MLR 78 2

RESEARCH SECTION
Office of Materials
Iowa Dept. of Transportation

A LABORATORY EVALUATION

OF

ASPHALTIC CONCRETE

CONTAINING

ASPHADUR

HIGHWAY DIVISION
OFFICE OF MATERIALS

DECEMBER 1978

A LABORATORY EVALUATION OF ASPHALTIC CONCRETE CONTAINING ASPHADUR

by

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December 1978

IOWA DEPARTMENT OF TRANSPORTATION
HIGHWAY DIVISION
OFFICE OF MATERIALS
Ames, Iowa 50010

Disclaimer

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TABLE OF CONTENTS

	Page
SUMMARY	1
CONCLUSIONS	1
INTRODUCTION	2
SCOPE	4
RESULTS	6
Ames Project (Laboratory Testing Only)	6
Sioux City Project	7
Cedar Rapids Project (Linn County)	8
ACKNOWLEDGEMENT	10
APPENDIX A Mix Designs	11
APPENDIX B Test Results	16

A LABORATORY EVALUATION OF ASPHALTIC CONCRETE CONTAINING ASPHADUR

SUMMARY

A laboratory evaluation of three asphaltic concrete, plant produced mixtures containing Asphadur has been made. The mixtures represent a type A asphaltic concrete and two type B asphaltic concretes.

The type A and one of the type B mixtures were used in pavements and will be evaluated later for durability and serviceability. The second type B mixture was made only for laboratory testing.

In each instance, control batches of the same mixtures but without Asphadur were made for comparison.

Type A is a high type asphaltic concrete, requires a minimum of 65% crushed particles and is generally used for higher traffic volume roads. Type B is used for intermediate or lower traffic volumes and requires a minimum of 30% crushed particles.

CONCLUSIONS

In each of the three projects, the addition of Asphadur to the asphalt mixtures increased the Marshall stability and the indirect tensile strength. These characteristics certainly would increase the resistance of the pavement to deformation due to heavy traffic loads or shoving due to accelerating or decelerating traffic.

We must also remain cognizant of the fact that the high temperature to which the mixture is subjected would also tend to give test results in the same direction as the Asphadur. If the Asphadur negates the hardening effect due to the overheating of the asphalt and does, in fact, improve the durability and temperature susceptability of the asphalt, then Asphadur could become an important tool in certain areas of asphaltic concrete usage.

It appears, at this point, that the most meaningful and valid evaluation of the represented characteristics of Asphadur must come from performance reports, both visual and by laboratory testing, after the pavements have been in usage over periods of time.

It is recommended at this time, that for continued evaluation, that Asphadur be considered for additional projects in suitable and selected locations.

INTRODUCTION

Asphadur is the trade name of an Austrian manufactured mixture of polymers of unsaturated hydrocarbons of varying lengths used with asphaltic concrete to improve its properties. Asphadur when added to the asphalt mixture is represented as increasing resistance to deformation due to heavy traffic, increasing the durability of the pavement, increasing the resistance to wear, decreasing the temperature susceptability of the asphalt, and influencing the structure of the asphalt so

that a favorable relationship between asphaltines and maltenes is achieved. This evaluation was directed primarily in studying the deformation problem through stability and indirect tensile strength and other related tests, i.e., asphalt content, aggregate gradations, etc. No effort was attempted to show any chemical change or shift in the composition of asphalt that might be effected by Asphadur.

Plastics can be classified broadly as thermosetting or thermoplastic. The thermosetting plastics remain solid at elevated temperatures until they reach a temperature at which they decompose. Thermoplastics have no definite melting point but become softer with an increase in temperature until they become liquid.

Asphadur is a thermoplastic and at a temperature of about 400° F. (204° C.), with sufficient shear force, can be mixed with asphalt cement or asphaltic concrete.

Figure 1 is a photomicrograph of 72X magnification showing the Asphadur particles recovered from a mix. These are the particles that were retained on a No. 325 sieve which has sieve openings of 0.045 mm. Note the irregularity of shape and the tendency toward elongation of the particles.

The most convenient method, at the present, to use Asphadur is to introduce the granulated material directly into the pugmill. The high shear force of the pugmill, the elevated temperature of the mix, and the increase in mixing time reduce the softened Asphadur into small sizes and shapes as shown in

Figure 1. Asphadur could be added directly to asphalt cement, but constant agitation would be required for dispersion and retaining the homogenous mixture.

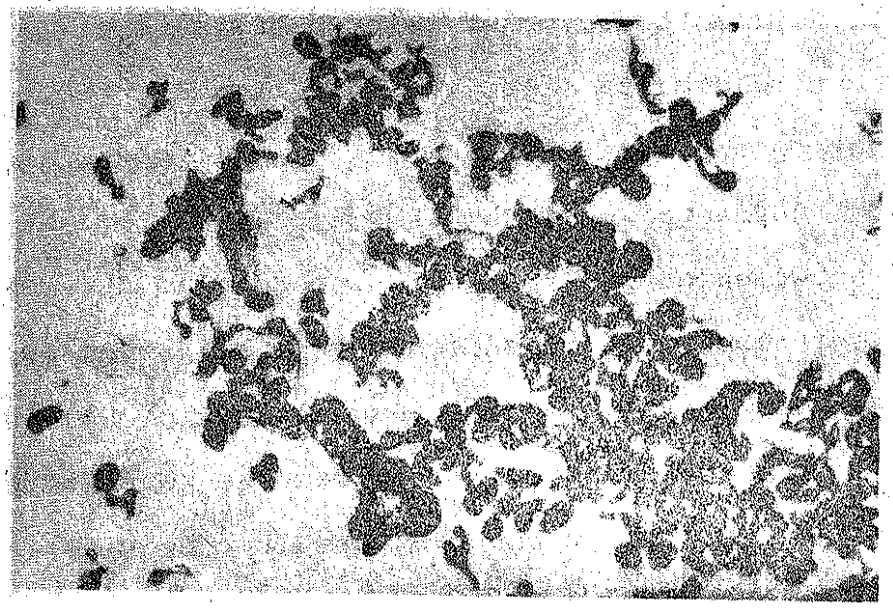

Figure 1. Extracted Asphadur

SCOPE

An Asphadur mixture was produced from batch plants at the following paving plant sites:

1. Contractor: Iowa Road Builders Co.

   Location of plant: Ames

   Location of project: -

   Length and description of project: Three batches of Asphadur mix along with one control batch were produced for laboratory testing only.

2. Contractor: Brower Construction Co.

   Location of plant: Sioux City

Location of project: Two locations in Sioux City; (1) on Glenn Avenue between St. Aubin and Royce Streets and (2) on Floyd Street south of Dace Avenue. Length and description of project: (1) The Glenn Avenue project was a one-block section on a steep incline in a residential area with a stop sign at the bottom of the section. It represented a typical problem area where movement and shoving occurred at the stop sign. (2) The one-block section on Floyd Street was in an industrialized area that received heavy truck traffic from an off ramp of Interstate 29.

3. Contractor: Cedar Rapids Asphalt and Paving Co.
Location of plant: Cedar Rapids
Location of project: At the intersection of U.S. 30 and West Post Road in Cedar Rapids. The Asphadur section was in the westbound lane only, and was from the west edge of the intersection extending to the east 500 feet. The taper on the westbound lane also used the Asphadur mix.

Six-percent Asphadur based on the weight of the asphalt being used was added to the mixes for each of the 3 projects. For the Sioux City and the Cedar Rapids projects the mixing cycle consisted of 5 seconds of drymixing, 20 seconds of wet mixing and 60 seconds of mixing after the addition of the Asphadur.

