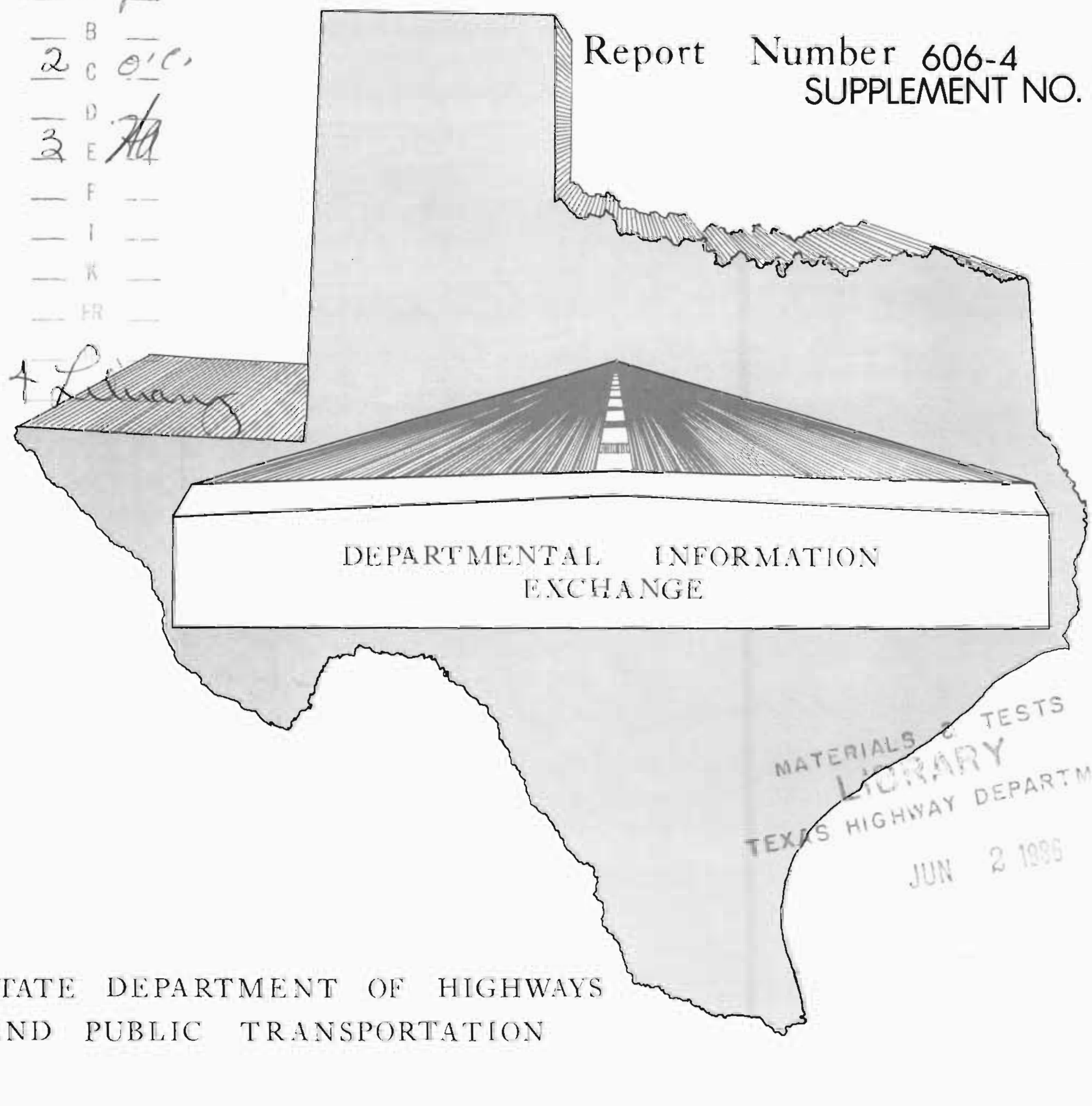
EXPERIMENTAL PROJECTS

EVALUATION OF SURFACE-SEALING SYSTEMS UTILIZING SEAL COATS AND POLY-FAB UNDERSEALS

Report Number 606-4
SUPPLEMENT NO. 5



STATE DEPARTMENT OF HIGHWAYS AND PUBLIC TRANSPORTATION

TECHNICAL REPORT STANDARD TITLE PAGE

1. Report No. Exp. Proj. Report 606-4, Supplement No. 5	3.
4. Title and Subtitle Evaluation of Surface-Sealing Systems Utilizing Seal Coats and Poly-Fab Underseal	5. Report Date December 1982 6. Performing Organization Code
7. Author(s) Donald D. Day	8. Performing Organization Report No. Exp. Proj. Report 606-4
9. Performing Organization Name and Address Texas State Department of Highways and Public Transportation District 4 Amarillo, Texas	10. Work Unit No. 11. Contract or Grant No.
12. Sponsoring Agency Name and Address Texas State Department of Highways and Public Transportation District 4 Amarillo, Texas	13. Type of Report and Period Covered 14. Sponsoring Agency Code

15. Supplementary Notes

Work done in cooperation with U.S. Department of Transportation, Federal Highway Administration. FHWA Experimental Project 064877001.

16. Abstract

This report summarizes the experimental project on I-40 in Potter County concerning the retardation of reflective cracking in overlay. The objectives were: to evaluate the performance in retarding reflective cracking of different systems of underseals containing the poly-fabric Petromat, as opposed to a conventional system of underseals without Petromat; to develop cost data for these various systems.

A background history delineating the extreme climatic conditions that plague the location is given. Also given in the history are soil characteristics and a description of the emergency maintenance prior to begining the project.

The report discusses design of the four expermental systems, construction of them, and problems in the handling of Petromat. It then explains the evaluation procedure which was done visually each year from 1978-1982. The evaluation is referenced with a series of photos. Statements of the systems' conditions are also included. Cost differences in the four systems are shown by bar graph.

Petromat, the report concludes, is effective in reducing the number of reflective and tensile cracks in the pavement structure. The greater cost of using Petromat may well be offset by the additional years of service it provides.

