EVALUATION OF RECYCLED RUBBER IN ASPHALT CONCRETE BLACK HAWK COUNTY

CONSTRUCTION REPORT
IOWA HIGHWAY RESEARCH BOARD
PROJECT HR-330D

SEPTEMBER 1992

Highway Division

Iowa Department of Transportation

Construction Report
for
Iowa Highway Research Board
Project HR-330D

Evaluation of Recycled Rubber in Asphalt Concrete - Black Hawk County FN-218-7(150)--21-07

By

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September 1992

TECHNICAL REPORT TITLE PAGE

1. REPORT NO.	2. REPORT DATE
HR-330D	September 1992

3. TITLE AND SUBTITLE	4. TYPE OF REPORT & PERIOD COVERED
Evaluation of Recycled Rubber in Asphalt Concrete - Black Hawk County FN-218-7(150)--21-07	Construction Report 10-91 through 5-92

5. AUTHOR(S)	6. PERFORMING ORGANIZATION ADDRESS
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7. ACKNOWLEDGEMENT OF COOPERATING ORGANIZATIONS

8. ABSTRACT

The disposal of discarded tires has become a major problem. Different methods of recycling have been researched. Currently, Iowa is researching the use of ground recycled crumb rubber from discarded tires in asphalt rubber cement. Six projects have been completed in Iowa using asphalt rubber cement.

This project is located on IA 947 (University Avenue) in Cedar Falls/Waterloo. The project contains one section with asphalt rubber cement used in both the binder and surface courses and one section using asphalt rubber cement in the surface course with a conventional binder. There are two control sections where conventional asphalt pavement was placed.

9. KEY WORDS	10. NO. OF PAGES
Asphalt Pavement, Crumb Rubber, Recycled tires, Asphalt rubber cement	32

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DISCLAIMER

INTRODUCTION

Disposal of discarded vehicle tires has become a problem. Recycling these tires into asphalt rubber cement (ARC) is currently being researched by the Iowa DOT.

The Iowa DOT currently has completed six projects using crumb rubber in ARC.

The project in Black Hawk County was constructed using ARC in both the binder and surface course of one section and one section with ARC in the surface course and a conventional mix used in the binder. There are two control sections in this project using conventional asphalt cement.

OBJECTIVE

The objective of this research project was to evaluate the use of finely ground recycled tire rubber to produce ARC.

CONTRACTOR

Aspro Inc. of Waterloo, Iowa was the contractor on this project. Both the ARC and conventional mixes were produced at Aspro's stationary plant in Waterloo.

PROJECT LOCATION

This project is located on IA 947 (University Avenue) from 1st Street to University Avenue in the city of Cedar Falls and from near Grove Street to Greenhills Road in the city of Waterloo. The test sections are listed in Table I.

Table I

Test Section	Sta. to Sta.	Lane	Type of Mix
#1	2360+00 to 2370+00	EB	Conventional Control Section
#2	2370+00 to 2395+00	EB	ARC Surface Only
#3	2395+00 to 2420+00	EB	ARC in Binder & Surface
#4	2420+00 to 2429+00	EB	Conventional Control

PRECONSTRUCTION SURVEY

The existing surface was portland concrete cement pavement. It is a six-lane highway. The daily traffic volume is 19,000 vehicles per day (V.P.D.) with 3% trucks.

A crack survey was conducted on the roadway prior to resurfacing. The Road Rater was also run prior to construction.

The original roadway had some cracking, but there were no apparent distressed areas. There was patching on the roadway prior to construction, but the only patches placed in the research area were where manholes had been adjusted.

MATERIALS

The ground rubber was provided by Rouse Rubber Products of Vicksburg, Mississippi. A GF-60 rubber was used on this project.

The coarse aggregate used was from BMI Waterloo South and the fine aggregate from Aspro Pits in Waterloo. The A.C. 5 was from Koch, Inc. of Dubuque.

Gradation limits on the rubber granules and the aggregates are located in the Special Provision in Appendix A. Gradations, at the time of construction, are found on the plant reports located in Appendix B.

VISCOSITY TESTING

Viscosity testing was done prior to construction and checked again with material obtained during production. This testing was done in the Iowa DOT Materials Laboratory in Ames. These results are in Appendix B. The viscosity requirements for this project were 1500 - 4000 cp. The viscosity was also checked with a Brookfield viscometer at the job site by Rouse. Viscosities met specification limits. The asphalt supply line required additional insulation to keep temperatures high enough for adequate reaction to occur but viscosities were still maintained within limits.

MIX DESIGN

Samples of all materials were obtained for preliminary testing. The job mixes are located in Appendix B.

The intended A.C. content in the ARC binder mix was 5.1% and 5.2% in the ARC surface mix. These are the percentages that were recommended and used in the project.

Lab voids were somewhat high, 4.3% average, but the good field densities kept voids below 8%. All lab densities and voids are shown on the plant reports in Appendix B.

PLANT OPERATION

Both the ARC and conventional mixes were produced at Aspro's Barber Greene batch plant in Waterloo, Iowa.

Because of cold weather, temperatures dropping to 46°F, they had to use torches to thaw out A.C. supply lines from the reactor to the plant, due to longer lines needed because of the rubber hook-up. The lines had to be insulated to keep the temperature around 350°F, high enough for reaction of the rubber to occur.

This set-up slowed down production by about 40 ton/hr. Their normal output was 240 ton/hr with only 200 ton/hr when producing the ARC mixes.

PAVING OPERATIONS

The placement of the ARC and conventional mixes in October 1991 went very well. The ARC mix appeared very stable under the rollers.

There appeared to be no shoving and cracking of the mat as was found on a previously constructed ARC project in Muscatine, Iowa. The PCC surface had been milled which could be a factor in there being no shoving.

Mat temperatures were around 300°F. The rollers stayed close behind the paver. There appeared to be no signs of segregation in the surface.

CONSTRUCTION TESTING

Samples were obtained during construction for viscosity testing and also for creep and resilient modulus testing.

The Road Rater was run again in March 1992 on the test and control sections. Friction testing was done shortly after construction. The results of all field testing are located in Appendix C and all lab test results in Appendix B.

The creep and resilient modulus tests have been completed on this project also. The results of this testing are in Appendix B.

COST COMPARISON

The conventional asphalt cement was bid at $115/ton on this project compared to $360/ton for the reacted ARC. The contract prices of the different asphalt mixes are summarized in Table II.

Table II

Conventional Binder used recycled asphalt so no cost comparison can be made.		Conventional Surface
		21.38
	AC-10	4.95
	(4.3%)	=====
		26.33

ARC Binder		ARC Surface
	38.68	42.76
AC-5	18.36	AC-5 18.72
(5.1%)	=====	(5.2%) =====
	57.04	61.48

EVALUATION

Friction testing was done shortly after construction. Road Rater was ran in the spring of 1992. A crack survey and rut depth

measurements were completed this spring also. No reflective cracking on the ARC or the control sections was noted at this time. Creep and resilient modulus testing has been completed also.

Friction testing, Road Rater testing and crack surveys and rut depth checks will be conducted annually.

Hopefully, a conclusion can eventually be reached to determine if using ARC will:

1. Improve performance
2. Extend the life of the roadway.
3. Be of enough value from an environmental standpoint to compensate for its higher cost.