The mix temperature at delivery from the pugmill for the

Sioux City project averaged slightly over 400° F. while at Cedar Rapids it was about 385° F. The Asphadur mix produced at Ames had a temperature of 350° F. and additional mixing times of 2, 3 and 5 minutes.

The original mix designs, the three projects are based upon, are shown in Appendix A. In addition, a laboratory mix design containing Asphadur is included for the Sioux City project.

The laboratory test results of the three Asphadur mixes along with their control batches are shown in Appendix B. The indirect tensile strengths were run at 140° F.

RESULTS

Ames Project

Table 1 shows an increase of Marshall stability and indirect tensile strength with the addition of Asphadur, but it also indicates these properties along with the laboratory density are related to the additional mixing time. The highest stability and indirect tensile strength and the lowest density are obtained with 2 minutes of additional mixing. As the mixing time increases, the stability and tensile strength decrease while the density increases. Normally with a decrease in laboratory density the stability and tensile strength also decrease but this condition is reversed with Asphadur in this instance.

Table 1
Laboratory Test Results

Control Batch			
Lab Density (Sp. Gr.)		2.38	
Marshall Stability - lbs.		1900	
Ind. Tensile Strength p.s.i.		11.4	
Additional Mixing Time		--	
Asphadur Mix			
Lab Density (Sp. Gr.)	2.33	2.38	2.39
Marshall Stability - lbs.	3020	2567	2175
Ind. Tensile Strength p.s.i.	24.4	18.3	14.2
Additional Mixing Time	2 min.	3 min.	5 min.

Sioux City Project

The mixing time on this project was an additional one minute of mixing after the introduction of the Asphadur. Table 2 shows the test results obtained for this project. The same trends are followed as were shown in the Ames Project; although, the amount of increase in stability was not as great.

Table 2
Laboratory Test Results

	Control Batch						Avg.
Lab Density (Sp. Gr.)	2.39		2.39		2.39		
Marshall Stability - lbs.	2770		2720		2783		2758
Ind. Tensile Strength p.s.i.	21.7		26.0		23.8		23.8
	Asphadur Mix						Avg.
Lab Density (Sp. Gr.)	2.32	2.32	2.33	2.33	2.33	2.33	
Marshall Stability - lbs.	3133	3007	2890	3083	2965	3190	3035
Ind. Tensile Strength p.s.i.	34.1	30.2	29.2	35.3	32.7	32.8	32.2

Cedar Rapids Project (Linn County)

The mixing time on this project again was an additional one minute of mixing after the introduction of the Asphadur. The stability and the indirect tensile strength increased with the use of Asphadur but the laboratory density did not decrease as was the case with the other two mixes. The test results are shown in Table 3.

One area that appeared to give a problem that was evident, especially in the Sioux City Project, was the probable interference of the Asphadur in the sieve analysis. All the Asphadur mixes appeared different from the control batches in the "wash" portion of the sieve analysis procedure. A bulking effect became apparent and difficulty was experienced in washing the samples on the No. 200 sieve. The Sioux City Project gave varying and

Table 3
Laboratory Test Results

Control Batch						
Lab Density (Sp. Gr.)			2.34			
Marshall Stability - lbs.			2817			
Ind. Tensile Strength p.s.i.			20.2			
Asphadur Mix						Avg.
Lab Density (Sp. Gr.)	2.33	2.34	2.34	2.34	2.33	
Marshall Stability - lbs.	3408	3170	3045	2843	2948	3083
Ind. Tensile Strength p.s.i.	32.6	33.1	30.8	28.3	30.0	31.0

unexpected results of the -200 material, as shown in Appendix B (pp. 25-26, 27-28, 29-30). The bulking effect evidently carried over to the dry sieving because on the control samples the No. 200 sieve averaged 8.2% passing, with little deviation between the individual samples. The Asphadur samples on the No. 200 sieve averaged 4.1% passing and had a large deviation between individual samples.

ACKNOWLEDGEMENT

Through efforts initiated by the Iowa Development Commission it was possible to introduce Asphadur into two demonstration paving projects in Iowa.

The authors would also like to thank Shicker and Co.(Austria), Iowa Road Builders Co., Brower Const. Co., Cedar Rapids Asphalt and Paving Co., The City of Sioux City, and Linn County for the cooperation and contribution that made this research possible. Appreciation is also extended to Mr. Charles Huisman, Materials Engineer of the Iowa D.O.T., for his contribution and guidance in the development and accomplishment of the project.

APPENDIX A

MIX DESIGNS

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

MIX, TYPE AND CLASS: TYPE B BINDER LAB NO. ABD8-107

INTENDED USE:

SIZE 3/4" SPEC. NO. 823 DATE REPORTED 6/26/78
COUNTY BOONE STORY STORY PROJECT FN-89-2(2)--21-08 FN-89-3(1)--21-85 IN-35-4(35)112--15-85
CONTRACTOR IOWA ROAD BLDG.
PROJ. LOCATION FROM WOODWARD EASTERLY 3.4 MI.; ON IA. 210 FROM I-35 WEST 6.0 MI. TO SLATER; TYPE B BINDER SUBSTITUTED FOR A.T.B. ON INTERCHANGE AT AMES
AGG. SOURCES 3/4" CR. GRAVEL - HALLETT PIT - STORY CO., 3/4" PIT RUN GRAVEL - HALLETT PIT - STORY CO.
JOB MIX FORMULA AGGREGATE PROPORTIONS: 30% AAT8-299, 70% AAT8-300

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	89	77	61	51	42	32	18	7.6	5.8
TOLERANCE: 98/100			7	7	6			5			3

75 BLOW MARSHALL DENSITY		2.36	
ASPHALT SOURCE AND APPROXIMATE VISCOSITY	SUGAR CREEK - 1050 POISES		
PLASTICITY INDEX	N. P.		
% ASPH. IN MIX	4.50	5.50	6.50
NUMBER OF MARSHALL BLOWS	50	50	50
MARSHALL STABILITY - LBS.	2133	2072	1613
FLOW - 0.01 IN.	6	7	9
SP.GR. BY DISPLACEMENT(LAB DENS.)	2.30	2.32	2.34
BULK SP. GR. COMB. DRY AGG.	2.683	2.683	2.683
SP. GR. ASPH. @ 77 F.	1.031	1.031	1.031
CALC. SOLID SP.GR.	2.52	2.48	2.45
% VOIDS - CALC.	8.8	6.6	4.4
R E SP. GR.	2.50	2.47	2.43
% VOIDS - RICE	7.9	6.1	3.8
% WATER ABSORPTION - AGGREGATE	0.67	0.67	0.67
% VOIDS IN THE MINERAL AGGREGATE	18.1	18.3	18.4
% V.M.A. FILLED WITH ASPHALT	51.4	63.8	76.1
CALCULATED ASPH.FILM THICKNESS(MICRONS)	6.6	8.2	9.9

A CONTENT OF 6.00% ASPHALT IS RECOMMENDED TO START THE JOB.

COPIES:
ASPH. MIX DESIGN
PROJECTS LISTED ABOVE
D. ANDERSON
D. SMITH
R. SHELQUIST
D. JORDISON
L. ZEARLEY
IOWA ROAD BLDG.
C. JONES
D. HINES

SIGNED: BERNARD C. BROWN
TESTING ENGINEER

* CORRECTED REPORT

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

MIX, TYPE AND CLASS: 1/2" TYPE B SURFACE LAB NO. ABD8-210

INTENDED USE:

SIZE 1/2" SPEC. NO. DATE REPORTED 10-19-78

COUNTY WOODBURY PROJECT DEPT. INFO.

CONTRACTOR BROWER CONST.

