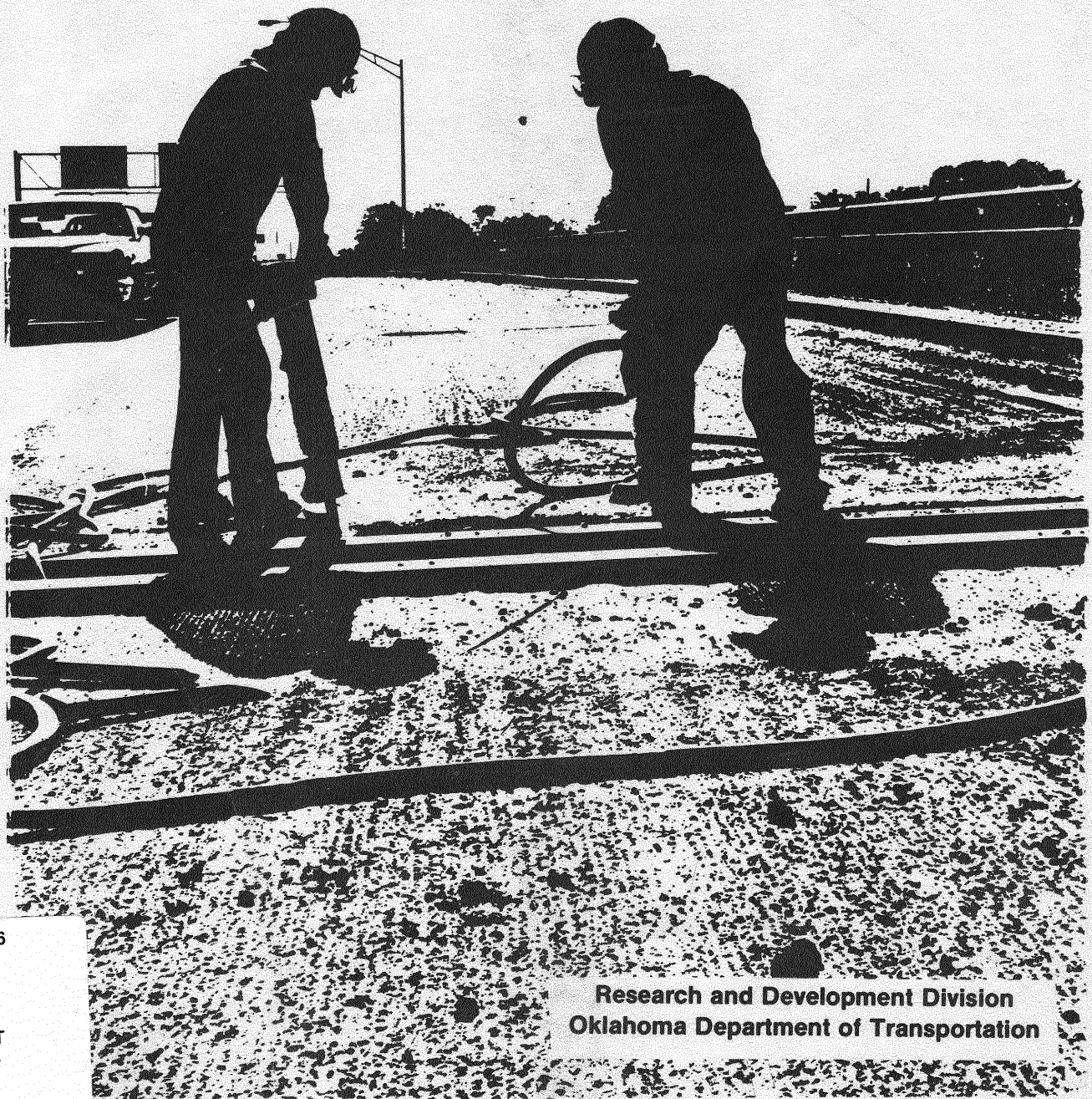


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# BRIDGE DECK REHABILITATION

PART 2 Oklahoma's Experience with Bridge  
Deck Protective Systems



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BRIDGE DECK REHABILITATION: METHODS AND MATERIALS  
PART 2  
OKLAHOMA'S EXPERIENCE WITH BRIDGE DECK PROTECTIVE SYSTEMS

By

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OKLAHOMA CITY, OKLAHOMA

June 1978



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|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                              |                                                                                                                                                                   |           |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| 1. Report No.<br>71-04-1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 2. Government Accession No.                  | 3. Recipient's Catalog No.                                                                                                                                        |           |
| 4. Title and Subtitle<br>Bridge Deck Rehabilitation: Part II<br>Oklahoma's Experience with Bridge Deck<br>Protective Systems                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                              | 5. Report Date<br>June 1978                                                                                                                                       |           |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                              | 6. Performing Organization Code                                                                                                                                   |           |
| 7. Author(s)<br>Phillip M. Ward                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                              | 8. Performing Organization Report No.<br>71-04-1                                                                                                                  |           |
| 9. Performing Organization Name and Address<br>Oklahoma Dept. of Transportation<br>Research Division<br>200 NE 21<br>Oklahoma City, OK 73105                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                              | 10. Work Unit No.                                                                                                                                                 |           |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                              | 11. Contract or Grant No.<br>71-04-1                                                                                                                              |           |
| 12. Sponsoring Agency Name and Address<br>Federal Highway Administration<br>200 NW Fifth, Room 454<br>Oklahoma City, OK 73102                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                              | 13. Type of Report and Period Covered<br>Type A<br>July 1971 - June 1978                                                                                          |           |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                              | 14. Sponsoring Agency Code                                                                                                                                        |           |
| 15. Supplementary Notes<br><br>Done in cooperation with the Federal Highway Administration                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                              |                                                                                                                                                                   |           |
| 16. Abstract<br><br>The objectives of this project were to study the factors involved in bridge deck deterioration and to formulate and evaluate techniques to prevent or halt such deterioration.<br><br>Part II of this project was concerned with the evaluation of two types of bridge deck protective systems; waterproof membranes and latex modified Portland Cement concrete overlays. This report contains construction and electrical resistance data on nine different membrane systems applied to 35 structures.<br><br>Also included is construction data on latex modified overlays applied to 5 structures. One of these structures is six years old and the results of the yearly bridge surveys are included. |                                              |                                                                                                                                                                   |           |
| 17. Key Words<br>Bridge deck, deterioration, waterproof membranes, electrical resistance testing, latex modified concrete overlay.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                              | 18. Distribution Statement<br>No restrictions. This document is available to the public through the National Technical Information Service, Springfield, VA 22161 |           |
| 19. Security Classif. (of this report)<br>None                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 20. Security Classif. (of this page)<br>None | 21. No. of Pages<br>151                                                                                                                                           | 22. Price |

## ACKNOWLEDGEMENT

I would like to acknowledge the assistance provided by Billy D. Cole under whose direction most of the electrical resistance data was gathered and compiled. I would also like to acknowledge the many crew members working under Mr. Cole's direction for their efforts on behalf of this project.



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## INTRODUCTION

In the fall of 1973 the Oklahoma Department of Highways, with the encouragement of the Federal Highway Administration, began a policy of placing a protective course on all new bridge structures. The intent of this protective course was to prevent the intrusion of deicing salts into the bridge deck that would subsequently lead to premature deterioration of the structure. Through the auspices of the National Experimental Evaluation Program (NEEP) the Highway Department began to schedule newly constructed bridges to receive applications of waterproof membrane and Latex modified Portland Cement concrete overlays.

In 1973 only one membrane was accepted as non-experimental by the FHWA, that one being a poured-in-place membrane consisting of alternating layers of coal tar emulsion and fiberglass mesh. However, one of the primary goals of NEEP was to get as much experience with as many membranes as possible in the shortest time. To facilitate the obtaining of this objective the states were encouraged to try different types of membranes. Rather than start out on a laboratory testing program, it was decided to send questionnaires to the various states concerning their membrane usage and then schedule applications of products that had met with success elsewhere. These questionnaires were sent and some 24 states replied. Out of these replies the membranes with the best record of use and success were Bituthene, manufactured by W. R. Grace Company, and Protecto Wrap M-400 manufactured by the Protecto Wrap Company.

These two, along with the approved coal tar emulsion membrane, formed the core of the early membrane attempts. Soon other membranes were added to the "will try" list for one reason or another. Eventually nine different types of membranes were tried.

During this same period of time a great deal of interest was shown in using Latex modified Portland Concrete cement overlays as protective treatments. This interest stemmed from the apparent success that many north central and north eastern states had experienced with this product. In 1972, two Oklahoma structures were scheduled for rehabilitation with this overlay and at the same time, a new structure received the same type of overlay as a preventative measure. These overlays have been surveyed yearly since 1972 and the results of these surveys along with construction data on the single new structure are reported (Construction details and results of the annual surveys of the rehabilitated structures may be obtained from the Research Division of the Oklahoma Department of Transportation).

Four new structures received Latex modified overlays in late 1975. Construction details on these structures are reported along with the results of a visual survey conducted approximately two years after their construction. Performance criteria for waterproof membranes was based on Electrical Resistance Testing and stability of the wearing course.

The performance of the Latex modified overlays is based on surface appearance and integrity, number and extent of delaminations, and half-cell potential. Other data sources may be used in the future such as core drill information relating to extent of rebar corrosion, linear transverse data on the cores obtained and chloride analysis of the overlays and substrata. This latter source may be of dubious value in the case of the overlay poured in 1972 as the Latex used contained a soluble chloride.

The membrane systems are listed alphabetically by brand name. When several projects were reported utilizing the same membrane, they are listed chronologically by construction date within brand name. Two projects contained

six and fourteen bridges. On these projects the construction data is a compendium of the construction data on all structures. The electrical resistance data is still listed individually.

Electrical resistance measurements have been taken on all reported membraned structures. The method used is very similar to the one reported by Spellman and Stratful in the California Division of Highway Research Report M & R 635116-5, "An Electrical Method for Evaluating Bridge Deck Coatings." The only modifications were in soak time (generally four hours) and method of soak.

The method of soaking that was most commonly used was to drill a small hole in the bottom of a half gallon sample can. Then place about two inches of fine sand in the bottom of the can and fill the remainder with water. This provides a slow leak of water out of the drilled hole. These cans are then placed on sponges at the grid locations on the structure to be tested. This procedure keeps the grid locations constantly wet without constant spraying.

An explanation of the electrical resistance reporting procedure is in order. There was some concern that testing too near an expansion dam or a parapet might lead to an erroneous reading if the water should migrate laterally through the A.C. matrix to the expansion dam or parapet. For this reason little weight is placed on readings in these areas. Data was also broken down by lane and shoulder areas in order that any susceptibility to traffic could be identified.



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### Project Data

Construction Project Number: RFI-I-35-4(74)182

Number of Bridges: 1

County: Noble

Bridge Number: A - Southbound

Expressway: I-35

Location of Project: A.T. and S.F. Railroad Overpass 4.5 miles south of Perry, OK

### Bridge Design Data

Type of Structure: Continuous I-Beam

Span Lengths: 75', 93', 75'

Overall Length: 247.33'

Width: 39' 4 1/2"

Skew: 33° 06' 15" RF

Horizontal Curvature: None

Vertical Curvature: 1.5°

Super Elevation: None

Concrete Cover over Steel: 2"

### Deck Construction Data

Date of Last Bridge Deck Pour: 10-5-73

Concrete Type: AA (AE)

Cement Type: I

Fine Aggregate Source: Fyfe Sand Co., Red Rock, OK

Coarse Aggregate Source: Stewart Rock Products, Pawnee, OK

Quapaw Rock Co., Drumright, OK

Method of Surface Texturing: Broom

Curing Type: Linseed oil emulsion

### Protective Treatment

Description of Product: Preformed roll membrane consisting of 60 mils of rubberized asphalt reinforced with a 4 mil sheet of polypropylene fabric and a top asphalt tack coat.

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Manufacturer's Recommended Application Procedure: Old bridge decks or those with wax like curing agents must be cleaned to provide good bonding surface. A coat of primer shall be applied to the cleaned surface at a rate of approximately 300 sq. ft./gal. After drying to tack free, the membrane is rolled onto the primed deck with 2 1/2" laps at all joints.

Deck Preparation Prior to Application of Protective Treatment: Sand blast and remove remaining residue.

### Dates of Membrane Application and Comments:

|         |                                                                                                                                    |
|---------|------------------------------------------------------------------------------------------------------------------------------------|
| 5-29-74 | Began placing membrane on west side of structure. Some difficulty encountered in placing strips straight without causing wrinkles. |
| 5-30-74 | Placed membrane.                                                                                                                   |
| 6-1-74  | Finished membrane placement and laid Type "C" asphaltic concrete on structure.                                                     |

## Asphaltic Concrete

Type: C

Thickness: 1 1/2"

### Dates of Application and Comments:

|        |                                                |
|--------|------------------------------------------------|
| 6-1-74 | Placed asphaltic concrete on entire structure. |
|--------|------------------------------------------------|

Membrane Treatment: \$9.00/sq. yd.

Asphaltic Concrete: \$19.00/ton

## Discussion

May 29 - Application of the Bituthene primer began at approximately 10:00 am. The primer application was completed by noon. Membrane application was delayed until 2:30 pm to assure all volatile material was out of the remaining film of rubberized asphalt left from an attempted application of Petromat membrane. It was aborted because of problems encountered during the lay down operation. The rubberized asphalt became soft with the heat and stuck to the workmen's feet creating quite a mess. A great deal of aggregate was tracked onto the structure. Application the first afternoon

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was very sloppy and a great deal of aggregate was trapped under the membrane. The strips were very crooked and many "fish mouths" were evident at the edges of the strips.

May 30 - Upon arrival on the job the workmen were attempting to place another layer of fabric and follow the old line which was very crooked. A suggestion was made that a string line be set to establish a new line and it was done. The remainder of the day went uneventfully except a high wind made placement rather difficult.

May 31 - Application was completed. Resistance readings were taken on the west three-fourths of the structure while the remaining one-fourth was being placed. No resistance readings were obtained on the east one-fourth. The workmanship on this day appeared to be of poor quality. There was rainfall on the structure in the early morning hours of May 31. Upon arrival to take resistance readings it was noted that most of the membrane wrinkles that extended to the edge of the roll (fish mouths) had taken and were holding water. In these areas low resistance readings were found.

June 1 - The asphaltic concrete overlay was placed. At virtually every joint and lap in the membrane a crack appeared about 20 to 30 feet behind the laydown machine. The cracks along the longitudinal laps were narrow (about 1/16") but at transverse laps (the ends of the rolls) they were sometimes several inches wide, particularly in the double lapped portion against the parapets. These cracks were filled prior to rolling with hot asphaltic concrete. Many of the narrow cracks were not filled because it was felt that the rolling operation would close them. This proved to be a false assumption. The asphaltic concrete was placed at over 280°F. This temperature is probably too hot for this membrane because these cracks were caused by shrinkage in the polypropylene backing of the membrane. Lower asphaltic

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concrete temperatures might alleviate this problem, but batch testing for shrinkage will be required on all other membrane installations. The hot asphaltic concrete liquified the rubber extended asphalt portion of the membrane and permitted it to flow effecting what appeared to be a good seal but delayed rolling somewhat. On the last pass of the laydown machine, the breakdown roller got on the asphaltic concrete too quickly and pushed a large roll of asphaltic concrete in front of the lead wheel. This caused some alligator cracking. These and other cracked areas were filled and rolled extensively with a pneumatic roller and the final appearance and ride was acceptable.

In November, 1974 several large areas of the asphaltic concrete wearing course became disbonded from the membrane and were beaten out by the traffic. Upon careful examination it was found that the asphaltic concrete had a poor adhesion to the membrane. In cooperation with representatives from the W. R. Grace Co., manufacturers of the membrane, a decision was made to remove the asphaltic concrete and membrane and replace it with a membrane with a more heat stable reinforcing. This was done rather uneventfully, except for great difficulty in removing the membrane from the deck. The asphaltic concrete placement was completed with none of the shrinkage problems encountered in the previous overlayment.

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## RESULT OF RESISTIVITY TESTING

MEMBRANE TYPE Bituthene PROJECT NO. RFI-35-4(74)182  
 BRIDGE NO. Southbound EXPRESSWAY I-35  
 DATE MEMBRANE INSTALLED 5-29 thru 6-1-74 TESTED 6-1-74  
 CUMULATIVE VEHICULAR PASSES None SOAK TIME 30 minutes

| Area Tested                                    | Readings Within Resistivity Ranges |     |                                |      |                |      |
|------------------------------------------------|------------------------------------|-----|--------------------------------|------|----------------|------|
|                                                | <100K $\Omega$                     |     | 100K $\Omega$ to 500K $\Omega$ |      | >500K $\Omega$ |      |
|                                                | No.                                | %   | No.                            | %    | No.            | %    |
| A. Within 2.5 Ft. of Curb                      | 0                                  | 0   | 3                              | 7.6  | 36             | 92.3 |
| B. Near Transverse Joints<br>(Excluding Above) | 0                                  | 0   | 1                              | 16.7 | 5              | 83.3 |
| C. Within Shoulder Area<br>(Excluding Above)   | 2                                  | 3.9 | 5                              | 9.8  | 44             | 86.3 |
| D. Within Outside Lane                         | 2                                  | 3.4 | 6                              | 10.3 | 50             | 86.2 |
| E. Within Inside Lane                          | 0                                  | 0   | 0                              | 0    | 0              | 0    |
| F. Total of C + D + E                          | 4                                  | 3.7 | 11                             | 10.1 | 94             | 86.2 |

COMMENTS: No apparent pattern for the low readings. Tested on bare membrane Grid:

MEMBRANE TYPE Bituthene PROJECT NO. RFI-35-4(74)182  
 BRIDGE NO. Southbound EXPRESSWAY I-35  
 DATE MEMBRANE INSTALLED 5-29 thru 6-1-74 TESTED 6-3-74  
 CUMULATIVE VEHICULAR PASSES None SOAK TIME 4 Hours

| Area Tested                                    | Readings Within Resistivity Ranges |      |                                |     |                |      |
|------------------------------------------------|------------------------------------|------|--------------------------------|-----|----------------|------|
|                                                | <100K $\Omega$                     |      | 100K $\Omega$ to 500K $\Omega$ |     | >500K $\Omega$ |      |
|                                                | No.                                | %    | No.                            | %   | No.            | %    |
| A. Within 2.5 Ft. of Curb                      | 14                                 | 21.2 | 6                              | 9.1 | 46             | 69.7 |
| B. Near Transverse Joints<br>(Excluding Above) | 0                                  | 0    | 0                              | 0   | 0              | 0    |
| C. Within Shoulder Area<br>(Excluding Above)   | 0                                  | 0    | 0                              | 0   | 79             | 100  |
| D. Within Outside Lane                         | 0                                  | 0    | 0                              | 0   | 46             | 100  |
| E. Within Inside Lane                          | 0                                  | 0    | 0                              | 0   | 47             | 100  |
| F. Total of C + D + E                          | 0                                  | 0    | 0                              | 0   | 172            | 100  |

COMMENTS: Opened to traffic June 3, 1974. Grid 10'.