CONCLUSIONS

From the project the following conclusions can be made:

1. ARC mix can be constructed with little or no difference from that of a conventional mix.

2. ARC pavement appears to be in as good a condition as the conventional after construction.

Appendix A
Contract and Special Provisions

Proposal I.D. No. 910802

ESTIMATING PROPOSAL ONLY

Bid Order No. A 71

Type of Work ASPH CEMENT CONC RESURFACING Project No. FN-218-7(150)--21-07

System PRIMARY ROAD Miles 4.4690 County BLACK HAWK

Location and Description ON IOWA 947 (MAIN ST.) FROM 1ST ST., S TO UNIVERSITY AVE. IN THE CITY OF CEDAR FALLS, & ON IA 947 (UNIVERSITY AVE.) FROM NEAR GROVE ST., SE TO GREENHILLS RD IN THE CITY OF WATERLOO.

INCLUDES SEALING OF CRACKS AND JOINTS, AND P.C. CONCRETE MEDIAN.

TO THE IOWA DEPARTMENT OF TRANSPORTATION HIGHWAY DIVISION

The bidder hereby certifies that no other principal is involved in or has an interest in this proposal; that the bidder has thoroughly examined the plans and specifications and this contract form and is aware of the special provisions contained herein; that the bidder has examined the site of the work and understands that the quantities of work required by the plans and specifications are approximate only and are subject to increases and decreases; that the bidder understands that all quantities of work actually required must be performed and that payment therefore shall be at the unit prices stipulated herein; that the bidder proposes to timely furnish the specified materials in the quantities required and to furnish the machinery, equipment, labor and expertise necessary to competently complete this project by the time specified; that no state or county official or employee has a direct or indirect interest in the contract which would cause violation of section 314.2 Code of Iowa, 1985; that the bidder has made no agreement with any supplier of motor fuel or special fuel which will result in a violation of section 324.17(8) Code of Iowa, 1985.

If this bid is accepted, Bidder agrees: to perform all "extra work" required to complete the project at unit prices or lump sums to be agreed upon in writing prior to commencement of such "extra work" or, if prior agreement cannot be reached, to perform the work on a "force-account basis" as provided in the specifications; to execute the formal contract within thirty days of the date of approval for award or to forfeit the proposal guaranty furnished herewith; to begin work in accordance with the contract documents and to either complete the work within the contract period or pay liquidated damages, which shall accrue at the daily rate specified below, for each additional working day the work remains uncompleted; and to furnish a performance bond in an amount equal to the contract award as security for the full and complete performance of the contract in accordance with the plans and specifications.

Group or Division No.	Amount of Proposal Guaranty	Working Days	Specified Starting Date	Approximate Starting Date	Specified Completion Date	Liquidated Damages Per Day
	$70,000.00	75			11/01/91	$750.00

Enclosed herewith is a certified check, credit union share draft, Cashier's check, bank draft on a solvent bank or a bid bond in the penal sum shown in the contract document as a proposal guaranty. It is understood by bidder that the said guaranty document shall be retained by the Iowa Department of Transportation as a forfeiture in the event the formal contract is not executed or performance bond is not furnished if the award is made to the undersigned.

By virtue of statutory authority preference will be given to products and provisions grown and coal produced within the state of Iowa where applicable.

DBE GOAL: NONE

SEE TIE INFORMATION: CI

Date of Letting: JUNE 4, 1991 9:00 A.M.

Form 650028 8-87 H-391

SCHEDULE OF PRICES

Proposal I.D. No. 910802 611000 891 Bid Order No. 71

Contractor's No. County BLACK HAWK Page No. 2

Project No. FN-218-7(150)--21-07 Type of Work ASPH CEMENT CONC RESURFACING

Unit bids must be typed or shown in ink or the bid will be rejected.

Line No. Item No.	Item on which bid is based. Bidder shall show unit price and extension for each item and total for each group	Item Quantity and Units	Unit Price Dollars X,XXX,XXX	Unit Price Cents XXXX	Amount Dollars XX,XXX,XXX	Amount Cents XX
SECTION 001 (CONTINUED)						
0130 4450245 418 84	INTAKE, REBUILDING, AS PER PLAN	10.000 ONLY				
0140 3400000 442 84	FIXTURES, ADJUSTMENT OF	120.000 ONLY				
0150 1960015 441 84	CURB REPAIR, AS PER PLAN	1562.000 LINEAR FT.				
0160 0475095 442 84	BASE, CLEANING & PREPARATION OF	5.232 MILES				
0170 0400175 442 84	ASPHALT CEMENT CONCRETE, TYPE A BINDER COURSE, MIXT. SIZE 3/4 IN.	8226.000 TONS				
0180 0400450 442 84	ASPHALT CEMENT CONCRETE, TYPE A SURFACE COURSE, MIXT. SIZE 1/2 IN.	7475.000 TONS				
0190 6375000 442 84	PRIMER OR TACK-COAT BITUMEN	11100.000 GALLONS				
0200 6375010 442 84	ASPHALT CEMENT	664.000 TONS				
0210 0425070 410 84	BACKFILL, SPECIAL	1109.000 TONS				
0220 8425005 410 84	TOPSOIL, FURNISH & SPREAD	9188.000 CUBIC YDS.				
0230 8445110 493 84	TRAFFIC CONTROL	1.000 LUMP SUM				
0240 9263010 493 84	PAVEMENT MARKINGS	1175.690 STAS.				
0250 4561000 493 90	LOOP DETECTORS	75.000 ONLY				

PROPOSAL REQUIREMENTS

Proposal I.D. No. 910802 SPECIAL PROVISIONS TEXT Bid Order No. 71 C

Contractor's No. County BLACK HAWK Page No. 1

Project No. FN-218-7(150)--21-07 Type of Work ASPH CEMENT CONC RESURFACING

SP-1007 APRIL 30, 1991

SPECIAL PROVISIONS FOR TRAFFIC SIGNAL DEVICES
*** INTENDED FOR BLACK HAWK COUNTY A.C.C. RESURFACING PROJECT
FN-218-7(150)--21-07 ***

SP-1008 APRIL 30, 1991

SPECIAL PROVISIONS FOR ASPHALT RUBBER CEMENT (ARC) CONCRETE
*** INTENDED FOR BLACK HAWK COUNTY A.C.C. RESURFACING PROJECT
FN-218-7(150)--21-07 ***

SS-1006 DECEMBER 17, 1985

SUPPLEMENTAL SPECIFICATIONS FOR CONTRACTOR-FURNISHED BORROW AREAS

SS-1008 NOVEMBER 5, 1985

SUPPLEMENTAL SPECIFICATIONS FOR EQUAL EMPLOYMENT OPPORTUNITY
RESPONSIBLITIES ON NON-FEDERAL-AID PROJECTS

SS-1057 FEBRUARY 23, 1988

SUPPLEMENTAL SPECIFICATIONS FOR CERTIFIED PLANT INSPECTION.

SS-1061 MAY 10, 1988

SUPPLEMENTAL SPECIFICATIONS FOR SPECIFIC AFFIRMATIVE ACTION
RESPONSIBILITIES ON NON-FEDERAL AID PROJECTS
(ASSIGNED DBE PARTICIPATION GOALS)

S-1062 AUGUST 1, 1988

SUPPLEMENTAL SPECIFICATIONS FOR MOBILIZATION

SS-1080 FEBRUARY 28, 1989

SUPPLEMENTAL SPECIFICATIONS FOR TRAFFIC SIGNALIZATION

SS-1083 JUNE 27, 1989

SUPPLEMENTAL SPECIFICATIONS FOR STANDARDIZED CONTRACT CLAUSES

SS-1089 DECEMBER 5, 1989

SUPPLEMENTAL SPECIFICATIONS FOR PORTLAND CEMENT CONCRETE PROPORTIONS

005 20

THE FOLLOWING PROPOSAL NOTE SUPERSEDES ANY PLAN NOTE IN REGARD TO SS-1083 AND/OR ARTICLE 1109.03 OF THE STANDARD SPECIFICATIONS.

