EXPERIMENTAL PROJECTS

COMPARISON OF REFLECTIVE CRACK RETARDATION BY FABRIC MATERIAL (PETROMAT), OPEN-GRADED FRICTION COURSES, AND CONVENTIONAL HOT MIX

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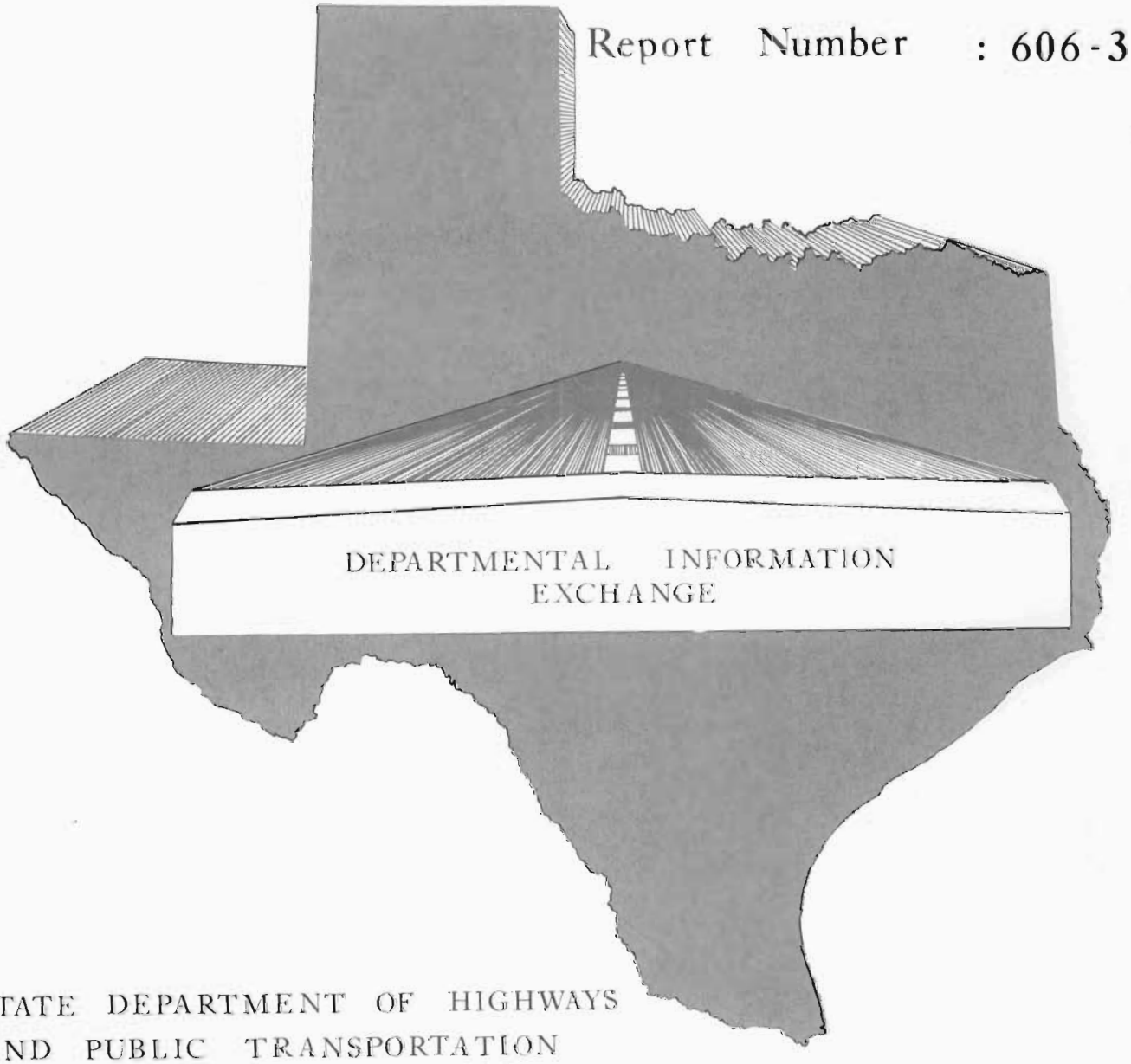

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16. Abstract

Performance of asphaltic concrete pavement in District 6 has not been satisfactory. The final surface usually begins to crack within 3 to 5 years. However, the flexible base affords excellent performance as a pavement structure.

