

72-3

31 BIT MIXES -
Production

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SPECIAL PROJECT REPORT

PRODUCTION & PLACEMENT

OF

BITUMINOUS TREATED AGGREGATE BASE
AND TYPE B ASPHALT CONCRETE
PRODUCED BY A DRUM MIXING PROCESS

Project Identification

Winnebago County S-2583(2)-50-95

Report Prepared by:

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PERMANENT FILE LOCATION	
WISCONSIN DEPT. OF TRANSPORTATION	
DIVISION OF HIGHWAYS	RESEARCH UNIT
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MADISON, WIS. 53715	
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10/72	#31 Bit. Mixes (S) Production

This is one of the projects included in Higley's report.

Project Information

Drum mixed base and upper base mixtures were substituted for Bituminous Treated Base mix, section 2205 and Type B Class 1 asphalt concrete, section 2204 on Winnebago County Project S-2583(2)--50-95. Actual mixing and placing operations began August 2, 1971 and were completed September 1, 1971. Project location description is as follows: On Secondary Road from SW Corner Sec. 34-99-23 North 5 miles to U.S.-69, all in Winnebago County.

The cross-section design required the construction of a soil aggregate subbase, 6 inch Bituminous Treated Aggregate Base, and a 2 inch Type B Class 1 Upper Base Course. Project length was 5.115 miles. Approximately 24,081 tons of lower base mixture and 7772 tons of Type B base mixture were placed.

The project was constructed by the Rohlin Construction Company of Estherville, Iowa; inspection was provided by Winnebago County staff personnel, supervised by County Engineer, Al Heeren. Specifications applicable were as follows: Iowa State Highway Commission Standard Specifications, series 1964, and Supplemental Specifications, Nos. 686, 689, and 696.

Methods and Equipment

The Rohlin Construction Company of Estherville, Iowa requested permission to substitute a drum mixing process for the standard requirements specified for Bituminous Treated Base, section 2205. The trial was requested as provided by section 1108.04 of the 1964 Standard Specifications. A subsequent request was submitted for mixing the Type B, Class 1 Asphalt Concrete upper base material utilizing the drum mixer. Both requests were approved; the latter approval was based on the results obtained on the lower base work. The contractor utilized a prototype drum mixer constructed and owned by the Bituminous Materials and Supply Co. of West Des Moines, Iowa, a K. E. McConnaughay affiliate. The drum mixer was operated as described in United States Patent 3,423,222 entitled "Method of Making a Paving Composition" by Kenneth E. McConnaughay, P. O. Box 871, Lafayette, Indiana. Conventional laydown equipment and procedures were followed; static steel, vibratory steel, and pneumatic rollers were used for compaction.

Materials and Mixtures ProcessedBituminous Treated Aggregate Base

The Bituminous Treated Aggregate Base, hereafter referred to as BTB was composed of locally produced glacial gravel and an intended asphalt content of 2.91 percent, dry weight basis. The binder materials normally used for BTB stabilization are SS-1 Emulsified Asphalt, AASHO M-140 or CSS-1 Emulsified Asphalt AASHO M-208. Since the emulsified asphalt provides 100-200 penetration residue, 120-150 penetration asphalt cement modified with 1 percent tall oil was used for binder in the drum mixing process. The Tall oil was incorporated as set out in the previously referenced patent. An aluminum sulfate-water mixing agent was also added as the asphalt cement was introduced into the drum mixer. Typical aggregate gradation tests and asphalt cement analysis are listed below for project S-2583(2):

Cold Feed Gradation		Central Lab Extr.	Specification
Sieve Size	Avg. % Passing	Avg. % Passing	Limits
1 inch	100	100	100
3/4 inch	100	100	90-100
3/8 inch	84	87	67-100
#4	68	73	47-80
#8	52	58	36-65
#30	22	27	17-40
#200	5.3	8.0	3-10

Asphalt Cement			
Penetration	134	Sol. Trichloroethylene	99.96
TFO Loss 5 hr./325°F	0.22%	Ductility @ 77°	130+CM
Pen. of TFO Residue	74	" " " TFO Res.	130+CM
% Original Pen.	55	Spot Test-Std. Solvent	Neg.
Flash	550°+		

The average laboratory unit weight of the mixture, compacted by the Marshall Method, 50 blows @ 200°F, was 129.7 lbs. per cu. ft. Job control density tests averaged 96.7 percent of laboratory density. Variability, as expressed in terms of the standard deviation was determined to be 2.2 lbs. per cu. ft. The moisture content of mixture at time of production ranged from 1.5 to 4.0 percent. No correction was made for moisture present in the density samples which were obtained with a portable 4 inch core drill lubricated with water. The contractor experimented throughout the course of the work with compaction equipment, steel, vibratory, and pneumatic rollers, and rolling patterns. No specific combination of equipment and procedures emerged as being significantly superior to the several combinations tried.