PROJ. LOCATION TWO SECTIONS OF CITY STREETS IN SIOUX CITY-STEEP GRADE-INTERSEC.

AGG. SOURCES 3/8" CR. LST.-GILMORE CITY-POCAHONTAS CO.; 5/8" QUARTIZITE CHIPS-DELL RPAIDS-S. DAK.; CONCRETE SAND-HAWARDEN-SIOUX CO.
JOB MIX FORMULA AGGREGATE PROPORTIONS: 30% AAT8-559; 30% AAT8-550; 40% AAT8-551

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	82	66	55	42	28	15	8.5	5.8

TOLERANCE: ASPHADUR ADDED TO THE MIX IN THE AMOUNT OF *6.0% BY WT. OF ASPHALT

75 BLOW MARSHALL DENSITY		2.38	
ASPHALT SOURCE AND APPROXIMATE VISCOSITY	SUGAR CREEK - 1000 POISES		
PLASTICITY INDEX	N.P.		
% ASPH. IN MIX	4.50	5.50	6.50
NUMBER OF MARSHALL BLOWS	50	50	50
MARSHALL STABILITY - LBS.	2835	2683	2173
FLOW - 0.01 IN.	9	9	14
SP.GR. BY DISPLACEMENT(LAB DENS.)	2.32	2.36	2.36
BULK SP. GR. COMB. DRY AGG.	2.657	2.657	2.657
SP. GR. ASPH. @ 77 F.	1.033	1.033	1.033
CALC. SOLID SP.GR.	2.48	2.45	2.42
% OIDS - CALC.	6.7	3.7	1.9
RICE SP. GR.	2.48	2.45	2.40
% VOIDS - RICE	6.6	3.6	1.9
% WATER ABSORPTION - AGGREGATE	0.20	0.20	0.20
% VOIDS IN THE MINERAL AGGREGATE	16.6	16.1	16.6
% V.M.A. FILLED WITH ASPHALT	59.5	76.9	88.6
CALCULATED ASPH.FILM THICKNESS(MICRONS)	7.1	8.8	10.5

ASPHADUR WAS NOT CONSIDERED IN THE CALCULATIONS FOR THE TEST RESULTS. SEE ABD8-171 (WOODBURY FN-141) FOR COMPARISON

COPIES:
~~ASPH.~~ MIX DESIGN
DEPT. INFO.
CITY OF SIOUX CITY
L. ZEARLEY
D. JORDISON
R. SHELQUIST
AMUNDSEN
BROWER
J. BUMP
C. JONES
D. HINES

SIGNED: BERNARD C. BROWN
TESTING ENGINEER

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

MIX, TYPE AND CLASS: TYPE B SURFACE LAB NO. ABD8-171

INTENDED USE:

SIZE 1/2" SPEC. NO. 823 DATE REPORTED 8-31-78

COUNTY WOODBURY PROJECT FN-141-1(10)--21-97

CONTRACTOR BROWER

PROJ. LOCATION FROM 3 MILES EAST OF HORWICK EAST 0.8 MI.

AGG. SOURCES 3/8" CR. LST.-GILMORE CITY - POCAHONTAS CO.; 5/8" QUARTZITE CHIPS - DELL RAPIDS, S. DAK.; CONC. SAND-HAWARDEN - SIOUX CO.

JOB MIX FORMULA AGGREGATE PROPORTIONS: 30% AAT8-559; 30% AAT8-550; 40% AAT8-551

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	82	66	55	42	28	15	8.5	5.8
TOLERANCE:			98/100	7	7	6		5			3

75 BLOW MARSHALL DENSITY		2.38	
ASPHALT SOURCE AND APPROXIMATE VISCOSITY	SUGAR CREEK - 968 POISES		
PLASTICITY INDEX	N.P.		
% ASPH. IN MIX	4.50	5.50	6.50
NUMBER OF MARSHALL BLOWS	50	50	50
MARSHALL STABILITY - LBS.	2207	2237	1822
FLOW - 0.01 IN.	7	8	11
SP.GR. BY DISPLACEMENT(LAB DENS.)	2.32	2.36	2.37
BULK SP. GR. COMB. DRY AGG.	2.657	2.657	2.657
SP. GR. ASPH. @ 77 F.	1.033	1.033	1.033
CALC. SOLID SP.GR.	2.48	2.45	2.42
% VOIDS - CALC.	6.7	3.7	1.9
RICE SP. GR.	2.48	2.44	2.41
% VOIDS - RICE	6.6	3.5	1.7
% WATER ABSORPTION - AGGREGATE	0.20	0.20	0.20
% VOIDS IN THE MINERAL AGGREGATE	16.6	16.1	16.6
% V.M.A. FILLED WITH ASPHALT	59.5	76.9	88.6
CALCULATED ASPH.FILM THICKNESS(MICRONS)	7.1	8.8	10.5

A CONTENT OF 5.25% ASPHALT IS RECOMMENDED TO START THE JOB.

COPIES:
ASPH. MIX DESIGN
FN-141-1(10)--21-97, WOODBURY
J. BUMP
R. BOLTON
R. SHELQUIST
D. JORDISON
BROWER
C. JONES
D. HINES

SIGNED: BERNARD C. BROWN
TESTING ENGINEER

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

MIX, TYPE AND CLASS: TYPE A SURFACE LAB NO. ABD6-107

INTENDED USE:

SIZE 1/2" SPEC. NO. 773 DATE REPORTED 7/2/76

COUNTY LINN PROJECT RF-970-2(2)--35-57

CONTRACTOR CEDAR RAPIDS ASPHALT

PROJ. LOCATION ON US 30 FROM BENTON CO. LINE EAST 4.0 MI.

AGG. SOURCES 1/2" CR. LST. - S. CEDAR RAPIDS QR. - LINN CO.,
SAND - BAIRD PIT - LINN CO.
JOB MIX FORMULA AGGREGATE PROPORTIONS: 65% AAT6-307, 35% AAT6-308

JOB MIX FORMULA - COMBINED GRADATION

1/2"	1"	3/4"	1/2"	3/8"	NO.4	NO.8	NO.16	NO.30	NO.50	NO.100	NO.200
			100	95	75	55	40	26	13	9.5	8.5
TOLERANCE: +OR- 98/100				7	7	5		4			2

75 BLOW MARSHALL DENSITY		2.37	
ASPHALT SOURCE AND APPROXIMATE VISCOSITY	SINCLAIR - 980 POISES (AC-10)		
PLASTICITY INDEX			
% ASPH. IN MIX	5.0	6.0	7.0
NUMBER OF MARSHALL BLOWS	50	50	50
MARSHALL STABILITY - LBS.	2692	2617	2092
FLOW - 0.01 IN.	7	8	9
SP.GR. BY DISPLACEMENT(LAB DENS.)	2.31	2.36	2.36
BULK SP. GR. COMB. DRY AGG.	2.717	2.717	2.717
SP. GR. ASPH. @ 77 F.	1.031	1.031	1.031
CALC. SOLID SP.GR.	2.52	2.49	2.45
% VOIDS - CALC.	8.6	5.2	3.8
ICE SP. GR.	2.49	2.45	2.41
% VOIDS - RICE	7.3	3.7	2.2
% WATER ABSORPTION - AGGREGATE	0.57	0.57	0.57
% VOIDS IN THE MINERAL AGGREGATE	19.2	18.4	19.2
% V.M.A. FILLED WITH ASPHALT	55.1	71.5	80.2
CALCULATED ASPH.FILM THICKNESS(MICRONS)	6.8	8.3	9.8

A CONTENT OF 5.50% OF ASPHALT IS RECOMMENDED TO START THE JOB.