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## RESULT OF RESISTIVITY TESTING

MEMBRANE TYPE Bituthene PROJECT NO. PFI-35-4 (74) 182  
 BRIDGE NO. (Southbound) EXPRESSWAY I-35  
 DATE MEMBRANE INSTALLED 5-29-73 thru 6-1-74 TESTED 8-3-76  
 CUMULATIVE VEHICULAR PASSES 5,304,000 SOAK TIME 3 Hours

| <u>Area Tested</u>                             | <u>Readings Within Resistivity Ranges</u> |          |                                                             |          |                                     |          |
|------------------------------------------------|-------------------------------------------|----------|-------------------------------------------------------------|----------|-------------------------------------|----------|
|                                                | <u>&lt;100K <math>\Omega</math></u>       |          | <u>100K <math>\Omega</math> to 500K <math>\Omega</math></u> |          | <u>&gt;500K <math>\Omega</math></u> |          |
|                                                | <u>No.</u>                                | <u>%</u> | <u>No.</u>                                                  | <u>%</u> | <u>No.</u>                          | <u>%</u> |
| A. Within 2.5 Ft. of Curb                      | 2                                         | 4        | 2                                                           | 4        | 46                                  | 92       |
| B. Near Transverse Joints<br>(Excluding Above) | 0                                         | 0        | 4                                                           | 21       | 15                                  | 79       |
| C. Within Shoulder Area<br>(Excluding Above)   | 1                                         | 1.4      | 1                                                           | 1.4      | 69                                  | 97.2     |
| D. Within Outside Lane                         | 4                                         | 8.5      | 2                                                           | 4.3      | 41                                  | 87.2     |
| E. Within Inside Lane                          | 0                                         | 0        | 1                                                           | 2.1      | 46                                  | 97.9     |
| F. Total of C + D + E                          | 1                                         | 0.6      | 4                                                           | 2.5      | 156                                 | 96.9     |

COMMENTS: Area of patches in overlay: Two feet<sup>2</sup>. Rain fell the previous day. 125' of transverse and longitudinal cracks. Opened to traffic June 3, 1974.

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### Project Data

Construction Project Number: ERI-35-4(89)212

Number of Bridges: 2 (Structures A & B)

County: Kay

Bridge Numbers: A - Northbound and B - Southbound

Expressway: I-35

Location of Project: Overflow structures for the Salt Fork of the Arkansas River

### Bridge Design Data

Type of structure: Simple concrete slab spans

Span lengths: 6 - 25"

Overall Length: 150'

Width: 40' 9"

Skew: None

Horizontal Curvature: None

Vertical Curvature: None

Super Elevation: None

Concrete Cover over Steel: 2"

### Deck Construction Data

Date of Last Bridge Deck Pour: A: 5-8-74 and B: 9-10-74

Concrete Type: AA (AE)

Cement Type: I

Fine Aggregate Source: Sober Sand Co., Ponca City, OK

Coarse Aggregate Source: Standard Ind., Burbank, OK

Method of Surfacing Texturing: Broom

Curing Type: Linseed oil emulsion

### Protective Treatment

Description of Product: Preformed roll membrane consisting of 60 mils of rubberized asphalt reinforced with a 4 mil sheet of polypropylene fabric and a top asphalt tack coat.



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Manufacturer's Recommended Application Procedure: Old bridge decks or those with wax like curing agents must be cleaned to provide a good bonding surface. A coat or primer shall be applied to the cleaned surface at a rate of approximately 300 ft.<sup>2</sup>/ga. After drying tack free the membrane is placed onto the primed deck with two and one-half inch laps at all joints then overlayed with asphaltic concrete.

Deck Preparation Prior to Application of Protective Treatment: Sand blast and remove residue.

### Dates of Membrane Application and Comments:

|         |                                                               |
|---------|---------------------------------------------------------------|
| 6-20-74 | Placed membrane on northbound structure. Temperature in 90's. |
| 9-25-74 | Placed membrane on southbound structure. Temperature in 70's. |

### Asphaltic Concrete

Type: C

Thickness: 1 1/2"

### Date of Application and Comments:

|         |                                                                                                 |
|---------|-------------------------------------------------------------------------------------------------|
| 6-21-74 | 1 1/2" of Type "C" asphaltic concrete placed on northbound structure. Temperature in high 80's. |
| 10-1-74 | 1 1/2" of Type "C" asphaltic concrete placed on southbound structure. Temperature in 70's.      |

### Cost of Protective System

Membrane Treatment: \$7.00/yd.<sup>2</sup>

Asphaltic Concrete: \$12.00/ton

### Discussion

Membrane was placed on the northbound structure on June 20, 1974. The day was quite hot, in the 90's and therefore, the membrane was very tacky. This fact makes it difficult to place this membrane because once it comes in contact with the primed deck or itself it is very difficult to pull loose. This workability problem resulted in many wrinkles. Two strips were placed in the morning and these strips were relatively straight and free from wrinkles;

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however, the next two strips were very crooked. A string line was then established and the following strips were much straighter. The asphaltic concrete was placed on the morning of June 21 and the operation was uneventful.

The membrane was placed on the southbound structure on September 25, 1974. The day was overcast and cool with temperatures in the 70's. A one-half inch rain had fallen the previous day. Placement of the overlay was quite easy because of the relatively cool weather. The membrane was much less tacky than when laid on the companion structure. The strips were straight with very few wrinkles or "fish mouths." The asphaltic concrete wearing course was placed on October 1, 1974, without incident.

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RESULT OF RESISTIVITY TESTING

MEMBRANE TYPE Bituthene PROJECT NO. ERI-35-4 (89) 212  
 BRIDGE NO. Northbound EXPRESSWAY I-35  
 DATE MEMBRANE INSTALLED 6-20-74 TESTED 2-12&13-75  
 CUMULATIVE VEHICULAR PASSES 4,400,000 SOAK TIME 5 Hours

| Area Tested                                    | Readings Within Resistivity Ranges |      |                                |      |                |      |
|------------------------------------------------|------------------------------------|------|--------------------------------|------|----------------|------|
|                                                | <100K $\Omega$                     |      | 100K $\Omega$ to 500K $\Omega$ |      | >500K $\Omega$ |      |
|                                                | No.                                | %    | No.                            | %    | No.            | %    |
| A. Within 2.5 Ft. of Curb                      | 12                                 | 42.9 | 7                              | 25   | 9              | 32.1 |
| B. Near Transverse Joints<br>(Excluding Above) | 9                                  | 50   | 1                              | 5.6  | 8              | 44.4 |
| C. Within Shoulder Area<br>(Excluding Above)   | 0                                  | 0    | 0                              | 0    | 38             | 100  |
| D. Within Outside Lane                         | 3                                  | 9.4  | 0                              | 0    | 29             | 90.6 |
| E. Within Inside Lane                          | 9                                  | 28.1 | 9                              | 28.1 | 14             | 43.8 |
| F. Total of C + D + E                          | 12                                 | 11.8 | 9                              | 8.8  | 81             | 79.4 |

COMMENTS: Area of patches in overlay was 1 patch approximately 1 ft.<sup>2</sup>.  
 Length of cracks in overlay were 60 feet. Grid: 5'. Opened to traffic  
 July 8, 1974.

MEMBRANE TYPE Bituthene PROJECT NO. ERI-35-4 (89) 212  
 BRIDGE NO. Northbound EXPRESSWAY I-35  
 DATE MEMBRANE INSTALLED 6-20-74 TESTED 1-28-76  
 CUMULATIVE VEHICULAR PASSES 5,121,600 SOAK TIME 4 Hours

| Area Tested                                    | Readings Within Resistivity Ranges |      |                                |      |                |      |
|------------------------------------------------|------------------------------------|------|--------------------------------|------|----------------|------|
|                                                | <100K $\Omega$                     |      | 100K $\Omega$ to 500K $\Omega$ |      | >500K $\Omega$ |      |
|                                                | No.                                | %    | No.                            | %    | No.            | %    |
| A. Within 2.5 Ft. of Curb                      | 3                                  | 5.2  | 3                              | 5.2  | 52             | 89.7 |
| B. Near Transverse Joints<br>(Excluding Above) | 6                                  | 33.3 | 2                              | 11.1 | 10             | 55.6 |
| C. Within Shoulder Area<br>(Excluding Above)   | 5                                  | 5.8  | 5                              | 5.8  | 77             | 88.5 |
| D. Within Outside Lane                         | 8                                  | 13.1 | 4                              | 6.6  | 49             | 80.3 |
| E. Within Inside Lane                          | 23                                 | 41.1 | 10                             | 17.9 | 23             | 41.1 |
| F. Total of C + D + E                          | 36                                 | 17.6 | 19                             | 9.3  | 149            | 73.0 |

COMMENTS: Area of patches in overlay: 1 patch approximately 1 square foot  
 Length of cracks in overlay: 420 ft. Several low readings in wheel paths  
 of inside lane. Grid: 5'. Opened to traffic July 8, 1974.

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## RESULT OF RESISTIVITY TESTING

MEMBRANE TYPE Bituthene PROJECT NO. ERI-35-4(89)212  
 BRIDGE NO. Southbound EXPRESSWAY I-35  
 DATE MEMBRANE INSTALLED 9-25-74 TESTED 2-14-75  
 CUMULATIVE VEHICULAR PASSES 1,232,000 SOAK TIME 4 Hours

| Area Tested                                    | Readings Within Resistivity Ranges |      |                                |      |                |      |
|------------------------------------------------|------------------------------------|------|--------------------------------|------|----------------|------|
|                                                | <100K $\Omega$                     |      | 100K $\Omega$ to 500K $\Omega$ |      | >500K $\Omega$ |      |
|                                                | No.                                | %    | No.                            | %    | No.            | %    |
| A. Within 2.5 Ft. of Curb                      | 14                                 | 50   | 1                              | 3.6  | 13             | 46.4 |
| B. Near Transverse Joints<br>(Excluding Above) | 16                                 | 88.9 | 1                              | 5.6  | 1              | 5.6  |
| C. Within Shoulder Area<br>(Excluding Above)   | 23                                 | 54.8 | 19                             | 45.2 | 0              | 0    |
| D. Within Outside Lane                         | 24                                 | 86.2 | 4                              | 13.8 | 0              | 0    |
| E. Within Inside Lane                          | 26                                 | 92.9 | 2                              | 7.1  | 0              | 0    |
| F. Total of C + D + E                          | 73                                 | 74.5 | 25                             | 25.5 | 0              | 0    |

COMMENTS: Area of patches in overlay: 2 patches for total of 80 square feet.  
 Length of cracks in overlay: 10 feet. Tested shortly after a rain, virtually  
 all readings climbed as testing progressed. Grid 10'. Opened to traffic October  
 7, 1974.

MEMBRANE TYPE Bituthene PROJECT NO. ERI-35-4(89)212  
 BRIDGE NO. Southbound EXPRESSWAY I-35  
 DATE MEMBRANE INSTALLED 9-25-74 TESTED 1-26 & 27-76  
 CUMULATIVE VEHICULAR PASSES 4,224,000 SOAK TIME 4 Hours

| Area Tested                                    | Readings Within Resistivity Ranges |      |                                |      |                |      |
|------------------------------------------------|------------------------------------|------|--------------------------------|------|----------------|------|
|                                                | <100K $\Omega$                     |      | 100K $\Omega$ to 500K $\Omega$ |      | >500K $\Omega$ |      |
|                                                | No.                                | %    | No.                            | %    | No.            | %    |
| A. Within 2.5 Ft. of Curb                      | 2                                  | 3.9  | 7                              | 13.7 | 42             | 82.4 |
| B. Near Transverse Joints<br>(Excluding Above) | 4                                  | 22.2 | 1                              | 5.6  | 13             | 72.2 |
| C. Within Shoulder Area<br>(Excluding Above)   | 4                                  | 4.9  | 1                              | 1.2  | 76             | 93.8 |
| D. Within Outside Lane                         | 42                                 | 72.4 | 6                              | 10.3 | 10             | 17.2 |
| E. Within Inside Lane                          | 5                                  | 10.4 | 4                              | 8.3  | 39             | 81.3 |
| F. Total of C + D + E                          | 51                                 | 27.3 | 11                             | 5.9  | 125            | 66.8 |

COMMENTS: Area of patches in overlay: Three patches for total of 85 ft.<sup>2</sup>.  
 Length of cracks in overlay: 120 feet. Most low readings were in wheelpaths  
 of outside lane. Grid: 5'. Opened to traffic October 7, 1974.

## BITUTHENE

### Project Data

Construction Project Number: RFI-35-4(78)166

Number of Bridges: 2

County: Payne

Bridge Numbers: Northbound (M) and Southbound (N)

Expressway: I-35

Location of Project: Approximately .2 mile north of Cimarron River on I-35.

### Bridge Design Data

Type of Structure: Simple I-beam

Span Length(s): 7 - 40'

Overall Length: 281.3'

Width: 39.37'

Skew: None

Horizontal Curvature: None

Vertical Curvature: None

Super Elevation: None

Concrete Cover Over Steel: 2"

### Deck Construction Data

Date of Last Bridge DEck Pour: Northbound: 10-11-74; Southbound: 1-27-75

Concrete Type: AA(AE)

Cement Type: I

Fine Aggregate Source: Dolese, Guthrie, OK

Coarse Aggregate Source: Dolese, Big Canyon, OK

Method of Surface Texturing: Burlap Drag

Curing Type: Linseed Oil Emulsion

### Protective Treatment

Description of Product: Preformed roll membrane consisting of 60 mils of rubberized asphalt reinforced with a 4 mil sheet of polypropylene fabric and a top asphalt tack coat.

## BITUTHENE

Manufacturer's Recommended Application Procedure: Old bridge decks or those with wax like curing agents must be cleaned to provide a good bonding surface. A coat of primer shall be applied to the cleaned surface at a rate of approximately 300 ft.<sup>2</sup>/gal. After drying tack free, the membrane is rolled onto the primed deck with 2 1/2" laps at all joints, then overlaid with asphaltic concrete.

Deck Preparation Prior to Application of Protective Treatment: Sand blast and remove remaining residue.

Dates of Membrane Application and Comments:

|          | Northbound                                                                                            |
|----------|-------------------------------------------------------------------------------------------------------|
| 11-18-74 | Membrane placement began about noon with the spreading of the prime and was completed about 4:30 p.m. |
|          | Southbound                                                                                            |
| 2-26-75  | Started application of membrane. Temperature 55°F.                                                    |
| 2-27-75  | Finished application of membrane. Temperature 40°F to 50°F.                                           |

### Asphaltic Concrete

Type: "C"

Thickness: 1 1/2"

Dates of Application and Comments:

|                  | Northbound      |
|------------------|-----------------|
| December 5, 1974 | Overlay placed. |
|                  | Southbound      |
| March 21, 1975   | Overlay placed. |

### Cost of Protective System

Membrane Treatment: \$7.00/yd.<sup>2</sup>

Asphaltic Concrete: \$12.00/ton

### Discussion

Northbound - Membrane placement was essentially uneventful except for the usual problems resulting from the brisk winds. These winds contributed to some wrinkling of the membrane. A bead of rubberized asphalt mastic was placed around the perimeter of the membrane along expansion joints and parapets, in an effort to provide a seal against the intrusion of rain water

## BITUTHENE

prior to overlay. A snow fell on the structure on November 29th, the day after the membrane placement, and remarkably little water seeped under the membrane. The mastic was at least partially responsible for this. Where water did penetrate, the membrane was laid back and the water allowed to evaporate. The membrane was then relaid and again caulked. In the ensuing days many blisters formed under the membrane. These were punctured to allow the vapor to escape. As usual, these blisters were most noticeable during the warmest part of the day. On the morning of December 12, a light tack count of AE-5 emulsion was shot on the membrane. After becoming tack-free the structure was overlaid with 1 1/2" of Type "C" asphaltic concrete. The surface appeared quite smooth with the possible exception of the asphalt placed under the screed extensions of the laydown machine. These areas had a coarse appearance.

Southbound - Membrane placement took place during the afternoon of February 26 and morning of February 27. The air temperature was in the 50's during the afternoon of the 26th and in the 49's during the morning of the 27th. The construction methods were relatively good with the result being a membrane with relatively few wrinkles. The contractor did not have a rubber tired paver available for the overlay so it was decided to spread a one inch layer of hot sand asphalt over the membrane to protect it from the paver's steel tracks. The hot sand was placed and spread by hand providing a variable thickness and temperature in place. The rooling operation was somewhat delayed and the resulting layer had poor uniformity. Upon examination of the hot sand layer it was found to have poor adhesion to the membrane in places and during the heat of the afternoons a number of outgassing blisters became evident. It was decided to remove the hot sand

## BITUTHENE

layer and attempt to overlay with Type "C" in the normal fashion paying close attention to any damage to the membrane that might be caused by the pavers tracks. The paver's tracks were not cleaned and caused no visible damage. Resistance testing confirmed the visual assessment.



# BITUTHENE

## RESULT OF RESISTIVITY TESTING

MEMBRANE TYPE Bituthene PROJECT NO. RFI-35-4(78)166  
 BRIDGE NO. Northbound EXPRESSWAY I-35  
 DATE MEMBRANE INSTALLED 11-28-74 TESTED 12-17-74  
 CUMULATIVE VEHICULAR PASSES 20,400 SOAK TIME 5 Hours

| Area Tested                                    | Readings Within Resistivity Ranges |   |                                |     |                |      |
|------------------------------------------------|------------------------------------|---|--------------------------------|-----|----------------|------|
|                                                | <100K $\Omega$                     |   | 100K $\Omega$ to 500K $\Omega$ |     | >500K $\Omega$ |      |
|                                                | No.                                | % | No.                            | %   | No.            | %    |
| A. Within 2.5 Ft. of Curb                      | 0                                  | 0 | 0                              | 0   | 49             | 100  |
| B. Near Transverse Joints<br>(Excluding Above) | 0                                  | 0 | 0                              | 0   | 24             | 100  |
| C. Within Shoulder Area<br>(Excluding Above)   | 0                                  | 0 | 1                              | 1.2 | 83             | 98.8 |
| D. Within Outside Lane                         | 0                                  | 0 | 0                              | 0   | 0              | 0    |
| E. Within Inside Lane                          | 0                                  | 0 | 0                              | 0   | 0              | 0    |
| F. Total of C + D + E                          | 0                                  | 0 | 0                              | 0   | 0              | 0    |

COMMENTS: Only the shoulder area was tested. Opened to traffic December 13, 1974. Grid: 5'.

MEMBRANE TYPE Bituthene PROJECT NO. RFI-35-4(78)166  
 BRIDGE NO. Northbound EXPRESSWAY I-35  
 DATE MEMBRANE INSTALLED 11-28-74 TESTED 7-76  
 CUMULATIVE VEHICULAR PASSES 3,876,000 SOAK TIME 4 Hours

| Area Tested                                    | Readings Within Resistivity Ranges |      |                                |      |                |      |
|------------------------------------------------|------------------------------------|------|--------------------------------|------|----------------|------|
|                                                | <100K $\Omega$                     |      | 100K $\Omega$ to 500K $\Omega$ |      | >500K $\Omega$ |      |
|                                                | No.                                | %    | No.                            | %    | No.            | %    |
| A. Within 2.5 Ft. of Curb                      | 0                                  | 0    | 4                              | 13.3 | 26             | 86.7 |
| B. Near Transverse Joints<br>(Excluding Above) | 11                                 | 22.4 | 7                              | 14.3 | 31             | 63.3 |
| C. Within Shoulder Area<br>(Excluding Above)   | 3                                  | 4.6  | 6                              | 9.2  | 56             | 86.2 |
| D. Within Outside Lane                         | 18                                 | 27.3 | 9                              | 13.6 | 39             | 59.1 |
| E. Within Inside Lane                          | 6                                  | 13.6 | 3                              | 6.8  | 35             | 79.5 |
| F. Total of C + D + E                          | 27                                 | 15.4 | 18                             | 10.3 | 130            | 74.3 |

COMMENTS: Area of patches in overlay: Two patches—one about 1 ft.<sup>2</sup>, the second 20 ft.<sup>2</sup>. Opened to traffic December 13, 1974. Grid 10'. The low readings in the outside lane followed the wheelpaths.