To experiment and compose various pavement designs for control or reduction of the cracking problem, four different designs were constructed. The control section was the usual district pavement design of a one-course surface treatment underseal with 2" of Type C HMAC followed by one-inch of Type D HMAC wearing course. The second design was a 2" course of Type C HMAC followed by a sealing membrane of Petromat fabric and a one-course surface treatment. A one-inch Type C HMAC wearing course was then placed. The third design was a one-course surface treatment with a 3/4-inch overlay of plant mix seal or open-graded friction course. The fourth design was an underseal composed of a Petromat fabric and one-course surface treatment overlaid with 3/4-inch plant mix seal.

This report describes the construction procedures, provides an evaluation after two winters and one summer of performance, and gives corresponding costs of the four designs. At the time of this reporting, the control section was judged by the district as performing the best.

17. Key Words		18. Distribution Statement
Crack Retardation	Hot Mix	No Restrictions
Fabric Materials	Surface Treatment	
Petromat	Plant Mix Seal	
Open-Graded Friction Courses	Membrane Seals	

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COMPARISON OF REFLECTIVE CRACK RETARDATION BY FABRIC MATERIAL (PETROMAT), OPEN-GRADED FRICTION COURSES, AND CONVENTIONAL HOT MIX

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Experimental Projects Report

No. 606-3

Typically, Interstate Highways in the Odessa District have been constructed in two stages. The first stage includes the construction of the flexible base structure, with a two course surface treatment applied as an interim surface. The second and final stage follows within one-to-four years, and consists of placing 3" of Asphaltic Concrete Pavement.

The performance of the Asphaltic Concrete Pavement has not been entirely satisfactory. The final surface begins to crack within three-to-five years. When additional asphalt is introduced into the mix to retard the cracking problem, flushing and rutting result. Seldom, if ever, has there been a subsurface failure.

Because of the excellent performance of the flexible base as a pavement structure, the final stages of construction needed only to be an effective surface-sealing system, with a riding quality and surface texture suitable for Interstate traffic volumes. Additional pavement thickness for strength was not required. Experimental Project I 20-1(23)009 was initiated in 1976 in an effort to develop such a system.

The control section for this Experimental Project is a design that has been used in the past. It consisted of a one-course surface treatment for an underseal; a 2" course of Ty C HMAC, followed by a 1" course of Ty D HMAC. This design was used on both roadways for 1.5 miles. The second design section was ex-

perimental, consisting of a 2" course of Ty C HMAC and a 1" course of Ty D HMAC, with a sealing membrane composed of Petromat Fabric, and a one-course surface treatment constructed between the two courses of HMAC. This design was also used on both roadways for 1.5 miles. The third design section provided for a one-course surface treatment applied to the existing surface as an underseal, and a 3/4" overlay of Plant Mix Seal. This design was used to overlay 7.5 miles on both roadways. It was divided into two segments in order to compare the performance on surfaces with different degrees of reflective cracking. The last design, which was the most unique of all, was an underseal composed of a Petromat Fabric and a one-course surface treatment overlayed with 3/4" of Plant Mix Seal. Like the third design, this design also covered 7.5 miles on both roadways, which were divided into two segments to determine the relative effect of different degrees of reflective cracking.

Of the four different designs constructed, the ones containing Petromat Fabric as a sealing membrane and the Plant Mix Seal were new to District 6. Plant Mix Seal has had some use around the State, however, and several Reports have been written. It is sufficient to say here, that this work went as predicted and without significant problems. The use of Petromat Fabric underseal in a design section of this nature and of this magnitude, however, was unique to this project; and the remainder of this Report deals with its construction. (See Figure 1 for Layout of Project; Figure 2 for Design Sections).

Placement of the Petromat Fabric began by applying to the

existing surface 0.15 gal/sy of AC-5 Asphalt as a binder course, or mastic, to secure the fabric. The length of placement was determined to coincide with an Asphalt Land. Asphalt shots for the binder course were made in widths approximately 12" wider than the fabric rolls. A string line was set to "guide" the distributor on the first application of Asphalt. The fabric was then placed on the binder course, using a small tractor, with a brush, reel, and braking assembly attached to the front. (This equipment was furnished the Contractor by Phillips Fibers Corporation, along with Technicians to train the Contractor's operators). The rental rate for this equipment was $0.03/sy of fabric placed. Two tractors were used. The ability of the tractors to smoothly un-spool the fabric at a moderate rate of speed was generally satisfactory. Three passes were required by the distributor to cover a Land, each time overlapping previously-placed fabric, in order to provide shingled longitudinal joints. A combination of fabric roll widths of 12½' and 6¼' were used to underseal a 30' width of pavement. Transverse joints at 300' intervals were generally lapped in the direction of traffic. On days when wind was a factor, the fabric was lapped in the direction necessary to prevent bellowing.

