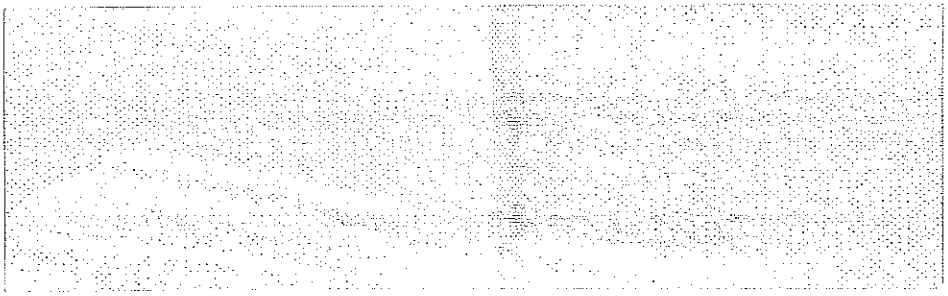
USE OF BONI FIBERS ON M 99 IN LANSING
Final Report

MATERIALS and TECHNOLOGY DIVISION



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USE OF BONI FIBERS ON M 99 IN LANSING
Final Report

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Research Laboratory Section
Materials and Technology Division
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Summary

A 500-ft long section of recycled bituminous overlay containing polyester fibers ('Boni Fibers') was constructed and its performance evaluated after two years of service. Laboratory tests of the modified mixtures were made to compare tensile properties with those of the conventional, or control mixes used on the major portion of the reconstruction project.

No difference in field performance could be observed even though laboratory tests indicate some improvement in tensile properties, especially in an overall increase in tensile failure strain.

Introduction

The purpose of this investigation was to evaluate the feasibility of using polyester fibers in bituminous overlay mixtures made with recycled asphalt pavement (RAP). Polyester fibers have been used for several years in bridge deck surfacing mixtures made with all new asphalts and aggregates. The polyester fibers used in this project are marketed under the Boni Fibers trade name and are approximately 1/4 in. long and .0008 in. in diameter. Fibers such as these purportedly increase the strength and stability of bituminous mixtures.

Evaluation Program

The evaluation involved the construction of a trial section along with laboratory testing of recycled bituminous paving mixtures for tensile strength and durability. The test section was placed in June 1984 on a short stretch of M 99 within the City of Lansing (Project FUR 33011-20533A). Boni Fibers were placed in both the leveling and top course recycled mixtures for a total thickness of 2.5 in. At this location Logan St (M 99) is a five-lane jointed concrete pavement with a bituminous overlay in the three center lanes.

The existing bituminous surfacing in the three center lanes was removed by milling and plant-mixed with new aggregate at a 30:70 percent ratio, to which 4 percent new asphalt cement was added. Material information for the project is as follows:

Recycled Asphalt Pavement	30% by weight
New Aggregate, 20AA	70% by weight
New Asphalt, AC-5	4% by weight
Boni Fibers	0.25% by weight
Design Marshall Stability	2079 lb
Flow	14.2, 1/100 in. units
Air Voids	2.5%
Voids in Mineral Aggregate	16.0%
Traffic	26,800 ADT (1981), 5% Commercial
Length of Boni Fiber Test Section	500 ft

Paving of the test sections was completed on June 15, 1984.

Laboratory evaluation consisted of testing for tensile properties before and after exposure of samples to saturated freeze-thaw conditions. Duplicate sets of samples were prepared for testing, one set for testing in the dry condition and the other set to be tested after vacuum saturation, freezing and thawing in a moist condition as described by Lottman.*

Results

Tensile strength and failure strain values for the mixtures are summarized in Table 1.

TABLE 1
PROPERTIES OF EXPERIMENTAL RECYCLED BITUMINOUS MIXTURES

	Leveling Course		Top Course	
	Fibers	Control	Fibers	Control
Dry Tensile Strength, psi	198	191	190	197
F-T Tensile Strength, psi	185	176	180	189
Retained Strength Ratio[1]	0.97	0.92	0.92	0.96
Dry Tensile Failure Strain, in./in.	.0074	.0088	.0077	.0077
F-T Tensile Failure Strain, in./in.	.0090	.0081	.0102	.0093
Marshall Stability, lb.	—	—	2132	2159
Marshall Flow (1/100 in. units)	—	—	11.3	11.6

[1] Freeze-Thaw Conditioned Strength ÷ Dry Strength of Control Mix.

Tensile Strength

The dry tensile strengths of the conventional control mixes were typical for high stability wearing and leveling course mixtures used throughout the state. Retained strength ratios were somewhat higher than those typically encountered. Wearing and leveling course mixtures from six different projects throughout Michigan were recently tested and the resulting dry tensile strength data are shown below for comparison:

	Dry Tensile Strength, psi		Retained Strength Ratio	
	Average	Std. Dev.	Average	Std. Dev.
Top Course	224	47	0.73	0.16
Level Course	188	31	0.65	0.21

Use of Boni Fiber increased the tensile strength of the leveling mixture but decreased the strength of the top course material as compared with

*Lottman, Robert P., "Laboratory Test Method for Predicting Moisture-Induced Damage to Asphalt Concrete," Transportation Research Record No. 843, 1982.

the respective control mixes. Since relatively high values of tensile strength were obtained for all mixtures these small changes (less than 4 percent) are insignificant. Retained strength ratios of 0.97 and 0.92 respectively, were obtained for the leveling and top course materials containing Boni Fibers whereas ratios for the control mixtures were 0.92 and 0.96 for these materials. Analysis of core samples in the Boni Fiber section show a significantly lower asphalt content in the top course than in the leveling course which could account for the somewhat lower strength.