# BITUTHENE

## RESULT OF RESISTIVITY TESTING

MEMBRANE TYPE Bituthene PROJECT NO. RFI-35-4 (78) 166  
 BRIDGE NO. Southbound EXPRESSWAY I-35  
 DATE MEMBRANE INSTALLED 2-26 & 27-75 TESTED 7-21-76  
 CUMULATIVE VEHICULAR PASSES 3,162,000 SOAK TIME 3 Hours

| <u>Area Tested</u>                             | <u>Readings Within Resistivity Ranges</u> |          |                                                             |          |                                     |          |
|------------------------------------------------|-------------------------------------------|----------|-------------------------------------------------------------|----------|-------------------------------------|----------|
|                                                | <u>&lt;100K <math>\Omega</math></u>       |          | <u>100K <math>\Omega</math> to 500K <math>\Omega</math></u> |          | <u>&gt;500K <math>\Omega</math></u> |          |
|                                                | <u>No.</u>                                | <u>%</u> | <u>No.</u>                                                  | <u>%</u> | <u>No.</u>                          | <u>%</u> |
| A. Within 2.5 Ft. of Curb                      | 0                                         | 0        | 0                                                           | 0        | 84                                  | 100      |
| B. Near Transverse Joints<br>(Excluding Above) | 1                                         | 1.1      | 3                                                           | 3.4      | 84                                  | 95.5     |
| C. Within Shoulder Area<br>(Excluding Above)   | 0                                         | 0        | 1                                                           | 1.6      | 62                                  | 98.4     |
| D. Within Outside Lane                         | 9                                         | 21.4     | 10                                                          | 23.8     | 23                                  | 54.8     |
| E. Within Inside Lane                          | 0                                         | 0        | 0                                                           | 0        | 42                                  | 100      |
| F. Total of C + D + E                          | 0                                         | 0        | 11                                                          | 80       | 127                                 | 92.0     |

COMMENTS: Opened to traffic April 8, 1975. Grid 10'. The low readings in the outside lane were near a construction joint and in the wheelpaths.

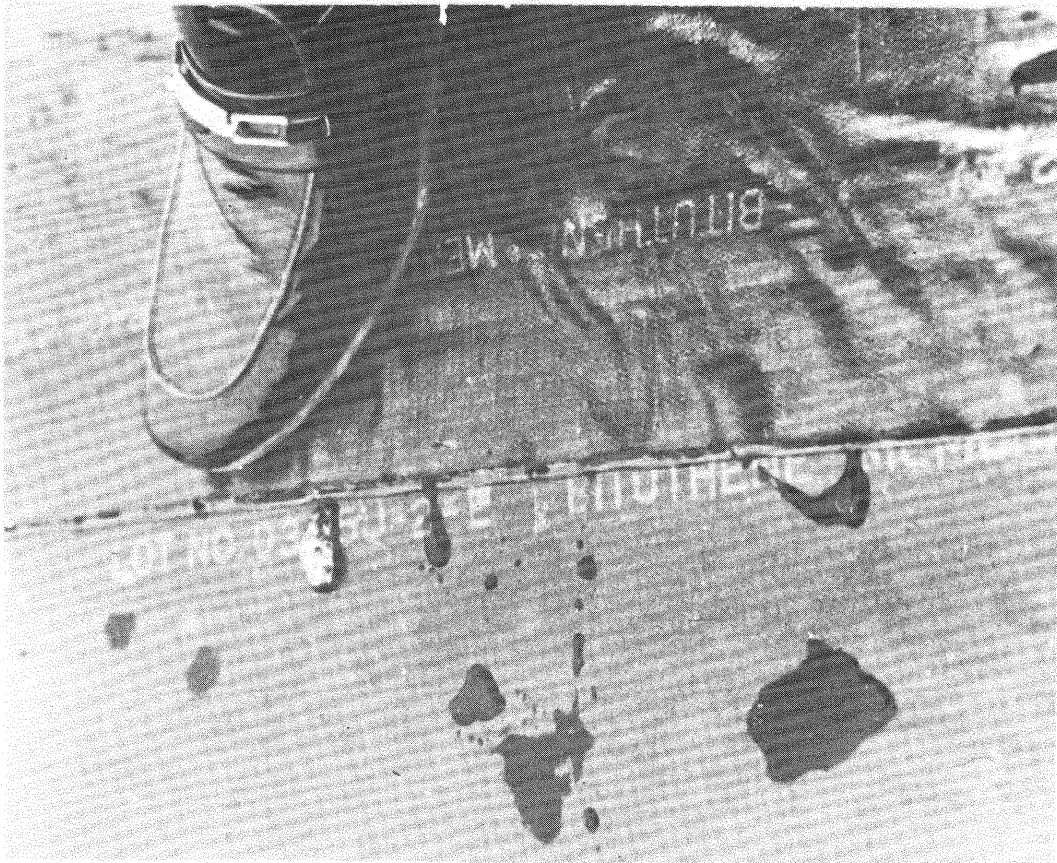
## BITUTHENE



Application exhibiting good and poor workmanship.



# BITUTHENE

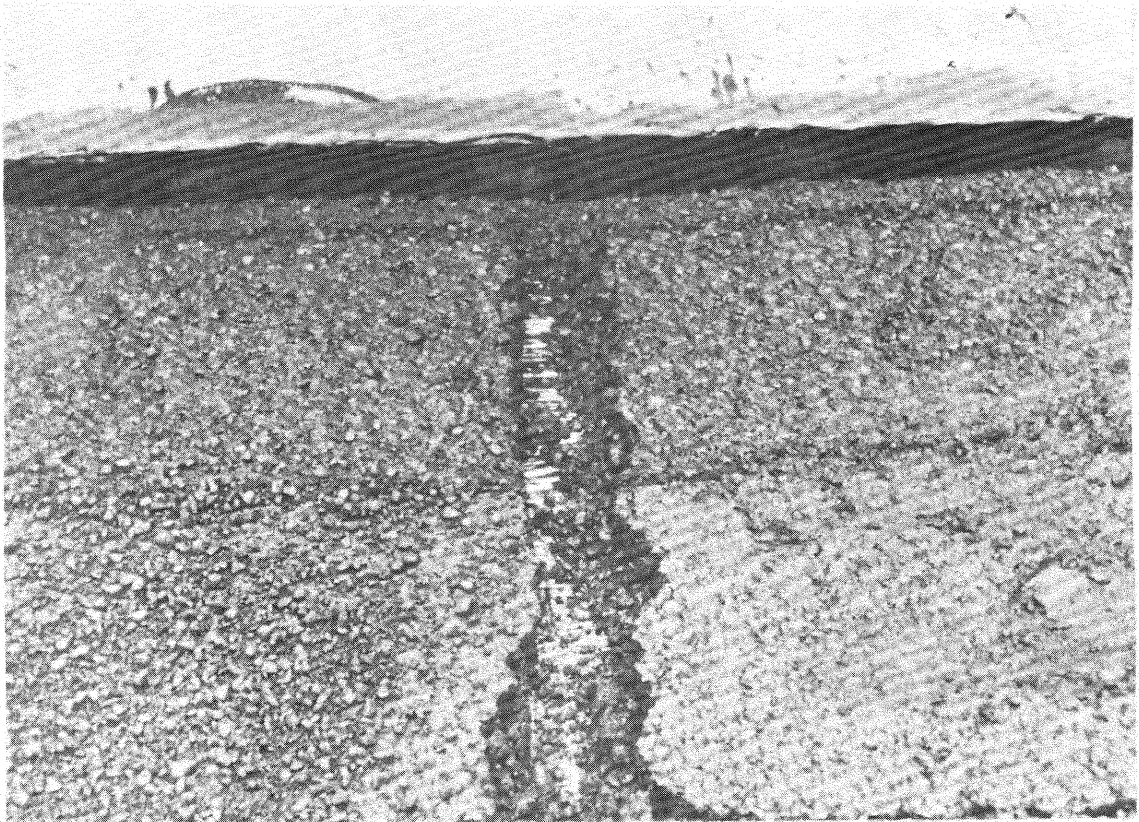


Water trapped under a wrinkle after a rainfall.





## BITUTHENE



Crack in asphalt overlay as a result of membrane shrinkage.





## BITUTHENE



Appearance of overlay approximately six (6) months after membrane application. Cracks are the result of membrane shrinkage.



## BITUTHENE



Type of failure encountered in first Bituthene application approximately six (6) months after application.



## KOPPER'S SUPER PAVEMENT SEALER

### Project Data

Construction Project Number: RFI-35-4(77)223

Number of Bridges: 2

County: Kay

Bridge Numbers: A - Southbound and B - Northbound

Expressway: I-35

Location of Project: North of Blackwell on I-35 over Doe Creek.

### Bridge Design Data

Type of Structure: Simple I-Beam

Span Lengths: 3 - 40'

Overall Length: 121' 4"

Width: 38'

Skew: None

Horizontal Curvature: None

Vertical Curvature: None

Super Elevation: None

Concrete Cover over Steel: 2"

### Deck Construction Data

Date of Last Bridge Deck Pour: A: 1-17-74 and B: 4-15-74

Concrete Type: AA (AE)

Cement Type: I

Fine Aggregate Source: Sober Sand, Ponca City, OK

Coarse Aggregate Source: Standard Ind., Burbank, OK

Method of Surface Texturing: Bull Float

Curing Type: Linseed oil emulsion

### Protective Treatment

Description of Product: A built up, poured in place type membrane that consists of a prime coat of cut back coal tar pitch followed by two coats of latex rubber modified coal tar emulsion with a layer of woven fiberglass

## KOPPER'S SUPER PAVEMENT SEALER

fabric rolled into the still wet second emulsion coat. After the emulsion has had sufficient time to set a third layer of coal tar emulsion is placed with a second layer of fiberglass mesh rolled into the still wet emulsion. Finally the entire system receives a layer of coal tar slurry.

**Manufacturer's Recommended Application Procedure:** The primer shall be applied to the cleaned deck by spray, brush or squeegee at a rate of 0.01 to 0.02 gallons per square yard. After a 24 hour cure, the first of three applications of rubberized coal tar emulsion shall be made at a rate of 0.08 to 0.10 gallons per square yard. After the emulsion has cured dry (approximately four hours) the second coat of emulsion shall be applied crosswise to the first and the first layer of fiberglass mesh shall be rolled or brushed into the still wet emulsion. After another four hour curing period, a third coat of emulsion shall be applied and a second layer of fiberglass mesh rolled into it while still wet. After this layer has cured a slurry consisting of the rubberized coal tar emulsion to which 4 - 1 pounds of sand has been added shall be placed at a rate of 0.28 to 0.30 gallons per square yard.

**Deck Preparation Prior to Application of Protective Treatment:** Cleaned by air blast.

### Dates of Application and Comments:

| Date    | <u>Southbound</u>                                                                                                                                                         |
|---------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2-12-74 | Deck was cleaned and primed                                                                                                                                               |
| 2-13-74 | First and second coats of emulsion and first layer of fiberglass mesh placed on northern span.                                                                            |
| 2-14-74 | First and second coats of emulsion and first layer of fiberglass mesh placed on two south spans. Third coat of emulsion and second fiberglass layer placed on north span. |
| 2-15-74 | Rain                                                                                                                                                                      |
| 2-16-74 | South spans received third coat of emulsion and second fiberglass layer.                                                                                                  |
| 2-17-74 | Coal tar slurry placed on structure.                                                                                                                                      |
|         | <u>Northbound</u>                                                                                                                                                         |
| 4-14-74 | Prime coat applied to structure.                                                                                                                                          |
| 4-15-74 | First and second coats of emulsion and first layer of fiberglass mesh applied to structure.                                                                               |
| 4-16-74 | Third coat of emulsion and second coat of fiberglass applied.                                                                                                             |
| 4-17-74 | Slurry placed on previous layers.                                                                                                                                         |

## KOPPER'S SUPER PAVEMENT SEALER

### Asphaltic Concrete

Type: "C"

Thickness: 1 1/2"

Date of Application and Comments:

Date

Southbound

2-26-74

1 1/2" of Type "C" laid on structure.

Northbound

4-18-74

1 1/2" of Type "C" laid on structure.

### Cost of Protective System

Membrane Treatment: \$12.00/sq. yd.

Asphaltic Concrete: \$26.00/ton

### Discussion

Southbound - Prime was placed February 12, 1974. Contractor attempted to apply the prime with Hudson sprayer but this proved unsuccessful and the prime was spread with squeegees and paint rollers. The coverage was not even, being much too heavy against the curb on the low side of the deck. On broomed structures this placing of prime could be impossible without a spray because of the roughness of the deck. The placement of the emulsion went very smoothly the paint rollers aiding immensely. Upon drying of the emulsion it was observed that in areas where the prime had been thick the emulsion pulled away from the prime. This could have been the result of unevaporated carrier in the prime. The second coat of emulsion went on just as easily but when the fiberglass fabric was placed in the emulsion much difficulty was encountered in removing all the bubbles. The fabric for this structure had an imperfection running lengthwise for almost the entire length of the rolls. This imperfection made it exceedingly difficult to remove entrapped air bubbles. A method was arrived at that produced good results



## KOPPER'S SUPER PAVEMENT SEALER

with a reasonable effort. A fairly heavy coat of emulsion was placed. The fabric was stretched over the emulsion then, starting at the center and working simultaneously toward both ends, the fabric was rolled into the emulsion with paint rollers. The workman holding the fabric on either end held the fabric up out of the emulsion until the workmen with the paint rollers forced it down into the emulsion. To completely soak the fabric and fill any footprints, additional emulsion was rolled onto the fabric. Both fabric layers were placed this way.

The first layer of fabric was placed on the northern span on the evening of February 13 and on the remaining two spans on February 14. The second coat was placed on the northern span also on February 14. It rained on February 15, and on the morning of February 16 there was heavy ground fog. The remaining spans received the second fabric coat on the evening of February 16. The slurry was placed on February 17 over all three spans. Approximately .6 inch of rain fell on the job site on February 18. On February 19, electrical resistance tests were taken on the complete membrane.

Inspection of the job at 11:15 am, on February 19, indicated an almost flawless job. The paint rollers had done an exceptional job on sealing the fabric to the parapets and the homogeneity of the job was excellent. At 1:00 p.m. a few small (1" x 6" in diameter) blisters were noted in the membrane (the temperature had climbed into the 50's with a brisk south wind). By 2:30 pm about 35 small blisters had formed. A decision was made to puncture each blister to vent the air. The gas within each blister had no odor and was non-flammable and was assumed to be expanding air and water vapor. On February 20, another warm day, 20 to 30 new blisters appeared and were punctured. After puncturing, the holes were sealed with a rubberized coal tar mastic.



## KOPPER'S SUPER PAVEMENT SEALER

On February 26 the membrane was overlayed. At this time new blisters were apparent but were not punctured and the overlay operation proceeded. The laydown machine was a Blaw-Knox rubber tracked machine. The machine had rubber skirts on the front side of the hopper that all but eliminated asphalt spillage in front of the tracks. The tracks did not damage the integrity of the membrane. An excellent overlay was placed with no problems.

On March 1, electrical resistance tests were conducted. In a three and one-half hour wetting period all readings were infinite. On March 6, a second set of resistance readings were taken. This time only in the 12 foot waterway because the structure was now carrying two-way traffic. After seven hours of soaking all readings were infinite.

Northbound - On April 14, 1974, the prime coat of cut back rubberized coal tar pitch was applied to the air blasted structure. Paint rollers were used to apply the prime and a very even coat was obtained (the prime on the companion structure was applied by squeegee and coverage was not uniform). The prime was allowed to dry for 24 hours and on April 15, 1974, the two coats of emulsion were applied to the entire structure. The first coat was applied longitudinal to the structure, allowed to dry (approximately three hours), and the second coat was applied transversely to the first. The first coat of fiberglass mesh was rolled into the second emulsion layer. Appearance was very uniform. On April 16, 1974 the third coat of emulsion and second layer of fiberglass mesh were applied. On April 17, 1974 the slurry was applied at the recommended application rate. After the slurry had cured the membrane was examined and no flaws could be found. All fiberglass had been saturated with emulsion and all layers adhered well to the parapets and expansion dams. On April 18, 1974 just before the overlay was to begin, eleven blisters ranging in size from two inches to approximately one foot in diameter were noted.

## KOPPER'S SUPER PAVEMENT SEALER

These blisters were punctured and the resulting hole filled with a dab of rubberized coal tar mastic. The overlay operation proceeded uneventfully. There was no evidence of blisters in the overlay when it was examined five days after overlayment.

# KOPPER'S SUPER PAVEMENT SEALER

## RESULT OF RESISTIVITY TESTING

MEMBRANE TYPE Koppers Super Pavement Sealer PROJECT NO. RFT-35-4(77)223  
 BRIDGE NO. Southbound EXPRESSWAY I-35  
 DATE MEMBRANE INSTALLED 2-17-74 TESTED 2-19-74  
 CUMULATIVE VEHICULAR PASSES None SOAK TIME Instantly

| Area Tested                                    | Readings Within Resistivity Ranges |       |                                |   |                |   |
|------------------------------------------------|------------------------------------|-------|--------------------------------|---|----------------|---|
|                                                | <100K $\Omega$                     |       | 100K $\Omega$ to 500K $\Omega$ |   | >500K $\Omega$ |   |
|                                                | No.                                | %     | No.                            | % | No.            | % |
| A. Within 2.5 Ft. of Curb                      | 0                                  | 0     | 0                              | 0 | 0              | 0 |
| B. Near Transverse Joints<br>(Excluding Above) | 14                                 | 100   | 0                              | 0 | 0              | 0 |
| C. Within Shoulder Area<br>(Excluding Above)   | 105                                | 100.0 | 0                              | 0 | 0              | 0 |
| D. Within Outside Lane                         | 70                                 | 100.0 | 0                              | 0 | 0              | 0 |
| E. Within Inside Lane                          | 70                                 | 100.0 | 0                              | 0 | 0              | 0 |
| F. Total of C + D + E                          | 245                                | 100.0 | 0                              | 0 | 0              | 0 |

COMMENTS: No reading exceeded 100,000 ohms resistance on bare membrane.  
 Grid 5'.

MEMBRANE TYPE Koppers Super Pavement Sealer PROJECT NO. RFT-35-4(77)223  
 BRIDGE NO. Southbound EXPRESSWAY I-35  
 DATE MEMBRANE INSTALLED 2-17-74 TESTED 9-22-77  
 CUMULATIVE VEHICULAR PASSES 11,264,000 SOAK TIME 4 Hours

| Area Tested                                    | Readings Within Resistivity Ranges |      |                                |      |                |      |
|------------------------------------------------|------------------------------------|------|--------------------------------|------|----------------|------|
|                                                | <100K $\Omega$                     |      | 100K $\Omega$ to 500K $\Omega$ |      | >500K $\Omega$ |      |
|                                                | No.                                | %    | No.                            | %    | No.            | %    |
| A. Within 2.5 Ft. of Curb                      | 7                                  | 38.9 | 0                              | 0    | 11             | 61.1 |
| B. Near Transverse Joints<br>(Excluding Above) | 2                                  | 6.3  | 1                              | 3.1  | 29             | 90.6 |
| C. Within Shoulder Area<br>(Excluding Above)   | 0                                  | 0    | 0                              | 0    | 18             | 100  |
| D. Within Outside Lane                         | 7                                  | 21.2 | 7                              | 21.2 | 19             | 57.6 |
| E. Within Inside Lane                          | 7                                  | 26.9 | 1                              | 3.8  | 18             | 62.2 |
| F. Total of C + D + E                          | 14                                 | 18.2 | 8                              | 10.4 | 55             | 71.4 |

COMMENTS: 75% of low readings were on transverse cracks or followed two longitudinal A.C. construction joints that had opened. Grid: 10'. 90' of transverse cracks and 2 longitudinal A.C. construction joints the entire lengths of the structure. Opened to traffic March 1, 1974.