The mastic between the fabric at transverse joints consisted of Asphalt RC-2, which was mopped on with a broom. Treatment of the transverse joints was all handwork; and this operation often lagged behind.

Wrinkles were in the fabric each time the tractor began a new roll of fabric. These wrinkles were worked out, by hand, at

each joint, before a coat of Asphalt was applied between the fabric layers. Frequently, nails and tin washers were required to further secure the fabric to the pavement at the transverse joints. Treatment of the transverse joints in this manner was satisfactory, but perhaps a better method would have been to spray the Asphalt between fabric laps, rather than applying it with a mop. This would have speeded up the work as well as providing for a more even distribution of the Asphalt.

The one-course surface treatment was applied immediately after the fabric was in place.

The most difficult problem was to achieve a wrinkle-free application of the fabric. This was rarely accomplished. The degree of wrinkling varied with the rate and type of asphalt applied as a binder course. The horizontal degree of curvature in the roadway alignment, and weather conditions, also produced problems with wrinkling.

As previously mentioned, Asphalt AC-5 was used as the binder course at the beginning of the project. The rate of application was varied between 0.07 gal/sy and 0.17 gal/sy, with 0.15 gal/sy judged to be the best rate of application. A lesser rate would not adequately adhere the fabric to the surface; and more than 0.15 gal/sy would penetrate through the fabric, causing it to cling to the wheels of construction equipment. The optimum rate of application will also vary, depending on the texture of the existing surface. A coarse texture, such as existed on the shoulder and passing lane, required more; while a smooth texture required less. However, since the texture varied within the limits

of an Asphalt Land on this project, a rate of 0.15 gal/sy was used throughout. The type of asphalt was changed to AC-10 on the third day of the fabric placement. The result was an improvement in the adherance of the fabric to the surface. The fabric had a greater affinity for the heavier asphalt, causing a decrease in wrinkling from slippage of the fabric. Perhaps an even heavier asphalt would perform better as the binder course, but this was not attempted, because the same asphalt and equipment was being used for the placement of the one-course surface treatment.

The roadway on which the fabric was applied had horizontal curves of 30 minutes, 1 degree, and 2 degrees. There was no noticeable difference in the quality of work through the curves up to 2 degrees; however, on the 2 degree curve, the frequency of wrinkling increased.

As was anticipated, weather dictated the quality of work achieved in fabric placement more than any other factor. It was learned the fabric could be placed more rapidly, and in a near wrinkle-free condition, when air temperature was 85^{o}or below. At this range of temperature, the fabric could be rolled with a pneumatic roller without the binder course of asphalt penetrating through the fabric and sticking to equipment tires. Wind gusts (judged to be 10-to-15 MPH) experienced during the cooler working hours, did not handicap the fabric work. Winds during the warmer part of the day (when temperature was above 85^{o}degrees) caused the work to be slowed, and increased the frequency of wrinkling. Preferably, the fabric should be placed when the air temperature

is 65-to-85 degrees. In this area of the State, this temperature range occurs three to four hours during daylight, but this short period would be too restrictive to be practical as a requirement for the placement of the fabric.

The expansive characteristic of the fabric is quickly susceptible to temperature change. Fabric placed in a smooth condition under cloud cover will wrinkle immediately when exposed to sunlight. Hot asphalt applied directly on the Petromat, as part of the one-course surface treatment, will cause the fabric to expand, resulting in wrinkling. From this experience, it has been our conclusion that the fabric, when used together with an asphaltic surface treatment, cannot be placed without some degree of wrinkling. It is believed, however, that an excellent sealing membrane was constructed in spite of the wrinkling -- the only detriment being that the wrinkles may determine the life of the fabric. The wrinkling is not apparent through the final overlay course.

A wrinkle-free condition was accomplished on the two small areas where the one-course surface treatment was eliminated. By initially applying all the asphalt necessary to satisfy the fabric, and blotting the excess asphalt with sand, it was possible to iron out all of the wrinkles with a pneumatic roller. The fabric conformed to the existing surface very well, and one of the areas was left exposed to traffic for three weeks without apparent harm to the fabric. Also, the overlay operation ran very smoothly over the exposed area without damage to the fabric. This method should be carefully considered for future use, because of the lower cost

resulting from the elimination of the one-course surface treatment and the fewer problems encountered in the placement of the fabric.

