses. Separate stockpiles will not be required. However, the method of removal, processing, and handling of the salvaged material shall result in a uniform blending of salvaged material. The method shall be subject to approval of the engineer.

This material shall not be intermingled with material salvaged from the FN-75-1(39)--21-97 project.

The recycling work will be paid for according to Supplemental Specification 939.

Remaining Salvaged Material.

Any salvaged material taken from the roadway of either project and remaining at the completion of the work shall be the property of the contractor, regardless of the alternate basis on which these contracts are awarded.

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

Appendix A-4

MIX. TYPE AND CLASS: TYPE A SURFACE - BINDER LAB NO. ABD4-113

INTENDED USE:

SIZE 1/2" SPEC. NO. 941, 951, 942 DATE REPORTED 7/3/84

COUNTY WOODBURY PROJECT FR-12-1(8)--2G-97

CONTRACTOR BROWER

PROJ. LOCATION FROM SOUTH LINN STREET TO E.C.L. IN SIOUX CITY

AGG. SOURCES AGG. LIME - HALLETT, GILMORE CITY - POCAHONTAS CO.: 3/16". 5/8"X4, 3/8"X8 QTZ. - L. G. EVERIST, MINNEHAHA CO., S. DAK.: SAND - L. G. EVERIST, 15-95-48 - SIOUX CO.

JOB MIX FORMULA AGGREGATE PROPORTIONS: 15% AAT4-408; 15% AAT4-352; 30% AAT4-351; 10% AAT4-372; 30% AAT4-353

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		99	90	68	57	46	32	17	9.0	5.4
TOLERANCE:		98/100		7	7	5		4			2*

ASPHALT SOURCE AND APPROXIMATE VISCOSITY PLASTICITY INDEX	BITUCOTE-3240 POISES (STYRELF 13)		
% ASPH. IN MIX	4.50	5.50	6.50
NUMBER OF MARSHALL BLOWS	75	75	75
MARSHALL STABILITY - LBS.	3443	3227	3130
FLOW - 0.01 IN.	7	8	12
SP.GR. BY DISPLACEMENT(LAB DENS.)	2.32	2.34	2.36
BULK SP. GR. COMB. DRY AGG.	2.651	2.651	2.651
SP. GR. ASPH. @ 77 F.	1.028	1.028	1.028
CALC. SOLID SP.GR.	2.486	2.449	2.414
% VOIDS - CALC.	6.67	4.46	2.24
RICE SP. GR.	2.476	2.441	2.398
% VOIDS - RICE	6.30	4.14	1.58
% WATER ABSORPTION - AGGREGATE	0.37	0.37	0.37
% VOIDS IN THE MINERAL AGGREGATE	16.42	16.59	16.67
% V.M.A. FILLED WITH ASPHALT	59.41	73.08	86.65
CALCULATED ASPH.FILM THICKNESS(MICRONS)	6.68	8.32	9.99
FILLER/BITUMEN RATIO		1.05	

A CONTENT OF 5.15% ASPHALT IS RECOMMENDED TO START THE JOB.
* ALSO CONTROLLED BY FILLER/BITUMEN RATIO.

COPIES:
ASPH. MIX DESIGN
FR-12-1(8)--2G-97, WOODBURY
J. BUMP
R. BOLTON
R. SHELQUIST
D. JORDISON
D. HEINS
BROWER
W. OPPEDAL

SIGNED: BERNARD C. BROWN
TESTING ENGINEER

AC-13 A.C.C. Mix Test Results

I. Sieve Size	Design % Passing	Lab No. ABC4- 156 Binder	178 Binder & Surface	181 Surface	203 Surface	221	AVE
1/2"	98 - 100	100	99	100	100	100	100
3/8"	83 - 97	92	89	89	88	88	89
4	61 - 75	71	66	66	65	66	67
8	52 - 62	59	54	54	53	55	55
16	46	46	43	44	42	44	44
30	28 - 36	33	31	33	31	31	32
50	17	18	17	18	18	17	18
100	9.0	10	9.5	9.7	9.9	9.6	9.7
200	5.4	7.1	6.5	6.0	6.3	6.5	6.5
II. Extracted AC %		5.77	5.38	5.31			5.49
III. Marshall Stability	3345 (interpolated)	3737	4541	3862	3958	4307	4081
IV. Absolute Viscosity Extracted AC (140°F 300 MMHG Poises)		13,750		11,160	14,100		13,000
V. Penn Extracted AC (77°F, 100 gm 5 sec)		45		50	49		48
VI. % AC Batch Wt.	5.15%	5.15	5.15	5.15	5.15	5.15	5.15
VII. Filler/Bit		*1.38	1.26	1.16	1.22	1.26	1.22

* Dist 3 Mtls Lab Extraction 3.8 #200 cound not extract the AC-13.

Test Results on AC-13 (Styrelf 13)

I. One Project Assurance Sample Tested in Ames Lab

	Test	Spec	Test Results
A.	Absolute Viscosity 140°F, 300 MMHG Poises	2500 min	4390
B.	Penetration 77°F, 100 gm 5 sec	60-90	48
C.	Ductility 77°F (thin film residue) CMS		40 CMS
D.	Absolute Viscosity (thin film residue) 104°F, 300 MMHG Poises		14,990
E.	Penetration of Residue 77°F, 100 gm 5 sec		48

II. NIne Porject Control Samples Tested in Dist 3 Mtls Lab

		Sample Sender No. L.G.-									
	Spec	1	1A	4	5	8	11	11A	17	17A	AVE
A. Absolute Viscosity 140°F, 300 MMHG POises	Min 2500	3050		3720	3840	3980	4170		3940		3912
B. Penetration 77°F, 100 gm 5 sec	60-90		86		79					78	81

III. Field Test Results for Construction Testing

A. Field Core Test Results

Lift Placed	Date Placed	75 Blow Marshall Density	% Lab Density Field Core	% Voids in Field Core	Day's Ave % Density Field Cores	Day's Ave % Air Voids Field Cores
Binder	7-5-84	* 2.28	96.5	10.6		
"	"		100.0	7.3		
"	"		100.4	6.9		
"	"		100.0	7.3		
"	"		100.0	7.3	99.4	7.9
Binder	7-6-84	2.35	97.0	7.3		
"	"		97.4	7.0		
"	"		98.3	6.1		
"	"		97.4	7.0		
"	"		95.3	8.9	97.1	7.2
Binder	7-7-84	2.37	98.3	4.5		
"	"		97.5	5.3		
"	"		95.4	7.4		
"	"		97.0	5.7		
"	"		97.9	4.9	97.2	5.6
Binder	7-9-84	2.35	95.7	8.2		
"	"		99.0	4.5		
"	"		97.0	6.9		
"	"		95.3	8.6		
"	"		97.0	6.9	96.7	7.0
Binder	7-10-84	2.32	98.7	6.5		
"	"		97.8	7.3		
"	"		97.0	8.2		
"	"		98.5	6.5		
"	"		97.0	8.2	97.8	7.3
Surface	7-13-84	2.35	97.0	6.9		
"	"		95.7	8.2		
"	"		98.3	5.7	97.0	6.9
Surface	7-16-84	2.33	97.9	7.3		
"	"		100.0	5.3		
"	"		98.3	6.9	98.7	6.5
Surface	7-17-84	2.34	98.7	6.5		
"	"		98.3	6.9		
"	"		98.3	6.9	98.4	6.8

* Lab Density run at 50 blow, traffic volume requires 75 blow.