# KOPPER'S SUPER PAVEMENT SEALER

## RESULT OF RESISTIVITY TESTING

MEMBRANE TYPE Koppers Super Pavement Sealer PROJECT NO. RFI-35-4(72)223  
 BRIDGE NO. Northbound EXPRESSWAY I-35  
 DATE MEMBRANE INSTALLED 4-17-74 TESTED 5-3-74  
 CUMULATIVE VEHICULAR PASSES None SOAK TIME 4 Hours

| Area Tested                                    | Readings Within Resistivity Ranges |      |                                |   |                |      |
|------------------------------------------------|------------------------------------|------|--------------------------------|---|----------------|------|
|                                                | <100K $\Omega$                     |      | 100K $\Omega$ to 500K $\Omega$ |   | >500K $\Omega$ |      |
|                                                | No.                                | %    | No.                            | % | No.            | %    |
| A. Within 2.5 Ft. of Curb                      | 18                                 | 100  | 0                              | 0 | 0              | 0    |
| B. Near Transverse Joints<br>(Excluding Above) | 5                                  | 25.0 | 0                              | 0 | 15             | 75.0 |
| C. Within Shoulder Area<br>(Excluding Above)   | 0                                  | 0    | 0                              | 0 | 27             | 100  |
| D. Within Outside Lane                         | 0                                  | 0    | 0                              | 0 | 18             | 100  |
| E. Within Inside Lane                          | 0                                  | 0    | 0                              | 0 | 18             | 100  |
| F. Total of C + D + E                          | 0                                  | 0    | 0                              | 0 | 63             | 100  |

COMMENTS: Grid 10'. Opened to traffic May 3, 1974

MEMBRANE TYPE Kopper Super Pavement Sealer PROJECT NO. RFI-35-4(72)223  
 BRIDGE NO. Northbound EXPRESSWAY I-35  
 DATE MEMBRANE INSTALLED 4-17-74 TESTED 2-3-76  
 CUMULATIVE VEHICULAR PASSES 5,544,000 SOAK TIME 4 Hours

| Area Tested                                    | Readings Within Resistivity Ranges |      |                                |      |                |      |
|------------------------------------------------|------------------------------------|------|--------------------------------|------|----------------|------|
|                                                | <100K $\Omega$                     |      | 100K $\Omega$ to 500K $\Omega$ |      | >500K $\Omega$ |      |
|                                                | No.                                | %    | No.                            | %    | No.            | %    |
| A. Within 2.5 Ft. of Curb                      | 8                                  | 19.0 | 6                              | 14.3 | 28             | 66.7 |
| B. Near Transverse Joints<br>(Excluding Above) | 6                                  | 17.6 | 3                              | 8.8  | 25             | 73.5 |
| C. Within Shoulder Area<br>(Excluding Above)   | 0                                  | 0    | 0                              | 0    | 63             | 100  |
| D. Within Outside Lane                         | 0                                  | 0    | 4                              | 9.3  | 39             | 90.7 |
| E. Within Inside Lane                          | 8                                  | 19.0 | 4                              | 9.5  | 30             | 71.4 |
| F. Total of C + D + E                          | 8                                  | 5.4  | 8                              | 5.4  | 132            | 89.2 |

COMMENTS: Construction joint: Most low readings followed an A.C. construction joint that ran the length of the structure. Grid 5'. One patch approximately 1 foot<sup>2</sup> and 2' of transverse cracks.

## KOPPER'S SUPER PAVEMENT SEALER



Applying Kopper's prime coat.

## KOPPER'S SUPER PAVEMENT SEALER



Applying first fabric layer into the second emulsion coat.





# KOPPER'S SUPER PAVEMENT SEALER



Rolling the fiber glass into the second emulsion coat.





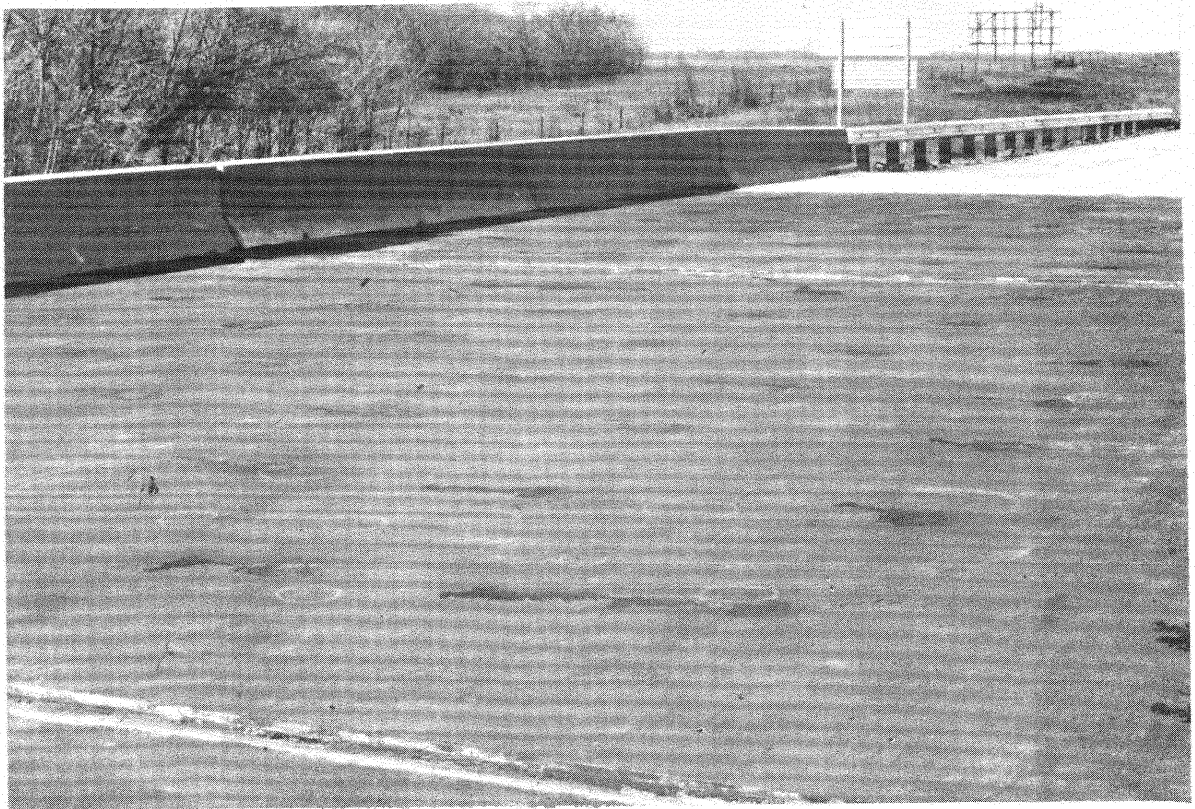
# KOPPER'S SUPER PAVEMENT SEALER



Application of the third coat of emulsion.



# KOPPER'S SUPER PAVEMENT SEALER



Blisters (circled) in the finished membrane.



Puncturing and venting blister.



## PETROMAT

### Project Data

Construction Project Number: RFI-35-4(74)182

Number of Bridges: Two

County: Noble

Bridge Number(s): A (Northbound) and B (Southbound)

Expressway: I-35

Location of Project: 3.5 miles south of Perry, Oklahoma. I-35 over the A.T. and S. F. Railroad.

### Bridge Design Data

Type of Structure: Continuous I Beam

Span length(s): 75'-93'-75'

Width: 39' 4½"

Skew: 33° 06' 15" RF

Horizontal Curvature: None

Vertical Curvature: 1.5°

Super Elevation: None

Concrete Cover Over Steel: 2"

### Deck Construction Data

Date of Last Bridge Deck Pour: Northbound A-(4-8-74) Southbound B-(10-5-73)

Concrete Type: AA(AE)

Cement Type: I

Fine Aggregate Source: Fyfe Sand Company, Red Rock, OK

Coarse Aggregate Source: Quapaw Rock Company, Drumright, OK  
Stewart Rock Products, Pawnee, OK

Method of Surface Texturing: Broom

Curing Type: Linseed Oil Emulsion



## PETROMAT

### Protective Treatment

Description of Product: System consists of an application of CRS-2, which is modified by the addition of 5% cationic latex rubber. Into this application is rolled a layer of non-woven polypropylene fabric.

Manufacturer's Recommended Application Procedure: The asphalt binder (CRS-2 plus 5% latex) is applied to the cleaned bridge deck at a rate of 0.25 to 0.30 gallon/yd<sup>2</sup> (residual). After the emulsion has broken the fabric shall be rolled into the binder eliminating all bubbles or wrinkles. After total curing of the binder, the membrane shall be overlaid with an A.C. wearing course.

Deck Preparation Prior to Application of Protective Treatment: Sand Blast and remove remaining residue.

Dates of Membrane Application and Comments:

#### Northbound

November 30, 1973

Membrane placed on structure.

#### Southbound

May 17, 1974

Membrane application started. Emulsion broke in distributor. Temperature 70's.

May 18, 1974

Membrane application completed. Again emulsion broke in the distributor. Temperature 70's.

May 21, 1974

1½ inch rainfall.

May 22, 1974

Laydown operation attempted. Temperature in the high 70's.

May 23, 1974

Membrane removal begun.

May 24, 1974

Membrane removal completed.

### Asphaltic Concrete

Type: "C"

Thickness: 1½"

Dates of Application and Comments:

#### Northbound

December 12, 1973

1½ inch Type "C" A.C. placed on structure  
Temperature 60's.



## PETROMAT

### Southbound

May 22, 1974

Laydown operation aborted after approximately 150' when membrane tearing became evident.

### Cost of Protective System

Membrane Treatment: \$9.00/sq. yd.

Asphaltic Concrete: \$19.00/Ton

### Discussion

Northbound Structure - The membrane was placed on this structure on November 30, 1973. The binder (emulsion plus latex) was placed with the aid of an asphalt distributor. The emulsion was heated to approximately 140°F before application. The first pass with the distributor was uneventfully. After each pass the fabric was rolled into the binder. The distributor pass was wide enough to accomodate two strips of fabric. At the beginning of the second pass with the distributor the emulsion began to coagulate and plug up the nozzles. Application was then attempted with the hand gun but its nozzle repeatedly became clogged. Finally the nozzle was removed from the wand and the binder sprayed on in this manner. Large coagulated lumps came out with the binder and the lumps and binder were spread with squeegees and brooms. Most lumps were removed but the thickness of binder varied greatly.

The membrane application was completed in this manner. It was later determined that the emulsion was unstable even before the addition of the latex. The finished membrane had several "fat spots" indicating a heavy application of binder and all areas where the fabric was lapped were loose. Other than these visual problems the membrane appeared much better than would have been expected considering the problems encountered with the binder. The A.C. placement took place on the afternoon of December 12, 1973. The paver was a flat steel tracked model. Where A.C. was spilled out

## PETROMAT

of the hopper the tracks crushed the aggregate through the membrane and tore the fabric very possibly impairing the integrity of the membrane. No other problems were encountered with the laydown operation.

Southbound Structure - On May 17 the application of the Petromat began.

Some difficulty was encountered when the second emulsion application was to be made for the area to receive the double thickness. The distributor tires were not clean and had a tendency to pull up the first layer of fabric.

The emulsion was then applied by the hand gun. The other passes were made uneventfully. At 1:00 p.m. the emulsion broke in the distributor. May 18 -

At noon after the last application of binder, the emulsion again broke in the distributor. The application procedure was to mix the Latex with the

emulsion then heat it to 160°F in the distributor. This heating would be done in the morning prior to application and then again at noon. The final

passes were made and the structure was completed. May 21 - Approximately

1.5 inches of rain fell on membraned structure. May 22- Lay down operation

began about noon. Soon after beginning the overlay it was observed that the paver tracks were pulling the membrane under the paver. This progressed to

such an extent that the membrane was being lifted and torn under the overlay. Water bubbles appeared at the edge of the fabric as it was pulled

under the machine indicating water was under the membrane. Upon lifting several fabric layers and finding water under all, along with emulsified

asphalt, a decision was made to remove the membrane and place another.

During removal, water was observed under essentially all of the membrane.

# PETROMAT

## RESULT OF RESISTIVITY TESTING

MEMBRANE TYPE Petromat PROJECT NO. RFT-35-4(74)182  
 BRIDGE NO. Northbound EXPRESSWAY I-35  
 DATE MEMBRANE INSTALLED 11-30-73 TESTED 12-11-73  
 CUMULATIVE VEHICULAR PASSES None SOAK TIME 15 minutes

| Area Tested                                    | Readings Within Resistivity Ranges |      |                                |     |                |   |
|------------------------------------------------|------------------------------------|------|--------------------------------|-----|----------------|---|
|                                                | <100K $\Omega$                     |      | 100K $\Omega$ to 500K $\Omega$ |     | >500K $\Omega$ |   |
|                                                | No.                                | %    | No.                            | %   | No.            | % |
| A. Within 2.5 Ft. of Curb                      | 49                                 | 92.5 | 4                              | 7.5 | 0              | 0 |
| B. Near Transverse Joints<br>(Excluding Above) | 0                                  | 0    | 0                              | 0   | 0              | 0 |
| C. Within Shoulder Area<br>(Excluding Above)   | 113                                | 92.6 | 9                              | 7.4 | 0              | 0 |
| D. Within Outside Lane                         | 75                                 | 10.0 | 0                              | 0   | 0              | 0 |
| E. Within Inside Lane                          | 75                                 | 10.0 | 0                              | 0   | 0              | 0 |
| F. Total of C + D + E                          | 263                                | 96.7 | 9                              | 3.3 | 0              | 0 |

COMMENTS: Opened to traffic June 3, 1974. Grid: 5'. Tested on Membrane only.

MEMBRANE TYPE Petromat PROJECT NO. RFT-35-4-(74)182  
 BRIDGE NO. Northbound EXPRESSWAY I-35  
 DATE MEMBRANE INSTALLED 11-30-73 TESTED 10-17-74  
 CUMULATIVE VEHICULAR PASSES 912,200 SOAK TIME 4 Hours

| Area Tested                                    | Readings Within Resistivity Ranges |      |                                |       |                |      |
|------------------------------------------------|------------------------------------|------|--------------------------------|-------|----------------|------|
|                                                | <100K $\Omega$                     |      | 100K $\Omega$ to 500K $\Omega$ |       | >500K $\Omega$ |      |
|                                                | No.                                | %    | No.                            | %     | No.            | %    |
| A. Within 2.5 Ft. of Curb                      | 49                                 | 100  | 0                              | 0     | 0              | 0    |
| B. Near Transverse Joints<br>(Excluding Above) | 4                                  | 36.4 | 1                              | 9.1   | 6              | 54.5 |
| C. Within Shoulder Area<br>(Excluding Above)   | 4                                  | 6.4  | 2                              | 4.3   | 42             | 89.4 |
| D. Within Outside Lane                         | 50                                 | 53.2 | 31                             | 33.10 | 13             | 13.8 |
| E. Within Inside Lane                          | 34                                 | 40.0 | 4                              | 4.7   | 47             | 55.3 |
| F. Total of C + D + E                          | 87                                 | 38.5 | 37                             | 16.4  | 102            | 45.1 |

COMMENTS: Length of cracks in overlay: 110 ft. of cracking. Most low readings are in or near wheelpaths. Opened to traffic June 3, 1974. Grid: 5'.

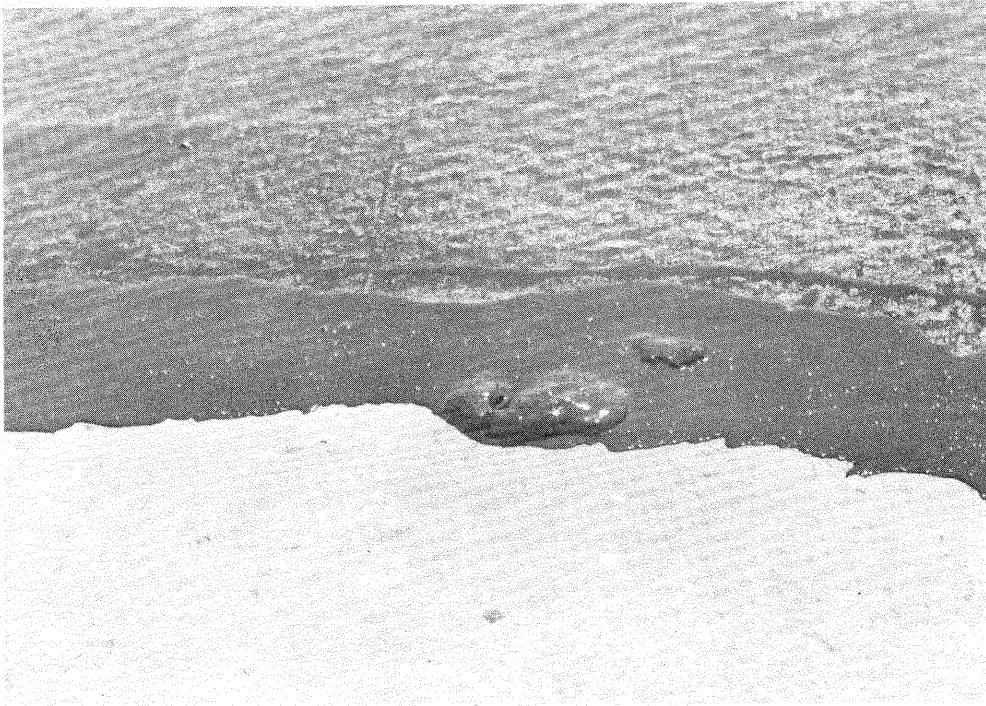
## RESULT OF RESISTIVITY TESTING

MEMBRANE TYPE Petromat PROJECT NO. PET-35-4(74)182  
 BRIDGE NO. Northbound EXPRESSWAY I-35  
 DATE MEMBRANE INSTALLED 11-30-73 TESTED 7-29-76  
 CUMULATIVE VEHICULAR PASSES 6,768,000 SOAK TIME 4 Hours

| Area Tested                                    | Readings Within Resistivity Ranges |      |                                |      |                |      |
|------------------------------------------------|------------------------------------|------|--------------------------------|------|----------------|------|
|                                                | <100K $\Omega$                     |      | 100K $\Omega$ to 500K $\Omega$ |      | >500K $\Omega$ |      |
|                                                | No.                                | %    | No.                            | %    | No.            | %    |
| A. Within 2.5 Ft. of Curb                      | 0                                  | 0    | 0                              | 0    | 23             | 100  |
| B. Near Transverse Joints<br>(Excluding Above) | 0                                  | 0    | 0                              | 0    | 0              | 0    |
| C. Within Shoulder Area<br>(Excluding Above)   | 0                                  | 0    | 0                              | 0    | 23             | 100  |
| D. Within Outside Lane                         | 28                                 | 58.3 | 9                              | 18.8 | 11             | 22.9 |
| E. Within Inside Lane                          | 9                                  | 18.8 | 18                             | 37.5 | 21             | 43.8 |
| F. Total of C + D + E                          | 37                                 | 31.1 | 27                             | 22.7 | 55             | 46.2 |

COMMENTS: Opened to traffic June 3, 1974. Grid 10'. Most low readings were in or near the wheelpath.