ANY AND ALL REFERENCES TO ARTICLE 1109.03 OF THE STANDARD SPECIFICATIONS SHALL BE NULL AND VOID ON ALL STANDARDS, PLANS, SPECIFICATIONS, SUPPLEMENTAL SPECIFICATIONS, AND SPECIAL PROVISIONS. IN LIEU THEREOF, THE PROVISIONS OF SS-1083, DATED JUNE 27, 1989 SHALL APPLY.

005 21

*** REVISE ARTICLE 1101.03 OF THE STANDARD SPECIFICATIONS ***

DELETE THE THIRD AND FOURTH SENTENCES IN THE SECOND PARAGRAPH FOR THE DEFINITION OF A WORKING DAY IN ARTICLE 1101.03 AND REPLACE WITH THE FOLLOWING THREE NEW SENTENCES IN LIEU THEREOF.

"WORKING DAYS WILL NOT BE COUNTED FOR SATURDAYS, SUNDAYS, AND RECOGNIZED LEGAL HOLIDAYS THE CONTRACTOR DOES NOT WORK. WORKING DAYS WILL BE COUNTED FOR SUNDAYS AND RECOGNIZED LEGAL HOLIDAYS THE CONTRACTOR DOES WORK. WORKING DAYS WILL NOT BE COUNTED FOR SATURDAYS THE CONTRACTOR DOES WORK, UNLESS OTHERWISE SPECIFIED IN THE CONTRACT DOCUMENTS."

005 30

*** REQUIREMENT FOR DISCLOSURE OF ALL SUBCONTRACTORS ***

IOWA CODE 307.49 AS ADDED BY HOUSE FILE 2201 REQUIRES THAT:

"A BIDDER AWARDED A CONTRACT WITH THE DEPARTMENT SHALL DISCLOSE THE NAMES OF ALL SUBCONTRACTORS, WHO WILL WORK ON THE PROJECT OR WHO THE BIDDER ANTICIPATES WILL WORK ON THE PROJECT.... IF A SUBCONTRACTOR NAMED BY A BIDDER AWARDED A CONTRACT IS REPLACED, OR IF THE COST OF WORK TO BE DONE BY A SUBCONTRACTOR IS REDUCED, THE BIDDER SHALL DISCLOSE THE NAME OF THE NEW SUBCONTRACTOR OR THE AMOUNT OF THE REDUCED COST. IF A SUBCONTRACTOR IS ADDED BY A BIDDER AWARDED A CONTRACT, THE BIDDER SHALL DISCLOSE THE NAME OF THE NEW SUBCONTRACTOR...."

THE LIST OF PROPOSED SUBCONTRACTORS SHALL BE SUBMITTED TO THE OFFICE OF CONTRACTS WITH THE PERFORMANCE BOND AND SIGNED CONTRACT.

FAILURE TO PRESENT THE SUBCONTRACTOR LIST SHALL CAUSE THE CONTRACTOR TO BE RE-EVALUATED FOR FUTURE BIDDER QUALIFICATION AS PER ARTICLE 1102.03.

THESE REQUIREMENTS ARE IN ADDITION OF ARTICLE 1108.01.

090 00

*** DBE/TSB GOAL INFORMATION ***

THE DISADVANTAGED BUSINESS ENTERPRISE (DBE) OR TARGETED SMALL BUSINESS (TSB) GOAL ESTABLISHED FOR THIS CONTRACT (E.G., SUPPLIERS, AND SUBCONTACTORS) IS SHOWN ON THE FRONT OF THIS PROPOSAL FORM.

THE CONTRACTOR IS ENCOURAGED TO SEEK PARTICIPATION OF DISADVANTAGED INDIVIDUALS IN BUSINESS ENTERPRISES. THESE BUSINESS ENTERPRISES MAY BE EITHER DBE CERTIFIED OR TSB CERTIFIED IN ACCORDANCE WITH THE CURRENT 'SUPPLEMENTAL SPECIFICATIONS FOR SPECIFIC AFFIRMATIVE ACTION RESPONSIBILITIES ON NON-FEDERAL AID PROJECTS (ASSIGNED DBE PARTICIPATION GOALS)'.

(Additional Attached Requirements)

1 of 1

Black Hawk County FN-218-7(150)--21-07 ACC Resurfacing

SALVAGING AND RECYCLING OF ASPHALT CEMENT CONCRETE

Salvaged Asphalt Cement Concrete Material

Salvaged asphalt cement concrete material is that which is to be removed from the existing surface to depths shown on the plans as work of the bid item, Pavement Scarification.

Existing Asphalt Cement Concrete Material

The existing asphalt cement concrete binder and surface courses were placed in 1970. The binder course is a 3/4" Type "A" Asphalt Cement Concrete mixture placed 2 inches thick with leveling and wedge courses. The surface course is a 3/8" Type "A" Asphalt Cement Concrete mixture placed 1 inch thick.

When placed these mixes had the following average extracted gradations, asphalt contents, and aggregate proportions.

Sieve Size	Percent Passing	
	Binder	Surface
3/4"	100	
1/2"	90	100
3/8"	70	99
#4	60	82
#8	45	67
#30	26	34
#200	6.5	9.0
A.C. Content	5.6%	6.0%
Aggregates	65% Crushed Limestone 35% Sand	65% Crushed Limestone 35% Sand

Recycling of Salvaged Asphalt Cement Concrete Material

Asphalt cement concrete material salvaged from this project as work of bid item Pavement Smoothness shall be recycled into all asphalt cement concrete mixtures on this project except the mixtures which include the asphalt rubber cement (ARC).

SP-1008
(New)

Iowa Department of Transportation

SPECIAL PROVISIONS
for
ASPHALT RUBBER CEMENT (ARC) CONCRETE

FN-218-7(150)—21-07, Black Hawk County

April 30, 1991

THE STANDARD SPECIFICATIONS, SERIES OF 1984, ARE AMENDED BY THE FOLLOWING MODIFICATIONS. THESE ARE SPECIAL PROVISIONS, WHICH SHALL PREVAIL OVER THOSE PUBLISHED IN THE STANDARD SPECIFICATIONS.

1008.01 DESCRIPTION.

The asphalt rubber cement (ARC) concrete mix composition will include the incorporation of ARC in the mixture, using the aggregates selected by the Contractor.

The Contractor shall have a representative of the rubber supplier available on the project site during the initial production of the ARC materials. The Contractor shall have a representative of the rubber supplier on call for technical assistance during production operations.

1008.02 GENERAL REQUIREMENTS.

The ARC concrete mixes shall conform to the requirements of the standard specifications for the standard asphalt cement concrete mixes as specified in the plans. The Standard Specifications are modified as follows:

A. Mineral Aggregate for the ARC Concrete Mixes.

Mineral aggregates shall meet Type "A" quality as specified in the plans and specifications except the gradation shall meet the following:

Sieve size	Percent passing
1"	100
3/4"	98-100
1/2"	76-92
3/8"	60-83
#4	40-62
#8	26-45
#30	11-24
#200	3-7

1008.05 CERTIFICATION.

The manufacturer shall ship with the rubber, certificates of compliance which certify that all requirements of these specifications are complied with for each production lot number of shipment.