17. Key Words Crack retardation Surface sealing Underseal Poly-fab underseal Seal coat	18. Distribution Statement This report is available from: State Department of Highways and Public Transportation Transportation Planning Division P.O. Box 5051; Austin, Texas 78763

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
Unclassif.	Unclassif.	27	

Form DOT F 1700.7 (8-69)

EVALUATION OF SURFACE-SEALING SYSTEMS UTILIZING SEAL COATS AND POLY-FAB UNDERSEAL

FINAL REPORT
FOR EVALUATION OF EXPERIMENTAL
CONSTRUCTION PROJECT

ON

INTERSTATE HIGHWAY 40
OLDHAM AND POTTER COUNTIES
TEXAS

CONTROLS: 90-4 & 5
FROM: 0.3 MI. WEST OF POTTER COUNTY LINE
TO: 2.0 MI. WEST OF BUSHLAND

PROJECT SUPERVISION
LEWIS R. LOYD, SUPERVISING RESIDENT ENGINEER
DONALD D. DAY, SENIOR RESIDENT ENGINEER

REPORT PREPARED BY
DONALD D. DAY, SENIOR RESIDENT ENGINEER
STATE DEPARTMENT OF HIGHWAYS & PUBLIC TRANSPORTATION
DISTRICT 4
AMARILLO, TEXAS

IN COOPERATION WITH
U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION

DATES OF CONSTRUCTION:
JULY 11, 1977 to AUGUST 30, 1977

EXPERIMENTAL PROJECT REPORT 606-4

The material contained in this report is experimental in nature and is published for informational purposes only. Any discrepancies with official views or policies of the DHT should be discussed with the appropriate Austin Division prior to implementation of the procedures or results.

TABLE OF CONTENTS

OBJECTIVES

A major problem encountered in overlaying a distressed pavement with asphaltic concrete pavement concerns the retardation of reflective cracks in the new pavement. The objectives of an experimental project on IH 40 in Potter County were to evaluate the performance of various construction materials and techniques in retarding reflective cracking and to develop cost data for these various systems. These various systems consisted of:

1. A surface-sealing system in conjunction with the asphaltic concrete pavement, consisting of an underseal of asphalt and aggregate.
2. A surface-sealing system in conjunction with the asphaltic concrete pavement consisting of an underseal containing a poly-fab underseal at various depths below the surface.

PROJECT BACKGROUND

The research project is at the location of one of the first sections of U.S. Highway 66 upgraded to full interstate standards in 1959. The project is located approximately 18 miles west of Amarillo. The roadway is at an elevation of 3900 ft., gently sloping (1 percent to 3 percent) and oriented west-northwest to east-southeast. The soil is a clay loam with a Plasticity Index (PI) between 17 and 25 and a Triaxial Class of 4.0 to 5.0.

The average annual rainfall is 18.23 in. with an average of 13 in. of snow. The mean annual temperature is 59 degrees Fahrenheit with an average minimum temperature of 20.9 degrees Fahrenheit in January. The lowest recorded temperature is -8 degrees Fahrenheit and daily variations of 30 degrees to 40 degrees are common. Drops of 60 degrees are not uncommon with passages of northers during the winter. Hard freezes for three or four days with rapid thaws are not unusual.

The original main lanes consisted of two 12 ft. lanes, 5 ft. inside shoulders and 10 ft. outside shoulders and were constructed of 18 in. compacted flexible base with 150 lbs/sq.yd. asphaltic pavement on three lanes and a one course surface treatment on the shoulders. The roadway sloped $^1/_8$ in. per 1 ft.-0 in. from the edge of the inside shoulder to the outside shoulder.

During the winter of 1968-1969 there was an unusual amount of moisture followed by excessively low temperatures for several days. The ground froze to a depth of approximately 18 inches. This deep freeze of the pavement was followed by southwest winds with temperatures in the low 70's. This very quickly thawed out the surface of the roadway and with the volume of truck traffic (1300 trucks per day), the surface of the thawed areas quickly degenerated. Samples were taken in seven locations. The average soil characteristics were Liquid Limit, 30; Plasticity Index, 12.5; and passing #40, 31 percent. Emergency funds were obtained and plans were rushed through for letting. The plans included cement stabilization of the top 6 in. of the existing base material with 6 percent portland cement. (Fig. I, pg.14). A level-up course of Type D asphaltic concrete pavement averaging 175 lbs/sq.yd. was placed over the stabilized base and an additional 150 lbs/sq.yd. riding surface was placed over the main lanes. The geometrics of the main lanes were not altered.

Approximately one year after the completion of the emergency construction, cracks began to appear in the surface of the roadway. With the $^1/_8$ in. per 1 ft. slope, water did not drain off the roadway, especially in the wheel paths. With the cracking and standing of the moisture during wet periods, pumping and increasing deterioration of the pavement resulted.

DESIGN

The design of the roadway incorporated four different concepts so that each could be evaluated as to its success in preventing and/or retarding cracks. The average daily traffic count during construction was 7,060 of which 25.6 percent were trucks. The average daily 1980 traffic count was 8,200 with approximately 26 percent being trucks. This volume of traffic added to the problems of construction and the sequence of work-required detours at each end of the project used during actual construction operations. Traffic was carried on the main lanes through the new construction, except during actual construction operations.

The same geometrics were used in each of the four designs. This revised design changed the slope in the outside lane from $^1/_8$ in. per 1 ft. to $^1/_4$ in. per 1 ft. This gave an average thickness of 3 in. at the outside shoulder and 4 $^1/_2$ in. average thickness at the centerline. The slope on the inside lane was changed from $^1/_8$ in. per 1 ft. slope to the outside to $^3/_{16}$ in. per 1 ft. slope to the inside. This lane had 4 $^1/_2$ in. average depth at the centerline and $^3/_4$ in. average thickness at the inside shoulder. This design put the additional thickness where needed in the outside lane and provided a rooftop crown allowing snow to be graded off instead of melting and running across the pavement during the day, then freezing again at night (Fig. II).

As previously stated, the experimental portion of this project dealt with the evaluation of a surface-sealing system only and the geometrics were the same for each of the four alternate systems.

System I (Fig. III) consisted of a seal coat using 0.35 gal/sq.yd. asphalt and Type A Grade 3 aggregate applied directly to the existing pavement at the rate of 1 cu.yd. per 85 sq.yd. This was followed with the level-up and final course of asphaltic concrete pavement.

System II (Fig. IV) consisted of placing asphalt and poly-fab underseal directly on the existing pavement. This was covered with a seal coat using 0.25 gal/sq.yd. asphalt and Type A Grade 5 aggregate applied at a rate of 1 cu.yd. per 120 sq.yd. This was followed with the level-up and final course of asphaltic concrete pavement.