The extra equipment required over the normal complement of tools for an HMAC paving project and a surface treatment project was the two tractors (previously mentioned) to place the fabric. Additional manpower, however, is required above the normal paving crew, to apply the fabric. Ten-to-twelve men assisted with this operation. The crew's expertise in applying the fabric increased daily, and, toward the end of the project, the Contractor was applying approximately 6 lane miles of fabric daily. This included application of the surface treatment to the fabric.

During the planning stage, there was concern that the cost to construct the project would be unusually high, since there was practically no history upon which the Contractors could base their Bids for such a large volume of fabric work. Fortunately, this was not the case, as bidding was competitive. Six Bids were submitted, ranging from $1,195,000 to $1,457,000. All Bids were well under the State's estimate of $2,068,600. Apparently the experimental nature of the project did not influence the bidding. Based on the low Bid, the following is a Cost Comparison of each surface sealing system:

1. Underseal containing Petromat and one-course surface treatment with a 3/4" open-graded friction course.

Item 3039 - Asphalt	$0.06/SY
Item 3039 - Fabric	0.75/SY
Item 320 - Asphalt	0.12/SY
Item 320 - Aggregate	0.10/SY
Item 210 & 213 - Rolling	0.01/SY
Item 3022 - Asph	0.15/SY
Item 3022 - Aggr	0.32/SY
	$1.51/SY

2. One course surface treatment underseal with a 3/4" open-graded friction course.

Item 320 - Asphalt	$0.12/SY
Item 320 - Aggregate	0.10/SY
Item 210 & 213 - Rolling	0.01/SY
Item 3022 - Asphalt	0.15/SY
Item 3022 - Aggregate	0.32/SY
	$0.70/SY

3. Two inches of Ty C HMAC, fabric underseal, one-course surface treatment, and 1¼" of Ty D HMAC.

Item 340 HMAC Ty C	$1.62/SY
Item 3039 Asphalt (Petromat)	0.06/SY
Item 3039 Fabric	0.75/SY
Item 320 Asphalt	0.12/SY
Item 320 Aggregate	0.10/SY
Item 210 & 213 - Rolling	0.01/SY
Item 340 HMAC Ty D	0.99/SY
	$3.65/SY

4. One course surface treatment, 2" Ty C HMAC, and 1¼" HMAC Ty D.

Item 320 - Asphalt	$0.12/SY
Item 320 - Aggregate	0.10/SY
Item 210 & 213 - Rolling	0.01/SY
Item 340 - HMAC Ty C	1.62/SY
Item 340 HMAC Ty D	0.99/SY
	$2.84/SY

The project has now gone through a severe winter, an unusually hot summer, and into winter again. Generally, Sections 3 and 4 (the HMAC Sections) have out-performed Sections 1 and 2 (Plant Mix Seal).

During the first winter, a random pattern of cracking appeared in isolated areas of the Plant Mix Seal. However, there is a noticeable difference in the amount of cracking between the Sections with, and without, the fabric underseal. The Sections with the fabric underseal have fewer cracks than the Section without fabric underseal. This pattern of cracking was in the roadway prior to

this Project, and could be described as "fractures" rather than cracks. It is believed that they are geological in nature, and not the fault of construction materials. In places, the crack can be followed off the roadway surface and into the Right-of-Way. Samples have been taken, which straddle the cracks, and the fabric underseal is intact and undamaged. A good sealing membrane still exists in the areas with the fabric underseal.