1008.06 ASPHALT RUBBER CEMENT (ARC) MIXTURE DESIGN

The asphalt cement to be reacted with rubber shall be grade AC-5. The proportion of ground rubber shall be between 15 and 25 percent by weight of the asphalt cement.

The Contractor shall supply to the Engineer, for approval, a mix formulation at least 10 days before pavement construction is scheduled to begin. Mix design criteria for the ARC concrete mixes shall be the same for the non-rubber asphalt cement concrete (ACC) mixtures used on this project.

1008.07 ASPHALT RUBBER CEMENT (ARC) MIXING AND PRODUCTION EQUIPMENT

Unless otherwise authorized by the Engineer, all equipment utilized in production and proportioning of the ARC shall be described as follows:

A. An asphalt heating tank with a hot oil heat transfer system or retort heating system capable of heating asphalt cement to the necessary temperature for blending with the ground rubber. If required, this unit shall be capable of heating a minimum of 3,000 gallons of asphalt cement to 375^{O} F.

B. An ARC mechanical blender with a two stage continuous mixing process capable of producing a homogeneous mixture of asphalt cement and ground rubber, at the mix design specified ratios, as recommended by the supplier of the ground rubber. This unit shall be equipped with a ground rubber feed system capable of supplying the asphalt cement feed system as not to interrupt the continuity of the blending process. A separate asphalt cement feed pump and finished product pump are required. This unit shall have both an asphalt cement totalizing meter in gallons and a flow rate meter in gallons per minute.

C. An ARC storage tank equipped with a heating system to maintain the proper temperature for pumping and adding of the binder to the aggregate and an internal mixing unit within the ground vessel capable of maintaining a proper mixture of asphalt cement and ground rubber.

D. An ARC supply system equipped with a pump and metering device capable of adding the ARC by volume to the aggregate at the percentage required by the job-mix formula.

An interlock of the ARC and aggregate feed systems will not be required. The Contractor shall accurately proportion the ARC into the mixture.

952A.08 ASPHALT RUBBER CEMENT MIXING AND REACTING PROCEDURE.

A. Asphalt Cement Temperature.

The temperature of the asphalt cement shall be between 290^{O} and 400 degrees F. at the addition of the ground rubber, as directed by the supplier.

IOWA DEPARTMENT OF TRANSPORTATION

TO OFFICE: Contracts DATE: May 21, 1991

ATTENTION: Harvey Olson REF. NO.: 436/HR-330D

FROM: Vernon J. Marks

OFFICE: Materials - Research

SUBJECT: Request for Addendum on Black Hawk FN-218-7(150)--21-07

By this memo we are requesting modifications of Special Provision SP-1008. Section 1008.02 A. should be modified as follows:

A. Mineral Aggregate for the ARC Concrete Mixes

Mineral aggregates shall meet Type "A" quality as specified in the plans and specifications. The gradation for the size 3/4 inch mixture shall meet the following:

Sieve Size	Percent Passing
1"	100
3/4"	98-100
1/2"	76-92
3/8"	60-83
#4	40-62
#8	26-45
#30	11-24
#200	3-7

The gradation for the size 1/2 inch mixture shall be as specified in the plans and specifications.

The second sentence of Section 1008.06 should be modified to read "The proportion of ground rubber shall be between 10 and 25 percent by weight of the asphalt cement."

VJM:kmd
cc: B. Brown
R. Monroe
T. Cackler

IOWA DEPARTMENT OF TRANSPORTATION

TO OFFICE: Contracts DATE: May 20, 1991

ATTENTION: Harvey Olson REF. NO.: 436/HR-330D

FROM: Vernon J. Marks

OFFICE: Materials - Research

SUBJECT: Request for Addendum on Black Hawk FN-218-7(150)--21-07

By this memo we are requesting an addendum to modify the second sentence of Section 1008.06 of Special Provision SP-1008 to read "The proportion of ground rubber shall be between 10 and 25 percent by weight of the asphalt cement."

VJM:kmd
cc: B. Brown
R. Monroe
T. Cackler

Appendix B
Lab Testing

IOWA DEPARTMENT OF TRANSPORTATION
OFFICE OF MATERIALS
TEST REPORT - ASPHALT MIX DESIGN
LAB LOCATION - AMES

LAB NO....:ABD1-0195

MATERIAL.....:TYPE A ARC
INTENDED USE....:BINDER
PROJECT NO.....:FN-218-7(150)--21-07
COUNTY.....:BLACK HAWK — CONTRACTOR:ASPRO
SPEC NO.....:5015.00 — SIZE.....:3/4
SAMPLED BY.....: — SENDER NO.:
DATE SAMPLED: — DATE RECEIVED: — DATE REPORTED: 08/28/91
PROJ. LOCATION: UNIVERSITY AVE. IN CEDAR FALLS & WATERLOO

- -

AGG SOURCES: CR LST, 3/4 & 1/2" CHIPS- BASIC MATERIALS, WATERLOO SOUTH, BLACK HAWK CO.; SAND- MANATTS, ASPRO PIT, BLACK HAWK CO.
BINDER IS 15% REACTED RUBBER

JOB MIX FORMULA-COMB. 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
	100.0	99.0	82.0	64.0	42.0	30.0	23.0	15.0	7.0	4.6	4.0

TOLERANCE /100 :

98	7	7	7	5	4	2

MATERIAL MIX	A07004	A07004	A07004	A07506	
% AGGR. PROP.	45.00	24.00	10.00	21.00	0.00

ASPHALT SOURCE AND	KOCH			
APPROXIMATE VISCOSITY POISES	0496			
% ASPHALT IN MIX	5.00	6.00	7.00	0.00
NUMBER OF MARSHALL BLOWS	75	75	75	0
MARSHALL STABILITY - LBS.	1970	1957	1567	0
FLOW - 0.01 IN.	7	7	9	0
SP GR BY DISPLACEMENT (LAB DENS)	2.363	2.375	2.362	0.000
BULK SP. GR. COMB. DRY AGG.	2.712	2.712	2.712	0.000
SP. GR. ASPH. @ 77 F.	1.024	1.024	1.024	0.000
CALC. SOLID SP. GR.	2.534	2.495	2.458	0.000
% VOIDS - CALC.	6.75	4.82	3.90	0.00
RICE SP.GR.	2.468	2.430	2.409	0.000
% VOIDS - RICE	4.22	2.26	1.95	0.00
% WATER ABSORPTION - AGGREGATE	0.97	0.97	0.97	0.00
% VOIDS IN MINERAL AGGREGATE	17.23	17.68	19.00	0.00
% V.M.A. FILLED WITH ASPHALT	60.81	72.73	79.50	0.00
CALC. ASPH. FILM THICK. MICRONS	11.49	14.03	16.58	0.00
FILLER/BITUMEN RATIO	0.00	0.78	0.00	0.00
TEMP=	210			
WT=	7300			
SLOPE=	4.67			
INTER=	-5.53			

A CONTENT OF 5.1% BINDER IS RECOMMENDED TO START THE JOB.

COPIES TO:

CENTRAL LAB	W. OPPEDAL	ASPRO
D. HEINS	J. ADAM	R. MONROE
DIST. 2	WATERLOO RES.	