COPIES:
ASPH. MIX DESIGN
RF-970-2(2)--35-57, LINN
VAN SNYDER
D. DAVICK
B. ORTGIES
C. HUISMAN
L. ZEARLEY
C. R. ASPHALT
C. JONES
D. HINES

SIGNED: BERNARD C. BROWN
TESTING ENGINEER

APPENDIX B

TEST RESULTS

Asph. Concrete
~~L.~~ Zearley
R. Shelquist

IOWA DEPARTMENT OF TRANSPORTATION
Highway Division
Office of Materials

FORM 257
20M 4-71

TEST REPORT — BITUMINOUS MATERIALS

Material Asphaltic Concrete (Asphadur) **Laboratory No.** ABC8-383

Intended Use Laboratory Evaluation

Project No. Department Information **County**

Contractor

Producer Iowa Road Builders

Plant North of Ames

Unit of Material Sample #1 regular mix sample

Sampled by Producer **Sender's No.**

Date Sampled 9-8-78 **Date Rec'd** 9-11-78 **Date Reported** 10-5-78

SIEVE ANALYSIS — PER CENT PASSING

1½"	1"	3/4"	1/2"	3/8"	No. 4	No.8	No. 16	No. 30	No. 50	No. 100	No. 200
		100	93	81	64	53	44	35	20	9.2	6.9

% Aggregate—By Extraction 93.6 %
% Bitumen—By Extraction 6.4 %

% Psg. No. 8 after 16 Cycles F&T, Water-Alco. Sol.
% Psg. No. 8 after 25 Cycles F&T, Water Solution
% of Wear, Los Angeles Abrasion, Grading

Liquid Limit
Plastic Limit
Plasticity Index

COMPACTION & STABILITY TESTS

Laboratory Density (Specific Gravity) 2.38
Marshall Stability (lbs.) 1900
Marshall Flow (ins.) 10
Hveem Side Pressure (PSI)
Rice Sp. Gr. 2.441
Indirect tensile strength p.s.i. 11.4

DISPOSITION:

By [signature]
Testing Engineer

Asph. Concrete
T. Zearley
R. Shelquist

IOWA DEPARTMENT OF TRANSPORTATION
Highway Division

Office of Materials

FORM 257
20M 4-71

TEST REPORT — BITUMINOUS MATERIALS

Material Asphaltic Concrete (Asphadur) **Laboratory No.** ABC8-384

Intended Use Laboratory Evaluation

Project No. Department Information **County**

Contractor

Producer Iowa Road Builders

Plant North of Ames

Unit of Material 2 contained asphadur mixed @ 350° F.
mixed for 2 minutes

Sampled by Producer **Sender's No.**

Date Sampled 9-8-78 **Date Rec'd** 9-11-78 **Date Reported** 10-5-78

SIEVE ANALYSIS — PER CENT PASSING

1½"	1"	3/4"	1/2"	3/8"	No. 4	No.8	No. 16	No. 30	No. 50	No. 100	No. 200
		100	93	82	70	58	48	37	20	8.9	6.6

% Aggregate—By Extraction 95.0 %
% Bitumen—By Extraction 5.0 %

% Peg. No. 8 after 16 Cycles F&T, Water-Alco. Sol.
% Peg. No. 8 after 25 Cycles F&T, Water Solution
% of Wear, Los Angeles Abrasion, Grading

Liquid Limit
Plastic Limit
Plasticity Index

COMPACTION & STABILITY TESTS

Laboratory Density (Specific Gravity) 2.33
Marshall Stability (lbs.) 3020
Marshall Flow (ins.) 8
Hveem Side Pressure (PSI)
Rice Sp. Gr. 2.463
Indirect tensile strength p.s.i. 24.4

DISPOSITION:

By [signature]
Testing Engineer

Asph. Concrete
L. Zearley
R. Shelquist

IOWA DEPARTMENT OF TRANSPORTATION
Highway Division

Office of Materials

FORM 257
20M 4-71

TEST REPORT — BITUMINOUS MATERIALS

Material Asphaltic Concrete (Asphadur) **Laboratory No.** ABC8-385

Intended Use Laboratory Evaluation

Project No. Department Information **County**

Contractor

Producer Iowa Road Builders

Plant North of Ames

Unit of Material 3 contained asphadur mixed @ 350° F.
mixed for 3 minutes

Sampled by Producer **Sender's No.**

Date Sampled 9-8-78 **Date Rec'd** 9-11-78 **Date Reported** 10-5-78

SIEVE ANALYSIS — PER CENT PASSING

1½"	1"	3/4"	1/2"	3/8"	No. 4	No.8	No. 16	No. 30	No. 50	No. 100	No. 200
		100	95	86	72	60	48	38	21	8.9	6.4

% Aggregate—By Extraction 94.1 %
% Bitumen—By Extraction 5.9 %

% Psg. No. 8 after 16 Cycles F&T, Water-Alco. Sol.
% Psg. No. 8 after 25 Cycles F&T, Water Solution
% of Wear, Los Angeles Abrasion, Grading

Liquid Limit
Plastic Limit
Plasticity Index

COMPACTION & STABILITY TESTS

Laboratory Density (Specific Gravity) 2.38
Marshall Stability (lbs.) 2567
Marshall Flow (ins.) 12
Hveem Side Pressure (PSI)

Rice Sp. Gr. 2.422
Indirect tensile strength p.s.i. 18.3

DISPOSITION:

By [signature]
Testing Engineer

Asph. Concrete
E. Zearley
R. Shelquist

IOWA DEPARTMENT OF TRANSPORTATION
Highway Division
Office of Materials

FORM 257
20M 4-71

TEST REPORT — BITUMINOUS MATERIALS

Material Asphaltic Concrete (Asphadur) **Laboratory No.** ABC8-386

Intended Use Laboratory Evaluation

Project No. Department Information **County**

Contractor

Producer Iowa Road Builders

Plant North of Ames

Unit of Material 4 contained asphadur mixed @ 350° F.
mixed for 5 minutes

Sampled by Producer **Sender's No.**

Date Sampled 9-8-78 **Date Rec'd** 9-11-78 **Date Reported** 10-5-78

SIEVE ANALYSIS — PER CENT PASSING

1½"	1"	3/4"	1/2"	3/8"	No. 4	No.8	No. 16	No. 30	No. 50	No.100	No.200
		100	96	85	69	56	45	35	19	7.4	5.0

% Aggregate—By Extraction 94.0 %
% Bitumen—By Extraction 6.0 %

% Psg. No. 8 after 16 Cycles F&T, Water-Alco. Sol.
% Psg. No. 8 after 25 Cycles F&T, Water Solution
% of Wear, Los Angeles Abrasion, Grading

Liquid Limit
Plastic Limit
Plasticity Index

COMPACTION & STABILITY TESTS

Laboratory Density (Specific Gravity) 2.39
Marshall Stability (lbs.) 2175
Marshall Flow (ins.) 14
Hveem Side Pressure (PSI)
Rice Sp. Gr. 2.424
Indirect tensile strength p.s.i. 14.2

DISPOSITION:

By [signature]

Zearley
Shelquist

IOWA DEPARTMENT OF TRANSPORTATION
Highway Division
Office of Materials

FORM 257
JOM 4-71

TEST REPORT — BITUMINOUS MATERIALS

Material Asphaltic Concrete @ 5.5% **Laboratory No.** ABC8-723

Intended Use

Project No. U-7 (Dept. Info.) **County** Linn

Contractor

Producer

Plant

Unit of Material Sample Without Asphudur for Central Laboratory for experimental testing and analysis

