EVALUATION OF AN ASPHALT-TREATED DRAINAGE BLANKET IN A RIGID PAVEMENT SECTION

Final Report

By

HAROLD R. PAUL
RESEARCH ENGINEER-IN-TRAINING

Under the General Supervision of

WILLIAM H. TEMPLE
ASSISTANT PAVEMENT RESEARCH ENGINEER

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ABSTRACT

This study was undertaken to develop a permeable yet stable, asphalt-treated, layered shoulder drainage system for a typical pavement section. Stability and permeability characteristics of several mixes were evaluated in the laboratory. Two installations were constructed in North Louisiana on Interstate 20 using the design criteria established by the laboratory findings.

Field evaluations consisted of Dynaflect testing for stability, permeability tests, and a visual evaluation of excavated sections of the drainage blanket. Faulting measurements were taken on the pavement joints adjacent to drainage blanket No. 2 and on the corresponding joints on the opposite-bound pavement to determine pavement-related performance of the drainage blanket.

A permeable and stable asphalt-treated shoulder drainage system was constructed as determined by performance criterion. Faulting measurements showed that improved pavement performance could be directly related to the installation of the drainage system.

The favorable results of this study provided the stimulus for further investigations in the field of surface water drainage. A full-roadway-width drainage blanket and a perforated pipe underdrain system were both examined on an experimental basis. The relevancy of these systems to the subject of this report dictate their inclusion in the form of appendices.

Key Words

Subsurface drainage, open-graded bases, drainage layers, asphalt-treated shoulder drainage blanket, full-roadway-width drainage blanket, perforated pipe underdrains, permeability, stability.

IMPLEMENTATION STATEMENT

The results of this study have been implemented in the new-construction mode on Interstate 20 between Tallulah and Mound in North Louisiana (State Project 451-08-11). Total project length is 11.8 miles (19 km). An open-graded, asphaltic concrete drainage blanket has been constructed along the shoulder for the full length of the project. Additionally, a 1500-foot (457.2-m) experimental section consisting of a full-roadway-width drainage blanket has been included in this project. Pertinent information can be found in Appendix A.

Departmental recognition of the importance of the findings of this study spawned investigation of other types of drainage systems. A perforated pipe underdrain system utilizing various filter materials received particular attention due to its outstanding performance under field trial conditions. At the time of writing, six state projects using perforated pipe underdrain systems have been let totaling 48.9 miles (78.7 km) on Interstate 20. Details of this system are included in Appendix B.

INTRODUCTION

Approximately 60 inches (152.4 cm) of rain falls in Louisiana each year. Slurry seals and joint sealant materials have been found to be insufficient as effective means of base course protection from surface water infiltration. As a result, base courses are in a continual state of deterioration. This condition is particularly evident on Interstate 20, where support from the iron ore shoulder material has been undermined by excessive surface water infiltration.

The need for removal of excess water from roadways has been recognized since the construction of the earliest roads. Concern for water removal has generally been concentrated in the area of ground water. Surface water, or that water which infiltrates a pavement system through its surface, cracks and open joints, has received relatively little attention with regard to drainage. The problems associated with surface water drainage neglect, such as subbase pumping and cracked concrete pavements, have been well documented by Cedergren (1).* This study is addressed to possible solutions of these problems in the state of Louisiana.

Due to the condition of Interstate 20, remedial action was deemed necessary. It was decided to replace the shoulder material with a permeable yet stable, asphalt-treated drainage blanket. A library search found works advocating the use of layered systems based on both cost and performance (1, 2, 3). Laboratory-tested mixes were used in the construction of a layered drainage blanket east of Ruston, Louisiana, in 1973. The desired stability was not obtained, however, and a second layered drainage blanket was installed west of Ruston, Louisiana, in 1975.

*Underlined numbers in parentheses refer to numbered entries in the section of this report entitled "References."

The findings derived from the experimental shoulder drainage blankets are discussed in this report. Also reported are two experimental features closely related to shoulder drainage blankets--a full-roadway-width drainage blanket and a perforated pipe underdrain system.

SCOPE

The aim of this research project was to develop a permeable yet stable, asphaltic drainage system for a typical pavement section. Development of such a system should provide the department with an effective means of draining water from highway bases and subbases and thus prolong the lives of those highways.

Previous research indicates that a multi-layered system of asphalt-treated drainage courses is many times more effective than single-layered aggregate drains. In this study the investigators evaluated the permeability and stability of layered, asphalt-treated drainage systems incorporated into the shoulders of a major roadway.

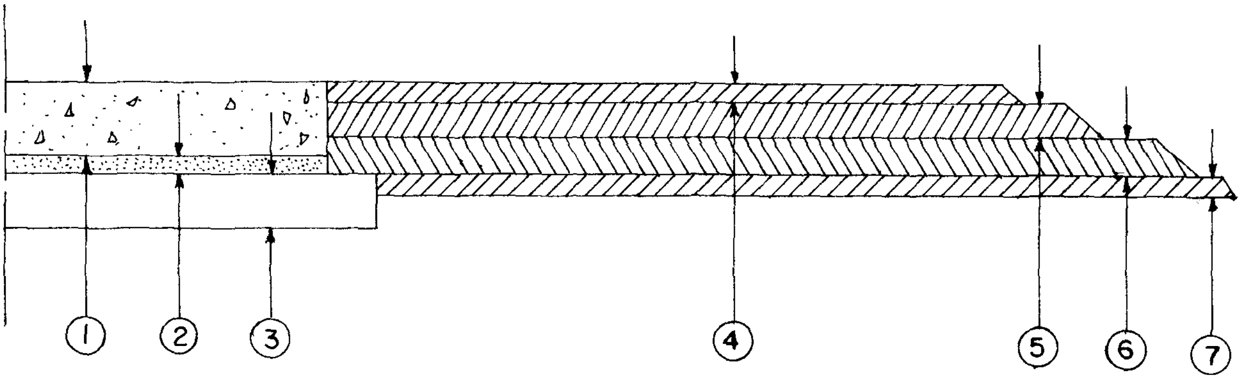
METHODOLOGY

Construction Procedures

The sites chosen for construction of the two asphalt-treated shoulder drainage blankets were located in areas that exhibited signs of edge pumping and shoulder deterioration. Excess water in the pavement system was believed to be eroding both the iron ore fill in the shoulder and the 2-inch sand cushion under the portland cement concrete pavement. The sites were situated in a vertically curved section of roadway which increased the opportunity for the water to collect. Pertinent data on the sites is given as follows:

Site No.	Project No.	Site Location	Length	Roadway	Construction Date
1	451-05-01	1.5 miles (2.4 km) east of Ruston	950 ft. (289.6 m)	I-20 Westbound	May 30, 1973
2	451-05-10	6.5 miles (10.5 km) west of Ruston	1,000 ft. (304.8 m)	I-20 Eastbound	Aug 18, 1975

Preliminary mix design research was accomplished by the District 62 Laboratory in Hammond, Louisiana. This research is documented in Interim Report No. 1 (5). Trial mixes were selected and used in the construction of a shoulder drainage blanket at site 1. A typical section of the first drainage blanket and its composition are presented in Figure 1 and Table 1, respectively. Reference 5 contains a detailed account of installation procedures. Of noteworthy mention in this report was the inability to achieve the desired compaction, due to the inherent instabilities of the open graded design mixes. Unfamiliarity with the properties of open graded mixes resulted in an initial attempt to roll this section at an elevated temperature. A second attempt was made but the mix had cooled too much to reach an effective density. This lack of proper compaction was manifested in the lateral movement of the section under a static load. The concern generated by these initial instabilities prompted the construction of a second installation.