System III (Fig. V) consisted of placing the level-up course of asphaltic concrete pavement, then placing asphalt and poly-fab underseal over the level-up. The last step was to place a final course over the poly-fab. The final course averaged 75 lbs/sq.yd.

System IV (Fig. VI) consisted of applying asphalt and poly-fab underseal directly to the existing pavement. This was blotted with sand and overlaid with the level-up and final course of asphaltic concrete pavement.

CONSTRUCTION PHASE

The placing of poly-fab underseal fabric was the only construction procedure that varied from the normal construction practices. Therefore, for this report this construction procedure will be the only construction discussed. The poly-fab underseal used for this project was Petromat.

Petromat is the trade name for a nonwoven fabric developed by Phillips Fiber Corporation, a subsidiary of Phillips Petroleum Company. It is a specially engineered reinforcing material used to increase fatigue life of an overlay and to help keep cracks from reflecting through to the new surface. Petromat fabric, made with polypropylene fiber, is designed to resist chemicals and rot. When combined with asphalt, it forms a barrier to moisture.

Phillips Fiber Corporation furnished a machine and operator to aid in placing the Petromat. This machine was especially designed for the placing of this fabric. The machine was a converted small front-end loader adapted as a placement vehicle for the Petromat. The overall performance of the machine was satisfactory.

The Petromat on this project was supplied in 6 ft.-3 in. or 12 ft.-6 in. by 300 ft. strips rolled on a cardboard tube. The weight was about 60 lbs for the short roll and 120 lbs for the long roll.

The transverse joints were lapped 6 to 14 in. and additional asphalt was applied, then the joints were nailed down for protection from damage by the traffic. The joints were lapped with the traffic to lessen damage and wear.

The longitudinal joints were a different problem. The edge of the Petromat previously placed curled if the asphalt underseal for the strip adjacent was applied at temperatures above 260 degrees Fahrenheit. When temperature of the underseal asphalt was applied within the 225 degrees to 240 degrees Fahrenheit range, the curling action did not occur. A change in the grade of asphalt did not change the observed reaction at the edge of the material.

The section (Section II) receiving the seal coat on the Petromat developed more wrinkles than the other sections. The material expanded when the hot asphalt was applied. There were some wrinkles present in all sections. There has been no apparent ill effect in the succeeding layers of material placed above there wrinkles, as of this report.

Air temperature varied from the 60's to the 90's during the placing operations. As the temperature rose, the material needed to remain in contact longer before it would bond to the raw asphalt. A small pneumatic roller was used to aid in bonding the asphalt and Petromat.

The Petromat absorbed about 0.21 gal. of asphalt per square yard. The application rate on this project was approximately 0.25 gal. of asphalt per square yard. The surface would become sticky or tacky after the bonding had taken place. The asphalt not absorbed was blotted by the addition of sand before the surface was opened to through traffic.

Wind was a problem during the placing of the Petromat. The wind velocity varied from 15 to 30 miles per hour during most of the placement operation. Interstate 40, at the location of this project, has an east-west orientation with the prevailing wind from the southwest. The wind would cause the most trouble where there was a break in the cross slope of the section near the edge of the material. To keep the Petromat in place, the edge on the windward side was nailed with concrete nails and roofing washers. The spacing of the nails was 5 ft. more or less along the edge of the material.

The traffic was carried on the main lanes through the new construction except during actual construction operations. The traffic was carried on the Petromat without difficulty and without damage to the surface. The longest period the traffic was on the Petromat surface was four days. Rain did not adversely effect the Petromat that was carrying traffic.

Care in the operations of construction equipment was necessary during placing of successive construction activities. The tracks of the laydown machine and loaded truck could cause damage to the Petromat by turning, starting and stopping.

PROCEDURE OF EVALUATION

The purpose of this experimental project was primarily to evaluate the performance of various surface sealing systems and to develop cost data for these systems.

The performance of the roadway will be watched regularly by the Maintenance Foreman and any unusual changes in the surface along this project will be called to the attention of the District Engineer. The midpoint of each section is clearly marked with guardposts for easy identification. The ends of each section can readily be identified by a construction joint.

A point was selected in each of the four sections which has been marked for future relocation. Photos were taken before and after construction at each of these reference points. A total of eight photos were taken at each reference point. Additional photos were taken and referenced at points in existing pavement that indicated structural weakness.

Additional photos will be taken at each of these points each year for five years for evaluation of each system. These photographs are marked and retained at the office of the Resident Engineer, Lewis R. Loyd, in Canyon, Texas.

A bar graph (Fig. VII) indicates the difference in cost per square yard for the four different typical sections. The Petromat and underseal were significant factors in the total cost per square yard.

1978 CONDITION

A visual inspection of all sections was made in November 1978. The following observations were made:

Normal wearing has occurred in all of the test sections. Weather and traffic have resulted in bleaching of the surface.

There are some areas where depression is evident in the outside wheel paths in all sections. Associated with this depression are some longitudinal cracks between the wheel paths. This cracking is not considered to be serious at this time.

Some flushing of the asphaltic concrete pavement has occurred in all of the sections which have poly-fab included in the pavement structure. This flushing appears to be most noticeable in the System IV section. The flushing has not developed to the extent that it is a problem. Flushing has not occurred in the System I section, which has no poly-fab included.

Some cracks have appeared in all test section. It has not been established if these cracks are reflective. They have required no maintenance. There are more cracks in the System I section (no poly-fab) than in the other three sections which contain poly-fab.

Captioned pictures for each section are included in the appendix.

1979 CONDITION

A visual inspection of all sections was made in November 1979. The following observations were made:

Normal wearing has occurred in all of the test sections. Weather and traffic have continued bleaching the surface.

The depression of the outside lane wheel paths in all sections has remained relatively stable. There have been some minor longitudinal cracks in the outside lanes associated with this depression. This cracking is not considered serious at this time in Systems II, III and IV.

The flushing of the asphaltic concrete pavement noted in 1978 has lessened in all the sections which have poly-fab included in the pavement structure. Flushing has not developed in the System I section, which has no poly-fab included.

Some cracks have appeared in all test sections. It has not been established if these cracks are reflective. They have not required maintenance. There are transverse cracks in all sections across both the inside and outside lanes at intervals of about 40 ft. There are a greater number of cracks and they are more pronounced in System I than in the other systems.