The asphalt cement was supplied to the drum mixer by a positive displacement pump driven by a variable speed motor; the speed was adjusted manually with a rheostat type control as required by the calibration. The resultant asphalt contents as determined by the job control tank measurements averaged 3.10 percent. Central laboratory extraction tests averaged 3.13 percent. Standard deviations for the two types of measurements were found to be 0.11 and 0.54 percent respectively.

Due to an inadequate sampling plan, an insufficient number of samples were obtained to reliably evaluate the effects of mixing with respect to asphalt hardening. Additionally, some difficulty was encountered during testing due to apparatus deficiencies and lack of operator proficiency. The resultant scatter of test results precluded credible assessment of the degree of asphalt hardening attributable to mixing and heat source exposure.

Type B Asphalt Concrete Upper Base

The Type B Asphalt Concrete was formulated according to the Marshall Design Procedure and was composed of 70 percent local glacial gravel, 30 percent graded crushed calcareous limestone and 6.25 percent 85-100 penetration asphalt cement modified with 1 percent Tall Oil. The average laboratory unit weight, 50 blow, Marshall 200°F Compaction, was 141.1 lbs. per cu. ft. at 7.2 percent average voids. Laboratory unit weight determined at 275°F compaction temperature averaged 142.9 lbs. per cu. ft. at 6.0 percent voids.

Typical aggregate gradation tests and asphalt cement analysis are listed below for project S-2583(2):

Cold Feed Gradation		Central Lab Extr.	Specification
Sieve Size	Avg. % Passing	Avg. % Passing	Limits
1 inch	100	100	100
3/4 inch	100	99	98-100
3/8 inch	82	83	67-100
#4	66	66	47-80
#8	54	53	36-65
#30	30	30	17-40
#200	5.9	7.5	3-10

Asphalt Cement			
Penetration Avg.	95	Solubility	99.91%
TFO Loss	0.16%	Ductility @ 77°F	130+CMS
Pen. of TFO Residue	57	" " " Residue	130+CMS
% Orig. Pen.	58	Spot Test Std. Solvent	Neg
Flash	550°F		

The contractor again varied the compaction equipment and procedures, and obtained an average level of 95.6 percent of laboratory density based on the 141.1 lbs. per cu. ft. with a standard deviation of 1.34 lbs. per cu. ft. No correction was made for the moisture present in the core samples.

The asphalt content of the mixture as determined by the specified job control tank measurements averaged 6.15 percent with a standard deviation 0.23 percentage points. The final record extraction tests uncorrected for unextractable asphalt averaged 5.78 percent with a standard deviation of 0.29 percent. Previous unextractable asphalt content determinations indicated the unextractable asphalt content to be approximately 0.5 percent.

Due to an inadequate sampling plan, an insufficient number of samples were obtained to reliably evaluate the effects of mixing with respect to asphalt hardening. Additionally, some difficulty was encountered during testing due to apparatus deficiencies and lack of operator proficiency. The resultant scatter of test results precluded credible assessment of the degree of asphalt hardening attributable to mixing and heat source exposure.

Effects of Tall Oil

An effort was made in the laboratory to assess the effect of adding Tall Oil to 2 laboratory asphalt cements. One percent by weight of a Tall Oil-fuel oil mixture was added to samples of 85-100 and 120-150 penetration asphalt. The following test results were obtained.

<u>Asphalt</u>	<u>Tall Oil Added</u>	<u>Pen. @ 77°F</u>	<u>Absolute Visc. @ 140°F</u>
A	0%	86	1350
A	1%	95	1230
B	0%	121	805
B	1%	132	731

Additional tests will be performed in future studies to verify the effect noted above; the effect of extraction processing will also be evaluated.

Closure

The foregoing information is reported without summarization or conclusions, and is subject to further review and analysis. Moreover, no attempt has been made to assign a level of comparability or predict performance. This project together with several smaller local projects are being subjected to continuing study by the County Engineer, District #2 Staff and Central Office Staff.

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