(1) 10-inch (25.4-cm) Portland Cement Concrete

(2) 2-inch (5.1-cm) Sand Blanket

(3) 6-inch (15.2-cm) Soil-Cement

(4) 2-inch (5.1-cm) Type C Asphaltic Concrete

(5) 5-inch (12.7-cm) Type A Asphaltic Concrete

(6) 5-inch (12.7-cm) Type B Asphaltic Concrete

(7) 2-inch (5.1-cm) Type C Asphaltic Concrete

Asphalt-Treated Shoulder Drainage Blanket

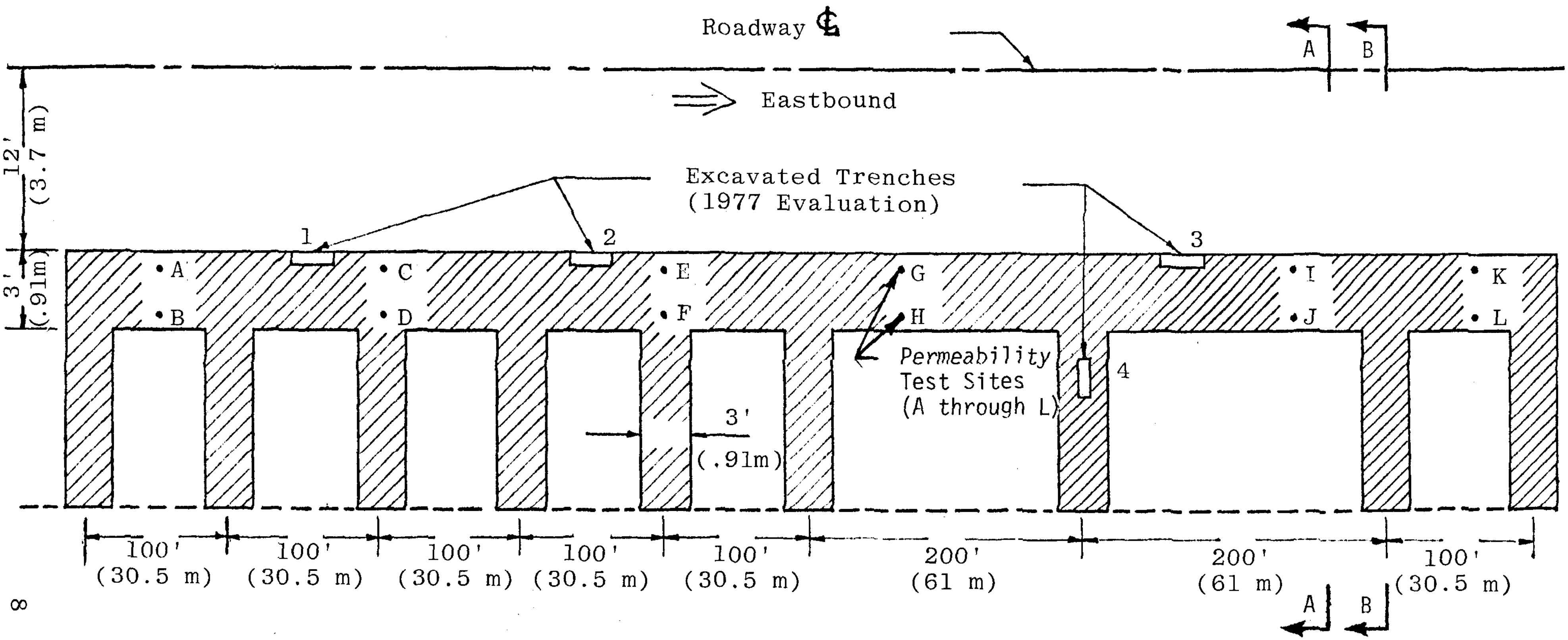
Typical Section - Site No. 1

FIGURE 1

TABLE 1

DRAINAGE BLANKET GRADATIONS
(PERCENTAGE PASSING BY WEIGHT)

Sieve Designation	Shoulder Blanket No. 1			Shoulder Blanket No. 2	
	Type A	Type B	Type C	Type A	Type B
3/4 in (19.0 mm)	97	100	100	100	100
1/2 in (12.5 mm)	90	93	94	96	94
3/8 in (9.5 mm)	68	65	82	77	82
No. 4 (4.75 mm)	20	8	56	28	54
No. 10 (2.0 mm)	8	2	45	14	44
No. 40 (425 µm)	4	1	22	7	26
No. 80 (180 µm)	3	1	12	4	11
No. 200 (75 µm)	2	-	6	3	7
% Asphalt Cement	3.2	2.6	5.1	3.5	4.7



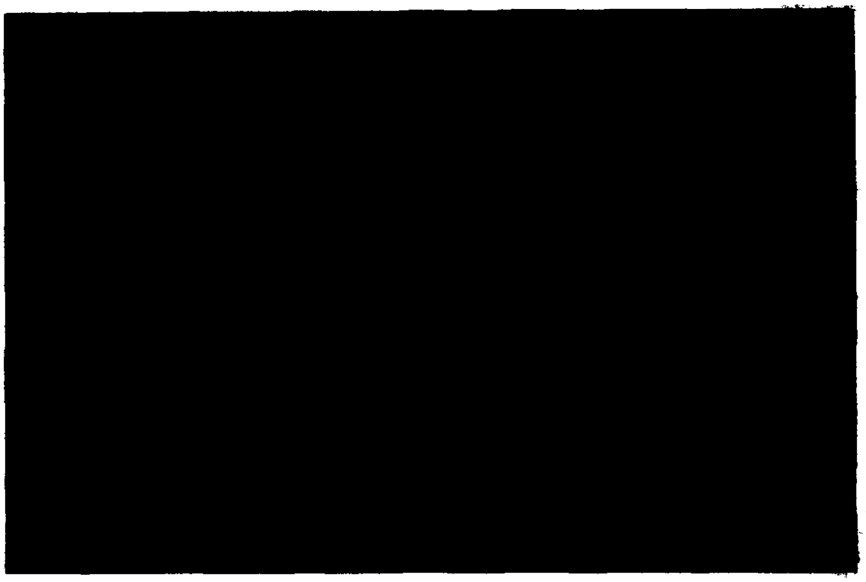
Section 1	Section 2	Section 3
250' (76.2 m)	250' (76.2 m)	500' (152.4 m)
2 3" (7.6-cm) lifts of Type A drainage material	1 6" (15.2-cm) lift of Type A drainage material	1 6" (15.2-cm) lift of Type A drainage material
2 3" (7.6-cm) lifts of Type B wearing course	2 3" (7.6-cm) lifts of Type B wearing course	1 6" (15.2-cm) lift of Type B wearing course
Filter cloth folded over Type A layer	*Filter cloth extended* 5" (12.7 cm) up pavement-shoulder interface	*Filter cloth extended up pavement-shoulder* interface to the surface

Asphalt-Treated Shoulder Drainage Blanket
Plan View - Site No. 2

FIGURE 2

The second drainage blanket was installed in an area similar in geometry to the original site. This particular area had already been considered potentially susceptible to the pooling of water, as french drains had been installed. However, water was remaining in the pavement system and edge pumping could be observed.

A 1,000-foot (304.8-m) section of the shoulder was excavated at site No. 2 for a width of 3 feet (.91 m), with the material being removed down to the soil-cement base course. Lateral trenches were dug to provide drainage into the embankment at the intervals shown in Figure 2. The french drains were uncovered during this excavation. An indication of the cause of their ineffectiveness is shown in Figure 3.



Clogged French Drainpipe

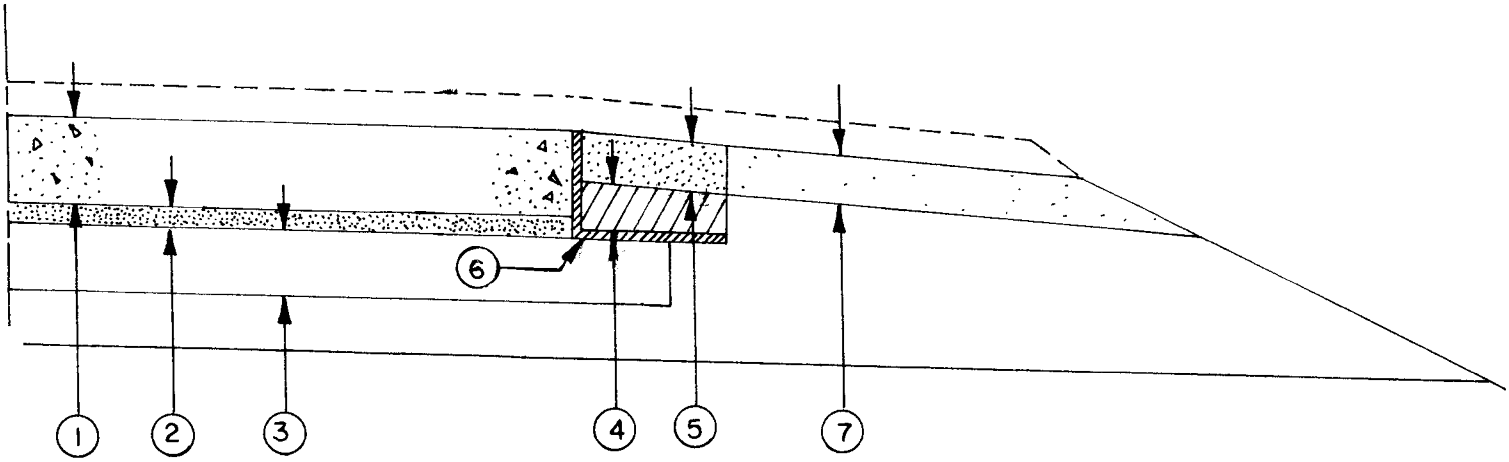
FIGURE 3

Like the original system, this drainage blanket was built in three sections. In the first 250 feet (76.2 m) a filter cloth was first placed over the existing soil-cement base course and extended upward along the edge of the pavement. The Type A drainage layer (see Table 1 for composition of this material and also the Type B wearing course) was placed in 3-inch (7.6-cm) lifts to a depth of 6 inches (15.2 cm). Filter Cloth was then folded over onto the Type A mix to create an overlapping condition. Type B wearing course material was also laid in 3-inch (7.6-cm) lifts in this section.