There are approximately three times as many linear feet of longitudinal cracks in System I than in the other systems. These longitudinal cracks are more nearly continuous in System I.

1980 CONDITION

A visual inspection of all sections was made in November 1980. The following observations were made:

Normal wearing has occurred in all of the test sections. Weather and traffic have continued bleaching the surface.

The depression of the outside lane wheel paths in all sections has remained relatively stable. There have been some minor longitudinal cracks in the outside lanes associated with this depression. This cracking is not considered serious at this time in Systems II, III and IV.

The flushing of the asphaltic concrete pavement noted in 1978 has lessened in all the sections which have poly-fab included in the pavement structure. Flushing has not developed in the System I section, which has no poly-fab included.

Some cracks have appeared in all test sections. It has not been established if these cracks are reflective. They have not required maintenance. There are transverse cracks in all sections across both inside and outside lanes at intervals of about 40 ft. There are a greater number of cracks and they are more pronounced in System I than in the other systems.

The longitudinal cracks are more nearly continuous in System I than in the other systems. There are approximately three times as many linear feet of longitudinal cracks in System I. It is evident that the cracks are wider and deeper in System I than in the other test sections. The longitudinal cracks were about 1/2 in. in width and 1 in. deep in System I. The cracks in the other test sections were less than 1/4 in. wide and 1/2 in. deep.

The differences between System I and the other systems were more evident than during the previous report periods. Cracks have been poured on Section I during the period.

1981 CONDITION

A visual inspection of all sections was made in August 1981. The following observations were made:

Normal wearing has occurred in all of the test sections. Weather and traffic have continued bleaching the surface.

The depression of the outside lane wheel paths in all sections has remained relatively stable. There have been some minor longitudinal cracks in the outside lanes associated with this depression. This cracking is not considered serious at this time in Systems II, III and IV.

The flushing of the asphaltic concrete pavement noted in 1978 has lessened in all the sections which have poly-fab included in the pavement structure. Flushing has not developed in System I which has no poly-fab in the section.

Some cracks have appeared in all test sections. It has not been established if these cracks are reflective. They have not required maintenance. There are transverse cracks in all sections across both the inside and outside lanes at intervals of about 40 ft. There are a greater number of cracks and they are more pronounced in System I than the other systems.

The longitudinal cracks are more nearly continuous in System I than in the other systems. There are approximately three times as many linear feet of longitudinal cracks in System I. It is evident that the cracks are wider and deeper in System I than in the other test sections. The longitudinal cracks were about $^1/_2$ in. in width and 1 in. deep in System I. The cracks in the other test sections were less than $^1/_4$ in. wide and less than $^1/_2$ in. deep.

The differences between System I and the other systems were more evident than during the previous report periods.

1982 CONDITION

A visual inspection of all sections was made in October 1982. The following observations were made:

Normal wearing has occurred in all of the test sections. Weather and traffic have continued bleaching the surface.

The depression of the outside wheel paths in all sections has remained relatively stable. There have been some minor longitudinal cracks in the outside lanes associated with this depression. This cracking is not considered serious at this time in Systems II, III and IV.

The flushing of the asphaltic concrete pavement noted in 1978 has lessened in all the sections which have poly-fab included in the pavement structure. Flushing has not developed in System I which has no poly-fab in the section.

Some cracks have appeared in all test sections. It has not been established if these cracks are reflective. They have not required maintenance. There are transverse cracks in all sections across both the inside and outside lanes at intervals of about 40 ft. There are a greater number of cracks and they are more pronounced in System I than in the other systems.

The longitudinal cracks are more nearly continuous in System I than in the other systems. There are approximately three times as many linear feet of longitudinal cracks in System I. It is evident that the cracks are wider and deeper in System I than in the other test sections. The longitudinal cracks were about $^1/_2$ in. in width and 1 in. deep in System I. The cracks in the other test sections were about $^1/_4$ in. wide and $^1/_2$ in. deep.

The differences between System I and the other systems are more evident than during the previous report periods. There has been some crack pouring done on System I. It appears at this time major maintenance on this portion will be required 3 to 4 years before the other test sections. This is in regard to the cracks that have appeared on the riding surface.

The cracks could be reflective in nature and indicate Petromat is effective in combating this problem.

SUMMARY AND CONCLUSIONS

The complete project outside the test section has shown rutting over approximately 60 percent of both eastbound and westbound lanes. This is unrelated to the testing of the Petromat. The humps have been bladed off by motor grader to lessen the danger of hydroplaning and of steering problems for the traveling public.

In a portion of System IV, blading has been done to reduce the rutting condition in the outside lane in the eastbound direction (Picture 1). The other test systems have not rutted as much as System IV. The cause may be subgrade and/or excessive densification of the asphalt base and surface by the high volume of heavily loaded vehicles.

Punch outs occurred in System III (Pictures 2 and 3) and System IV. The punch outs probably were caused by the asphaltic concrete pavement being placed at a depth of less than 1 1/2 in. The location of the Petromat within the section does not appear to influence the punch out effect. In System III the Petromat is located on the old pavement. In System IV the Petromat is between the black base and Type D hot mix.

The Petromat is effective in reducing the number of cracks, both reflective and tensile, produced within the pavement structure. The linear feet of cracks in System I is approximately three times greater than in the other three systems. The width of the cracks is also three or more times that of the other systems. The cracking is severe enough in System I to cause the loss of some hot mix, creating holes and requiring additional maintenance.

The location of the Petromat within the design section does not appear to change the effectiveness. The same serviceability can be expected with any placement of the Petromat. It should be noted that a minimum depth of the riding surface course should be greater than 1 1/2 in.

The addition of a one course surface treatment does not appear justified in the study.

The cost of the Petromat (or other poly-fabric) may well be offset by the additional years of service provided by its use.