DISPOSITION:

SIGNED: ORRIS J. LANE, JR.
TESTING ENGINEER

ooooo

ABD1-0196 MIX DESIGN
BD

IOWA DEPARTMENT OF TRANSPORTATION
OFFICE OF MATERIALS
TEST REPORT - ASPHALT MIX DESIGN
LAB LOCATION - AMES

LAB NO....:ABD1-0196

MATERIAL.....:TYPE A ARC
INTENDED USE....:SURFACE
PROJECT NO.....:FN-218-7(150)--21-07
COUNTY.....:BLACK HAWK CONTRACTOR:ASPRO
SPEC NO.....:5015.00 SIZE.....:1/2
SAMPLED BY.....: SENDER NO.:
DATE SAMPLED: DATE RECEIVED: DATE REPORTED: 08/28/91
PROJ. LOCATION: UNIVERSITY AVE. IN CEDAR FALLS & WATERLOO

- -

AGG. SOURCES: CR. LST. & CHIPS - BASIC MATERIALS, WATERLOO SOUTH, BLACK HAWK CO. SAND - MANATTS, ASPRO PIT, BLACK HAWK CO.
BINDER IS 15% REACTED RUBBER

JOB MIX FORMULA-COMB. 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
	100.0	98.0	82.0	52.0	36.0	27.0	18.0	7.9	4.7		4.2

TOLERANCE /100 :

92	7	7	5	4		2

MATERIAL MIX	A07004	A07004	A07506		
% AGGR. PROP.	39.00	36.00	25.00	0.00	0.00

ASPHALT SOURCE AND	KOCH			
APPROXIMATE VISCOSITY POISES	0496			
% ASPHALT IN MIX	5.00	6.00	7.00	0.00
NUMBER OF MARSHALL BLOWS	75	75	75	0
MARSHALL STABILITY - LBS.	2263	2028	1653	0
FLOW - 0.01 IN.	6	7	8	0
SP GR BY DISPLACEMENT (LAB DENS)	2.358	2.365	2.353	0.000
BULK SP. GR. COMB. DRY AGG.	2.715	2.715	2.715	0.000
SP. GR. ASPH. @ 77 F.	1.024	1.024	1.024	0.000
CALC. SOLID SP. GR.	2.534	2.495	2.457	0.000
% VOIDS - CALC.	6.93	5.20	4.24	0.00
RICE SP.GR.	2.469	2.428	2.398	0.000
% VOIDS - RICE	4.50	2.59	1.88	0.00
% WATER ABSORPTION - AGGREGATE	0.87	0.87	0.87	0.00
% VOIDS IN MINERAL AGGREGATE	17.49	18.12	19.40	0.00
% V.M.A. FILLED WITH ASPHALT	60.38	71.27	78.12	0.00
CALC. ASPH. FILM THICK. MICRONS	10.60	12.92	15.94	0.00
FILLER/BITUMEN RATIO	0.00	0.81	0.00	0.00
TEMP=	220			
WT=	7200			
SLOPE=	4.95			
INTER=	-6.05			

A CONTENT OF 5.2% BINDER IS RECOMMENDED TO START THE JOB.
COPIES TO:

CENTRAL LAB	R. MONROE	J. ADAM
D. HEINS	ASPRO	W. OPPEDAL
DIST. 2	WATERLOO RES.	

DISPOSITION:

SIGNED: ORRIS J. LANE, JR.
TESTING ENGINEER

ooooo

Form 820007 08/90 H-1691

Iowa Department of Transportation

DAILY PLANT REPORT

BITUMINOUS TREATED BASE, ASPHALT TREATED BASE, ASPHALT CONCRETE

County BLACK HAWK
Project FN-218-7(150)--
Contract No. 33272
Date 10-3-91
Report No. 6

Contractor ASPRO, INC. Plant Location 3613 TEXAS ST., WATERLOO, IA
Plant Type BATCH Make BARBER-GREENE Pollution Equipment BAG HOUSE Resident Engineer GERALD LUND
Mix Type SURFACE Class A Size 1/2" ARC Crushed Aggr. Sources WATERLOO SOUTH QUARRY Recycle Source NONE
Asphalt Source & Grade KOCH ASPHALT AC-5 Sand Sources ASPRO PIT Plant Operated 7:00 A.M. to 3:45 P.M. Mix No. ABD1-0196

SIEVE ANALYSIS OF COMBINED AGGREGATES

SAMPLE			SIEVE NO. - % PASSING											
JOB MIX FORMULA - LIMITS						92-100	75-89	45-59	31-41	-	14-22	-	-	2.2-6.2
Spl. ID.	Time	Compl.	1½	1	¾	½	⅜	4	8	16	30	50	100	200
1	AM	YES				99	85	58	42	31	21	8.5	4.3	3.6

SAMPLES SUBMITTED

Materials	Senders No.
1/2" ARC	16
SURFACE	17
" "	18

SAMPLES SUBMITTED

Materials	Senders No.
AC-5	6

Intended Added 5.2 % A.C. Tank Meas. 5.21 % A.C.
Intended Total 5.2 % A.C. Total 5.21 % A.C.

LAB. DEN. 2.360 SOLID DEN. 2.466

DENSITY RECORD

Course Laid	Station	¢ Refer	Date Laid	* (1)	Density	% Density	% Voids
SURFACE			10-3-91	1 3/4"	2.300	97.458	6.7
				1 1/2	2.255	95.561	8.6
				1 1/2	2.302	97.542	6.7
				1 3/4	2.297	97.331	6.9
				1 1/2	2.304	97.627	6.6
				1 1/2	2.313	98.006	6.2
				1 1/2	2.293	97.174	7.0
			AVG		2.295	97.239	6.9

TEMPERATURE RECORD

Time	7	9	11	1	3	5
Air	46	50	61	62	58	
A.C.	300	300	300	295	295	
Aggr.	360	365	365	370	365	
Mix	300	305	310	310	305	
Mat						

RECYCLED MIX ONLY

Total RAP Used Tons
Total Aggr. Used Tons
RAP Used %
Aggr. Used %

MATERIALS DELIVERIES

Type	Ticket No.	Quantity
AC-5	9299	49900
"	9393	50280

Avg. Field Density Lot #1 2.295
Avg. Field Density Lot #2
Advisory - Fines/Bitumen Ratio = 3.6 ÷ 5.21 = 0.691
Ave. % Field Voids = 6.9
Lab % Voids = [redacted]
Q.I. (Density) = 2.83
(Show Calculation)

NUCLEAR 5.40

$$SX = \sqrt{\frac{\Sigma(97.239 - X)^2}{(7-1)}} = 0.790$$

$$QI = \frac{97.239 - 95.000}{0.790} = 2.83$$

Acceptance Fines/Bitumen Ratio =

PRODUCTION AND PLACEMENT RECORD

* (2)	Side	Course Laid	From Station to Station	Tons Today	Tons To Date
1 1/2		SURFACE		1325.272	1926.369
			WASTE	- 30.322	1896.047

Acceptance Cold Feed (Certified Projects Only)	1	¾	½	⅜	4	8	16	30	50	100	200

COMMENTS

COMMENTS: Delays, Breakdowns, Corrective Action, etc.
*Thickness: (1) Actual, (2) Intended
Bituminous Treated Base: Enter % Moisture in % Voids Column

Signed [signature] Inspector 1356 Cert. No.