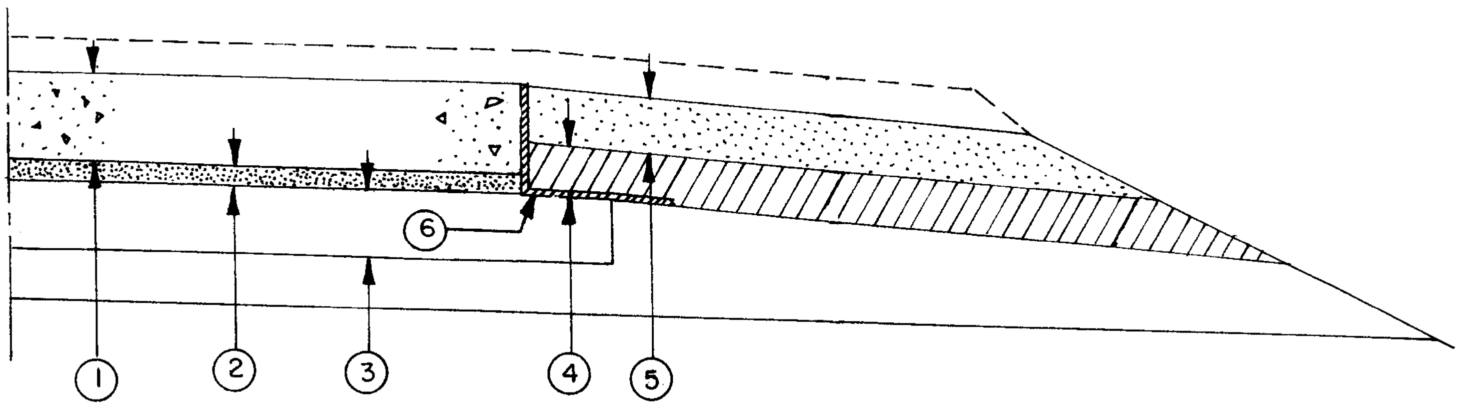
In the second section, consisting of 250 feet (76.2 m), filter cloth was again placed on the soil-cement base course but was extended only 5 inches (12.7 cm) up the pavement-shoulder interface. A 6-inch (15.2-cm) lift of Type A material was followed by two 3-inch (7.6-cm) lifts of Type B wearing course.

The final 500 feet (152.4 m) of the system has single 6-inch (15.2-cm) lifts of both Type A and Type B material. Filter material placement in this section is identical to the second section with the exception that it extends for the full height of the pavement slab.

This drainage blanket took three days in construction. Material was delivered between 245° F (118.5° C) to 300° F (149° C) and was rolled between 175° F (79.5° C) to 200° F (93° C). Construction problems occurred in the section where the wearing course was placed in one 6-inch (15.2-cm) lift. The surface in this section rolled out wavy, presumably due to a nonuniform densification. Typical sections are shown in Figure 4.



SECTION A-A



SECTION B-B

(1) 10-inch (25.4-cm) Portland Cement Concrete

(2) 2-inch (5.1-cm) Sand Blanket

(3) 6-inch (15.2-cm) Soil-Cement Base Course

(4) 6-inch (15.2-cm) Asphaltic-Treated Drainage Layer (Type A)

(5) 6-inch (15.2-cm) Asphaltic Concrete Wearing Course (Type B)

(6) Filter Cloth

(7) Existing Shoulder Base Course and Surfacing

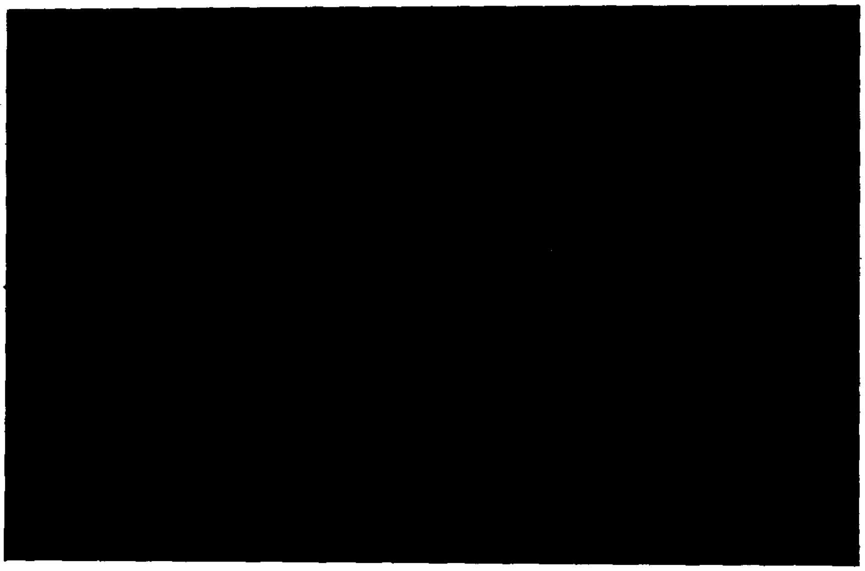
Asphalt-Treated Shoulder Drainage Blanket
Typical Sections - Site No. 2

FIGURE 4

Testing Procedures

Testing methods consisted of dynamic deflection measurements for stability, permeability tests, and faulting measurements to determine the extent of slab movement due to base course or subgrade erosion. Also, trenches were excavated for observing the effectiveness of the filter cloth material in areas where edge pumping was evident.

Permeability tests were conducted using a falling head method. A metal gallon can with the bottom removed was placed on the mix and weighted with a steel plate (Figure 5). Grease was applied around the base of the can to form a seal. Measured volumes of water were poured in the can while the elapsed time to empty was recorded. Because of extremely fast dispersement into blanket No. 1, only several test locations were measured. Permeability tests at the second blanket were conducted at six locations. Tests were taken in pairs at each location, with one test 6 inches (15.2 cm) from the pavement and the other at 2.5 feet (.76 m) (Figure 2, A through L).



Permeability Testing Device

FIGURE 5

Dynamic deflection measurements were taken with the Dynaflect Deflection Determination System. The sampling procedure consisted of readings located every hundred feet for the entire length of the drainage sections. Readings were also taken on the roadway shoulders adjacent to the trial section for comparative purposes.

Faulting measurements were conducted on the pavement joints adjacent to drainage blanket No. 2 and on the corresponding joints on the opposite-bound pavement. The sampling procedure included measurements on the edges of the pavement, center of pavement and center of both lanes.

Trenches were excavated at both drainage facilities for examining the drainage layers for infiltration by foreign material. The excavations extended several feet from the pavement-shoulder interface to a depth consistent with the soil-cement base course. Care was taken not to disturb the filter cloth material on blanket No. 2. The filter cloth was examined for clogging and any evidence of sand or iron ore was noted.

DISCUSSION OF RESULTS

Shoulder Drainage Blanket No. 1

The original scope of this study made provisions for the construction of an asphalt-treated shoulder drainage blanket on a section of Interstate 20 east of Ruston, Louisiana. Remedial action had been dictated by shoulder deterioration in this area. A laboratory investigation yielded what was thought to be a viable drainage blanket mix. This design mix was placed in 1973, according to the account given in the first interim report (5).

Shortly after construction it became apparent that this design mix was unstable. Under a static load (truck located near pavement-shoulder joint), the drainage blanket was observed to displace laterally. The unstable nature of this mix was reinforced by high deflection readings, obtained with the Department's Dynaflect. Within six months after construction, a continuous surface patch had been placed along the shoulder edge adjacent to the pavement. Additional surface patches were necessitated by indentations due to truck traffic. Although the stability was not as expected, the mix was so permeable that the available equipment could not measure the flow rate. A decision was made at that time to concentrate efforts towards a new installation with a mix consisting of more fines to stabilize the blanket.

In February, 1975, a second evaluation was conducted at the first site. This evaluation was prompted by edge pumping observations. Three trenches approximately 2 feet (.61 m) wide and 14 inches (35.6 cm) deep were excavated. Two were in areas exhibiting signs of edge pumping, and one was in an area showing no sign of pumping. The vertical walls of the first two trenches (pumping areas) contained sand intrusion extending 3 inches (7.6 cm) into the upper layers and 6 inches (15.2 cm) into the lower layers of the shoulder. The third trench (no pumping) contained only traces of sand on the shoulder wall. Thus a condition of lateral movement of the sand cushion from under the concrete pavement to the drainage blanket was creating a dam effect, allowing the water to collect at the pavement-shoulder joint. This discovery was supported by permeability testing. It was found that the permeability of the drainage blanket near the shoulder-pavement interface had substantially decreased.