Tensile Strain

Boni Fibers improved both mixtures in terms of the freeze-thaw tensile strain at failure. The increase in the tensile failure strain indicates a tougher mixture (as compared with mixtures having lower values of tensile failure strain), which should have less susceptibility to disintegration at reflective cracks in overlays as well as thermal cracks in flexible pavement surface.

Field Performance

Inspection of the test area shows no observable differences between the two recycled mixtures. Figure 1 shows two views of the same section of roadway, one in which the Boni Fiber mixture is in the foreground and the other with the conventional mixture in the nearest bituminous lane. These photos represent the typical condition of the recycled bituminous surface throughout the test area.

Conclusions

The recycled bituminous mixture used on this project was a high quality material with good tensile characteristics even without modification. The addition of Boni Fibers generally improved the tensile properties of the mixes despite causing a slight decrease in the strength of the top course material. Freeze-thaw tensile failure strains were increased for both materials indicating a very slight increase in toughness and resistance to termal cracking. Field performance of the Boni Fiber mixture is comparable to that of the conventional recycled material, which is to be expected since the amount of change in properties due to introduction of the fibers was so small. Reflective cracking was not prevented by the addition of fibers. Fibers could possibly help prevent the breaking away of material along the cracks (this tendency would be indicated by increased tensile strength).

Recommendations

The fibers evaluated in this study should not be considered for use by the Department in road surface overlays. The fibers used in this study were 1/4 in. in length as provided by the supplier. Recent laboratory studies (by others) indicate the optimal length of such fibers to be 1/2 in. Any further evaluation of such materials should use fibers 1/2 in. in length.

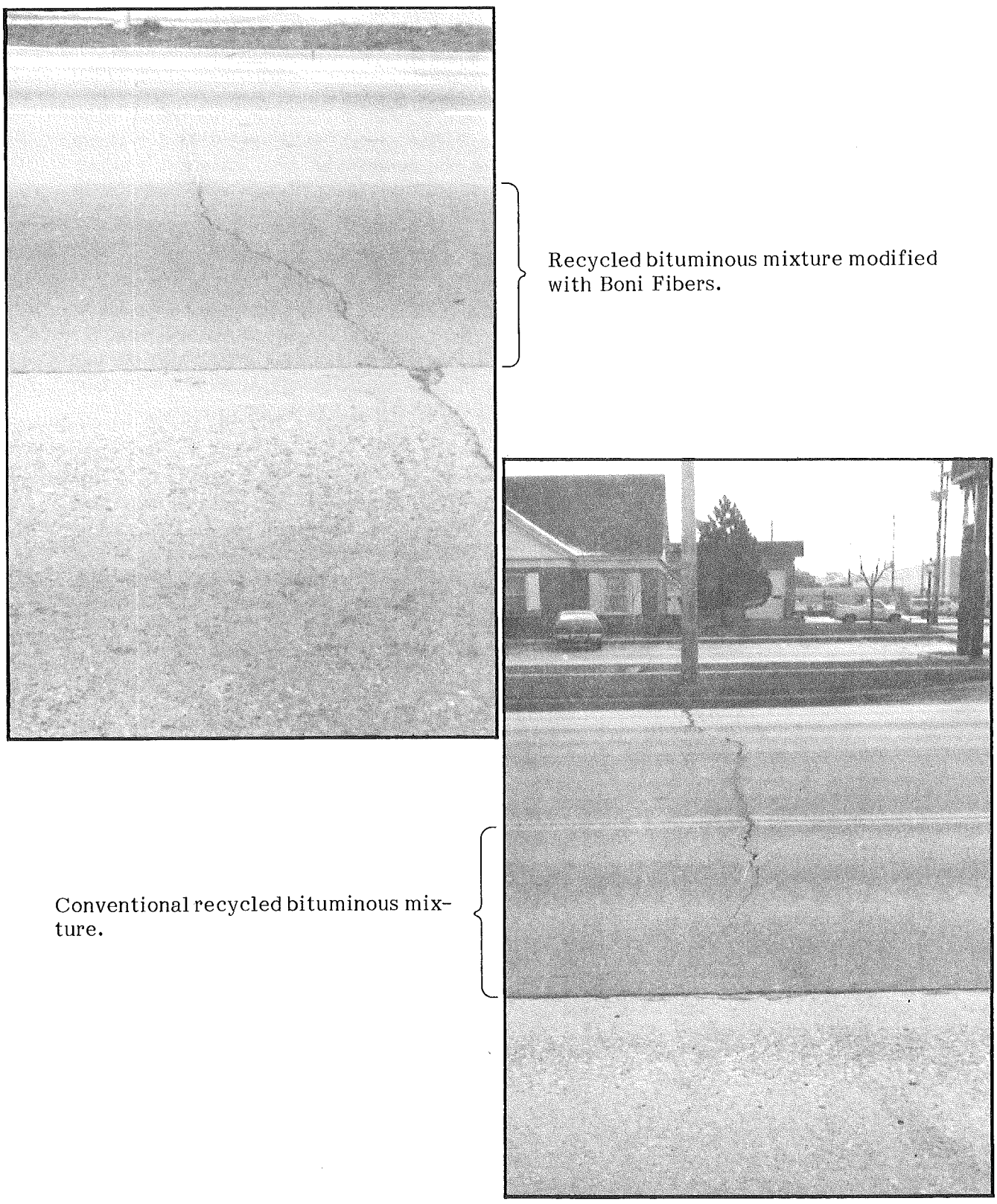

Figure 1. A typical reflective crack through both Boni Fiber and conventional bituminous overlay.