PETROMAT



Area of Coagulated Binder.



Binder adhering to workman's boots two days after application.





PETROMAT



"Fat Spot" in binder application.





## PETROMAT

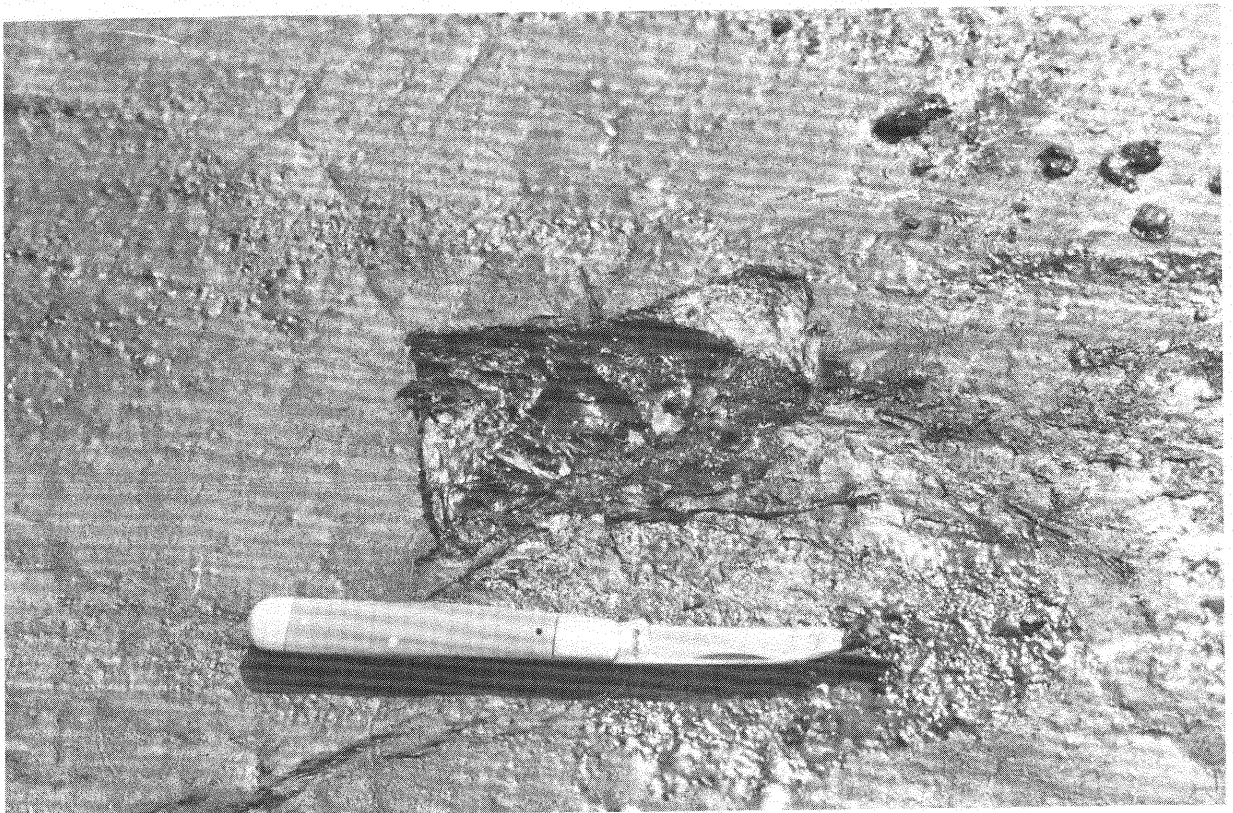


Applying and brooming the Petromat Fabric into the binder.





Appearance of overlay behind paver.



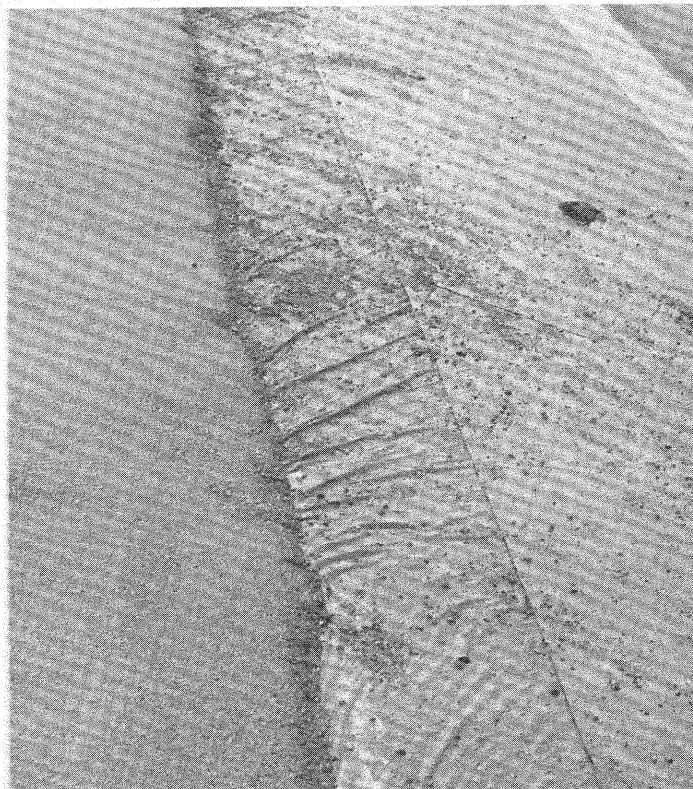
Unbroken emulsion under fabric layer.







Damage to membrane caused by paver's tracks.



Wrinkling of membrane during paving operation.





## POLYGUARD

### Project Data

Construction Project Number: I-240-4(205)147

Number of Bridges: 1

County: Oklahoma

Bridge Number: A

Expressway: SW 29th over I-240

Location of Project: SW 29th in Oklahoma City

### Bridge Design Data

Type of Structure: Continuous Plate Girder Spans

Span Lengths: 2 - 106' 9"

Overall Length: 213.5'

Width: 128"

Skew: None

Horizontal Curvature: None

Vertical Curvature: None

Super Elevation: None

Concrete Cover over Steel: 2"

### Deck Construction Data

Date of Last Bridge Deck Pour: March 1972

Concrete Type: AA(AE)

Cement Type: I

Fine Aggregate Source: Dolese - Newcastle, OK

Coarse Aggregate Source: Dolese - Richard's Spur, OK

Method of Surface Texturing: Broom

Curing Type: Linseed oil emulsion

### Protective Treatment

Description of Product: A roll type membrane consisting of a layer of vinyl modified bitumen laminated to a reinforcing sheet of woven polypropylene mesh with a total thickness of 60 mils.

## POLYGUARD

Manufacturer's Recommended Application Procedure: Primer shall be applied to the cleaned deck at approximately 100 ft.<sup>2</sup>/gal. After the primer has dried tack free the membrane shall be rolled onto the primer coat with sufficient pressure to assure good bond. A wearing course of asphaltic concrete shall be placed by a rubber padded paver.

Deck Preparation Prior to Application of Protective Treatment: Sand blast and remove remaining residue.

### Dates of Membrane Application and Comments:

|         |                                                                                        |
|---------|----------------------------------------------------------------------------------------|
| 6-18-75 | Primer and membrane applied to eastbound lanes. Temperatures in 80's.                  |
| 6-25-75 | Primer and membrane applied to westbound lanes. Temperature in high 70's and low 80's. |

### Asphaltic Concrete

Type: C

Thickness: 1½"

### Date of Application and Comments:

|         |                                                                           |
|---------|---------------------------------------------------------------------------|
| 6-26-75 | Overlaid structure with Type "C" asphaltic concrete. Temperature in 80's. |
|---------|---------------------------------------------------------------------------|

### Cost of Protective System

Membrane Treatment: \$5.20/sq/ yd.

Asphaltic Concrete: \$18.00/ton

### Discussion

The primer was poured on the deck and spread with squeegees. The primer was thin and an even coat was easily obtained. After approximately one hour of drying during which the primer became essentially tack free the membrane was rolled onto the primed deck. Initially the membrane had little adhesion to the primed deck; but, within an hour the membrane had developed a fairly good adhesion. This period of low adhesion proved helpful in placement and eliminating air bubbles. During the overlay the membrane stuck to the paver's tracks at one spot; but, this area was pulled loose from the paver's track and replaced. and the overlay was completed with no further complications. The membrane appeared more resistant to aggregate puncture than most.

# POLYGUARD

## RESULT OF RESISTIVITY TESTING

MEMBRANE TYPE Polyguard 860 PROJECT NO. I-240-4 (205) 147  
 BRIDGE NO. Westbound EXPRESSWAY I-240  
 DATE MEMBRANE INSTALLED 6-26-75 TESTED 8-19-20-75  
 CUMULATIVE VEHICULAR PASSES 960,000 SOAK TIME 4 hours

| Area Tested                                    | Readings Within Resistivity Ranges |   |                                |   |                |     |
|------------------------------------------------|------------------------------------|---|--------------------------------|---|----------------|-----|
|                                                | <100K $\Omega$                     |   | 100K $\Omega$ to 500K $\Omega$ |   | >500K $\Omega$ |     |
|                                                | No.                                | % | No.                            | % | No.            | %   |
| A. Within 2.5 Ft. of Curb                      | 0                                  | 0 | 0                              | 0 | 42             | 100 |
| B. Near Transverse Joints<br>(Excluding Above) | 0                                  | 0 | 0                              | 0 | 16             | 100 |
| C. Within Shoulder Area<br>(Excluding Above)   | 0                                  | 0 | 0                              | 0 | 0              | 0   |
| D. Within Outside Lane                         | 0                                  | 0 | 0                              | 0 | 63             | 100 |
| E. Within Inside Lane                          | 0                                  | 0 | 0                              | 0 | 63             | 100 |
| F. Total of C + D + E                          | 0                                  | 0 | 0                              | 0 | 126            | 100 |

COMMENTS: Opened to traffic June 28, 1975. Grid 10'.

MEMBRANE TYPE Polyguard 860 PROJECT NO. I-240-4 (205) 147  
 BRIDGE NO. Eastbound EXPRESSWAY I-240  
 DATE MEMBRANE INSTALLED 6-26-75 TESTED 8-18-75  
 CUMULATIVE VEHICULAR PASSES 960,000 SOAK TIME 4 Hours

| Area Tested                                    | Readings Within Resistivity Ranges |     |                                |     |                |      |
|------------------------------------------------|------------------------------------|-----|--------------------------------|-----|----------------|------|
|                                                | <100K $\Omega$                     |     | 100K $\Omega$ to 500K $\Omega$ |     | >500K $\Omega$ |      |
|                                                | No.                                | %   | No.                            | %   | No.            | %    |
| A. Within 2.5 Ft. of Curb                      | 0                                  | 0   | 0                              | 0   | 42             | 100  |
| B. Near Transverse Joints<br>(Excluding Above) | 0                                  | 0   | 0                              | 0   | 16             | 100  |
| C. Within Shoulder Area<br>(Excluding Above)   | 0                                  | 0   | 0                              | 0   | 0              | 0    |
| D. Within Outside Lane                         | 0                                  | 0   | 0                              | 0   | 63             | 100  |
| E. Within Inside Lane                          | 3                                  | 4.7 | 1                              | 1.6 | 59             | 93.7 |
| F. Total of C + D + E                          | 3                                  | 2.4 | 1                              | 0.8 | 122            | 96.8 |

COMMENTS: Area of patches in overlay: One patch approximately 3 ft.<sup>2</sup>.  
 Opened to traffic June 28, 1975. Grid 10'.

## POLYTOK

### Project Data

Construction Project Number: RFI-35-4(78)166

Number of Bridges: 2

County: Payne

Bridge Number(s): Northbound (K) and Southbound (L)

Expressway: I-35

Location of Project: .1 mile north of Cimarron River on I-35

### Bridge Design Data

Type of Structure: Simple I-beam

Span Length(s): 5 - 40'

Overall Length: 200'

Width: 39' 4½"

Skew: None

Horizontal Curvature: None

Vertical Curvature: None

Super Elevation: None

Concrete Cover over Steel: 2"

### Deck Construction Data

Date of Last Bridge Deck Pour: Northbound (10-4-74) Southbound (1-6-75)

Concrete Type: AA(AE)

Cement Type: I

Fine Aggregate Source: Dolese, Guthrie, OK

Coarse Aggregate Source: Dolese, Big Canyon, OK

Method of Surface Texturing: Burlap Drag

Curing Type: Linseed Oil Emulsion

### Protective Treatment

Description of Product: A two component cold applied, modified polyurethane elastomer.

## POLYTOK

Manufacturer's Recommended Application Procedure: Mix components in 3 to 1 ratio and apply to clean bridge deck with uniform 40 mil (dry) thickness. After 20 minutes dry time at 70°F, but while still tacky, roll 50 lb. asphalt impregnated sheeting into wet membrane. Allow 5 hours curing time and overlay with asphaltic concrete.

Deck Preparation Prior to Application of Protective Treatment: Sand blast and remove remaining residue.

### Dates of Membrane Application and Comments:

|          | <u>Northbound</u>                                                                            |
|----------|----------------------------------------------------------------------------------------------|
| 11-27-74 | Spraying of membrane began. Temperature 50's.                                                |
| 11-28-74 | Spraying of membrane completed. Temperature 40's.                                            |
| 11-29-74 | 6" snowfall.                                                                                 |
| 12-3-74  | Membrane removed with motor grader, (see discussion)                                         |
| 12-4-74  | Membrane was placed on deck using squeegees. Placement completed this day. Temperature 50's. |
| 12-5-74  | Overlay placement aborted.                                                                   |
| 12-6-74  | Rain                                                                                         |
| 12-9 -74 | Rain                                                                                         |
| 12-10-74 | Snow                                                                                         |
| 12-12-74 | Asphaltic concrete overlay placed.                                                           |
|          | <u>Southbound</u>                                                                            |
| 2-13-75  | Membrane placed by squeegee. Temperature 50's to 60's.                                       |
| 2-27-75  | One inch of hot sand asphaltic concrete laid on membrane.                                    |
| 2-21-75  | 1½" of Type "C" laid over membrane and hot sand.                                             |

### Asphaltic Concrete

Type: Hot sand asphaltic concrete and Type "C"

## POLYTOK

Thickness: 1" and 1 1/2"

### Date of Applications and Comments:

#### Northbound

12-5-74

Overlay aborted because of lifting of the protective paper by the paver.

12-12-74

Overlay begun and completed this day.

#### Southbound

3-21-75

1 1/2" Type "C" placed on membrane.

### Cost of Protective System

Membrane Treatment: \$7.00/sq. yd.

Asphaltic Concrete: \$12.00/Ton

### Discussion

Northbound - Wednesday, November 27, 1974. The membrane was applied on the deck with airless spray equipment at a rate of 50 to 65 mils wet thickness. The temperature was 50°F plus. Placement of the overlay was planned for Friday, November 29th. The membrane was sprayed in three foot wide strips the full length of the deck at approximately one-half of the required thickness, and allowed to break or become tacky; that required approximately one hour. At that time, the second thickness was applied to the first three feet plus the next three feet to bring the first three feet to the full film thickness. At the end of the second hour, the asphalt grade roofing sheet was rolled out onto the Polytok membrane material. The roofing sheet was placed only after the membrane had become very tacky. This procedure was repeated across the deck until the entire deck had been covered. All measurements for wet film thickness exceeded the required 50 mils minimum. The membrane material was thinned with an appropriate thinner at the rate of one quart per gallon of material.

The specifications called for 50 lb. roofing sheet, however, 65 lb. roofing sheet was substituted because the 50 lb. sheet was not available. Some difficulty was encountered with the edges and ends of the sheet tending to break adhesion with the membrane and curling up. Attempts to roll the sheet with a half ton pick up met with limited success. On November 29th, approximately 6 inches of snow fell on the exposed membrane and the overlay was postponed. It was discovered that quite a lot of water from the melting snow had gotten under the roofing paper. Attempts to determine the extent of trapped water resulted in lifting some membrane from the deck with the roofing paper. Because of this damage and the inability to accurately determine the areas and extents of trapped moisture, a decision was made to remove the membrane. A motor grader was used for removal. During removal it was estimated that 20% of the membrane had water trapped under the roofing sheet. Some areas were removed quite easily and often these areas had a strong smell of the thinner used in the application indicating that possibly the membrane was not thoroughly cured before the roofing paper was applied. Other areas were removed only with great difficulty.

On December 4 - The membrane was again applied to the cleaned deck, this time with squeegees. The coverage was not as uniform as the spray and the thickness was generally in excess of 65 mils even though no thinner was required for this application. Forty five lb. roofing paper was used instead of the heavier 65 lbs. and placement was better although some edge curling was still experienced. An attempt to overlay was made on December 5; however, soon after the operation began the paver lifted two adjacent sheets of the roofing paper and rolled them into the spreader box. The operation



was halted and the membrane inspected to find a poor bond of the membrane to the roofing paper, very probably the result of uncured membrane. The overlay was postponed to give the membrane an opportunity to cure. A rain fell on the structure December 6th and again on December 9th.

On December 11 the membrane was inspected and several areas were found that had water under the roofing paper. In these areas the paper was removed to allow evaporation of the trapped water. On December 12th the deck was cleaned with an air blast that succeeded in removing the roofing paper where poorly bonded and exposed several areas of water under the paper. Also found were two areas of uncured membrane eight days after application. The membrane in these two areas was approximately 120 mils thick. The overlay operation began at noon on December 12th. The paver's steel tracks tore the roofing paper but did not dislodge it from the membrane so the paving operation continued. In the areas where the roofing paper had been removed the pavers's tracks did no apparent damage. During the rolling it was observed that after three or four passes the asphalt began to push around in front of the roller. It was decided to make two breakdown passes, then wait until the asphalt temperature dropped to 180°F before completing the rolling. The rolling was then completed with no further incidents.

Southbound On February 13, 1975 the membrane was placed by squeegee. A representative from the membrane manufacturer was present. The thickness of the membrane was not uniform and the thickness was generally much greater than specified. After the difficulties encountered with the roofing paper protective layer on the adjacent structure, it was decided to use hand spread hot sand asphaltic concrete as the protective layer. This layer was placed on February 27.

## POLYTOK

The placement and rolling of the hot sand was not uniform. Some areas of poor adhesion between the hot sand and the membrane were noted, but it was felt that the heat of the insuing layer of type "C" A.C. would assist in creating a bond. On March 21, the Type "C" asphaltic concrete was placed without incident.

# POLYTOK

## RESULT OF RESISTIVITY TESTING

MEMBRANE TYPE Polytok PROJECT NO. RFI-35-4(78)166  
 BRIDGE NO. K (Northbound) EXPRESSWAY I-35  
 DATE MEMBRANE INSTALLED 11-27 & 28 - 74 TESTED 12-13-74  
 CUMULATIVE VEHICULAR PASSES None SOAK TIME 3 Hours

| Area Tested                                    | Readings Within Resistivity Ranges |      |                                |     |                |      |
|------------------------------------------------|------------------------------------|------|--------------------------------|-----|----------------|------|
|                                                | <100K $\Omega$                     |      | 100K $\Omega$ to 500K $\Omega$ |     | >500K $\Omega$ |      |
|                                                | No.                                | %    | No.                            | %   | No.            | %    |
| A. Within 2.5 Ft. of Curb                      | 9                                  | 20.5 | 2                              | 4.5 | 33             | 75.0 |
| B. Near Transverse Joints<br>(Excluding Above) | 1                                  | 1.9  | 0                              | 0   | 51             | 98.1 |
| C. Within Shoulder Area<br>(Excluding Above)   | 0                                  | 0    | 0                              | 0   | 59             | 100  |
| D. Within Outside Lane                         | 0                                  | 0    | 0                              | 0   | 51             | 100  |
| E. Within Inside Lane                          | 0                                  | 0    | 0                              | 0   | 44             | 100  |
| F. Total of C + D + E                          | 0                                  | 0    | 0                              | 0   | 154            | 100  |

COMMENTS: Opened to traffic December 13, 1974. Grid: 5' & 10'.