Shoulder Drainage Blanket No. 2

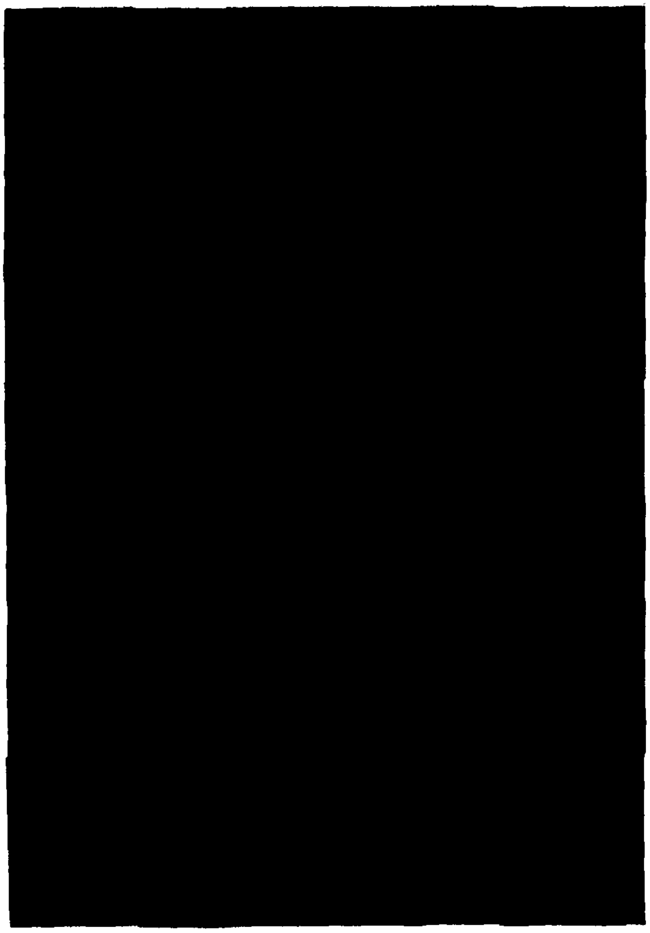
In August, 1975, the second drainage blanket was constructed west of Ruston with what was considered to be a more stable design mix. A filter cloth was utilized in the installation of this blanket to prevent the infiltration of sand particles found in the first drainage blanket. The filter material was placed as noted previously in the Methodology.

An evaluation was conducted on the second drainage blanket in March, 1976, approximately six months after construction. A period of steady rainfall occurred during this evaluation, during which time the drainage blanket was observed to be draining at all nine outlets. After the rain stopped the following day, very little water was seen, indicating that the water had passed through quickly. Cores taken directly over the shoulder joint were examined and indicated that the filter cloth had not become clogged with fines.

Permeability tests were considered to be another means of examining the effectiveness of the filter cloth. It was felt that particle intrusion could be substantiated by a decrease in permeability values. The data reflected, however, that such tests may not provide an accurate analysis of the filter cloth, as the tests did not prove repeatable. Adjacent test locations did not yield the expected similar results. Thus the value of yearly tests to produce data to be used in a comparative mode was considered limited. Yet it was felt that the drainage blanket could be characterized by a range of permeability values. This range for blanket No. 2 was found to be 2,800 to 8,500 ft/day (853.4 to 2,590.8 m/day) as opposed to 17,000 to 22,600 ft/day (5,181.6 to 6,888.5 m/day) for the original drainage blanket. The permeability of blanket No. 1 was reduced to 5,700 ft/day (1,737.4 m/day) for those sections reported above as experiencing sand infiltration. This appears to be comparable to blanket No. 2. However, the filter cloth of blanket No. 2 should continue to halt the influx of foreign material into the drainage system, thus maintaining the current flow rate while blanket No. 1 will experience a further reduction in flow rate as more sand infiltrates the system.

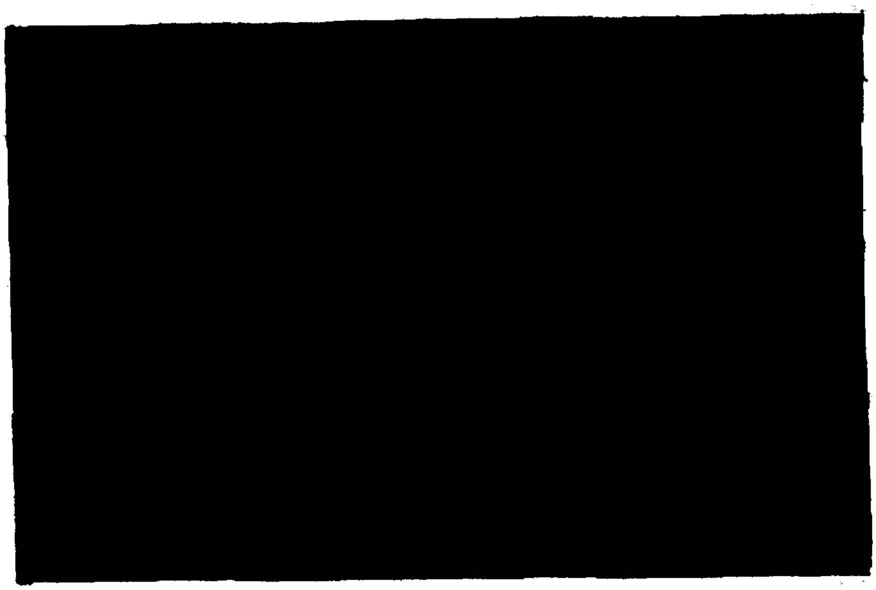
During this evaluation, faulting measurements were taken on the roadway of blanket No. 2 adjacent to the shoulder drainage blanket. For comparative purposes, measurements were taken on the pavement opposite the experimental section. Readings were taken at both outside edges, the center of the lanes and the center of the roadway. It was believed that future readings consistent with the original readings would be indicative of a successful drainage facility.

A final evaluation was conducted approximately 20 months after construction in March, 1977. It consisted of deflection measurements on both drainage blankets, along with faulting measurements and excavations on blanket No. 2. This evaluation occurred several days after a heavy rainfall. Visual observations were made upon arrival at the second installation. The pavement joint material had deteriorated beyond the failure mode, so that the opportunity for excess surface water to percolate into the base existed. There were no signs of staining or edge pumping, however, indicating that the drainage system was operating effectively. The embankment surrounding the outlets was moist, showing that the excess water was being properly channeled out of the pavement-shoulder system. Faulting measurements uncovered little or no slab movement. It is believed that the differences in readings between this evaluation and that of March, 1976, were small enough to be within reading error.