Sampled by **Sender's No.** 1

Date Sampled **Date Rec'd** 11-14-78 **Date Reported** 11-15-78

SIEVE ANALYSIS — PER CENT PASSING

1½"	1"	3/4"	1/2"	3/8"	No. 4	No.8	No. 16	No. 30	No. 50	No. 100	No. 200
			100	92	69	52	39	27	17	13	11

% Aggregate—By Extraction 94.3%
% Bitumen—By Extraction 5.7%

% Peg. No. 8 after 16 Cycles F&T, Water-Alco. Sol.
% Peg. No. 8 after 25 Cycles F&T, Water Solution
% of Wear, Los Angeles Abrasion, Grading

Liquid Limit
Plastic Limit
Plasticity Index

COMPACTION & STABILITY TESTS

Laboratory Density (Specific Gravity) 2.41
Marshall Stability (lbs.) 3603
Marshall Flow (ins.) 9
Hveem Side Pressure (PSI)
Rice Sp. Gr. 2.485
Indirect tensile strength psi 24.3
Recovered Asphalt
Penetration @ 77F. 100 gms. 5 Sec. 64
Abs. Vis. @ 140F. 300 MM. Hg (poises) 1660

DISPOSITION:

By Testing Engineer

IOWA DEPARTMENT OF TRANSPORTATION
OFFICE OF MATERIALS
AMES LABORATORY
TEST REPORT - BITUMINOUS MATERIALS

MATERIAL PLANT MIX (ASPHADUR RESEARCH) LAB NO ABC8-708
INTENDED USE ASPH. CONC. PAVING
PROJECT NO CITY OF SIOUX CITY STS. COUNTY WOODBURY
CONTRACTOR BROWER CONSTR. CO.
PRODUCER CONTRACT NO
PLANT
UNIT OF MATERIAL SAMPLED FROM TRUCK @ PLANTSITE (CONTAINS NO ASPHADUR)
SENDERS NO 3ELB-21026
SAMPLED BY E. LAMOUREUX
DATE SAMPLED 10/25/78 DATE RECD 11/1/78 DATE REPORTED 11/9/78

SIEVE ANALYSIS PERCENT PASSING

SIEVE	GM.RET	% RET	% PSD
1-1/2	0.0	0.00	0.00
1.05	0.0	0.00	0.00
3/4	0.0	0.00	0.00
1/2	0.0	0.00	100.00
3/8	143.0	9.84	90.16
4	224.5	15.44	74.72
8	213.5	14.68	60.04
16	245.0	16.85	43.19
30	230.5	15.86	27.33
50	181.5	12.49	14.84
100	66.0	4.54	10.30
200	30.5	2.10	8.20
WASH	81.0	8.20	0.00
PAN	38.0	0.00	0.00

DRY WT. 1451.000
SUM OF RETAINED WTS. 1453.500

% AGGREGATE BY EXTRACTION 94.800
% BITUMEN BY EXTRACTION 5.200
SPECIFIC GRAVITY 2.390
MARSHALL STABILITY 2770.000
MARSHALL FLOW 0.01 IN. 10.000

INDIRECT TENSILE STRENGTH, P.S.I. 21.7
RICE SP. GR. 2.467
RECOVERED ASPHALT
PENETRATION @ 77 F. 100 GMS. 5 SEC. 32
ABS. VIS. @ 140 F. 300 MM HG, POISES 3920

COPIES TO:

ASPH. CONC.
J. BUMP
R. SHELQUIST
~~L.~~ ZEARLEY

BY BERNARD C. BROWN
TESTING ENGINEER

IOWA DEPARTMENT OF TRANSPORTATION
OFFICE OF MATERIALS
AMES LABORATORY
TEST REPORT - BITUMINOUS MATERIALS

MATERIAL PLANT MIX (ASPHADUR RESEARCH) LAB NO ABC8-709
INTENDED USE ASPH. CONC. PAVING
PROJECT NO CITY OF SIOUX CITY STS. COUNTY WOODBURY
CONTRACTOR BROWER CONSTR. CO.
PRODUCER CONTRACT NO
PLANT
UNIT OF MATERIAL SAMPLED FROM TRUCK @ PLANTSITE. (CONTAINS NO ASPHADUR)
SENDERS NO 3EL88-21926
SAMPLED BY E. LAMOUREUX
DATE SAMPLED 10/25/78 DATE RECD 11/1/78 DATE REPORTED 11/9/78

SIEVE ANALYSIS PERCENT PASSING

SIEVE	GM.RET	% RET	% PSG
1-1/2	0.0	0.00	0.00
1.05	0.0	0.00	0.00
3/4	0.0	0.00	0.00
1/2	0.0	0.00	100.00
3/8	135.0	9.35	90.65
4	234.0	16.22	74.43
8	207.5	14.38	60.05
16	244.5	16.94	43.11
30	221.5	15.35	27.76
50	180.5	12.51	15.25
100	69.5	4.82	10.43
200	31.0	2.15	8.28
WASH	81.0	8.28	0.00
PAN	38.5	0.00	0.00

DRY WT. 1442.000
SUM OF RETAINED WTS. 1443.000

% AGGREGATE BY EXTRACTION 94.900
% BITUMEN BY EXTRACTION 5.100
SPECIFIC GRAVITY 2.390
MARSHALL STABILITY 2720.000
MARSHALL FLOW 0.01 IN. 9.000

INDIRECT TENSILE STRENGTH-P.S.I. 26.0
RECOVERED ASPHALT
PENETRATION @77 F. 100 GMS. 5 SEC. 30
ABS. VIS. @ 140 F. 300 MM HG, POISES 4260

COPIES TO:

ASPH. CONC.
J. BUMP
R. SHELQUIST
~~L. ZEARLEY~~

IOWA DEPARTMENT OF TRANSPORTATION
OFFICE OF MATERIALS
AMES LABORATORY
TEST REPORT - BITUMINOUS MATERIALS

MATERIAL PLANT MIX (ASPHADUR RESEARCH) LAB NO ABCR-710
INTENDED USE ASPH. CONC. PAVING
PROJECT NO CITY OF SIOUX CITY STS. COUNTY WOODBURY
CONTRACTOR BROWER CONSTR. CO.
PRODUCER CONTRACT NO
PLANT
UNIT OF MATERIAL SAMPLED FROM TRUCK @ PLANTSITE. (CONTAINS NO ASPHADUR)
SENDERS NO 3ELB-21926
SAMPLED BY E. LAMOUREUX
DATE SAMPLED 10/25/78 DATE RECD 11/1/78 DATE REPORTED 11/9/78

SIEVE ANALYSIS PERCENT PASSING

SIEVE	GM.RET	% RET	% PSG
1-1/2	0.0	0.00	0.00
1.05	0.0	0.00	0.00
3/4	0.0	0.00	100.00
1/2	3.5	0.24	99.76
3/8	142.5	9.89	89.87
4	224.5	15.57	74.30
8	205.0	14.22	60.08
16	246.5	17.10	42.98
30	222.0	15.40	27.58
50	182.5	12.66	14.92
100	69.5	4.82	10.10
200	30.5	2.12	7.98
WASH	76.0	7.98	0.00
PAN	39.0	0.00	0.00

DRY WT. 1441.000
SUM OF RETAINED WTS. 1441.500

% AGGREGATE BY EXTRACTION 94.800
% BITUMEN BY EXTRACTION 5.200
SPECIFIC GRAVITY 2.390
MARSHALL STABILITY 2783.000
MARSHALL FLOW 0.01 IN. 9.000

INDIRECT TENSILE STRENGTH, P.S.I. 25.8
Strength Retention
Marshall Stability (original) 2623
Marshall Stability (after soak) 2627
% strength retention 100

COPIES TO:

ASPH. CONC.
J. BUMP
R. SHELQUIST
L. ZEARLEY

IOWA DEPARTMENT OF TRANSPORTATION
OFFICE OF MATERIALS
AMES LABORATORY
TEST REPORT - BITUMINOUS MATERIALS

MATERIAL ASPHALT MIX-TYPE B SURFACE 1/2" LAB NO ABC8-711
INTENDED USE TO BE USED ON CITY STREETS
PROJECT NO DEPT. INFO. COUNTY WOODBURY
CONTRACTOR BROWER CONST. CO.
PRODUCER BROWER CONST. CO. CONTRACT NO
PLANT SIOUX CITY, IA
UNIT OF MATERIAL ONE BLOCK SECTION OF STREET (CONTAINS 0.32% ASPHADUR)
SENDERS NO 3-RA8-37
SAMPLED BY ALLAN AND TUTTLE
DATE SAMPLED 10-24-78 DATE RECD 11-1-78 DATE REPORTED 11-9-78

SIEVE ANALYSIS PERCENT PASSING

SIEVE	GM.RET	% RET	% PSG
1-1/2	0.0	0.00	0.00
1.05	0.0	0.00	0.00
3/4	0.0	0.00	100.00
1/2	16.0	1.10	98.90
3/8	147.0	10.12	88.78
4	223.5	15.39	73.39
8	225.0	15.53	57.86
16	216.0	14.88	42.98
30	224.0	15.43	27.55
50	194.0	13.36	14.19
100	76.0	5.23	8.96
200	29.0	2.00	6.96
WASH	61.0	6.96	0.00
PAN	40.0	0.00	0.00

DRY WT. 1452.000
SUM OF RETAINED WTS. 1451.500

% AGGREGATE BY EXTRACTION 95.000
% BITUMEN BY EXTRACTION 5.000
SPECIFIC GRAVITY 2.320
MARSHALL STABILITY 3133.000
MARSHALL FLOW 0.01 IN. 9.000
INDIRECT TENSILE STRENGTH PSI 34.1

COPIES TO:

ASPHALTIC CONCRETE
J. BUMP
E. ZEARLEY
R. SHELQUIST

IOWA DEPARTMENT OF TRANSPORTATION
OFFICE OF MATERIALS
AMES LABORATORY
TEST REPORT - BITUMINOUS MATERIALS

MATERIAL ASPHALT MIX-TYPE B SURFACE 1/2" LAB NO ABC8-712
INTENDED USE TO BE USED ON CITY STREETS
PROJECT NO DEPT. INFO. COUNTY WOODBURY
CONTRACTOR BROWER CONST. CO.
PRODUCER BROWER CONST. CO. CONTRACT NO
PLANT SIOUX CITY, IA
UNIT OF MATERIAL ONE BLOCK SECTION OF STREET (CONTAINS 0.32% ASPHADUR)
SENDERS NO 3-RA8-37
SAMPLED BY ALLAN AND TUTTLE
DATE SAMPLED 10-24-78 DATE RECD 11-1-78 DATE REPORTED 11-9-78

SIEVE ANALYSIS PERCENT PASSING

SIEVE	GM.RET	% RET	% PSG
1-1/2	0.0	0.00	0.00
1.05	0.0	0.00	0.00
3/4	0.0	0.00	0.00
1/2	0.0	0.00	100.00
3/8	199.0	13.44	86.56
4	230.5	15.56	71.00
8	200.0	13.51	57.49
16	207.0	13.98	43.51
30	233.0	15.72	27.79
50	218.5	14.74	13.05
100	91.5	6.17	6.88
200	34.0	2.29	4.59
WASH	42.0	4.59	0.00
PAN	26.0	0.00	0.00

DRY WT. 1482.000
SUM OF RETAINED WTS. 1481.500

% AGGREGATE BY EXTRACTION 95.000
% BITUMEN BY EXTRACTION 5.000
SPECIFIC GRAVITY 2.320
MARSHALL STABILITY 3007.000
MARSHALL FLOW 0.01 IN. 9.000

INDIRECT TENSILE STRENGTH PSI 30.2
RICE SP. GR. 2.458
RECOVERED ASPHALT
PENETRATION @ 77 F. 100 GMS 5 SEC 26
ABS. VIS. @ 140 F. 300 MM. HG. (POISES) 9320

COPIES TO:

ASPHALTIC CONCRETE
J. BUMP
L. ZEARLEY
R. SHELQUIST

IOWA DEPARTMENT OF TRANSPORTATION
OFFICE OF MATERIALS
AMES LABORATORY
TEST REPORT - BITUMINOUS MATERIALS

MATERIAL ASPHALT MIX - TYPE B SURFACE 1/2" LAB NO ABC8-713
INTENDED USE TO BE USED ON CITY STREETS
PROJECT NO DEPT. INFO. COUNTY WOODBURY-SIOUX
CONTRACTOR BROWER CONSTR. CO.
PRODUCER BROWER CONSTR. CO. CONTRACT NO
PLANT SIOUX CITY, IOWA
UNIT OF MATERIAL ONE LOCK SECTION OF STREET (CONTAINS 0.32% ASPHADUR)
SENDERS NO 3-RA8-37
SAMPLED BY ALLAN AND TUTTLE
DATE SAMPLED 10/24/78 DATE RECD 11/1/78 DATE REPORTED 11/9/78

SIEVE ANALYSIS PERCENT PASSING

SIEVE	GM.RET	% RET	% PSG
1-1/2	0.0	0.00	0.00
1.05	0.0	0.00	0.00
3/4	0.0	0.00	100.00
1/2	20.5	1.43	98.57
3/8	159.5	11.09	87.48
4	236.5	16.46	71.02
8	219.5	15.27	55.75
16	208.0	14.47	41.28
30	234.5	16.32	24.96
50	213.0	14.81	10.15
100	88.5	6.15	4.00
200	25.5	1.77	2.23
WASH	20.0	2.23	0.00
PAN	12.0	0.00	0.00

DRY WT. 1438.000
SUM OF RETAINED WTS. 1437.500

% AGGREGATE BY EXTRACTION 94.900
% BITUMEN BY EXTRACTION 5.100
SPECIFIC GRAVITY 2.330
MARSHALL STABILITY 2890.000
MARSHALL FLOW 0.01 IN. 9.000
CITY

INDIRECT TENSILE STRENGTH, P.SI. 29.2
RECOVERED ASPHALT
PENETRATION @ 77 F. 100 GMS. 5 SEC. 28
ABS. VIS. @ 140 F. 300 MM HG. POISES 8450

COPIES TO:

ASPH. CONC.
J. BUMP
R. SHELQUIST
L. ZEARLEY

IOWA DEPARTMENT OF TRANSPORTATION
OFFICE OF MATERIALS
AMES LABORATORY
TEST REPORT - BITUMINOUS MATERIALS

MATERIAL ASPHALT MIX-TYPE B SURFACE 1/2" LAB NO ABC8-714
INTENDED USE TO BE USED ON CITY STREETS
PROJECT NO DEPT. INFO. COUNTY WOODBURY
CONTRACTOR BROWER CONST. CO.
PRODUCER BROWER CONST. CO. CONTRACT NO
PLANT SIOUX CITY, IA
UNIT OF MATERIAL ONE BLOCK SECTION OF STREET (CONTAINS 0.32% ASPHADUR)
SENDERS NO 3-RA8-37
SAMPLED BY ALLAN AND TUTTLE
DATE SAMPLED 10-24-78 DATE RECD 11-1-78 DATE REPORTED 11-9-78