MEMBRANE TYPE Polytok PROJECT NO. RFI-35-4(78)166  
 BRIDGE NO. K (Northbound) EXPRESSWAY I-35  
 DATE MEMBRANE INSTALLED 11-27 & 28 - 74 TESTED July 1976.  
 CUMULATIVE VEHICULAR PASSES 4,902,000 SOAK TIME 4 Hours

| Area Tested                                    | Readings Within Resistivity Ranges |      |                                |      |                |      |
|------------------------------------------------|------------------------------------|------|--------------------------------|------|----------------|------|
|                                                | <100K $\Omega$                     |      | 100K $\Omega$ to 500K $\Omega$ |      | >500K $\Omega$ |      |
|                                                | No.                                | %    | No.                            | %    | No.            | %    |
| A. Within 2.5 Ft. of Curb                      | 0                                  | 0    | 3                              | 10.0 | 27             | 90.0 |
| B. Near Transverse Joints<br>(Excluding Above) | 18                                 | 33.3 | 5                              | 9.3  | 31             | 57.4 |
| C. Within Shoulder Area<br>(Excluding Above)   | 6                                  | 13.3 | 6                              | 13.3 | 33             | 73.3 |
| D. Within Outside Lane                         | 12                                 | 40.0 | 11                             | 36.7 | 10             | 33.3 |
| E. Within Inside Lane                          | 9                                  | 28.1 | 7                              | 21.9 | 16             | 50.0 |
| F. Total of C + D + E                          | 27                                 | 24.5 | 24                             | 21.8 | 59             | 53.6 |

COMMENTS: Area of patches in overlay: One patch approximately 10 ft.<sup>2</sup>.  
 Length of cracks in overlay: Two feet. Opened to traffic December 13, 1974.  
 Grid 10'.

POLYTOK

RESULT OF RESISTIVITY TESTING

MEMBRANE TYPE Polytok PROJECT NO. RFI-I-35-4(78)166  
 BRIDGE NO. L (Southbound) EXPRESSWAY I-35  
 DATE MEMBRANE INSTALLED 2-13-75 TESTED 2-26-75  
 CUMULATIVE VEHICULAR PASSES None SOAK TIME 2 Hours

| Area Tested                                    | Readings Within Resistivity Ranges |      |                                |      |                |      |
|------------------------------------------------|------------------------------------|------|--------------------------------|------|----------------|------|
|                                                | <100K $\Omega$                     |      | 100K $\Omega$ to 500K $\Omega$ |      | >500K $\Omega$ |      |
|                                                | No.                                | %    | No.                            | %    | No.            | %    |
| A. Within 2.5 Ft. of Curb                      | 15                                 | 37.5 | 5                              | 12.5 | 20             | 50.0 |
| B. Near Transverse Joints<br>(Excluding Above) | 11                                 | 26.8 | 5                              | 12.2 | 25             | 61.0 |
| C. Within Shoulder Area<br>(Excluding Above)   | 5                                  | 11.9 | 10                             | 23.8 | 27             | 64.3 |
| D. Within Outside Lane                         | 5                                  | 16.7 | 1                              | 3.3  | 24             | 80.0 |
| E. Within Inside Lane                          | 2                                  | 6.3  | 4                              | 12.5 | 26             | 81.3 |
| F. Total of C + D + E                          | 12                                 | 11.5 | 15                             | 14.4 | 77             | 74.0 |

COMMENTS: Opened to traffic April 8, 1975. Grid 10'. Tested on bare membrane.

MEMBRANE TYPE Polytok PROJECT NO. RFI-I-35-4(78)166  
 BRIDGE NO. L (Southbound) EXPRESSWAY I-35  
 DATE MEMBRANE INSTALLED 2-13-75 TESTED 3-6-75  
 CUMULATIVE VEHICULAR PASSES None SOAK TIME 3 Hours

| Area Tested                                    | Readings Within Resistivity Ranges |      |                                |      |                |      |
|------------------------------------------------|------------------------------------|------|--------------------------------|------|----------------|------|
|                                                | <100K $\Omega$                     |      | 100K $\Omega$ to 500K $\Omega$ |      | >500K $\Omega$ |      |
|                                                | No.                                | %    | No.                            | %    | No.            | %    |
| A. Within 2.5 Ft. of Curb                      | 7                                  | 23.3 | 7                              | 23.3 | 16             | 53.3 |
| B. Near Transverse Joints<br>(Excluding Above) | 8                                  | 14.8 | 8                              | 14.8 | 38             | 70.4 |
| C. Within Shoulder Area<br>(Excluding Above)   | 4                                  | 8.9  | 1                              | 2.2  | 40             | 88.9 |
| D. Within Outside Lane                         | 0                                  | 0    | 0                              | 0    | 30             | 100  |
| E. Within Inside Lane                          | 1                                  | 3.3  | 0                              | 0    | 29             | 96.7 |
| F. Total of C + D + E                          | 5                                  | 4.8  | 1                              | 1.0  | 99             | 94.3 |

COMMENTS: Opened to traffic April 8, 1975. Grid 10'. Tested with hot sand applied.

# POLYTOK

## RESULT OF RESISTIVITY TESTING

MEMBRANE TYPE Polytok PROJECT NO. RFI-I-35-4(78) 166  
 BRIDGE NO. L (Southbound) EXPRESSWAY I-35  
 DATE MEMBRANE INSTALLED 2-13-75 TESTED 7-76  
 CUMULATIVE VEHICULAR PASSES 3,060,000 SOAK TIME 4 Hours

| <u>Area Tested</u>                             | <u>Readings Within Resistivity Ranges</u> |          |                                                             |          |                                     |          |
|------------------------------------------------|-------------------------------------------|----------|-------------------------------------------------------------|----------|-------------------------------------|----------|
|                                                | <u>&lt;100K <math>\Omega</math></u>       |          | <u>100K <math>\Omega</math> to 500K <math>\Omega</math></u> |          | <u>&gt;500K <math>\Omega</math></u> |          |
|                                                | <u>No.</u>                                | <u>%</u> | <u>No.</u>                                                  | <u>%</u> | <u>No.</u>                          | <u>%</u> |
| A. Within 2.5 Ft. of Curb                      | 0                                         | 0        | 0                                                           | 0        | 30                                  | 100      |
| B. Near Transverse Joints<br>(Excluding Above) | 4                                         | 7.4      | 3                                                           | 5.6      | 47                                  | 87.0     |
| C. Within Shoulder Area<br>(Excluding Above)   | 0                                         | 0        | 1                                                           | 2.3      | 44                                  | 97.8     |
| D. Within Outside Lane                         | 8                                         | 26.7     | 12                                                          | 40.0     | 10                                  | 33.3     |
| E. Within Inside Lane                          | 3                                         | 10.0     | 1                                                           | 3.3      | 26                                  | 86.7     |
| F. Total of C + D + E                          | 11                                        | 10.5     | 14                                                          | 13.3     | 80                                  | 76.2     |

COMMENTS: Most low readings in the outside lane were in or near the wheel path. Opened to traffic April 8, 1975. Grid: 10'.

## POLYTOK



Typical failure of A.C. surfacing over Polytok membrane.





## PROTECTO WRAP

### Project Data

Construction Project Number: RFI-I-35-4(78)166

Number of Bridges: 2

County: Payne

Bridge Number(s): Northbound (O) and Southbound (P)

Expressway: I-35

Location of Project: Approximately .3 mile north of Cimarron River on  
I-35

### Bridge Design Data

Type of Structure: Simple I Beam

Span Length(s): 4 - 40'

Overall Length: 162'

Width: 39' 4½"

Skew: None

Horizontal Curvature: None

Verticle Curvature: None

Super Elevation: None

Concrete Cover Over Steel: 2"

### Deck Construction Data

Date of Last Bridge Deck Pour: Northbound 10-22-74 and Southbound 1-17-75

Concrete Type: AA (AE)

Cement Type: I

Fine Aggregate Source: Dolese, Guthrie, OK

Coarse Aggregate Source: Dolese, Big Canyon, OK

Method of Surface Texturing: Burlap Drag

Curing Type: Linseed Oil Emulsion

### Protective Treatment

Description of Product: Preformed roll type membrane consisting of approximately 70 mils of vinyl modified coal tar which is reinforced with a synthetic fibrous mat.

## PROTECTO WRAP

Manufacturer's Recommended Application Procedure: Deck should be dry and clean of dirt, grease, etc. Primer should be applied by spray or brush at a rate of approximately 200 ft<sup>2</sup>/gal. The membrane is then pressure applied while the primer is still tacky. An asphaltic concrete wearing course is then applied.

Deck Preparation Prior to Application of Protective Treatment: Sand Blast and clean and remove remaining residue.

Dates of Membrane Application and Comments:

### Northbound

11-28-74

Primer application began at approximately 3:00 p.m. membrane placement began at 4:00 p.m. and was completed at 7:30 p.m.

### Southbound

2-27-75

Application started in the afternoon. Temperature in the 50's.

2-28-75

Application completed morning of the 28th.

### Asphaltic Concrete

Type: C

Thickness: 1½"

Date of Application & Comments:

### Northbound

12-5-74

Overlay placed on the membrane.

### Southbound

2-28-75

1" hot sand applied.

3-21-75

1 1/2" Type "C" applied.

### Cost of Protective System

Membrane Treatment: \$7.00/sq. yd.

Asphaltic Concrete: \$12.00/ton

### Discussion

Northbound - Placement of the membrane began late on the afternoon of November 28 and was completed by pickup lights about 7:30 pm that evening.

Upon inspection the following day the membrane appeared relatively free of

## PROTECTO WRAP

fish mouths; but, contained many transverse wrinkles that were the result of the cold weather. The wrinkles settled a great deal after the several heating and cooling cycles before overlayment. A bead of rubberized asphalt mastic was placed around the perimeter of the finished membrane to aid in sealing should rain fall on the membrane prior to overlayment. This membrane, like most roll type membranes, does not form a waterproof seal until the hot asphaltic concrete wearing course is applied. A snow fell on the membrane on November 29. Upon inspection it was found that very little water had seeped under the membrane. Where water was found the membrane was folded back and the water allowed to evaporate then relayed and recaulked. Very few blisters occurred prior to overlayment and these were punctured. Overlayment with 1½" of Type "C" went uneventfully.

Southbound - Membrane installation began on the afternoon of February 27 and was completed the morning of February 28. The air temperature was in the low 50's on the 27th and mid 40's on the 28th. The membrane was placed with few wrinkles and no blisters. One inch of hot sand asphalt was spread by hand over the membrane and compacted with a steel wheel. The hand placement and spreading resulted in a less than uniform hot sand layer but it was felt that it provided sufficient adhesion to provide protection to the membrane during placement of the Type "C" asphaltic concrete. The riding course of one and one-half inches of Type "C" asphaltic concrete was placed March 21 and the resulting surface looked very good with no apparent blistering, raveling, or other visible problems.

# PROTECTO WRAP

## RESULT OF RESISTIVITY TESTING

MEMBRANE TYPE Protecto Wrap PROJECT NO. RFT-I-35-4 (78) 166  
 BRIDGE NO. O (Northbound) EXPRESSWAY I-35  
 DATE MEMBRANE INSTALLED 11-28-74 TESTED 7-29-76  
 CUMULATIVE VEHICULAR PASSES 4,025,600 SOAK TIME 4 Hours

| <u>Area Tested</u>                             | <u>Readings Within Resistivity Ranges</u> |          |                                                             |          |                                     |          |
|------------------------------------------------|-------------------------------------------|----------|-------------------------------------------------------------|----------|-------------------------------------|----------|
|                                                | <u>&lt;100K <math>\Omega</math></u>       |          | <u>100K <math>\Omega</math> to 500K <math>\Omega</math></u> |          | <u>&gt;500K <math>\Omega</math></u> |          |
|                                                | <u>No.</u>                                | <u>%</u> | <u>No.</u>                                                  | <u>%</u> | <u>No.</u>                          | <u>%</u> |
| A. Within 2.5 Ft. of Curb                      | 1                                         | 4.2      | 0                                                           | 0        | 23                                  | 95.8     |
| B. Near Transverse Joints<br>(Excluding Above) | 1                                         | 2.2      | 5                                                           | 11.1     | 39                                  | 86.7     |
| C. Within Shoulder Area<br>(Excluding Above)   | 0                                         | 0        | 2                                                           | 5.6      | 34                                  | 94.4     |
| D. Within Outside Lane                         | 1                                         | 4.2      | 6                                                           | 25.0     | 17                                  | 70.8     |
| E. Within Inside Lane                          | 2                                         | 8.3      | 2                                                           | 8.3      | 20                                  | 83.3     |
| F. Total of C + D + E                          | 3                                         | 3.6      | 10                                                          | 11.9     | 71                                  | 84.5     |

COMMENTS: Length of cracks in overlay: 40ft. Low reading in the outside lane were in the wheel paths. Several low readings along open construction joints. Opened to traffic December 13, 1974. Grid 10'.

# PROTECTO WRAP

## RESULT OF RESISTIVITY TESTING

MEMBRANE TYPE Protecto Wrap PROJECT NO. FFI-I-35-4 (78) 166  
 BRIDGE NO. P (Southbound) EXPRESSWAY I-35  
 DATE MEMBRANE INSTALLED 2-27 & 28-75 TESTED 3-12-75  
 CUMULATIVE VEHICULAR PASSES None SOAK TIME 3 Hours

| Area Tested                                    | Readings Within Resistivity Ranges |     |                                |     |                |      |
|------------------------------------------------|------------------------------------|-----|--------------------------------|-----|----------------|------|
|                                                | <100K $\Omega$                     |     | 100K $\Omega$ to 500K $\Omega$ |     | >500K $\Omega$ |      |
|                                                | No.                                | %   | No.                            | %   | No.            | %    |
| A. Within 2.5 Ft. of Curb                      | 0                                  | 0   | 2                              | 8.3 | 22             | 91.7 |
| B. Near Transverse Joints<br>(Excluding Above) | 2                                  | 4.4 | 3                              | 6.7 | 40             | 88.9 |
| C. Within Shoulder Area<br>(Excluding Above)   | 0                                  | 0   | 0                              | 0   | 36             | 100  |
| D. Within Outside Lane                         | 0                                  | 0   | 0                              | 0   | 24             | 100  |
| E. Within Inside Lane                          | 0                                  | 0   | 0                              | 0   | 24             | 100  |
| F. Total of C + D + E                          | 0                                  | 0   | 0                              | 0   | 84             | 100  |

COMMENTS: Opened to traffic April 8, 1975. Grid 10'.

MEMBRANE TYPE Protecto Wrap PROJECT NO. FFI-I-35-4 (78) 166  
 BRIDGE NO. P (Southbound) EXPRESSWAY I-35  
 DATE MEMBRANE INSTALLED 2-27 & 28-75 TESTED 7-27-76  
 CUMULATIVE VEHICULAR PASSES 3,468,000 SOAK TIME 4 Hours

| Area Tested                                    | Readings Within Resistivity Ranges |      |                                |      |                |      |
|------------------------------------------------|------------------------------------|------|--------------------------------|------|----------------|------|
|                                                | <100K $\Omega$                     |      | 100K $\Omega$ to 500K $\Omega$ |      | >500K $\Omega$ |      |
|                                                | No.                                | %    | No.                            | %    | No.            | %    |
| A. Within 2.5 Ft. of Curb                      | 0                                  | 0    | 0                              | 0    | 24             | 100  |
| B. Near Transverse Joints<br>(Excluding Above) | 4                                  | 8.9  | 3                              | 6.7  | 38             | 84.4 |
| C. Within Shoulder Area<br>(Excluding Above)   | 0                                  | 0    | 0                              | 0    | 36             | 100  |
| D. Within Outside Lane                         | 7                                  | 28.0 | 8                              | 32.0 | 10             | 40.0 |
| E. Within Inside Lane                          | 0                                  | 0    | 0                              | 0    | 24             | 100  |
| F. Total of C + D + E                          | 7                                  | 8.2  | 8                              | 9.4  | 70             | 82.4 |

COMMENTS: Area of patches in overlay: One patch approximately one-half ft.<sup>2</sup>.  
 Opened to traffic April 8, 1975. Grid: 10'. The low readings in the outside  
 lanes were in the wheel paths.

## UNITED STATES DEPARTMENT OF JUSTICE

## FEDERAL BUREAU OF INVESTIGATION

## MEMORANDUM FOR THE DIRECTOR

## SUBJECT: [REDACTED]

## DATE: [REDACTED]

## BY: [REDACTED]

## TITLE: [REDACTED]

## SUMMARY: [REDACTED]

## DETAILS: [REDACTED]

## CONCLUSION: [REDACTED]

## RECOMMENDATION: [REDACTED]

## ACTION: [REDACTED]

## ADMINISTRATIVE: [REDACTED]

## OTHER: [REDACTED]

## REMARKS: [REDACTED]

## REFERENCE: [REDACTED]

## ATTACHMENTS: [REDACTED]

## DISTRIBUTION: [REDACTED]

## APPROVAL: [REDACTED]

## SIGNATURE: [REDACTED]

## DATE: [REDACTED]

## TITLE: [REDACTED]

## DEPARTMENT: [REDACTED]

## DIVISION: [REDACTED]

## SECTION: [REDACTED]

## SUBSECTION: [REDACTED]

## BRANCH: [REDACTED]

## OFFICE: [REDACTED]

## STATION: [REDACTED]

## REPORT: [REDACTED]

## PAGE: [REDACTED]

## TOTAL: [REDACTED]

## REMARKS: [REDACTED]

## REFERENCE: [REDACTED]

## ATTACHMENTS: [REDACTED]

## DISTRIBUTION: [REDACTED]

## APPROVAL: [REDACTED]

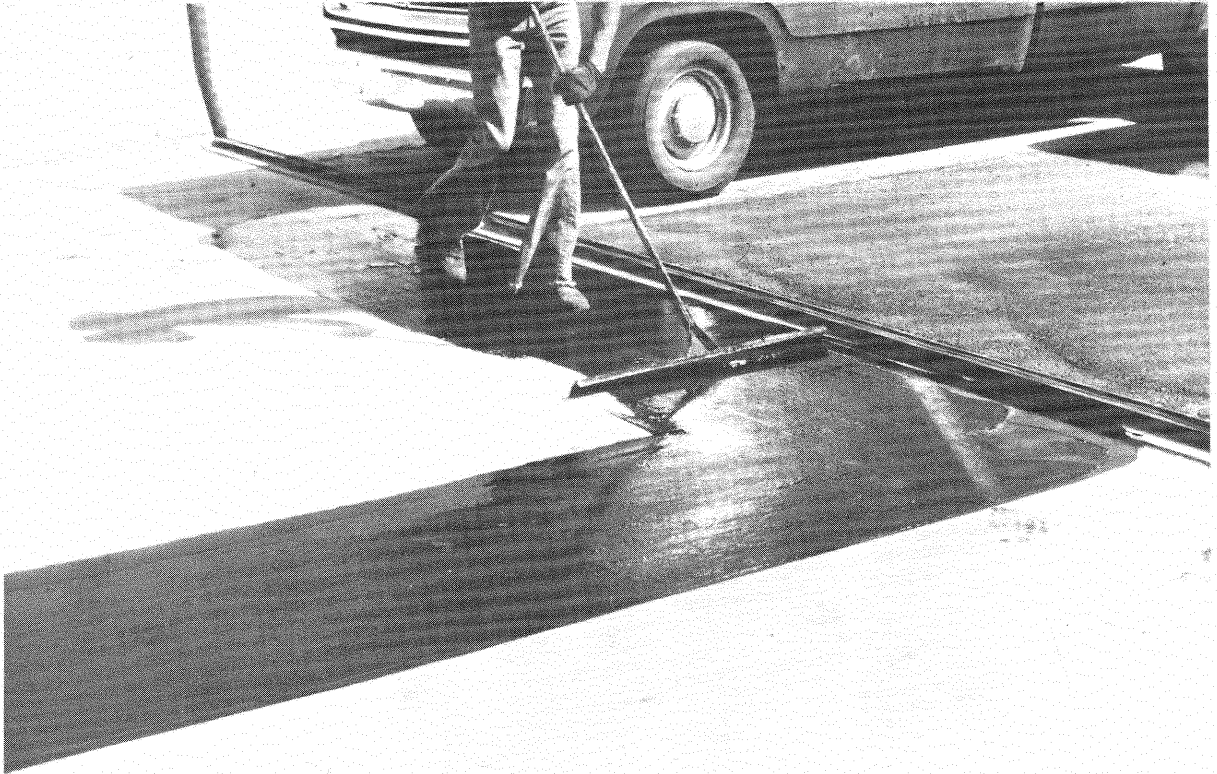
## SIGNATURE: [REDACTED]

## DATE: [REDACTED]

## TITLE: [REDACTED]

## DEPARTMENT: [REDACTED]

## PROTECTO WRAP



Application of Protecto Wrap prime coat.