Faulting Along Pavement-Shoulder Interface

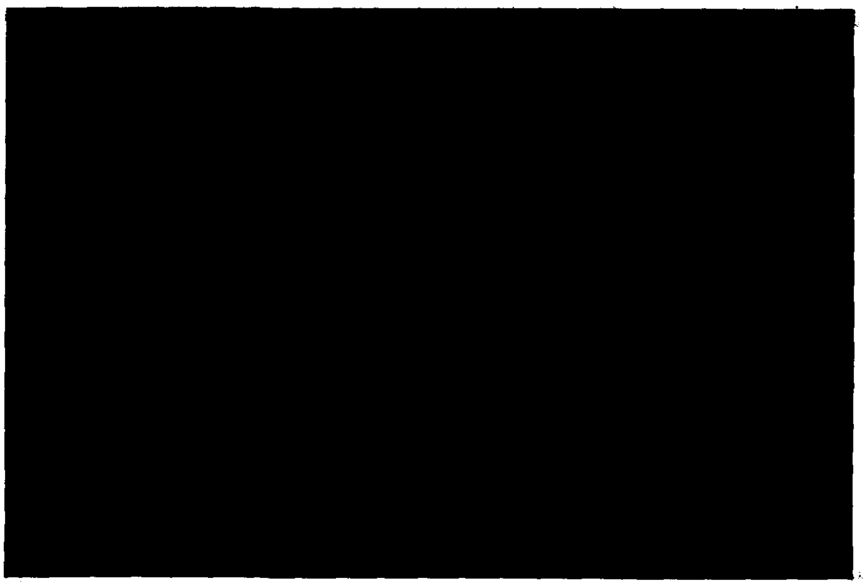
FIGURE 6



Sand Pumping

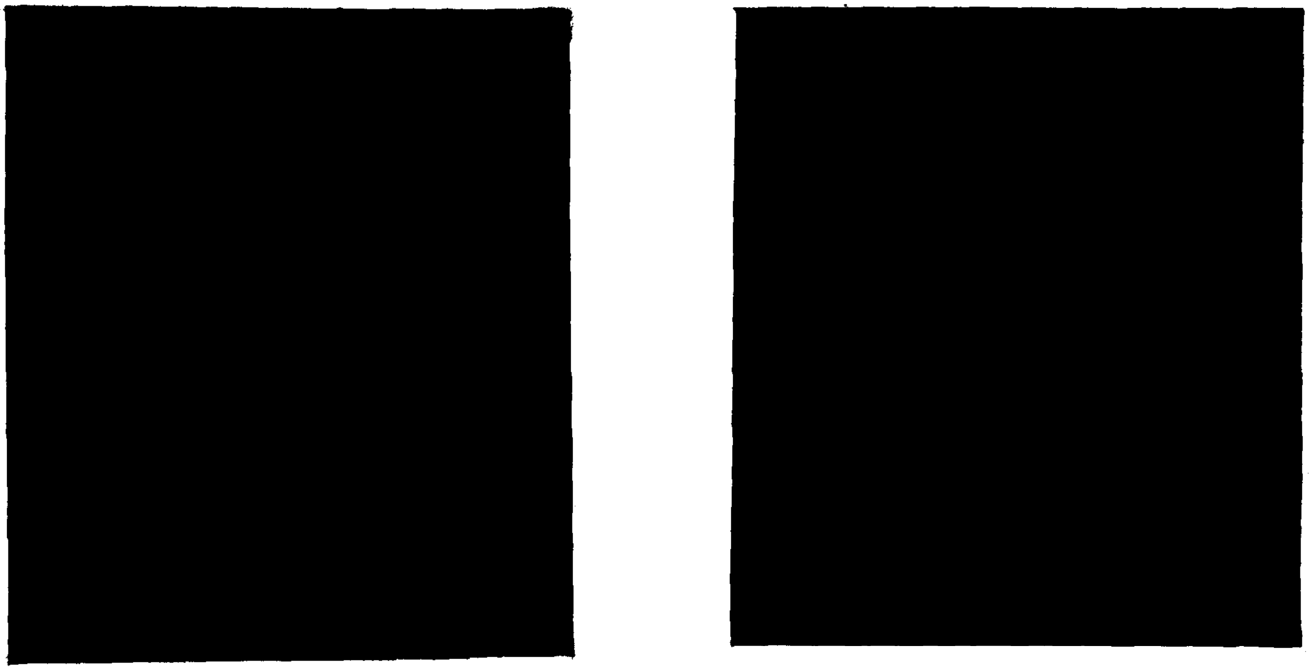
FIGURE 7

In contrast, the opposite roadway exhibited conditions calling for remedial maintenance in the near future. Substantial faulting was noted at the pavement-shoulder interface (Figure 6) along with isolated areas exhibiting sand pumping (Figure 7). As can be seen in Figure 8, water was still being pumped through the longitudinal and transverse joints several days after the rainfall. At this particular joint the pavement slabs had faulted 1/4 inch (.64 cm) in one year.



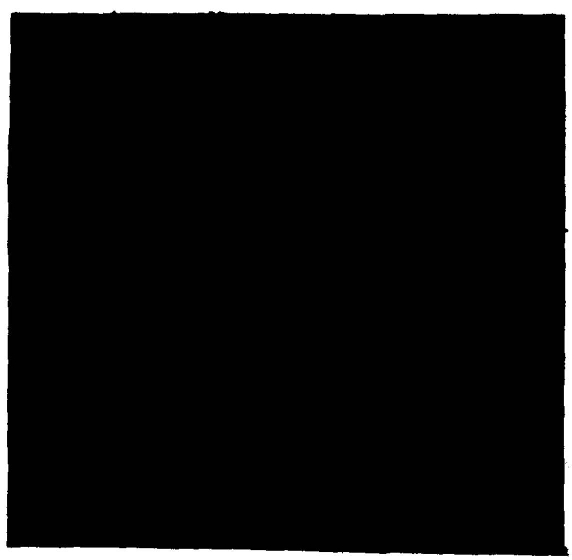
Longitudinal and Transverse Joint Water Pumping

FIGURE 8



Filter Fabric - Trench 3

FIGURE 9



Filter Fabric - Trench 2

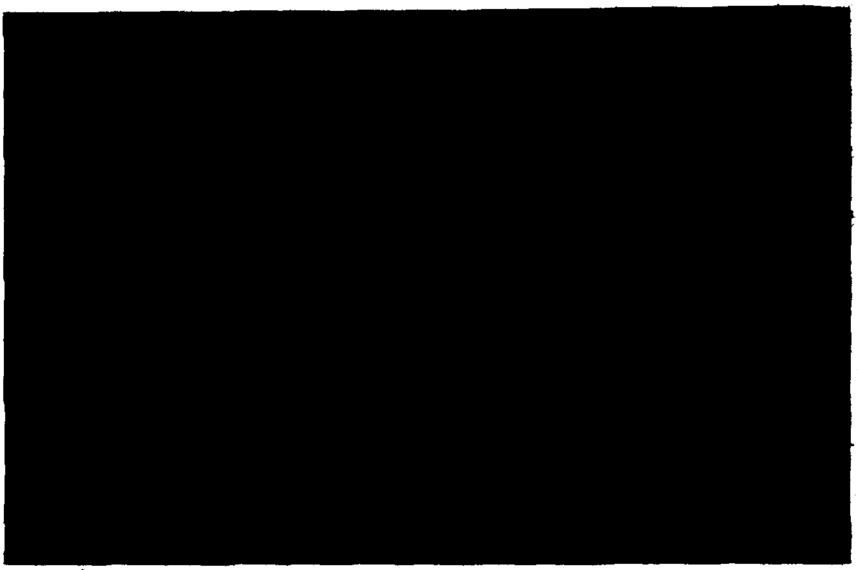
FIGURE 10

Department maintenance forces excavated three trenches at the pavement-shoulder interface of the second test site. Research personnel then inspected the exposed system to evaluate the effectiveness of the filter cloth in preventing foreign materials from clogging the open-graded, asphalt-treated drainage layer. Figure 2 shows the locations of these three trenches, plus that of a fourth trench created in order to inspect the drainage layer at a lateral.

Research personnel discovered that soil had permeated the drainage layer at all three sites next to the pavement edge. The soil which did intrude into the drainage layer was fine grained, not believed to be part of the sand blanket originally placed beneath the pavement, but possibly degraded soil-cement or roadway grit. No soil was found in the lateral.

Soil had migrated 1 inch (2.5 cm) laterally into the drainage layer at trench No. 3, located 750 feet (228.6 m) from the west end of the test section. At this point the filter cloth underlies the drainage layer and lines the entire face of the pavement-shoulder interface. Figure 9 illustrates the position of the filter cloth with respect to the edge.

Soil had traveled 4 to 5 inches (10.2 to 12.7 cm) with respect to the longitudinal shoulder joint into the drainage layer at trench No. 2, located 350 feet (106.7 m) from the west end of the test section. At this location, the design stipulated that the filter cloth would underlie the drainage layer and line the lower 5 inches (12.7 cm) of the pavement-shoulder interface. Research personnel noted in this second trench that the filter cloth had dropped from the pavement edge and folded upon itself during construction of the drainage layer. Nevertheless, the position of the filter cloth as folded should have prevented the travel of soil particles beneath the pavement into the drainage blanket. Moreover, the inside fold shown in Figure 10 would indicate that soil particles did not travel



Filter Fabric - Trench 1

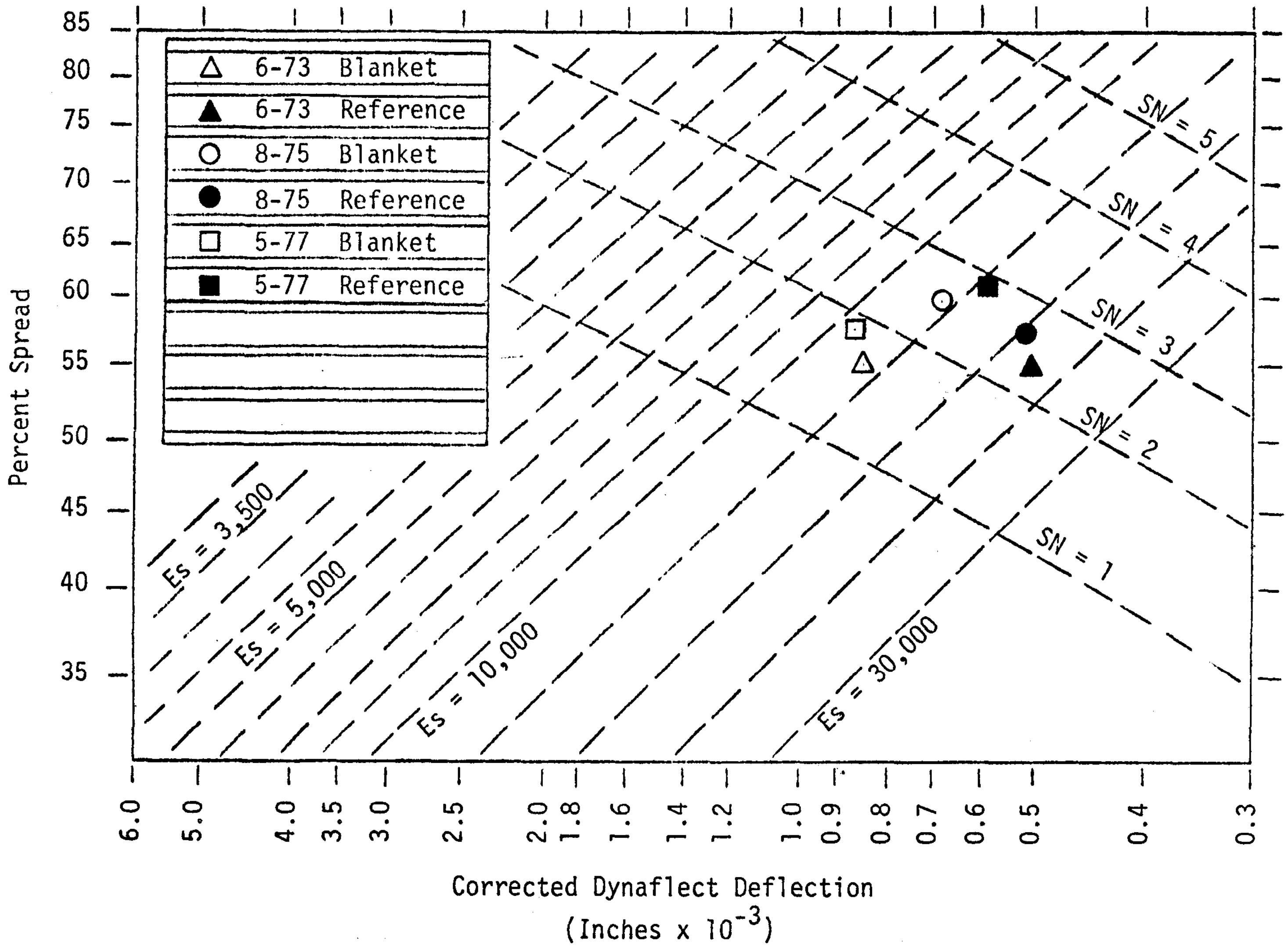
FIGURE 11

through the filter cloth. The large volume of rainfall [approximately 71 inches (180.3 cm)] to which this pavement system was subjected during the twenty-month evaluation period may have enabled the soil particles to circumvent the filter cloth and enter the drainage layer.