SIEVE ANALYSIS PERCENT PASSING

SIEVE	GM.RET	% RET	% PSG
1-1/2	0.0	0.00	0.00
1.05	0.0	0.00	0.00
3/4	0.0	0.00	100.00
1/2	6.5	0.45	99.55
3/8	158.5	10.96	88.59
4	217.5	15.05	73.54
8	223.0	15.43	58.11
16	214.5	14.84	43.27
30	237.0	16.40	26.87
50	216.5	14.98	11.89
100	89.5	6.19	5.70
200	31.5	2.18	3.52
WASH	29.0	3.52	0.00
PAN	22.0	0.00	0.00

DRY WT. 1447.000
SUM OF RETAINED WTS. 1445.500

% AGGREGATE BY EXTRACTION 94.600
% BITUMEN BY EXTRACTION 5.400
SPECIFIC GRAVITY 2.330
MARSHALL STABILITY 3083.000
MARSHALL FLOW 0.01 IN. 9.000

INDIRECT TENSILE STRENGTH PSI 35.3
Strength Retention
Marshall Stability (original) 3122
Marshall Stability (after soak) 2692
% strength retention 86.2

COPIES TO:

ASPHALTIC CONCRETE
J. BUMP
R. SHELQUIST
L. ZEARLEY

IOWA DEPARTMENT OF TRANSPORTATION
OFFICE OF MATERIALS
AMES LABORATORY
TEST REPORT - BITUMINOUS MATERIALS

MATERIAL ASPHALT MIX - TYPE B SURFACE 1/2" LAB NO ABC8-715
INTENDED USE TO BE USED ON CITY STRETTS - SIOUX CITY
PROJECT NO DEPT. INFO. COUNTY WOODBURY
CONTRACTOR BROWER CONSTR. CO.
PRODUCER BROWER CONSTR. CO. CONTRACT NO
PLANT SIOUX CITY, IOWA
UNIT OF MATERIAL ONE BLOCK SE C TION OF STREET (CONTAINS 0.32% ASPHADUR)
SENDERS NO 3-RA8-37
SAMPLED BY ALLAN & TUTTLE
DATE SAMPLED 10/24/78 DATE RECD 11/1/78 DATE REPORTED 11/9/78

SIEVE ANALYSIS PERCENT PASSING

SIEVE	GM.RET	% RET	% PSG
1-1/2	0.0	0.00	0.00
1.05	0.0	0.00	0.00
3/4	0.0	0.00	100.00
1/2	30.5	2.10	97.90
3/8	142.5	9.79	88.11
4	195.5	13.45	74.66
8	247.0	16.99	57.67
16	230.0	15.82	41.85
30	236.0	16.23	25.62
50	207.0	14.24	11.38
100	83.5	5.74	5.64
200	30.5	2.10	3.54
WASH	33.0	3.54	0.00
PAN	18.5	0.00	0.00

DRY WT. 1455.000
SUM OF RETAINED WTS. 1454.000

% AGGREGATE BY EXTRACTION 95.000
% BITUMEN BY EXTRACTION 5.000
SPECIFIC GRAVITY 2.330
MARSHALL STABILITY 2965.000
MARSHALL FLOW 0.01 IN. 9.000

INDIRECT TENSILE STRENGTH - P.S.I. 31.7
RICE SP. GR. 2.457
RECOVERED ASPHALT
PENETRATION @ 77 F. 100 GMS. 5 SEC. 27
ABS. VIS. @ 140 F. 300 MM HG, POISES 6470

COPIES TO:

ASPH. CONC.
J. BUMP
R. SHELQUIST
F. ZEARLEY

BY BERNARD C. BROWN
TESTING ENGINEER

IOWA DEPARTMENT OF TRANSPORTATION
OFFICE OF MATERIALS
AMES LABORATORY
TEST REPORT - BITUMINOUS MATERIALS

MATERIAL ASPHALT MIX-TYPE B SURFACE 1/2" LAB NO ABC8-716
INTENDED USE TO BE USED ON CITY STREETS
PROJECT NO DEPT. INFO. COUNTY WOODBURY
CONTRACTOR BROWER CONST. CO.
PRODUCER BROWER CONST. CO. CONTRACT NO
PLANT SIOUX CITY, IA
UNIT OF MATERIAL ONE BLOCK SECTION OF STREET (CONTAINS 0.32% ASPHADUR)
SENDERS NO 3-RA8-37
SAMPLED BY ALLAN AND TUTTLE
DATE SAMPLED 10-24-78 DATE RECD 11-1-78 DATE REPORTED 11-9-78

SIEVE ANALYSIS PERCENT PASSING

SIEVE	GM.RET	% RET	% PSG
1-1/2	0.0	0.00	0.00
1.05	0.0	0.00	0.00
3/4	0.0	0.00	100.00
1/2	29.5	2.02	97.98
3/8	159.0	10.93	87.05
4	202.0	13.88	73.17
8	236.5	16.26	56.91
16	235.0	16.16	40.75
30	228.0	15.68	25.07
50	198.0	13.61	11.46
100	80.5	5.54	5.92
200	28.5	1.96	3.96
WASH	28.0	3.96	0.00
PAN	29.5	0.00	0.00

DRY WT. 1457.000
SUM OF RETAINED WTS. 1454.500

% AGGREGATE BY EXTRACTION 95.100
% BITUMEN BY EXTRACTION 4.900
SPECIFIC GRAVITY 2.330
MARSHALL STABILITY 3190.000
MARSHALL FLOW 0.01 IN. 8.000

INDIRECT TENSILE STRENGTH PSI 32.8

COPIES TO:

ASPHALTIC CONCRETE
J. BUMP
R. SHELQUIST
L. ZEARLEY

BY BERNARD C. BROWN
TESTING ENGINEER

Asph. Concrete
Shelquist
~~Z~~earley

IOWA DEPARTMENT OF TRANSPORTATION
Highway Division

FORM 257
20M 4-71

Office of Materials

TEST REPORT — BITUMINOUS MATERIALS

Material Asphaltic Concrete @ 5.5 % **Laboratory No.** ABC8-724

Intended Use

Project No. U-7 Department Information **County** Linn

Contractor

Producer

Plant

Unit of Material Sample without asphudur for central lab. for experimental testing and analysis.

Sampled by **Sender's No.** 2

Date Sampled **Date Rec'd** 11-6-78 **Date Reported** 11-14-78

SIEVE ANALYSIS — PER CENT PASSING

1½"	1"	3/4"	1/2"	3/8"	No. 4	No.8	No. 16	No. 30	No. 50	No. 100	No. 200
			100	95	78	61	47	31	17	11	9.5

% Aggregate—By Extraction 94.4 %
% Bitumen—By Extraction 5.6 %

% Psg. No. 8 after 16 Cycles F&T, Water-Alco. Sol.
% Psg. No. 8 after 25 Cycles F&T, Water Solution
% of Wear, Los Angeles Abrasion, Grading

Liquid Limit
Plastic Limit
Plasticity Index

COMPACTION & STABILITY TESTS

Laboratory Density (Specific Gravity) 2.34
Marshall Stability (lbs.) 2817
Marshall Flow (ins.) 8
Hveem Side Pressure (PSI)

Indirect tensile strength p.s.i. 20.2

DISPOSITION:

By [signature]
Testing Engineer

IOWA DEPARTMENT OF TRANSPORTATION
Highway Division
Office of Materials

Asph. Concrete
Shelquist
~~Zearley~~

FORM 257
20M 4-71

TEST REPORT — BITUMINOUS MATERIALS

Material Asphaltic Concrete @ 5.5 % **Laboratory No.** ABC8-725

Intended Use

Project No. U-7 Department Information **County** Linn

Contractor

Producer

Plant

Unit of Material Sample with asphadur for central lab for experimental testing and analysis.