MATERIALS OFFICE – RECORDS CENTER COPY

Form 820007 08/90 H-1691

Iowa Department of Transportation

DAILY PLANT REPORT

BITUMINOUS TREATED BASE, ASPHALT TREATED BASE, ASPHALT CONCRETE

County BLACK HAWK
Project FN-218-2(150)21-07
Contract No. 33272
Date 10-1-91
Report No. 5

Contractor ASPRO, INC. Plant Location 3613 TEXAS ST. WATERLOO IA
Plant Type BATCH Make BARBER GREENE Pollution Equipment BAG HOUSE Resident Engineer C.L. LIND
Mix Type SURFACE Class A Size 1/2 ARC. Crushed Aggr. Sources WATERLOO SOUTH Recycle Source
Asphalt Source & Grade KOCH AC-5 Sand Sources ASPRO PITS Plant Operated 8:00 A.M. to P.M. Mix No. ABDI-0196

SIEVE ANALYSIS OF COMBINED AGGREGATES

SAMPLE			SIEVE NO. - % PASSING												
JOB MIX FORMULA - LIMITS						92-100	75-87	45-57	31-41		14-22			2.2-6.2	
Spl. ID	Time	Compl.	1½	1	¾	½	⅜	4	8	16	30	50	100	200	
1	AM	YES				98	79	48	32	24	17	7.4	4.3	3.7	

SAMPLES SUBMITTED

Materials	Senders No.
½ ARC	13
SURFACE	14
"	15

SAMPLES SUBMITTED

Materials	Senders No.
AC-5	5

Intended Added 5.2 % A.C. Tank Meas. 5.20 % A.C.
Intended Total 5.2 % A.C. Total 5.20 % A.C.

LAB. DEN. 2.360 DENSITY RECORD SOLID DEN. 2.471

Course Laid	Station	¢ Refer	Date Laid	* (1)	Density	% Density	% Voids
SURFACE			10-1-91	1 5/8"	2.311	97.924	6.5
				1 3/4	2.311	97.924	6.5
				1 3/4	2.307	97.754	6.6
				1 5/8	2.306	97.712	6.7
				1 7/8	2.320	98.305	6.1
				1 5/8	2.329	98.686	5.7
				1 3/4	2.297	97.331	7.0

TEMPERATURE RECORD

Time	7	8	10	12	3	5
Air		47	58			
A.C.		300	300	POWER WENT OFF		
Aggr.		360	365	SENT LAST 2		
Mix		295	300	LOADS AT 2:30		
Mat						

RECYCLED MIX ONLY

Total RAP Used Tons
Total Aggr. Used Tons
RAP Used %
Aggr. Used %

MATERIALS DELIVERIES

Type	Ticket No.	Quantity
AC 5	9217	49480
"	9259	49880

Avg. Field Density Lot #1 2.312
Avg. Field Density Lot #2

Advisory - Fines/Bitumen Ratio = 3.7 ÷ 5.20 = 0.712
Ave. % Field Voids = 6.5
Lab % Voids = 4.5
Q.I. (Density) = 6.75
(Show Calculation)
NUCLEAR 5.06

PRODUCTION AND PLACEMENT RECORD

* (2)	Side	Course Laid	From Station to Station	Tons Today	Tons To Date
1½		SURFACE		601.097	601.097

Acceptance Cold Feed (Certified Projects Only)	1	¾	½	⅜	4	8	16	30	50	100	200
		100	98	79	50	34	25	17	7.2	4.0	3.5

COMMENTS

Acceptance Fines/Bitumen Ratio =

COMMENTS: Delays, Breakdowns, Corrective Action, etc.
*Thickness: (1) Actual, (2) Intended
Bituminous Treated Base: Enter % Moisture in % Voids Column

Signed _____ Inspector 1356 Cert. No.

MATERIALS OFFICE – RECORDS CENTER COPY

Form 820007 08/90 H-1691

CORRECTED REPORT

Iowa Department of Transportation

DAILY PLANT REPORT

BITUMINOUS TREATED BASE, ASPHALT TREATED BASE, ASPHALT CONCRETE

County BLACK HAWK
Project FN-218-7(150)21-07
Contract No. 33272
Date 9-30-91
Report No. 4

Contractor ASPRO, INC. Plant Location 3613 TEXAS ST. WATERLOO IA
Plant Type BATCH Make BARBER GREENE Pollution Equipment BAG HOUSE Resident Engineer G.L. LUND
Mix Type BINDER Class A Size 3/4 ARC Crushed Aggr. Sources WATERLOO SOUTH Recycle Source
Asphalt Source & Grade KOCH AC-5 Sand Sources ASPRO PITS Plant Operated 8:30 A.M. to 3:00 P.M. Mix No. ABDI-0195

SIEVE ANALYSIS OF COMBINED AGGREGATES

SAMPLE			SIEVE NO. - % PASSING												
JOB MIX FORMULA - LIMITS					Q-100	25-81	57-71	35-44	25-35		11-19			2.0-6.0	
Spl. ID	Time	Compl.	1½	1	¾	½	⅜	4	8	16	30	50	100	200	
1	AM	YES			99	86	68	44	30	23	16	7.7	5.1	4.5	

SAMPLES SUBMITTED		SAMPLES SUBMITTED	
Materials	Senders No.	Materials	Senders No.
3/4 ARC	10	AC-5	4
BINDER	11		
"	12		

Intended Added 5.1 % A.C. Tank Meas. 5.12 % A.C.
Intended Total 5.1 % A.C. Total 5.12 % A.C.

LAB. DEN. ~~2.337~~ 2.375 DENSITY RECORD SOLID DEN. ~~2.465~~ 2.463

Course Laid	Station	¢ Refer	Date Laid	* (1)	Density	% Density	% Voids
BINDER			9-30-91	1 3/8"	2.357	99.242	4.3
				1 1/2	2.311	97.325	6.2
				1 3/4	2.303	96.968	6.5
				1 1/2	2.319	97.642	5.8
				1 1/2	2.300	96.842	6.6
				1 3/4	2.264	95.326	8.1
				1 7/8	2.310	97.263	6.2

TEMPERATURE RECORD

Time	7	8:30	10:30	12:30	2:30	5
Air		62	66	67		
A.C.		300	~~300~~	300		
Aggr.		360	355	360		
Mix		305	~~300~~	300		
Mat						

MATERIALS DELIVERIES

Type	Ticket No.	Quantity

RECYCLED MIX ONLY

Total RAP Used Tons
Total Aggr. Used Tons
RAP Used %
Aggr. Used %

Avg. Field Density Lot #1 2.309 2.309 97.230
Avg. Field Density Lot #2

PRODUCTION AND PLACEMENT RECORD

* (2)	Side	Course Laid	From Station to Station	Tons Today	Tons To Date
1½"		BINDER		811.732	4045.646

Acceptance Cold Feed (Certified Projects Only)	1	¾	½	⅜	4	8	16	30	50	100	200
	100	100	85	63	39	27	20	14	7.2	5.0	4.6

Advisory - Fines/Bitumen Ratio = 4.5 ÷ 5.12 = 0.879
Ave. % Field Voids = 6.3
Lab % Voids = ~~5.2~~ 3.6
Q.I. (Density) = 2.08 OK
(Show Calculation)

NUCLEAR 5.28

$$S_x = \sqrt{\frac{\Sigma (97.230 - x)^2}{(7-1)}} = 1.074$$

Q.I. = (97.230 − 95.000) ÷ 1.074 = 2.08

COMMENTS
MIX CONTAINS RECYCLED RUBBER.
THIS REPORT SHOWS NEW TEST RESULTS FROM DISTRICT LAB.

Acceptance Fines/Bitumen Ratio =

COMMENTS: Delays, Breakdowns, Corrective Action, etc.
*Thickness: (1) Actual, (2) Intended
Bituminous Treated Base: Enter % Moisture in % Voids Column

Signed [signature] Inspector 1356 Cert. No.