Soil particles had intruded into the drainage blanket for a distance of 7 to 8 inches (17.8 to 20.3 cm) from the shoulder joint at trench No. 1 near the west end of the test section. At this location, the filter cloth envelopes the bottom, top, and pavement edge side of the drainage layer. That portion of the filter cloth adjacent to the pavement was soiled, appearing to have permitted the entrance of foreign particles into the drainage layer (Figure 11).

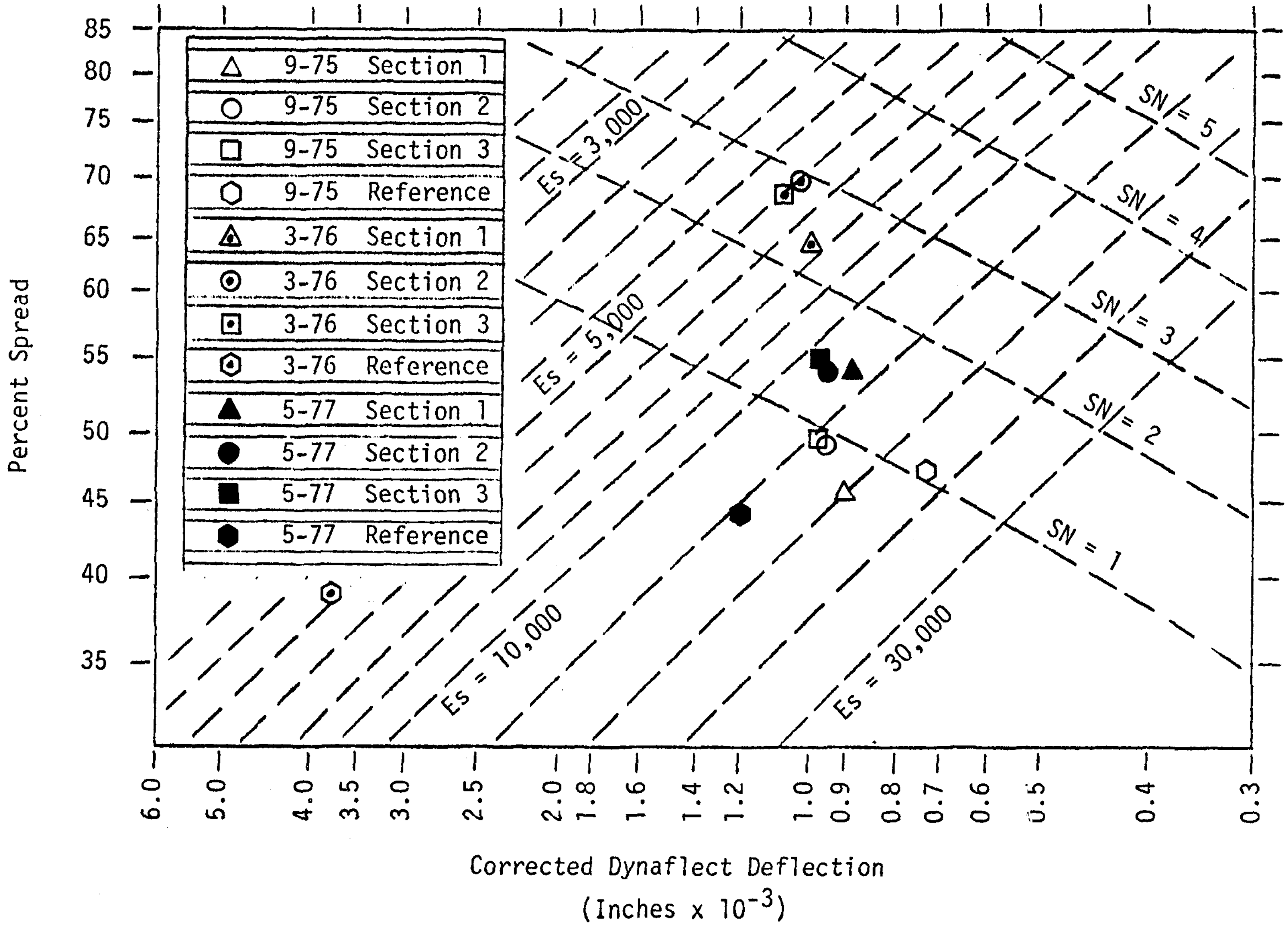
Figures 12 and 13 present the Department's Pavement Evaluation Chart (4) annotated to relate deflection data from drainage blankets 1 and 2 respectively. The chart translates deflection data into the more usable parameters of subgrade modulus Es and structural number SN. The chart is an excellent tool for monitoring time-relative strength changes.

The data points of Figures 12 and 13 represent averages of the deflection values obtained in the sampling program, as previously described in the Methodology. Deflection analyses showed that no structural advantage was obtained by constructing the drainage blanket in separate lifts. Two-year strength in terms of structural number was slightly greater for drainage blanket No. 1 presumably due to the aging of the asphalt. (Insufficient temperature data is responsible for the uncharacteristic data presented in Figure 13 for the March, 1976 evaluation.)



Pavement Evaluation Chart
Shoulder Drainage Blanket No. 1

FIGURE 12



Pavement Evaluation Chart
Shoulder Drainage Blanket No. 2

FIGURE 13

CONCLUSIONS

1. The asphalt-treated mix of the second trial drainage blanket, which was protected by filter cloth, appears to be sufficiently permeable to remove excess water from the pavement system. This mix exhibited acceptable stability as well.

2. Maintenance problems related to excess water buildup can be postponed through the use of asphalt-treated, filter cloth protected, shoulder drainage blankets.

3. The lateral movement of the 2-inch (5.1-cm) sand cushion layer which was observed at the first trial drainage blanket can be remedied by the use of filter cloth. As observed at the second installation, no sand had infiltrated the drainage layers.

4. A minimum amount of sand infiltration occurred where the filter material underlies the drainage layer and lines the pavement-shoulder interface to the surface.

5. Construction of the drainage layer in one or separate layers yielded similar structural strengths. However, it should be noted that nonuniform densification occurred when the drainage layer was laid in one lift.

RECOMMENDATIONS

1. Additional performance data should be collected in order to establish time-dependent characteristics of the design mix and the filter cloth material.

2. Further study is needed in the subsurface drainage system area. The use of shoulder drainage blankets, underdrain pipe and full width blankets, either separately or as integrated systems, should be examined with regard to performance and cost in both the new-construction and maintenance modes.