APPENDIX

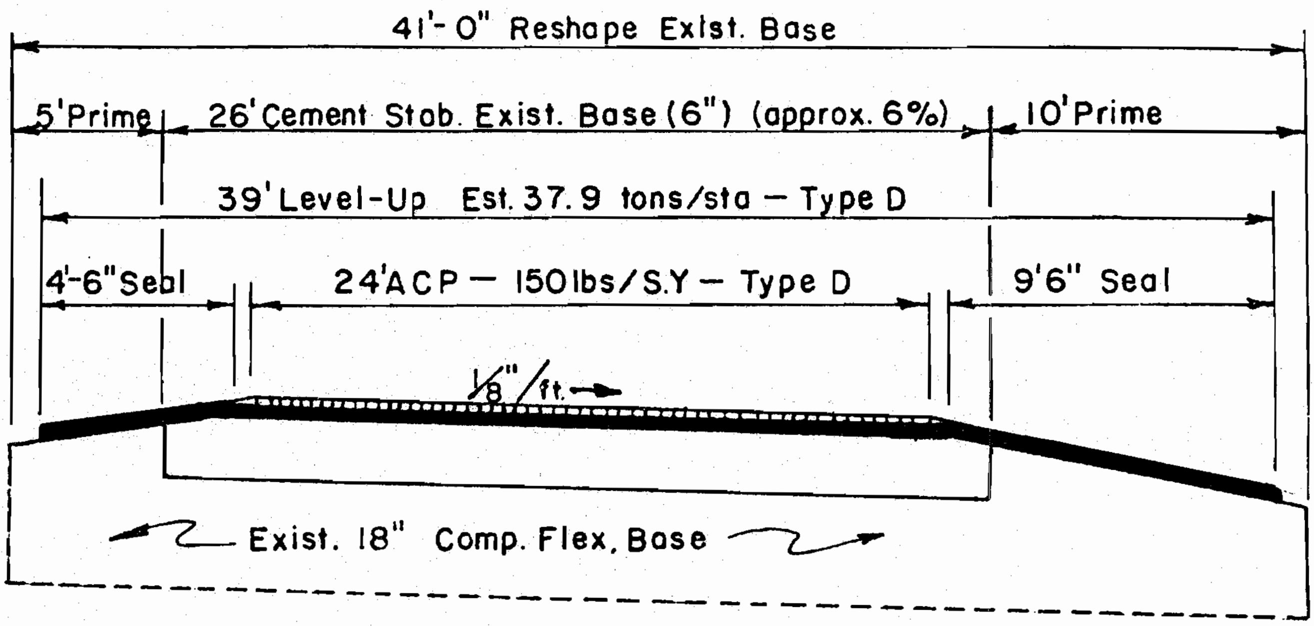


FIGURE I

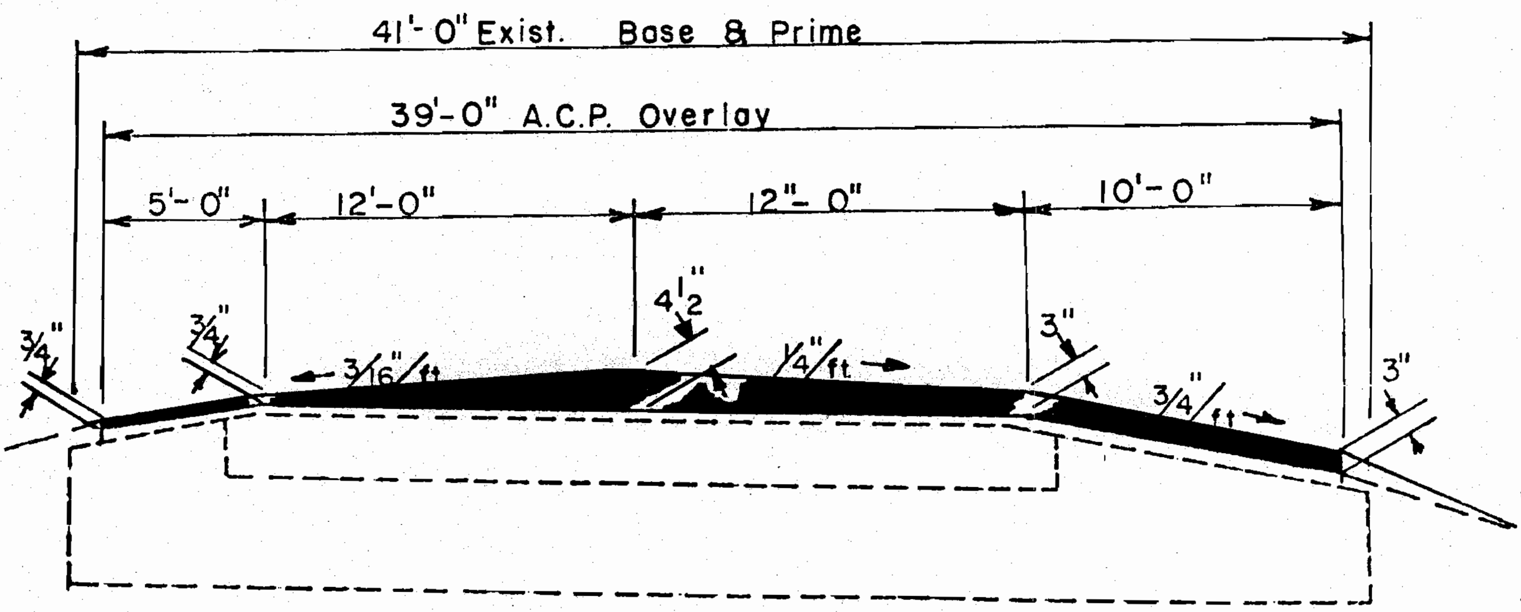


FIGURE II

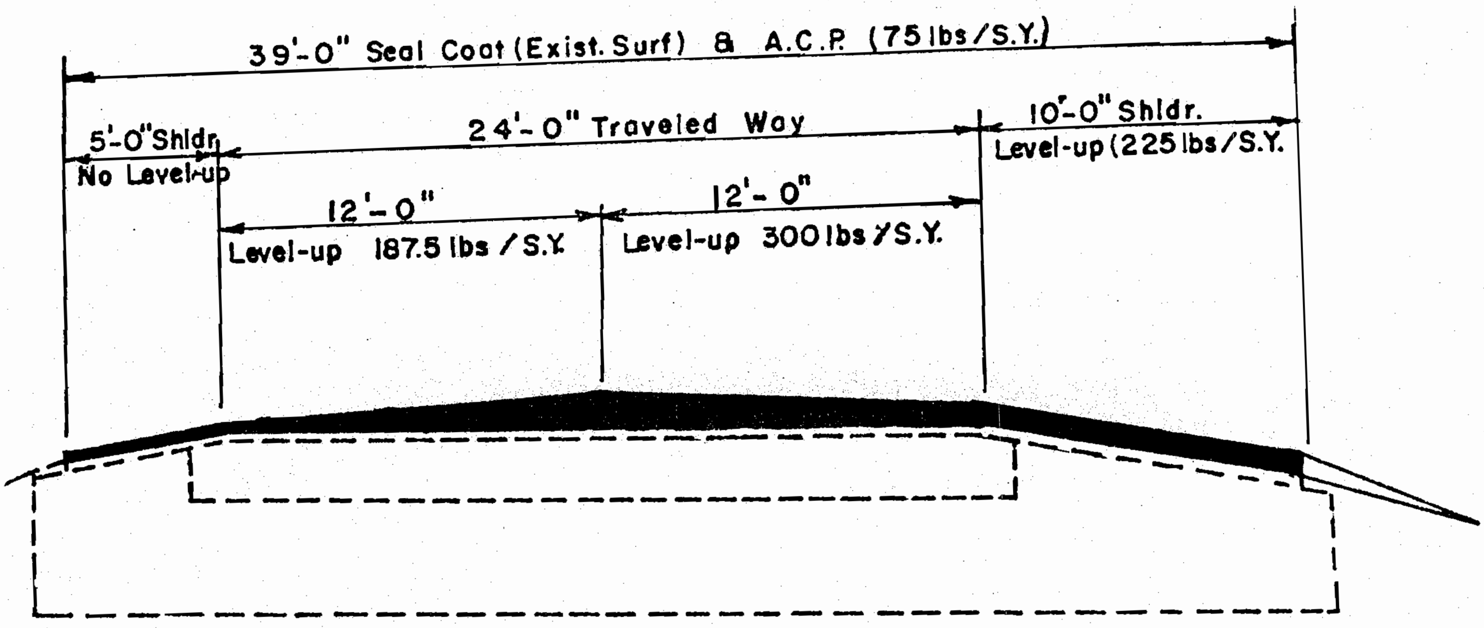


FIGURE III

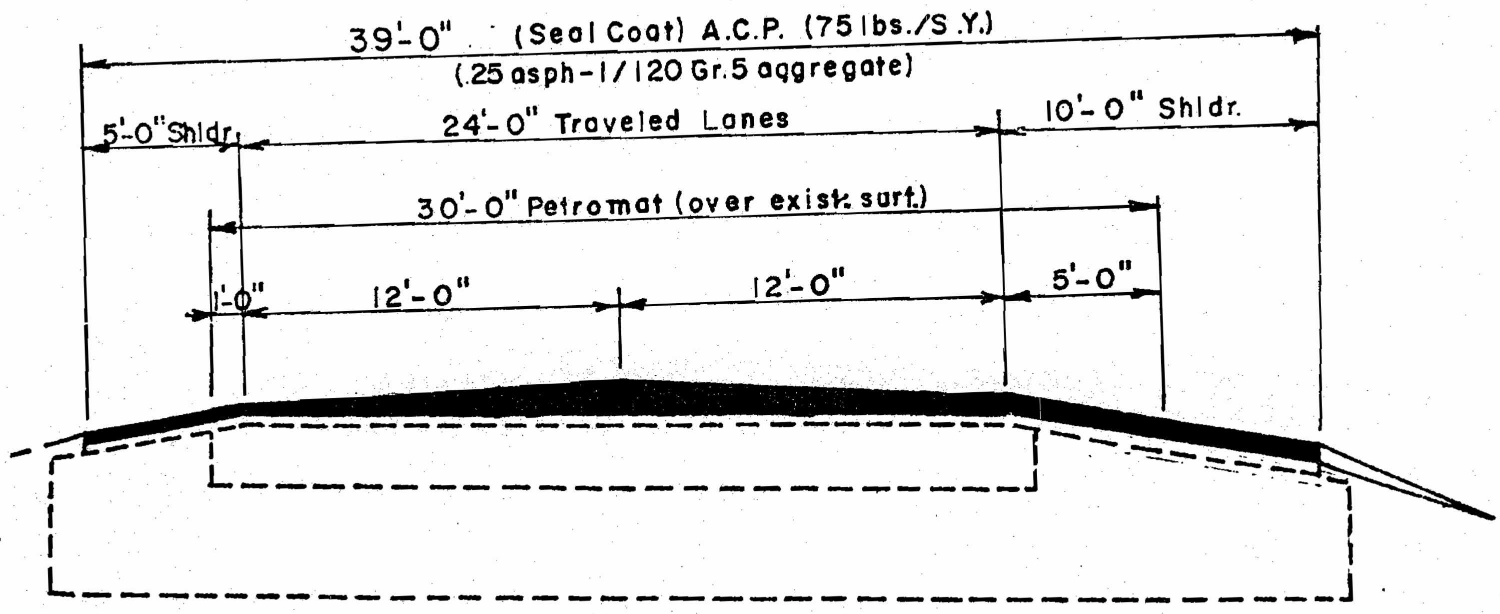


FIGURE IV