MATERIALS OFFICE – RECORDS CENTER COPY

IOWA DEPARTMENT OF TRANSPORTATION
OFFICE OF MATERIALS
TEST REPORT - BITUMINOUS AGGREGATES
LAB LOCATION - AMES

LAB NO....:AAT1-1519

MATERIAL........:GF-60 ROUSE RUBBER
INTENDED USE....:REACTED RUBBER SURFACE
PRODUCER........:ASPRO
PROJECT NO......:FN-218-7(150)--21-07 CONTRACTOR:ASPRO
COUNTY..........:BLACK HAWK
SOURCE..........:ASPRO PIT
UNIT OF MATERIAL:GF-60 RUBBER GRANULES
SAMPLED BY......:B. STEFFES SENDER NO.:CP1-31
DATE SAMPLED: 10/01/91 DATE RECEIVED: 10/30/91 DATE REPORTED: 10/31/91

GRADATION

% PSG.	
#10	100
#30	98
#50	37

COPIES TO:
CENTRAL LAB GEOLOGY ~~V. MARKS~~

DISPOSITION:

SIGNED: ORRIS J. LANE, JR.
TESTING ENGINEER

ooooo

IOWA DEPARTMENT OF TRANSPORTATION
OFFICE OF MATERIALS
TEST REPORT - ASPHALT
LAB LOCATION - AMES

LAB NO....:AB 1-0365

MATERIAL........:AC-5
INTENDED USE....:REACTED RUBBER SURFACE
PROJECT NO......:FN-218-7(150)--21-07
COUNTY..........:BLACK HAWK CONTRACTOR:ASPRO
UNIT OF MATERIAL:AC-5
SAMPLED BY......:C. ANDERSON SENDER NO.:CP1-32
DATE SAMPLED: 10/01/91 DATE RECEIVED: 10/15/91 DATE REPORTED: 10/16/91

ASPHALT AND RUBBER SUBMITTED FROM LAB.
MIXED @ 15% BY TOTAL WGT.OF ASPHALT RUBBER MIX

3 MIN. =	700 @ 347 F.
10 MIN. =	950 @ 347 F.
30 MIN. =	1250 @ 347 F.
1 HR. =	2350 @ 347 F.

COPIES TO:
CENTRAL LAB V. MARKS

DISPOSITION:

SIGNED: ORRIS J. LANE, JR.
TESTING ENGINEER

ooooo

HR-330D
Creep and Resilient Modulus Testing

		Resilient Modulus	Creep
Lab Mixed	Conventional 50	410,000	72
	Conventional 75	660,000	86
Lab Mixed	ARC Surface 50	1,590,000	21
	ARC Surface 75	2,640,000	30
Plant Mixed	Conventional 50	760,000	55
	Conventional 75	1,030,000	83
Plant Mixed	ARC Surface 50	680,000	79
	ARC Surface 75	800,000	85
Drilled Cores	ARC Surface	1,500,000	17

Appendix C
Field Testing

HR-330D - Black Hawk County
Eastbound Rut Depths
Post Construction

	11-21-91		3-25-92	
Station	OWT	IWT	OWT	IWT
2360+00	.00	.00	.01	.08
2361+00	.01	.00	.08	.01
2362+00	.03	.00	.03	.00
2363+00	.01	.01	.03	.01
2364+00	.01	.00	.01	.01
2365+00	.01	.00	.02	.01
2366+00	.00	.01	.04	.01
2367+00	.03	.01	.03	.01
2368+00	.02	.02	.02	.02
2369+00	.03	.00	.06	.02
2371+00	.02	.00	.09	.05
2373+00	.01	.01	.05	.01
2375+00	.05	.01	.09	.02
2377+00	.03	.00	.03	.01
2379+00	.08	.03	.08	.04
2381+00	.06	.01	.09	.01
2383+00	.03	.02	.03	.02
2385+00	.04	.00	.04	.02
2387+00	.04	.01	.04	.01
2389+00	.05	.01	.05	.01
2396+00	.04	.00	.04	.01
2398+00	.04	.01	.09	.05
2400+00	.02	.01	.02	.01
2402+00	.07	.03	.07	.03
2404+00	.04	.01	.08	.03
2406+00	.05	.00	.09	.01
2408+00	.03	.00	.05	.01
2410+00	.03	.00	.03	.03
2412+00	.02	.04	.02	.04
2414+00	.06	.05	.06	.05
2420+00	.01	.01	.01	.01
2421+00	.03	.03	.03	.03
2422+00	.04	.00	.05	.02
2423+00	.05	.02	.05	.02
2424+00	.02	.01	.03	.05
2425+00	.05	.01	.05	.01
2426+00	.05	.00	.05	.00
2427+00	.05	.01	.06	.01
2428+00	.04	.00	.04	.00
2429+00	.04	.00	.06	.01

IOWA DEPARTMENT OF TRANSPORTATION

TO OFFICE: DATE: December 6, 1991

ATTENTION: REF. NO.: 435.204

FROM: Chris Anderson

OFFICE: Materials - Research

SUBJECT: Friction Testing on US 218 in Black Hawk County from Station 2360+00 to Station 2430+00

Friction testing was conducted on US 218 on November 21, 1991 All testing was performed at 40 mph with standard tread (ASTM E-501-76) test tire. The results are as follows:

		Eastbound Driving Lane
Section #1	Control Section	45
Section #2	A.R.C. in binder course	43
Section #3	A.R.C. in surface course	39
Section #4	Control Section	46

CA:kmd

PROGRAM NUMBER- P2220050
COMPUTER RUN DATE- 08-19-91

OFFICE OF MATERIALS
ROAD RATER
STS

COUNTY- BLACK HAWK | BEGINNING MP.... 420.00 | LAB NO..... RA1-5620 | WEATHER SUNNY | FREQ. HZ... 30
U.S. ROUTE..... 0218 | ENDING MP..... 430.00 | YEAR BUILT.. 19 | OBS... FRETTE ANDERSON | DISP %..... 68
PAVEMENT TYPE... COMP | COMPUTED MILES.. 10.00 | DATE TESTED. 08-14-91 | TIME... 10:00 | TEST TYPE.. SI

ROAD RATER DEFLECTION (MILS)

	EASTBOUND						BOUND						
M-P	SENS 1	SENS 2	SENS 3	SENS 4	S.R.	SOIL K	SENS 1	SENS 2	SENS 3	SENS 4	S.R.	SOIL K	REMARKS
420.000	0.90	0.85	0.75	0.62	6.07	156.							
421.000	0.94	0.88	0.75	0.62	5.87	160.							
422.000	0.80	0.78	0.68	0.55	6.66	135.							
423.000	0.80	0.74	0.64	0.52	6.66	178.							
424.000	0.97	0.92	0.80	0.65	5.72	146.							
425.000	0.87	0.80	0.70	0.60	6.23	177.							
426.000	0.82	0.80	0.72	0.61	6.53	133.							
427.000	1.00	0.90	0.80	0.70	5.59	182.							
428.000	1.20	1.10	0.80	0.70	4.85	155.							
429.000	1.30	1.20	1.00	0.80	4.56	141.							

* S U M M A R Y O F D A T A *

	SENS1					SENS2	SENS3	SENS4			AVE.	80%	AVE.	BEG.	END
DIRECTION	STD.DEV.	MAX.	MIN.	AVE.	80%	AVE.	AVE.	AVE.	SCI	SCI/SENS1	SR	SR	SOIL K	TEMP	TEMP
EAST	0.17	1.30	0.80	0.96	1.10	0.90	0.76	0.64	0.06	0.066	5.87	5.27	156.	90.	90.