3. In order to achieve the desired stability and permeability of drainage blanket No. 2, it is proposed that the following aggregate gradation be specified on all future shoulder drainage blanket designs:

U.S. Sieve	Percent Passing by Weight
1"	100
3/4"	90 - 100
1/2"	75 - 95
3/8"	55 - 75
No. 4	20 - 35
No. 10	10 - 20
No. 80	0 - 5
% Asphalt	1 - 4

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APPENDIX A

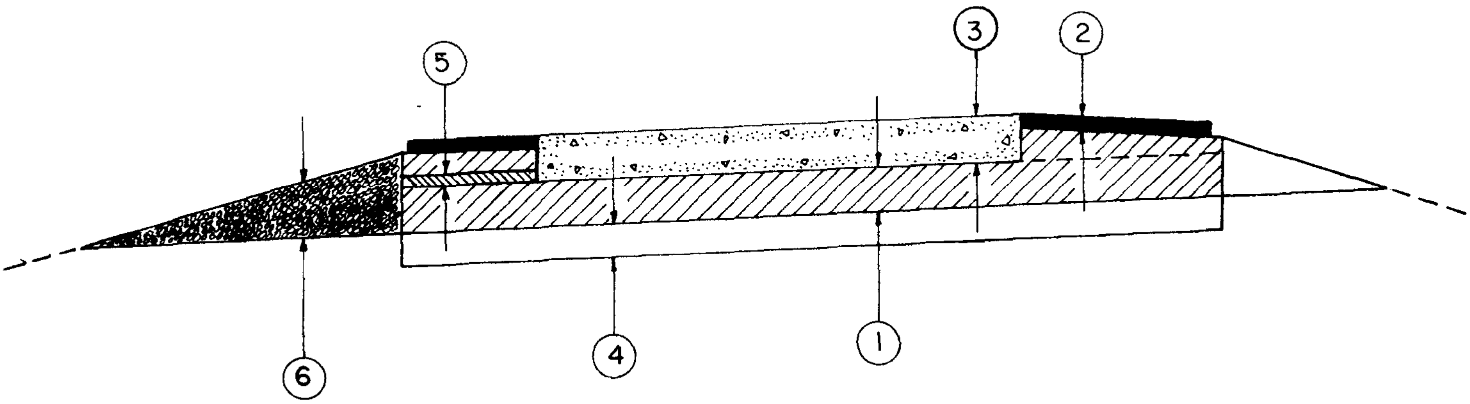
IMPLEMENTATION OF ASPHALT-TREATED SHOULDER DRAINAGE SYSTEMS INCLUDING A FULL-ROADWAY-WIDTH EXPERIMENTAL SECTION

IMPLEMENTATION OF ASPHALT-TREATED SHOULDER DRAINAGE SYSTEMS INCLUDING A FULL-ROADWAY-WIDTH EXPERIMENTAL SECTION

Construction of an asphalt-treated, shoulder drainage blanket has been implemented on Interstate 20 between Tallulah and Mound in North Louisiana (State Project 451-08-11) prior to the completion of the drainage blanket study. A 2-inch (5.1-cm) thick asphalt blanket of the following composition has been placed for the entire length of the project.

U.S. Sieve	Percent Passing
1 inch (25.4 mm)	100
3/4 inch (19.0 mm)	90-100
1/2 inch (12.5 mm)	70-100
3/8 inch (9.5 mm)	50-80
No. 4 (4.75 mm)	10-35
No. 10 (2.0 mm)	0-20
No. 80 (180 μm)	0-5
% A.C.	1-4

Included in the above project is a 1500-foot (457.2-m) section incorporating a full-roadway-width drainage blanket as an integral part of the base course. Typical sections are presented in Figures 14 and 15. As indicated in the section, the full-width blanket is 2 inches (5.1 cm) in thickness and extends between stations 223+00 and 238+00. Densification of the blanket was achieved in a two-pass process by a 10-ton tandem roller. The first pass was for breakdown. The second pass was made for dress-up purposes. It was felt that further compaction would have overdensified the material. While the portland cement concrete surface was being constructed, water was sprayed on the drainage surface in an attempt to prevent the material's absorption of moisture from the concrete. Shortly thereafter, the water was observed as runoff on the embankment.



(1) Asphaltic Concrete Base Course

(2) 1 1/2-inch (3.8-cm) Asphaltic Concrete Wearing Course

(3) 10-inch (25.4-cm) Portland Cement Concrete Pavement

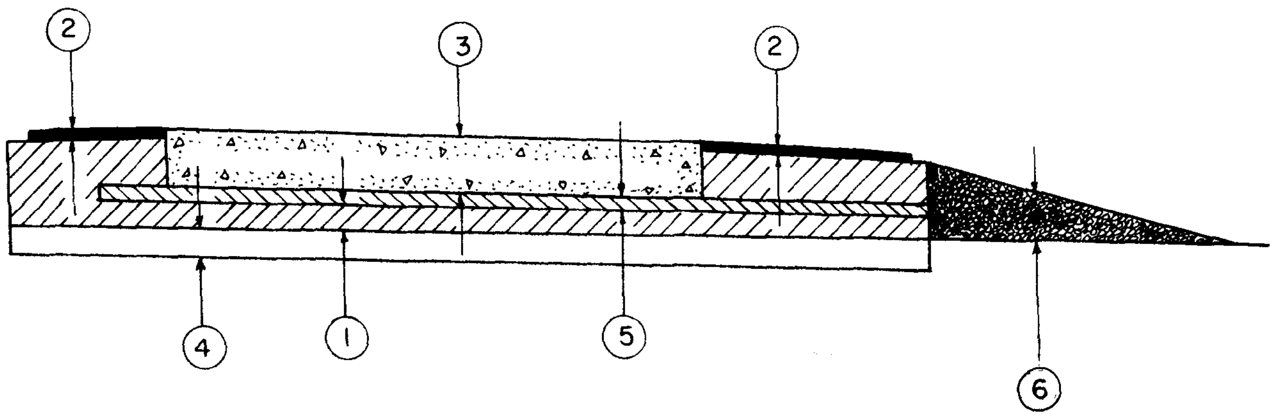
(4) 8-inch (20.3-cm) Subbase (Top 6 inches (15.2 cm) Treated with Lime or Cement)

(5) 2-inch (5.1-cm) Asphaltic-Treated Drainage Layer

(6) Aggregate Surface Course (Non-Plastic)

Asphalt Treated Shoulder Drainage Layer
Typical Section

FIGURE 14



(1) Asphaltic Concrete Base Course

(2) 1 1/2-inch (3.8-cm) Asphaltic Concrete Wearing Course

(3) 10-inch (25.4-cm) Portland Cement Concrete Pavement

(4) 8-inch (20.3-cm) Subbase (Top 6 inches (15.2 cm) Treated with Lime or Cement)

(5) 2-inch (5.1-cm) Asphaltic-Treated Drainage Layer

(6) Aggregate Surface Course (Non-Plastic)

Full-Roadway-Width Drainage Blanket
Typical Section

FIGURE 15

Concern was expressed prior to construction regarding the stability of the full width blanket. It would have to be able to withstand construction service truck loading without being overcompacted. Also, this layer was replacing 2 inches (5.1 cm) of a structural section of the pavement system. Would the drainage layer be an effective replacement? Overdensification occurred only along the edge of the drainage layer. Under the direction of the project engineer, these areas were removed and replaced.

After the concrete was laid and had set, deflection readings were taken at 100-foot (30.5-m) intervals. In addition, the adjacent pavement was tested. Shoulder, outside lane and inside lane locations were used in the sampling. The preliminary findings show that the 2-inch (5.1-cm) drainage layer provides support equivalent to the pavement system consisting entirely of black base.