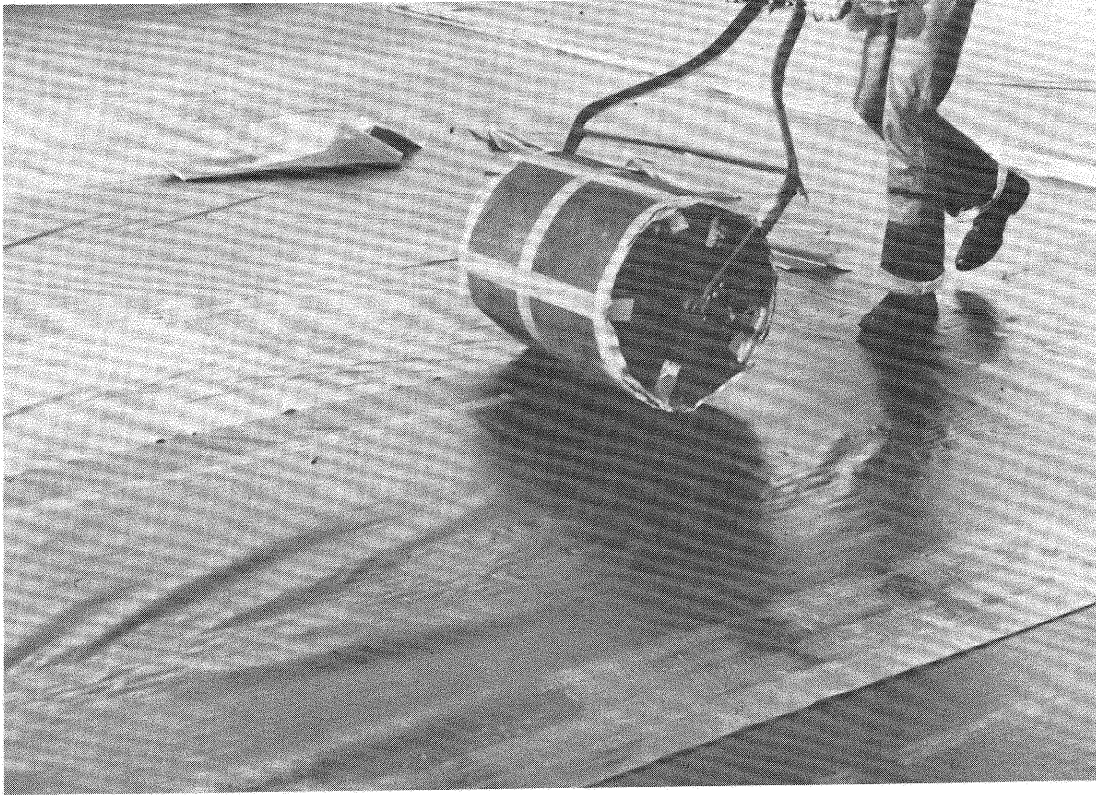
## PROTECTO WRAP



Applying Protecto Wrap to primed surface.



## PROTECTO WRAP



Rolling membrane into prime coat.



## ROYSTON

### Project Data

Construction Project Number: I-40-1(44)000

Number of Bridges: 14

County: Beckham

Bridge Numbers: "A" through "N"

Expressway: I-40

Location of Project: From Texola East approximately 15 miles.

### Bridge Design Data

Bridge Numbers: A & B

Type of Structure: Concrete slab spans

Span Lengths: 32' 9 1/8", 40', 32' 9 1/2"

Overall Length: 105' 6 1/4"

Width 38'

Skew: 81° 39' 43.53"

Horizontal Curvature: None

Vertical Curvature: None

Super Elevation: None

Concrete Cover over Steel: 2"

Bridge Numbers: C & D

Type of Structure: Concrete slab spans

Span Lengths: 32' 9", 46' 6", 32' 9"

Overall Length: 112'

Width: 38'

Skew: None

Horizontal Curvature: None

Vertical Curvature: 5° 01' 52"

Super Elevation: None

Concrete Cover over Steel: 2"

## ROYSTON

Bridge Numbers: E & F

Type of Structure: Continuous I-Beam

Span Lengths: 40' 9", 50', 40' 9"

Overall Lengths: 131' 6"

Width: 38'

Skew: None

Horizontal Curvature: None

Vertical Curvature:  $0^{\circ} 41' 45''$

Super Elevation: None

Concrete Cover over Steel: 2"

Bridge Numbers: G & H

Type of Structure: Continuous Plate Girder Spans

Span Lengths: 61' 4", 84', 61' 4"

Overall Length: 206' 8"

Width: 38'

Skew:  $49^{\circ} 47' 07.7''$

Horizontal Curvature: None

Vertical Curvature: None

Super Elevation: None

Concrete Cover over Steel: 2"

Bridge Number: I

Type of Structure: Continuous and Simple Plate Girder

Span Lengths: (2 - 82' 3" Cont.) and 142.05, 153.95, 75.83 Plate Girder

Overall Length: 598.9'

Width: 38'

Skew:  $34^{\circ} 09' \text{ LF}$

Horizontal Curvature: None

Vertical Curvature:  $1^{\circ} 13' 12''$

Super Elevation: 3/16"/foot

Concrete Cover over Steel: 2"



## ROYSTON

Bridge Number: J

Type of Structure: Continuous and Simple Plate Girder

Span Lengths: (2 - 82', 35' Cont.) and 142.05', 153.95', 74' Plate Girder

Overall Length: 592.66'

Width: 46'

Skew:  $34^{\circ} 09'$  LF

Horizontal Curvature: None

Vertical Curvature  $1^{\circ} 13' 12''$

Super Elevation: None

Concrete Cover over Steel: 2"

Bridge Numbers: K and L

Type of Structure: Continuous concrete slab span

Span lengths: 37', 57', 37'

Overall Length: 131'

Width: 38'

Skew:  $55^{\circ} 48' 13.8''$

Horizontal Curvature: None

Vertical Curvature:  $0^{\circ} 31' 22''$

Super Elevation: None

Concrete Cover over Steel: 2"

Bridge Numbers: M and N

Type of Structure: Continuous Plate Girder

Span Lengths: 57' 5", 70', 57' 5"

Overall Length: 184' 10"

Width: 38'

Skew:  $45^{\circ}$  LF

Horizontal Curvature: None

Vertical Curvature:  $0^{\circ} 16' 0''$

Super Elevation: None

Concrete Cover over Steel: 2"

## ROYSTON

### Deck Construction Data

| Bridge No. | Date of Last Bridge Deck Pour |
|------------|-------------------------------|
| A          | 11-20-71                      |
| B          | 10-18-72                      |
| C          | 9-13-72                       |
| D          | 8-18-72                       |
| E          | 3-17-72                       |
| F          | 3-30-72                       |
| G          | 5-09-72                       |
| H          | 6-01-72                       |
| I          | 8-09-72                       |
| J          | 9-29-72                       |
| K          | 6-18-72                       |
| L          | 7-06-72                       |
| M          | 10-31-68                      |
| N          | 12-11-68                      |

Concrete Type: AA (AE)

Cement Type: I

Fine and Coarse Source:

| Bridge No.      | Source                                     |
|-----------------|--------------------------------------------|
| A,B,C,D,E,F,G,H | Western Sand & Gravel, McLean, TX (Both)   |
| I,J,K,L         | Western Sand & Gravel, McLean, TX (Fine)   |
|                 | Dolese, Cooperton, OK (Coarse)             |
| M,N             | Southwest Sand & Gravel, Snyder, OK (Fine) |
|                 | Dolese, Cooperton, OK (Coarse)             |

Method of Surface Texturing: Pan, (except M and N) Metal strike off

Curing Type: Linseed oil emulsion

### Protective Treatment

Description of Product: A prefabricated roll type laminate consisting of a fiberglass mesh reinforcing laminated between layers of synthetic rubber and resin modified bituminous mastic with a top layer of mylar film.

Manufacturer's Recommended Application Procedure: The prime shall be applied to the sand blasted deck by brush, squeegee or roller at a rate of 90 ft.<sup>2</sup>/gal. After the prime has dried tack free, the membrane shall be

## ROYSTON

rolled into the prime with sufficient pressure to insure close contact between the prime and membrane. Roll ends should be overlapped six inches and the lapped area heated with a propane torch to provide bond. Heat sealing shall also be applied around the perimeter of the finished membrane at parapets and expansion dams.

### Dates of Membrane Application & Comments:

|         |                                                             |
|---------|-------------------------------------------------------------|
| 2-13-75 | Placed membrane on Structure C. Temperature in 50's.        |
| 2-20-75 | Placed membrane on Structure A. Temperature in 40's.        |
| 2-21-75 | Placed membrane on Structure B. Temperature in 40's.        |
| 2-25-75 | Placed membrane On Structure D. Temperature 40's.           |
| 2-26-75 | Placed membrane on Structure F. Temperature in low 40's.    |
| 3-18-75 | Placed membrane on Structure M. Temperature in 50's.        |
| 3-19-75 | Placed membrane on Structure I. Temperature in 60's.        |
| 3-20-75 | Placed membrane on Structure I. Temperature in 70's.        |
| 3-21-75 | Placed membrane on Structure E. Temperature in 70's.        |
| 3-24-75 | Placed membrane on Structure H. Temperature in 50's.        |
| 3-25-75 | Placed membrane on Structure G. Temperature in 40's.        |
| 3-31-75 | Placed membrane on Structure N. Temperature in 50's.        |
| 4-1-75  | Placed membrane on Structures K and L. Temperature in 50's. |
| 4-3-75  | Placed membrane on Structure J. Temperature in 70's.        |

## ROYSTON

### Asphaltic Concrete

Type: "B"

Thickness: 1 1/2"

Date of Application & Comments:

3-17-75

Laid AC on Structure A. Temperature in 40's.

3-18-75

Laid AC on Structures B, C, & D. Temperature in 50's.

3-19-75

Laid AC on Structures F and M. Temperature in low 60's.

3-20-75

Laid AC on Structure I. Temperature in low to mid 70's.

4-8-75

Laid AC on Structures E, G, & H. Temperature in 60's.

4-9-75

Laid AC on Structures J, K, L, & N. Temperature in 60's.

### Cost of Protective System

Membrane Treatment: \$6.00/yd.<sup>2</sup>

Asphalt Concrete: \$20.00/ton

### Discussion

These observations are a compendium of membrane placement on all 14 structures. The prime is quite viscous and covers the deck with what appears to be a membrane itself. It was placed using a squeegee. After drying there is initially very little adhesion of the laminate to the prime. This fact facilitates placement. The pressure to bond laminate to prime that the manufacturer calls for was hand applied with a squeegee, certainly not the most effective method: however, it must be pointed out that this created no problems. Heat sealing of the membrane apparently forms an effective seal. Several of the membranes were snowed and rained on prior to overlayment with no indication of water penetrating

## ROYSTON

the membrane. Overlayment was uneventful except for a decided tendency for the rubber-tired paver to lose traction on the relatively smooth surface of the membrane. A rubberpadded paver should have no such problem. A layer of asphaltic concrete spread in the wheel paths of a rubber tired paver might also eliminate this problem. Within a month of the paving operation outgassing blisters began to appear on several of these structures. Structure I and M were particularly afflicted having 30 and 9 blisters, respectively. Many of these blisters cracked the concrete above them and provided low resistance readings. In the following resistivity data, Structures A, B, C, D, K, & L, all being slab spans, were not tested.

## RESULT OF RESISTIVITY TESTING

MEMBRANE TYPE Royston PROJECT NO. I-40-1 (44) 000  
 BRIDGE NO. E EXPRESSWAY I-40  
 DATE MEMBRANE INSTALLED 3-21-75 TESTED 5-27-75  
 CUMULATIVE VEHICULAR PASSES None SOAK TIME 4 Hours

| Area Tested                                    | Readings Within Resistivity Ranges |      |                                |     |                |      |
|------------------------------------------------|------------------------------------|------|--------------------------------|-----|----------------|------|
|                                                | <100K $\Omega$                     |      | 100K $\Omega$ to 500K $\Omega$ |     | >500K $\Omega$ |      |
|                                                | No.                                | %    | No.                            | %   | No.            | %    |
| A. Within 2.5 Ft. of Curb                      | 0                                  | 0    | 0                              | 0   | 24             | 100  |
| B. Near Transverse Joints<br>(Excluding Above) | 3                                  | 16.7 | 0                              | 0   | 1.5            | 83.3 |
| C. Within Shoulder Area<br>(Excluding Above)   | 1                                  | 2.8  | 0                              | 0   | 35             | 97.2 |
| D. Within Outside Lane                         | 1                                  | 2.8  | 1                              | 2.8 | 34             | 94.4 |
| E. Within Inside Lane                          | 0                                  | 0    | 0                              | 0   | 28             | 100  |
| F. Total of C + D + E                          | 2                                  | 2    | 1                              | 1   | 97             | 97   |

COMMENTS: The low readings in the outside lane was over a punctured blister.  
 Opened to traffic on June 2, 1975. Grid 10'.

MEMBRANE TYPE Royston PROJECT NO. I-40-1 (44) 000  
 BRIDGE NO. E EXPRESSWAY I-40  
 DATE MEMBRANE INSTALLED 3-21-75 TESTED 5-24-76  
 CUMULATIVE VEHICULAR PASSES 2,420,800 SOAK TIME 4 Hours

| Area Tested                                    | Readings Within Resistivity Ranges |      |                                |      |                |      |
|------------------------------------------------|------------------------------------|------|--------------------------------|------|----------------|------|
|                                                | <100K $\Omega$                     |      | 100K $\Omega$ to 500K $\Omega$ |      | >500K $\Omega$ |      |
|                                                | No.                                | %    | No.                            | %    | No.            | %    |
| A. Within 2.5 Ft. of Curb                      | 12                                 | 50   | 0                              | 0    | 12             | 50   |
| B. Near Transverse Joints<br>(Excluding Above) | 2                                  | 10.5 | 2                              | 10.5 | 15             | 79.0 |
| C. Within Shoulder Area<br>(Excluding Above)   | 0                                  | 0    | 1                              | 4.2  | 23             | 95.8 |
| D. Within Outside Lane                         | 7                                  | 5.6  | 11                             | 88.7 | 7              | 5.6  |
| E. Within Inside Lane                          | 0                                  | 0    | 0                              | 0    | 28             | 100  |
| F. Total of C + D + E                          | 7                                  | 9.1  | 12                             | 15.6 | 58             | 75.3 |

COMMENTS: Low readings in the outside lane were in the wheelpath. Opened  
 to traffic June 2, 1975. Grid: 10'.

# ROYSTON

## RESULT OF RESISTIVITY TESTING

MEMBRANE TYPE Royston PROJECT NO. I-40-1(44)000  
 BRIDGE NO. F EXPRESSWAY I-40  
 DATE MEMBRANE INSTALLED 2-26-75 TESTED 5-27-75  
 CUMULATIVE VEHICULAR PASSES None SOAK TIME 4 Hours

| Area Tested                                    | Readings Within Resistivity Ranges |     |                                |     |                |      |
|------------------------------------------------|------------------------------------|-----|--------------------------------|-----|----------------|------|
|                                                | <100K $\Omega$                     |     | 100K $\Omega$ to 500K $\Omega$ |     | >500K $\Omega$ |      |
|                                                | No.                                | %   | No.                            | %   | No.            | %    |
| A. Within 2.5 Ft. of Curb                      | 1                                  | 4.2 | 1                              | 4.2 | 22             | 91.7 |
| B. Near Transverse Joints<br>(Excluding Above) | 1                                  | 5.6 | 1                              | 5.6 | 16             | 88.9 |
| C. Within Shoulder Area<br>(Excluding Above)   | 0                                  | 0   | 0                              | 0   | 36             | 100  |
| D. Within Outside Lane                         | 2                                  | 5.4 | 1                              | 2.7 | 34             | 91.9 |
| E. Within Inside Lane                          | 0                                  | 0   | 2                              | 7.7 | 34             | 92.3 |
| F. Total of C + D + E                          | 2                                  | 2   | 3                              | 3   | 94             | 95   |

COMMENTS: Three of four blisters had readings below 130 K $\Omega$ . Opened to traffic on June 2, 1975. Grid: 10'.

MEMBRANE TYPE Royston PROJECT NO. I-40-1(44)000  
 BRIDGE NO. F EXPRESSWAY I-40  
 DATE MEMBRANE INSTALLED 2-26-75 TESTED 6-1-76  
 CUMULATIVE VEHICULAR PASSES 2,475,200 SOAK TIME 6 hours

| Area Tested                                    | Readings Within Resistivity Ranges |      |                                |     |                |      |
|------------------------------------------------|------------------------------------|------|--------------------------------|-----|----------------|------|
|                                                | <100K $\Omega$                     |      | 100K $\Omega$ to 500K $\Omega$ |     | >500K $\Omega$ |      |
|                                                | No.                                | %    | No.                            | %   | No.            | %    |
| A. Within 2.5 Ft. of Curb                      | 12                                 | 50   | 0                              | 0   | 12             | 50   |
| B. Near Transverse Joints<br>(Excluding Above) | 6                                  | 33   | 0                              | 0   | 12             | 67   |
| C. Within Shoulder Area<br>(Excluding Above)   | 4                                  | 11   | 1                              | 2.8 | 31             | 86.1 |
| D. Within Outside Lane                         | 21                                 | 100  | 0                              | 0   | 0              | 0    |
| E. Within Inside Lane                          | 13                                 | 54.2 | 0                              | 0   | 11             | 45.8 |
| F. Total of C + D + E                          | 38                                 | 46.9 | 1                              | 1.2 | 42             | 51.9 |

COMMENTS: All low readings in the outside lane were in the wheelpaths. All low readings in the inside lane were next to the centerline. Opened to traffic June 2, 1975.