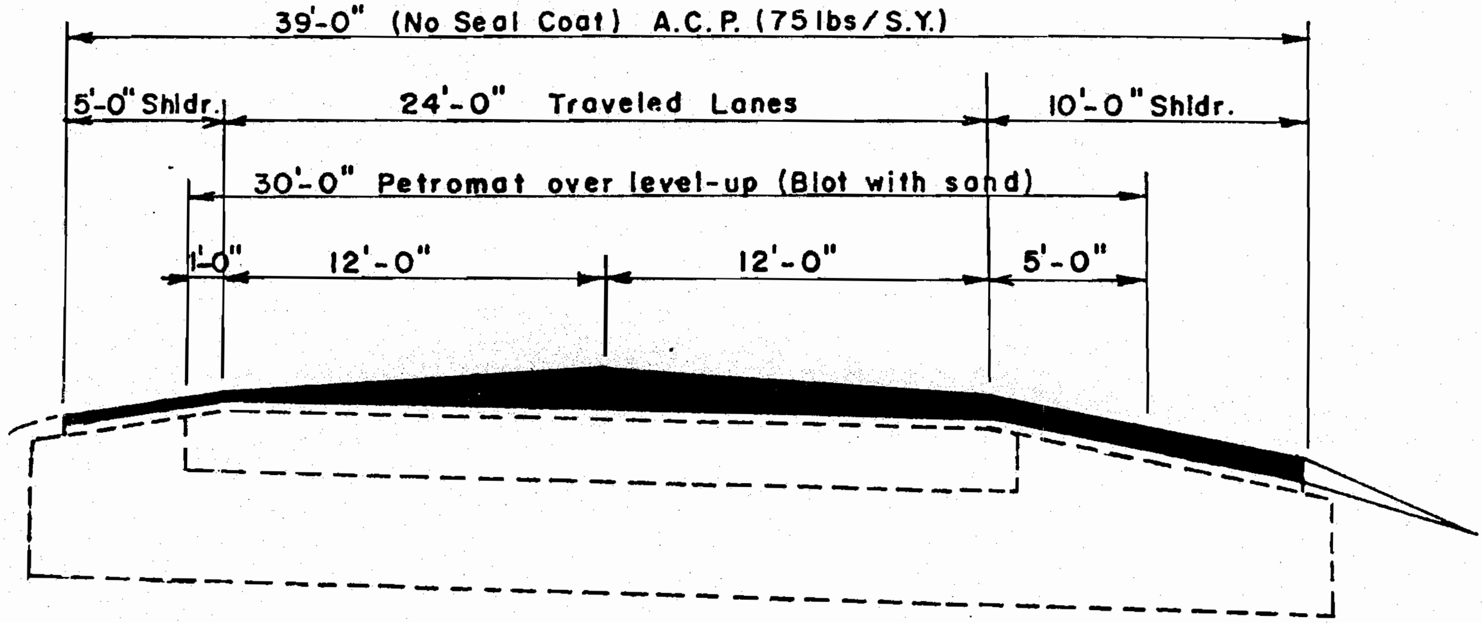


FIGURE V

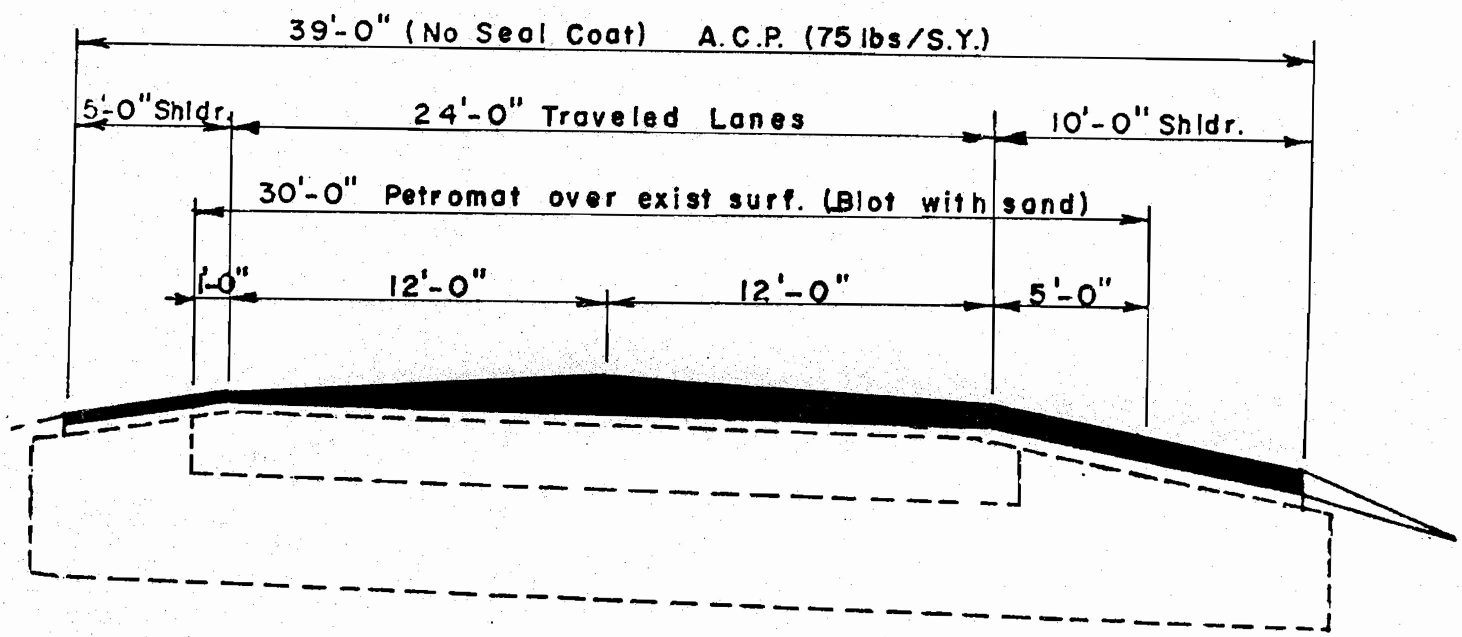


FIGURE VI

CONTRACT COSTS
COST PER SQUARE YARD

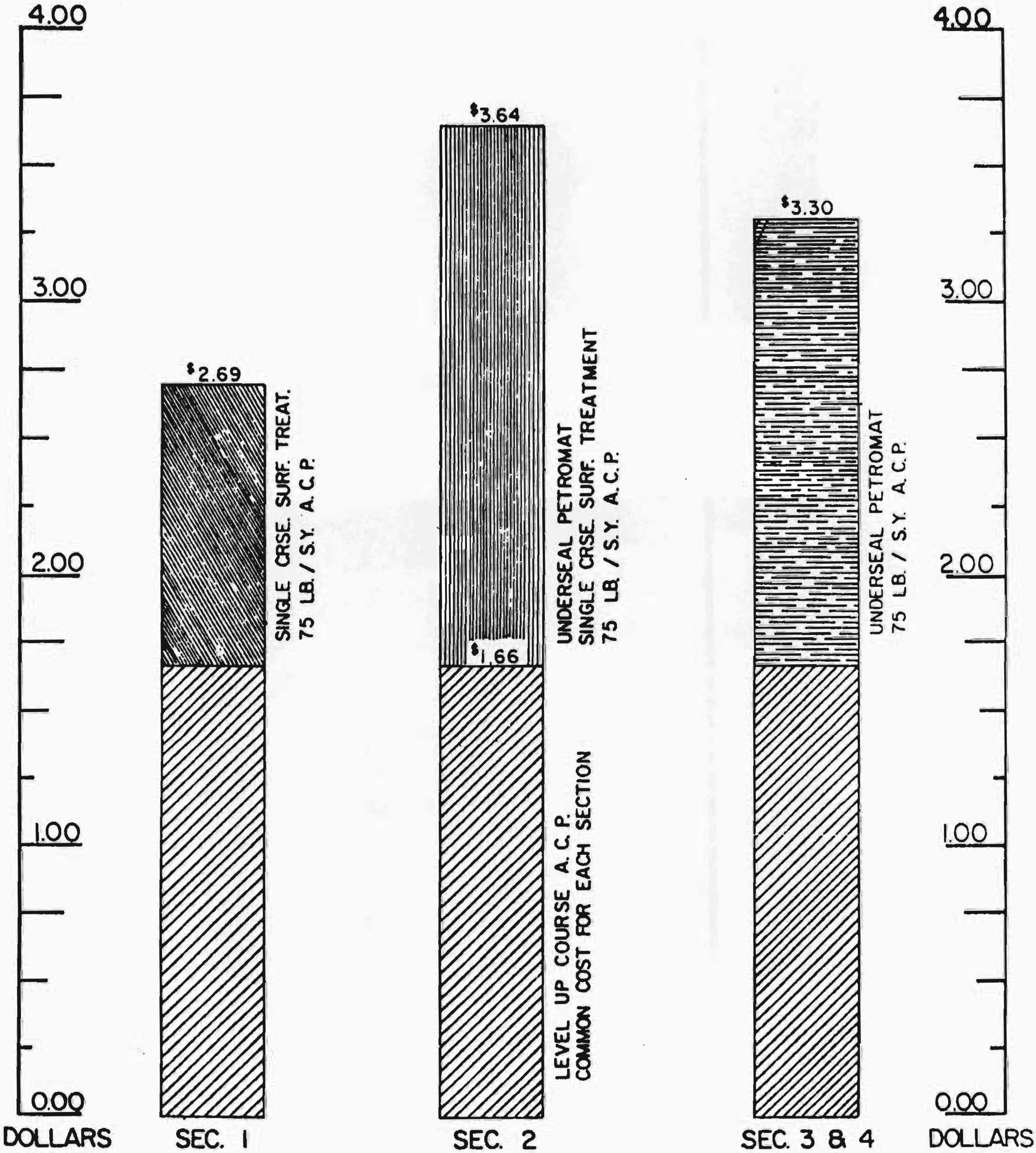
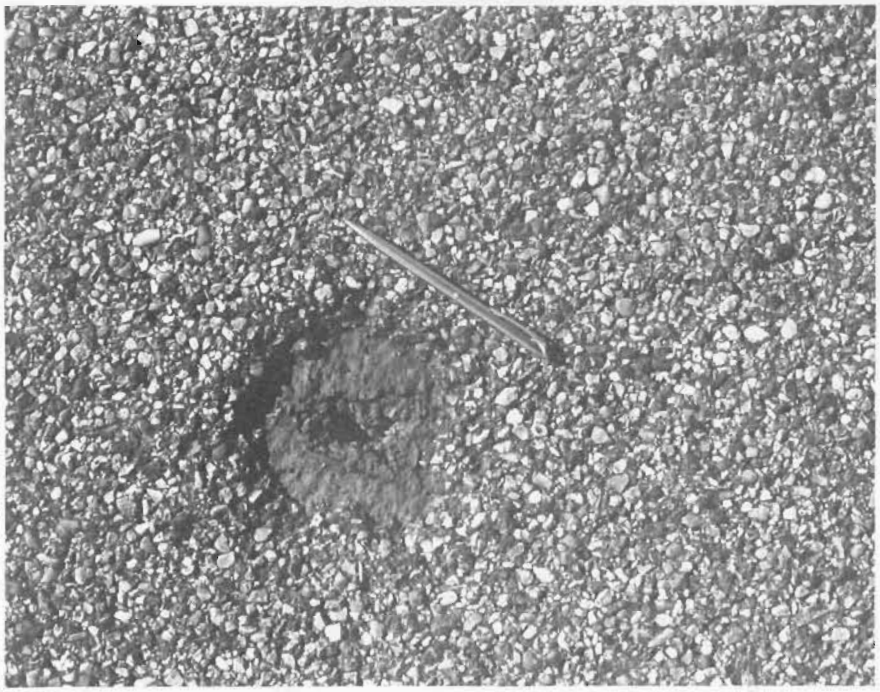


FIGURE VII