Sampled by **Sender's No.** 3

Date Sampled **Date Rec'd** 11-6-78 **Date Reported** 11-14-78

SIEVE ANALYSIS — PER CENT PASSING

1½"	1"	3/4"	1/2"	3/8"	No. 4	No.8	No. 16	No. 30	No. 50	No. 100	No. 200
			100	96	78	61	46	31	16	11	9.2

% Aggregate—By Extraction 94.7 %
% Bitumen—By Extraction 5.3 %

% Psg. No. 8 after 16 Cycles F&T, Water-Alco. Sol.
% Psg. No. 8 after 25 Cycles F&T, Water Solution
% of Wear, Los Angeles Abrasion, Grading

Liquid Limit
Plastic Limit
Plasticity Index

COMPACTION & STABILITY TESTS

Laboratory Density (Specific Gravity) 2.34
Marshall Stability (lbs.) 3045
Marshall Flow (ins.) 8
Hveem Side Pressure (PSI)

Indirect tensile strength p.s.i. 30.8

Retained stability percent 90.5

DISPOSITION:

By [signature]
Testing Engineer

Asph. Concrete
Shelquist
Zearley

IOWA DEPARTMENT OF TRANSPORTATION
Highway Division
Office of Materials

FORM 257
20M 4-71

TEST REPORT — BITUMINOUS MATERIALS

Material Asphaltic Concrete @ 5.5% Laboratory No. ABC8-726

Intended Use

Project No. U-7 (Dept. Info.) County Linn

Contractor

Producer

Plant

Unit of Material Sample with Asphadur for Central Lab for experimental testing and analysis.

Sampled by Sender's No. 4

Date Sampled Date Rec'd 11-6-78 Date Reported 11-14-78

SIEVE ANALYSIS — PER CENT PASSING

1½"	1"	3/4"	1/2"	3/8"	No. 4	No.8	No. 16	No. 30	No. 50	No. 100	No. 200
			100	96	80	63	47	31	16	11	8.7

% Aggregate—By Extraction 94.7 %
% Bitumen—By Extraction 5.3 %

% Psg. No. 8 after 16 Cycles F&T, Water-Alco. Sol.
% Psg. No. 8 after 25 Cycles F&T, Water Solution
% of Wear, Los Angeles Abrasion, Grading

Liquid Limit
Plastic Limit
Plasticity Index

Rice Sp. Gr. 2.480
Indirect tensile strength p.s.i. 30.0

COMPACTION & STABILITY TESTS

Laboratory Density (Specific Gravity) 2.33
Marshall Stability (lbs.) 2948
Marshall Flow (ins.) 8
Hveem Side Pressure (PSI)

RECOVERED ASPHALT
Penetration @ 77° F. 100 gms. 5 sec. 33
Abs. Vis. @ 140° F. 300 mm. hg. (Poises) 7900

DISPOSITION:

By

Testing Engineer

Asph. Concrete
Shelquist
~~Zearley~~

IOWA DEPARTMENT OF TRANSPORTATION
Highway Division
Office of Materials

FORM 257
20M 4-71

TEST REPORT — BITUMINOUS MATERIALS

Material Asphaltic Concrete @ 5.5 % **Laboratory No.** ABC8-727

Intended Use

Project No. U-7 Department Information **County** Linn

Contractor

Producer

Plant

Unit of Material Sample with Asphadur for Central Lab for experimental Testing and analysis.

Sampled by **Sender's No.** 5

Date Sampled **Date Rec'd** 11-6-78 **Date Reported** 11-14-78

SIEVE ANALYSIS — PER CENT PASSING

1½"	1"	3/4"	1/2"	3/8"	No. 4	No.8	No. 16	No. 30	No. 50	No. 100	No. 200
			100	97	80	62	46	31	17	12	9.7

% Aggregate—By Extraction 94.6 %
% Bitumen—By Extraction 5.4 %

% Pag. No. 8 after 16 Cycles F&T, Water-Alco. Sol.
% Pag. No. 8 after 25 Cycles F&T, Water Solution
% of Wear, Los Angeles Abrasion, Grading

Liquid Limit
Plastic Limit
Plasticity Index

COMPACTION & STABILITY TESTS

Laboratory Density (Specific Gravity) 2.34
Marshall Stability (lbs.) 2843
Marshall Flow (ins.) 7
Hveem Side Pressure (PSI)

Indirect tensile strength p.s.i. 28.3

DISPOSITION:

By [signature]
Testing Engineer

Asph. Concrete
Shelquist
~~Zearley~~

IOWA DEPARTMENT OF TRANSPORTATION
Highway Division

FORM 257
20M 4-71

Office of Materials

TEST REPORT — BITUMINOUS MATERIALS

Material Asphaltic Concrete @ 5.5 % **Laboratory No.** ABC8-728

Intended Use

Project No. U-7 Department Information **County** Linn

Contractor

Producer

Plant

Unit of Material Sample with asphudur for Central Lab for experimental Testing and analysis.

Sampled by **Sender's No.** 6

Date Sampled **Date Rec'd** 11-6-78 **Date Reported** 11-14-78

SIEVE ANALYSIS — PER CENT PASSING

1½"	1"	3/4"	1/2"	3/8"	No. 4	No.8	No. 16	No. 30	No. 50	No. 100	No. 200
			100	95	76	57	43	29	15	11	9.0

% Aggregate—By Extraction 94.8 %
% Bitumen—By Extraction 5.2 %

% Psg. No. 8 after 16 Cycles F&T, Water-Alco. Sol.
% Psg. No. 8 after 25 Cycles F&T, Water Solution
% of Wear, Los Angeles Abrasion, Grading

Liquid Limit
Plastic Limit
Plasticity Index

Rice Sp. Gr. 2.478
Indirect tensile strength p.s.i. 33.1

COMPACTION & STABILITY TESTS

Laboratory Density (Specific Gravity) 2.34
Marshall Stability (lbs.) 3170
Marshall Flow (ins.) 8
Hveem Side Pressure (PSI)

RECOVERED ASPHALT
Penetration @ 77°F. 100 gms 5 Sec. 35
Abs. Vis. @ 140°F. 300 mm. hg. (Poises) 5570

DISPOSITION:

By [signature]
Testing Engineer

Asph. Concrete
Shelquist
Zearley

IOWA DEPARTMENT OF TRANSPORTATION
Highway Division
Office of Materials

FORM 257
20M 4-71

TEST REPORT — BITUMINOUS MATERIALS

Material Asphaltic Concrete @ 5.5 % **Laboratory No.** ABC8-729

Intended Use

Project No. U-7 (Department Information) **County** Linn

Contractor

Producer

Plant

Unit of Material Sample with Asphudur for Central Lab. for experimental testing and analysis

Sampled by **Sender's No.**

Date Sampled **Date Rec'd** 11-6-78 **Date Reported** 11-14-78

SIEVE ANALYSIS — PER CENT PASSING

1½"	1"	3/4"	1/2"	3/8"	No. 4	No. 8	No. 16	No. 30	No. 50	No. 100	No. 200
			100	95	78	61	46	30	16	11	9.1

% Aggregate—By Extraction 94.7 %
% Bitumen—By Extraction 5.3 %

% Psg. No. 8 after 16 Cycles F&T, Water-Alco. Sol.
% Psg. No. 8 after 25 Cycles F&T, Water Solution
% of Wear, Los Angeles Abrasion, Grading

Liquid Limit
Plastic Limit
Plasticity Index

COMPACTION & STABILITY TESTS

Laboratory Density (Specific Gravity) 2.33
Marshall Stability (lbs.) 3408
Marshall Flow (ins.) 8
Hveem Side Pressure (PSI)

Indirect tensile strength psi 32.6

DISPOSITION:

By [signature]
Testing Engineer