* * * * * H I S T O R Y * * * * *

DATE TESTED	AVE.SR	AVE.SOIL K

REMARKS: SECL- SUPERELEVATED CURVE, LOW SIDE. SECH- SUPERELEVATED CURVE, HIGH SIDE

FORM DRV

PROGRAM NUMBER- P2220050
COMPUTER RUN DATE- 08-19-91

OFFICE OF MATERIALS
ROAD RATER
STS

COUNTY- BLACK HAWK
U.S. ROUTE..... 0218
PAVEMENT TYPE... COMP

BEGINNING MP.... 395.00
ENDING MP..... 415.00
COMPUTED MILES.. 20.00

LAB NO..... RA1-5619
YEAR BUILT.. 19
DATE TESTED. 08-14-91

WEATHER SUNNY
OBS... FRETTE ANDERSON
TIME... 10:00

FREQ. HZ... 30
DISP %..... 68
TEST TYPE.. SI

ROAD RATER DEFLECTION (MILS)

	EASTBOUND						BOUND						
M-P	SENS 1	SENS 2	SENS 3	SENS 4	S.R.	SOIL K	SENS 1	SENS 2	SENS 3	SENS 4	S.R.	SOIL K	REMARKS
396.000	0.94	0.88	0.80	0.67	5.87	160.							
398.000	0.87	0.85	0.79	0.65	6.23	126.							
400.000	1.00	0.90	0.80	0.70	5.59	182.							
402.000	1.10	1.00	0.90	0.70	5.19	169.							
404.000	0.88	0.85	0.74	0.62	6.18	137.							
406.000	1.00	0.90	0.80	0.70	5.59	182.							
408.000	0.95	0.90	0.78	0.63	5.82	149.							
410.000	1.10	1.00	0.90	0.70	5.19	169.							
412.000	0.98	0.92	0.80	0.70	5.68	154.							
414.000	0.85	0.80	0.70	0.60	6.35	162.							

* S U M M A R Y O F D A T A *

DIRECTION	SENS1 STD.DEV.	SENS1 MAX.	SENS1 MIN.	SENS1 AVE.	SENS1 80%	SENS2 AVE.	SENS3 AVE.	SENS4 AVE.	SCI	SCI/SENS1	AVE. SR	80% SR	AVE. SOIL K	BEG. TEMP	END TEMP
EAST	0.09	1.10	0.85	0.97	1.04	0.90	0.80	0.67	0.07	0.069	5.77	5.43	159.	90.	90.

* * * * * H I S T O R Y * * * * *

DATE TESTED	AVE.SR	AVE.SOIL K

REMARKS: SECL- SUPERELEVATED CURVE, LOW SIDE. SECH- SUPERELEVATED CURVE, HIGH SIDE

FORM GREV

PROGRAM NUMBER- P2220050
COMPUTER RUN DATE- 08-19-91

OFFICE OF MATERIALS
ROAD RATER
STS

COUNTY- BLACK HAWK | BEGINNING MP.... 370.00 | LAB NO..... RA1-5618 | WEATHER SUNNY | FREQ. HZ... 30
U.S. ROUTE..... 0218 | ENDING MP..... 390.00 | YEAR BUILT.. 19 | OBS.... FRETTE ANDERSON | DISP %..... 68
PAVEMENT TYPE... COMP | COMPUTED MILES.. 20.00 | DATE TESTED. 08-14-91 | TIME... 10:00 | TEST TYPE.. SI

ROAD RATER DEFLECTION (MILS)

	EASTBOUND						BOUND						
M-P	SENS 1	SENS 2	SENS 3	SENS 4	S.R.	SOIL K	SENS 1	SENS 2	SENS 3	SENS 4	S.R.	SOIL K	REMARKS
371.000	0.93	0.84	0.72	0.62	5.92	184.							
373.000	1.30	1.20	1.00	0.80	4.56	141.							
375.000	1.20	1.10	1.00	0.80	4.85	155.							
377.000	1.20	1.10	1.00	0.80	4.85	155.							
379.000	1.00	0.90	0.80	0.70	5.59	182.							
381.000	0.85	0.78	0.70	0.60	6.35	179.							
383.000	1.00	1.00	0.90	0.70	5.59	79.							
385.000	1.00	0.90	0.80	0.70	5.59	182.							
387.000	1.00	0.90	0.80	0.70	5.59	182.							
389.000	1.00	0.90	0.80	0.70	5.59	182.							

* S U M M A R Y O F D A T A *

DIRECTION	SENS1 STD.DEV.	SENS1 MAX.	SENS1 MIN.	SENS1 AVE.	SENS1 80%	SENS2 AVE.	SENS3 AVE.	SENS4 AVE.	SCI	SCI/SENS1	AVE. SR	80% SR	AVE. SOIL K	BEG. TEMP	END TEMP
EAST	0.14	1.30	0.85	1.05	1.17	0.96	0.85	0.71	0.09	0.082	5.45	4.99	162.	90.	90.

* * * * * H I S T O R Y * * * * *

REMARKS: SECL- SUPERELEVATED CURVE, LOW SIDE. SECH- SUPERELEVATED CURVE, HIGH SIDE

DATE TESTED	AVE.SR	AVE.SOIL K

FORM GREY

PROGRAM NUMBER- P2220050
COMPUTER RUN DATE- 08-19-91

OFFICE OF MATERIALS
ROAD RATER

STS

COUNTY- BLACK HAWK | BEGINNING MP.... 360.00 | LAB NO..... RA1-5617 | WEATHER SUNNY | FREQ. HZ... 30
U.S. ROUTE..... 0218 | ENDING MP..... 370.00 | YEAR BUILT.. 19 | OBS.... FRETTE ANDERSON | DISP %..... 68
PAVEMENT TYPE... COMP | COMPUTED MILES.. 10.00 | DATE TESTED. 08-14-91 | TIME... 10:00 | TEST TYPE.. SI

ROAD RATER DEFLECTION (MILS)

	EASTBOUND						BOUND						
M-P	SENS 1	SENS 2	SENS 3	SENS 4	S.R.	SOIL K	SENS 1	SENS 2	SENS 3	SENS 4	S.R.	SOIL K	REMARKS
360.000	1.10	1.00	0.90	0.70	5.19	169.							
361.000	2.10	1.90	1.60	1.20	3.17	66.							
362.000	1.10	1.00	0.90	0.70	5.19	169.							
363.000	1.50	1.40	1.30	1.20	4.09	107.							
364.000	1.50	1.40	1.20	1.00	4.09	107.							
365.000	1.40	1.30	1.10	0.90	4.31	125.							
366.000	1.80	1.70	1.60	1.30	3.56	50.							
367.000	1.60	1.50	1.40	1.20	3.89	89.							
368.000	1.20	1.10	1.00	0.80	4.85	155.							
369.000	1.00	1.00	0.90	0.70	5.59	79.							

* S U M M A R Y O F D A T A *

	SENS1					SENS2	SENS3	SENS4			AVE.	80%	AVE.	BEG.	END
DIRECTION	STD.DEV.	MAX.	MIN.	AVE.	80%	AVE.	AVE.	AVE.	SCI	SCI/SENS1	SR	SR	SOIL K	TEMP	TEMP
EAST	0.35	2.10	1.00	1.43	1.72	1.33	1.19	0.97	0.10	0.070	4.39	3.73	112.	90.	90.

* * * * * H I S T O R Y * * * * *

DATE TESTED	AVE.SR	AVE.SOIL K

REMARKS: SECL- SUPERELEVATED CURVE, LOW SIDE. SECH- SUPERELEVATED CURVE, HIGH SIDE

- FIRST READING IS AT STATION 2360+00