Bladed Hump in System IV

Punch Out in System III



Close Up of Punch Out in System III

System I Before 1977

System I After 1977

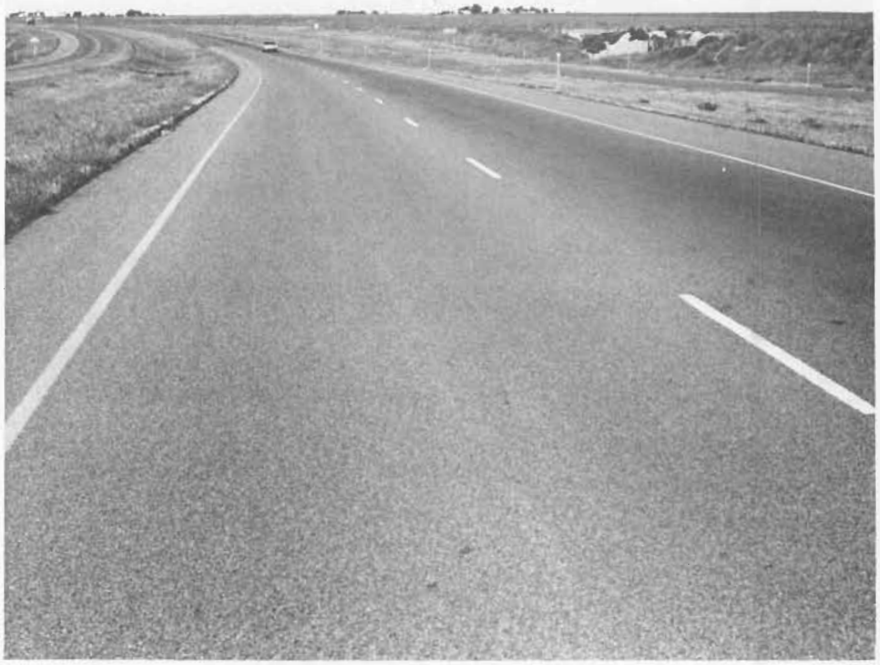
System I - 1978

System I - 1982

System II Before 1977

System II After 1977

System II - 1978



System II - 1982

System III Before 1977

System III After 1977

System III - 1978

System III - 1982

System IV Before 1977

System IV After 1977

System IV - 1978

System IV - 1982