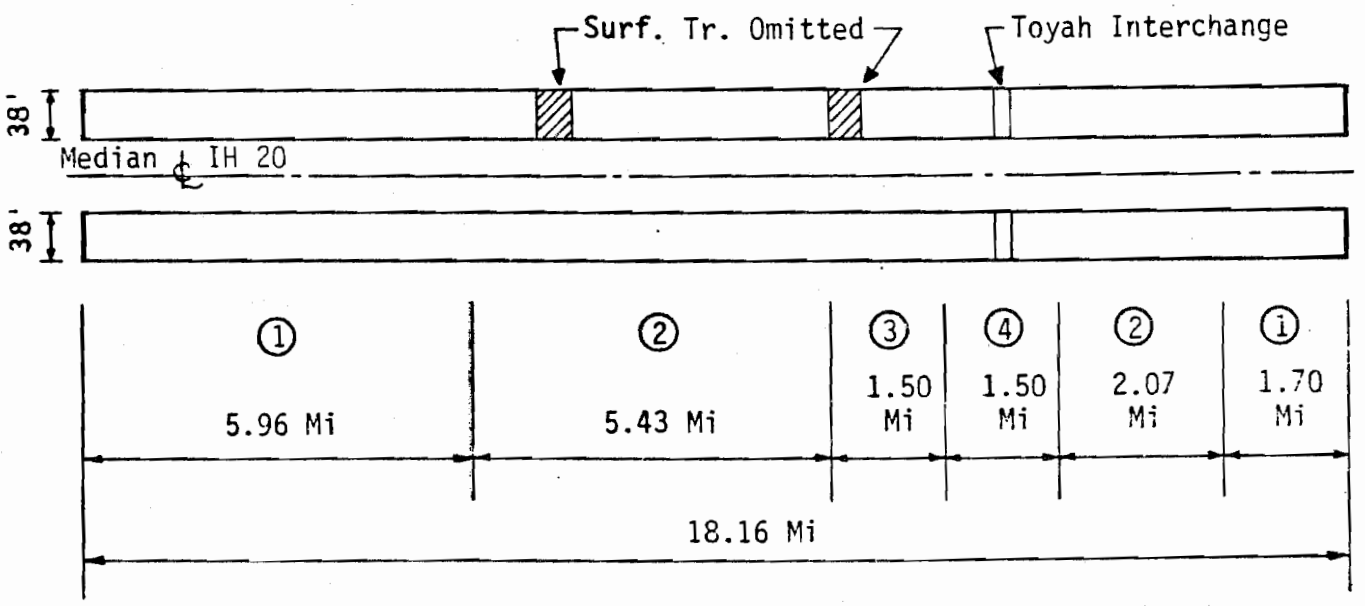
Through the summer, the Plant Mix Seal seemed to be "self-healing" since most of the cracks disappeared with the warm weather. The cracks reappeared going into the second winter.

The Sections that were constructed with HMAC have performed very well. Section 3, which has the fabric underseal and one-course surface treatment between layers of Ty C HMAC and Ty D HMAC shows a small amount of flushing and rutting. Apparently, asphalt in the sealing layer is finding a way into the top layer of HMAC, causing a loss of some stability. This problem could become more prevalent in years to come.

Section 4, the control Section, is un-blemished; and, based strictly on performance, judged to be the best Section to date.

# # # # # # #

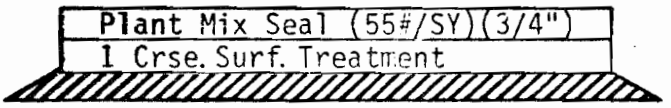
IH 20
Reeves County
Control 3-6



Length of Petromat = 9.00 Mi
Area of Petromat = 317,879 S.Y.

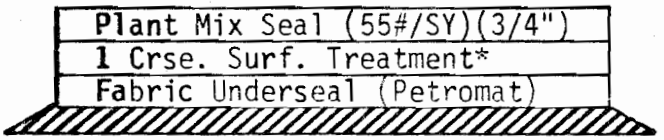
FIGURE 1

(1) Length = 7.66 Miles



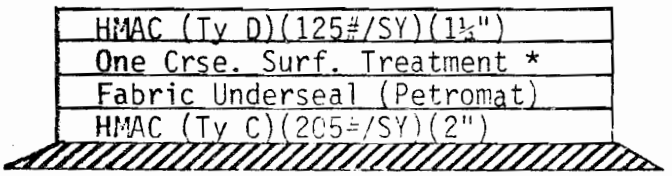
Typical: Existing 10" Flex. Base (Ty A Gr 1) and 11" of Foundation Course with a 2 course Surface Treatment

(2) Length = 7.50 Miles



*Seal Course Omitted for 0.2 Mi and replaced with Sand application over Petromat

(3) Length = 1.5 Miles



*Seal Course omitted for 0.38 Mi and replaced with Sand application over Petromat

(4) Length = 1.50 Mi

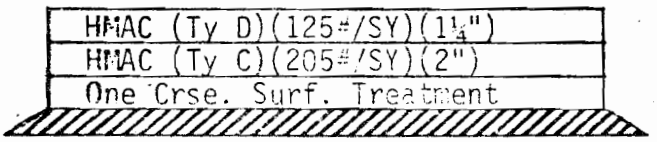


FIGURE 2