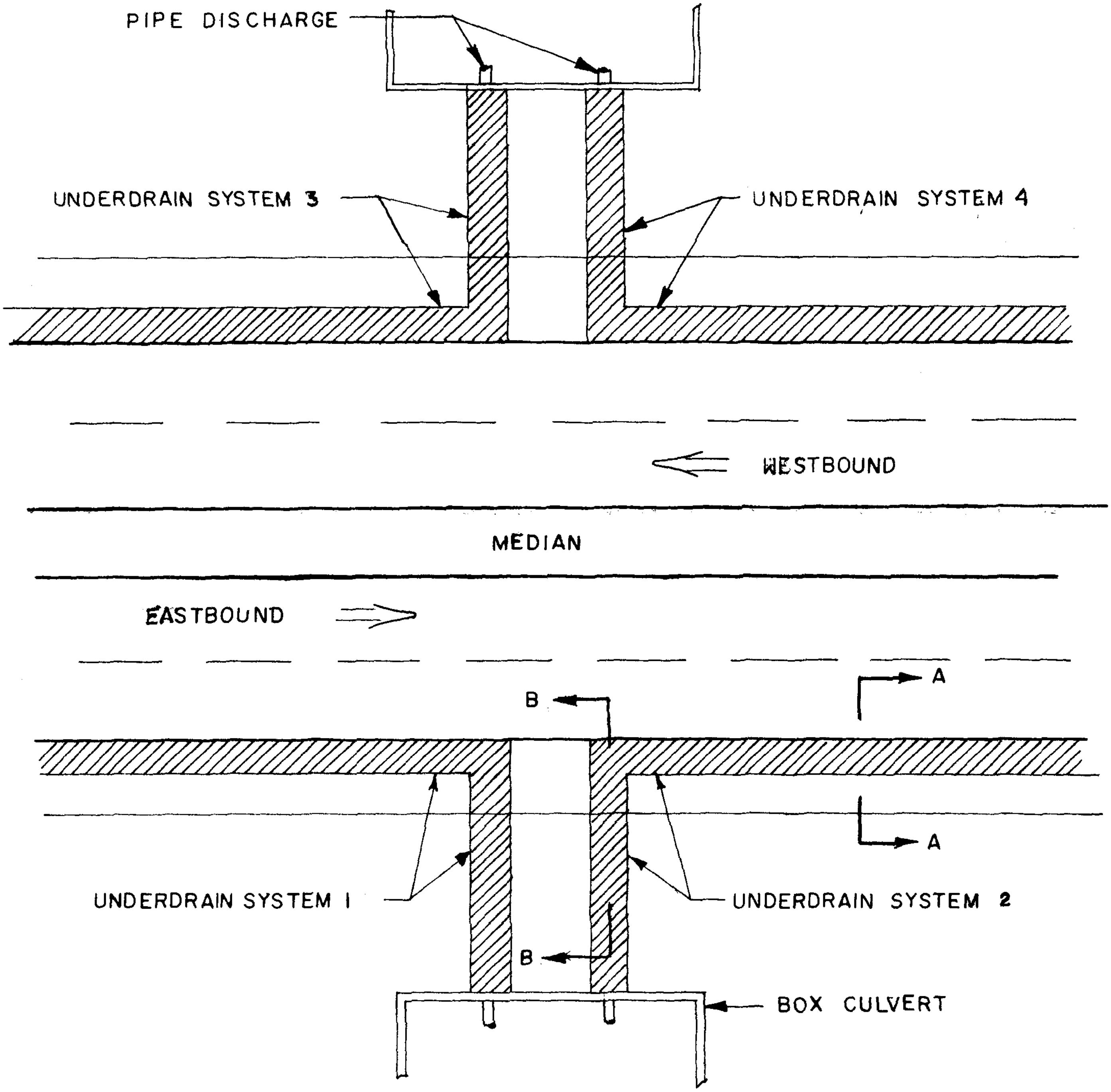
APPENDIX B

PERFORATED PIPE UNDERDRAIN SYSTEMS

PERFORATED PIPE UNDERDRAIN SYSTEMS

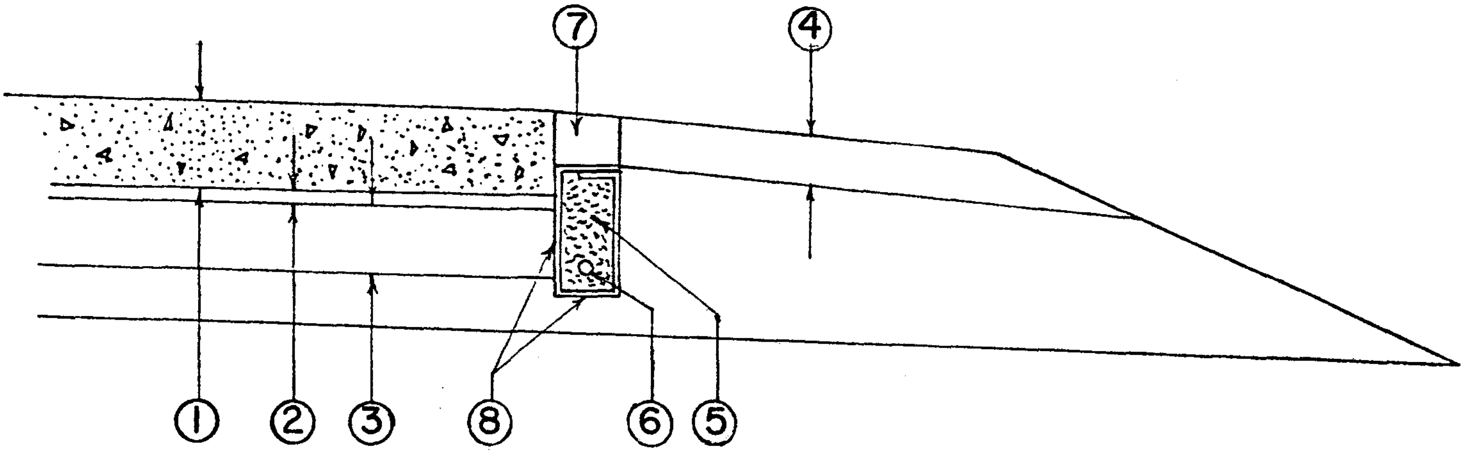
It is believed that the importance of subsurface drainage systems to maintain pavement system integrity dictates the inclusion in this study of another type of system not in the original scope. Specifically, this system involves the use of perforated drainage pipe in a shoulder trench backfilled with various filtering materials. Four distinct pipe underdrain systems have been constructed along Interstate 20 in North Louisiana. A plan view and typical sections are shown in Figures 16 and 17 and a capsule breakdown of composition is as follows:

Under-drain System No.	Roadway E-Eastern End W-Western End	Filter Cloth Material	Backfill Material	Trench Dimensions	Lateral Length
1	Eastbound (W)	Separate	Washed gravel, large	8 1/2"x24"x110' (21.6 cm x 61 cm x 33.5 m)	60' (18.3 m)
2	Eastbound (E)	Separate	Pea gravel	8 1/2"x24"x105' (21.6 cm x 61 cm x 32 m)	60' (18.3 m)
3	Westbound (W)	Attached	Concrete sand	9"x24"x100' (22.9 cm x 61 cm x 30.5 m)	70' (21.3 m)
4	Westbound (E)	Attached	Concrete sand	9"x14"x100' (22.9 cm x 61 cm x 30.5 m)	70' (21.3 m)

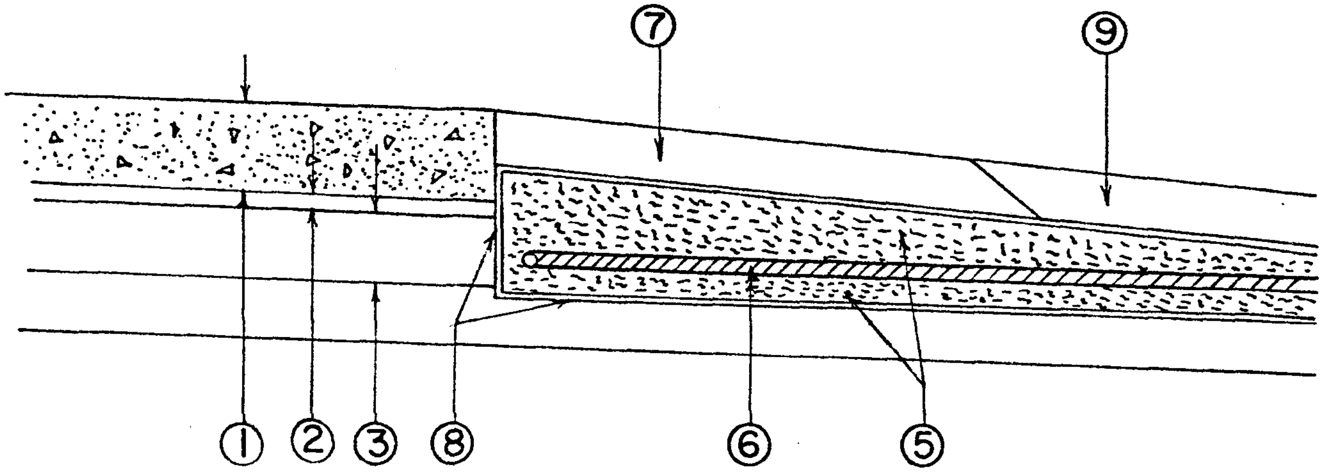


Pipe Underdrain Systems
Plan View

FIGURE 16



SECTION A-A



SECTION B-B

① EXISTING P.C.C. PAVEMENT
② EXISTING SAND BLANKET
③ EXISTING SOIL-CEMENT BASE COURSE
④ EXISTING SHOULDER
⑤ DRAINAGE MATERIAL
⑥ PERFORATED OR SLOTTED POLYETHYLENE PLASTIC CORRUGATED UNDERDRAIN
⑦ ASPHALTIC CONCRETE WEARING COURSE
⑧ FILTER CLOTH
⑨ SOIL BACKFILL

Pipe Underdrain Systems
Typical Sections

FIGURE 17

Trenches were excavated to the above indicated dimensions. Each trench used 3-inch (7.6-cm) diameter slotted polyethylene plastic pipe as its mode of conveyance. Rolled filter cloth material (designated as "separate" above) completely lined the inside of the trenches of systems 1 and 2, while systems 3 and 4 utilized a filter cloth which was factory-attached to the pipe. After placement of the pipe, washed gravel and pea gravel were used to backfill systems 1 and 2 respectively to within 6 inches (15.2) cm) of the surface along the pavement. The filter cloth was then overlapped to enclose the pipe and backfill material. This lapping should be away from the pavement to prevent water from entering the lap with contaminating elements. The trenches were completed at the pavement edge with hot mix. A hand-pushed vibratory roller was used for compaction. Laterals were constructed similarly with soil backfill finishing the trenches. The laterals were located at the bottom of vertically curved sections and their contents were deposited into box culverts.

Systems 3 and 4 were constructed in much the same manner, using sand as backfill. The construction crew noted that the factory-wrapped pipe provided easier installation, although the filter fabric appeared to be more fragile than the separate filter cloth, as tears due to handling had to be mended.

The discharge rates have been monitored under varying types of rainfall. At the time of writing it is felt that insufficient data has been collected to report significant findings. However, the following notations are made. First, system 1 consistently maintains the best flow rate. Discharge is observed soon after rainfall begins (and ceases more quickly than the discharge from the other systems), characteristic of good drainage design. Secondly, system 3 functions only in the heaviest rains. This is the system with the deep sand trench. The possibility exists that water is pooling in the sand below the pipe. Excavation will probably be needed to verify this point of view.