# ROYSTON

## RESULT OF RESISTIVITY TESTING

MEMBRANE TYPE Royston PROJECT NO. I-40-1(44)000  
 BRIDGE NO. G EXPRESSWAY I-40  
 DATE MEMBRANE INSTALLED 3-25-75 TESTED 5-28-75  
 CUMULATIVE VEHICULAR PASSES None SOAK TIME 5 hours

| Area Tested                                    | Readings Within Resistivity Ranges |     |                                |    |                |      |
|------------------------------------------------|------------------------------------|-----|--------------------------------|----|----------------|------|
|                                                | <100K $\Omega$                     |     | 100K $\Omega$ to 500K $\Omega$ |    | >500K $\Omega$ |      |
|                                                | No.                                | %   | No.                            | %  | No.            | %    |
| A. Within 2.5 Ft. of Curb                      | 3                                  | 7.5 | 4                              | 10 | 33             | 82.5 |
| B. Near Transverse Joints<br>(Excluding Above) | 1                                  | 5.5 | 0                              | 0  | 17             | 94.4 |
| C. Within Shoulder Area<br>(Excluding Above)   | 0                                  | 0   | 0                              | 0  | 40             | 100  |
| D. Within Outside Lane                         | 0                                  | 0   | 0                              | 0  | 40             | 100  |
| E. Within Inside Lane                          | 0                                  | 0   | 0                              | 0  | 52             | 100  |
| F. Total of C + D + E                          | 0                                  | 0   | 0                              | 0  | 132            | 100  |

COMMENTS: Opened to traffic June 2, 1975. Grid: 10'.

MEMBRANE TYPE Royston PROJECT NO. I-40-1(44)000  
 BRIDGE NO. G EXPRESSWAY I-40  
 DATE MEMBRANE INSTALLED 3-25-75 TESTED 5-26-76  
 CUMULATIVE VEHICULAR PASSES 2,434,400 SOAK TIME 4 Hours

| Area Tested                                    | Readings Within Resistivity Ranges |      |                                |      |                |      |
|------------------------------------------------|------------------------------------|------|--------------------------------|------|----------------|------|
|                                                | <100K $\Omega$                     |      | 100K $\Omega$ to 500K $\Omega$ |      | >500K $\Omega$ |      |
|                                                | No.                                | %    | No.                            | %    | No.            | %    |
| A. Within 2.5 Ft. of Curb                      | 8                                  | 21.0 | 6                              | 15.7 | 24             | 63.1 |
| B. Near Transverse Joints<br>(Excluding Above) | 4                                  | 22.2 | 1                              | 5.5  | 13             | 72.2 |
| C. Within Shoulder Area<br>(Excluding Above)   | 8                                  | 20.0 | 9                              | 22.5 | 23             | 57.5 |
| D. Within Outside Lane                         | 4                                  | 10   | 8                              | 20   | 28             | 70   |
| E. Within Inside Lane                          | 16                                 | 30.7 | 6                              | 11.5 | 30             | 57.6 |
| F. Total of C + D + E                          | 28                                 | 21.2 | 23                             | 17.4 | 81             | 61.4 |

COMMENTS: The low outside and inside lane readings were along a construction joint. Opened to traffic June 2, 1975. Grid: 10'.

# ROYSTON

## RESULT OF RESISTIVITY TESTING

MEMBRANE TYPE Royston PROJECT NO. I-40-1(44)000  
 BRIDGE NO. H EXPRESSWAY I-40  
 DATE MEMBRANE INSTALLED 3-24-75 TESTED 5-27-75  
 CUMULATIVE VEHICULAR PASSES None SOAK TIME 6 Hours

| <u>Area Tested</u>                             | <u>Readings Within Resistivity Ranges</u> |          |                                                             |          |                                     |          |
|------------------------------------------------|-------------------------------------------|----------|-------------------------------------------------------------|----------|-------------------------------------|----------|
|                                                | <u>&lt;100K <math>\Omega</math></u>       |          | <u>100K <math>\Omega</math> to 500K <math>\Omega</math></u> |          | <u>&gt;500K <math>\Omega</math></u> |          |
|                                                | <u>No.</u>                                | <u>%</u> | <u>No.</u>                                                  | <u>%</u> | <u>No.</u>                          | <u>%</u> |
| A. Within 2.5 Ft. of Curb                      | 1                                         | 2.5      | 6                                                           | 15.0     | 33                                  | 83.5     |
| B. Near Transverse Joints<br>(Excluding Above) | 1                                         | 5.5      | 1                                                           | 5.5      | 16                                  | 88.8     |
| C. Within Shoulder Area<br>(Excluding Above)   | 0                                         | 0        | 0                                                           | 0        | 60                                  | 100      |
| D. Within Outside Lane                         | 1                                         | 2.5      | 0                                                           | 0        | 39                                  | 97.5     |
| E. Within Inside Lane                          | 0                                         | 0        | 2                                                           |          | 38                                  | 95       |
| F. Total of C + D + E                          | 1                                         | 0.7      | 2                                                           | 1.       | 137                                 | 97.9     |

COMMENTS: Ten blisters, three had low resistance of below 500K  $\Omega$ . Opened to traffic June 2, 1975. Grid: 10'.

MEMBRANE TYPE Royston PROJECT NO. I-40-1(44)000  
 BRIDGE NO. H EXPRESSWAY I-40  
 DATE MEMBRANE INSTALLED 3-24-75 TESTED 6-2-76  
 CUMULATIVE VEHICULAR PASSES 2,482,000 SOAK TIME 4 Hours

| <u>Area Tested</u>                             | <u>Readings Within Resistivity Ranges</u> |          |                                                             |          |                                     |          |
|------------------------------------------------|-------------------------------------------|----------|-------------------------------------------------------------|----------|-------------------------------------|----------|
|                                                | <u>&lt;100K <math>\Omega</math></u>       |          | <u>100K <math>\Omega</math> to 500K <math>\Omega</math></u> |          | <u>&gt;500K <math>\Omega</math></u> |          |
|                                                | <u>No.</u>                                | <u>%</u> | <u>No.</u>                                                  | <u>%</u> | <u>No.</u>                          | <u>%</u> |
| A. Within 2.5 Ft. of Curb                      | 13                                        | 32.5     | 3                                                           | 7.5      | 24                                  | 60.0     |
| B. Near Transverse Joints<br>(Excluding Above) | 0                                         | 0        | 0                                                           | 0        | 18                                  | 100      |
| C. Within Shoulder Area<br>(Excluding Above)   | 5                                         | 12.5     | 3                                                           | 7.5      | 52                                  | 80.0     |
| D. Within Outside Lane                         | 16                                        | 30.7     | 24                                                          | 46.1     | 12                                  | 23.0     |
| E. Within Inside Lane                          | 15                                        | 37.5     | 6                                                           | 15.0     | 19                                  | 47.5     |
| F. Total of C + D + E                          | 36                                        | 24.0     | 33                                                          | 22.0     | 81                                  | 54.0     |

COMMENTS: The low readings in the outside lane were in the wheelpath. The low inside lane readings were along a construction joint. Grid: 10'.

# ROYSTON

## RESULT OF RESISTIVITY TESTING

MEMBRANE TYPE Royston PROJECT NO. I-40-1(44)000  
 BRIDGE NO. I EXPRESSWAY I-40  
 DATE MEMBRANE INSTALLED 3-19-75 TESTED 5-7-75  
 CUMULATIVE VEHICULAR PASSES None SOAK TIME 5 Hours

| Area Tested                                    | Readings Within Resistivity Ranges |      |                                |     |                |      |
|------------------------------------------------|------------------------------------|------|--------------------------------|-----|----------------|------|
|                                                | <100K $\Omega$                     |      | 100K $\Omega$ to 500K $\Omega$ |     | >500K $\Omega$ |      |
|                                                | No.                                | %    | No.                            | %   | No.            | %    |
| A. Within 2.5 Ft. of Curb                      | 3                                  | 2.5  | 2                              | 1.7 | 111            | 95.6 |
| B. Near Transverse Joints<br>(Excluding Above) | 3                                  | 10.3 | 1                              | 3.4 | 25             | 86.2 |
| C. Within Shoulder Area<br>(Excluding Above)   | 6                                  | 3.4  | 8                              | 4.6 | 160            | 91.9 |
| D. Within Outside Lane                         | 7                                  | 6.0  | 3                              | 2.5 | 106            | 91.3 |
| E. Within Inside Lane                          | 9                                  | 7.7  | 8                              | 6.9 | 99             | 85.3 |
| F. Total of C + D + E                          | 22                                 | 5.4  | 19                             | 4.7 | 365            | 89.9 |

COMMENTS: Numerous blisters. Opened to traffic June 2, 1975. Grid: 10'.

MEMBRANE TYPE Royston PROJECT NO. I-40-1(44)000  
 BRIDGE NO. I EXPRESSWAY I-40  
 DATE MEMBRANE INSTALLED 3-19-75 TESTED 6-14-76  
 CUMULATIVE VEHICULAR PASSES 2,639,000 SOAK TIME 4 Hours

| Area Tested                                    | Readings Within Resistivity Ranges |      |                                |      |                |      |
|------------------------------------------------|------------------------------------|------|--------------------------------|------|----------------|------|
|                                                | <100K $\Omega$                     |      | 100K $\Omega$ to 500K $\Omega$ |      | >500K $\Omega$ |      |
|                                                | No.                                | %    | No.                            | %    | No.            | %    |
| A. Within 2.5 Ft. of Curb                      | 10                                 | 10.4 | 9                              | 9.3  | 77             | 80.2 |
| B. Near Transverse Joints<br>(Excluding Above) | 4                                  | 15.3 | 3                              | 11.5 | 19             | 73.0 |
| C. Within Shoulder Area<br>(Excluding Above)   | 16                                 | 10   | 13                             | 9.1  | 131            | 81.8 |
| D. Within Outside Lane                         | 97                                 | 93.2 | 5                              | 4.8  | 2              | 1.9  |
| E. Within Inside Lane                          | 59                                 | 52.6 | 27                             | 24.1 | 26             | 23.2 |
| F. Total of C + D + E                          | 172                                | 45.7 | 45                             | 12   | 159            | 42.3 |

COMMENTS: Grid 10'. The inside and outside lane had 500 ft.<sup>2</sup> of instant 0 ohms resistance. Opened to traffic June 2, 1975.

# ROYSTON

## RESULT OF RESISTIVITY TESTING

MEMBRANE TYPE Royston PROJECT NO. I-40-1(44)000  
 BRIDGE NO. J EXPRESSWAY I-40  
 DATE MEMBRANE INSTALLED 4-3-75 TESTED 5-28-75  
 CUMULATIVE VEHICULAR PASSES None SOAK TIME 2 Hours

| Area Tested                                    | Readings Within Resistivity Ranges |     |                                |      |                |      |
|------------------------------------------------|------------------------------------|-----|--------------------------------|------|----------------|------|
|                                                | <100K $\Omega$                     |     | 100K $\Omega$ to 500K $\Omega$ |      | >500K $\Omega$ |      |
|                                                | No.                                | %   | No.                            | %    | No.            | %    |
| A. Within 2.5 Ft. of Curb                      | 5                                  | 4.1 | 20                             | 16.5 | 96             | 79.4 |
| B. Near Transverse Joints<br>(Excluding Above) | 0                                  | 0   | 1                              | 3.7  | 26             | 96.3 |
| C. Within Shoulder Area<br>(Excluding Above)   | 4                                  | 1.7 | 9                              | 3.9  | 218            | 94.4 |
| D. Within Outside Lane                         | 1                                  | 0.7 | 5                              | 3.5  | 135            | 95.8 |
| E. Within Inside Lane                          | 1                                  | 0.8 | 4                              | 2.9  | 131            | 96.3 |
| F. Total of C + D + E                          | 6                                  | 1.2 | 18                             | 3.7  | 464            | 95.1 |

COMMENTS: Eighteen blisters. Hard and soaking rain the night before resistance testing. Opened to traffic June 2, 1975. Grid: 10.

MEMBRANE TYPE Royston PROJECT NO. I-40-1(44)000  
 BRIDGE NO. J EXPRESSWAY I-40  
 DATE MEMBRANE INSTALLED 4-3-75 TESTED 6-7-76  
 CUMULATIVE VEHICULAR PASSES 2,590,000 SOAK TIME 6 Hours

| Area Tested                                    | Readings Within Resistivity Ranges |      |                                |      |                |      |
|------------------------------------------------|------------------------------------|------|--------------------------------|------|----------------|------|
|                                                | <100K $\Omega$                     |      | 100K $\Omega$ to 500K $\Omega$ |      | >500K $\Omega$ |      |
|                                                | No.                                | %    | No.                            | %    | No.            | %    |
| A. Within 2.5 Ft. of Curb                      | 20                                 | 17.1 | 11                             | 9.4  | 86             | 73.5 |
| B. Near Transverse Joints<br>(Excluding Above) | 6                                  | 18.2 | 3                              | 9.1  | 24             | 72.7 |
| C. Within Shoulder Area<br>(Excluding Above)   | 34                                 | 14.8 | 40                             | 17.4 | 156            | 67.8 |
| D. Within Outside Lane                         | 26                                 | 28.6 | 27                             | 29.7 | 38             | 41.7 |
| E. Within Inside Lane                          | 1                                  | 0.9  | 0                              | 0    | 102            | 99.1 |
| F. Total of C + D + E                          | 61                                 | 14.4 | 67                             | 15.9 | 294            | 69.7 |

COMMENTS: 90' of surface cracking. Low readings in the outside lane were in the wheelpath. Opened to traffic June 2, 1975. Grid: 10'.

# ROYSTON

## RESULT OF RESISTIVITY TESTING

MEMBRANE TYPE Royston PROJECT NO. I-40-1(44)000  
 BRIDGE NO. M EXPRESSWAY I-40  
 DATE MEMBRANE INSTALLED 3-18-75 TESTED 5-5-75  
 CUMULATIVE VEHICULAR PASSES None SOAK TIME 4 Hours

| Area Tested                                    | Readings Within Resistivity Ranges |      |                                |      |                |      |
|------------------------------------------------|------------------------------------|------|--------------------------------|------|----------------|------|
|                                                | <100K $\Omega$                     |      | 100K $\Omega$ to 500K $\Omega$ |      | >500K $\Omega$ |      |
|                                                | No.                                | %    | No.                            | %    | No.            | %    |
| A. Within 2.5 Ft. of Curb                      | 8                                  | 23.5 | 5                              | 14.7 | 21             | 61.8 |
| B. Near Transverse Joints<br>(Excluding Above) | 2                                  | 11.1 | 0                              | 0    | 16             | 88.9 |
| C. Within Shoulder Area<br>(Excluding Above)   | 0                                  | 0    | 0                              | 0    | 50             | 100  |
| D. Within Outside Lane                         | 6                                  | 15.0 | 9                              | 22.5 | 25             | 62.5 |
| E. Within Inside Lane                          | 4                                  | 10.5 | 0                              | 0    | 34             | 89.5 |
| F. Total of C + D + E                          | 10                                 | 7.8  | 9                              | 7.0  | 109            | 85.2 |

COMMENTS: Opened to traffic June 2, 1975. Grid: 10'.

MEMBRANE TYPE Royston PROJECT NO. I-40-1(44)000  
 BRIDGE NO. M EXPRESSWAY I-40  
 DATE MEMBRANE INSTALLED 3-18-75 TESTED 5-12-76  
 CUMULATIVE VEHICULAR PASSES 2,408,000 SOAK TIME 4 Hours

| Area Tested                                    | Readings Within Resistivity Ranges |      |                                |      |                |      |
|------------------------------------------------|------------------------------------|------|--------------------------------|------|----------------|------|
|                                                | <100K $\Omega$                     |      | 100K $\Omega$ to 500K $\Omega$ |      | >500K $\Omega$ |      |
|                                                | No.                                | %    | No.                            | %    | No.            | %    |
| A. Within 2.5 Ft. of Curb                      | 8                                  | 19.5 | 14                             | 34.2 | 19             | 46.3 |
| B. Near Transverse Joints<br>(Excluding Above) | 6                                  | 33.3 | 1                              | 5.6  | 11             | 61.1 |
| C. Within Shoulder Area<br>(Excluding Above)   | 6                                  | 12   | 6                              | 12   | 38             | 76   |
| D. Within Outside Lane                         | 18                                 | 50   | 16                             | 44.4 | 2              | 5.6  |
| E. Within Inside Lane                          | 13                                 | 35.1 | 6                              | 16.2 | 18             | 48.7 |
| F. Total of C + D + E                          | 37                                 | 30.0 | 28                             | 22.8 | 58             | 47.2 |

COMMENTS: The low readings in the outside and inside lane were in the wheel-path. Opened to traffic June 2, 1975. Grid: 10'.

ROYSTON

RESULT OF RESISTIVITY TESTING

MEMBRANE TYPE Royston PROJECT NO. I-40-1(44)000  
 BRIDGE NO. N EXPRESSWAY I-40  
 DATE MEMBRANE INSTALLED 3-31-75 TESTED 5-29-75  
 CUMULATIVE VEHICULAR PASSES None SOAK TIME 4 Hours

| Area Tested                                    | Readings Within Resistivity Ranges |     |                                |      |                |      |
|------------------------------------------------|------------------------------------|-----|--------------------------------|------|----------------|------|
|                                                | <100K $\Omega$                     |     | 100K $\Omega$ to 500K $\Omega$ |      | >500K $\Omega$ |      |
|                                                | No.                                | %   | No.                            | %    | No.            | %    |
| A. Within 2.5 Ft. of Curb                      | 1                                  | 2.3 | 1                              | 2.3  | 41             | 95.4 |
| B. Near Transverse Joints<br>(Excluding Above) | 0                                  | 0   | 0                              | 0    | 33             | 100  |
| C. Within Shoulder Area<br>(Excluding Above)   | 4                                  | 6.4 | 3                              | 4.8  | 56             | 88.8 |
| D. Within Outside Lane                         | 1                                  | 2.1 | 5                              | 10.4 | 42             | 87.5 |
| E. Within Inside Lane                          | 3                                  | 6.4 | 5                              | 10.6 | 39             | 83.0 |
| F. Total of C + D + E                          | 8                                  | 5.1 | 13                             | 8.2  | 137            | 86.7 |

COMMENTS: Opened to traffic June 2, 1975. Grid 10'.

MEMBRANE TYPE Royston PROJECT NO. I-40-1(44)000  
 BRIDGE NO. N EXPRESSWAY I-40  
 DATE MEMBRANE INSTALLED 3-31-75 TESTED 5-13-76  
 CUMULATIVE VEHICULAR PASSES 2,415,000 SOAK TIME 4 Hours

| Area Tested                                    | Readings Within Resistivity Ranges |      |                                |      |                |      |
|------------------------------------------------|------------------------------------|------|--------------------------------|------|----------------|------|
|                                                | <100K $\Omega$                     |      | 100K $\Omega$ to 500K $\Omega$ |      | >500K $\Omega$ |      |
|                                                | No.                                | %    | No.                            | %    | No.            | %    |
| A. Within 2.5 Ft. of Curb                      | 1                                  | 2.4  | 1                              | 2.4  | 39             | 95.2 |
| B. Near Transverse Joints<br>(Excluding Above) | 5                                  | 15.2 | 3                              | 0.1  | 25             | 75.7 |
| C. Within Shoulder Area<br>(Excluding Above)   | 2                                  | 5.6  | 2                              | 5.6  | 32             | 88.8 |
| D. Within Outside Lane                         | 11                                 | 33.3 | 6                              | 18.2 | 16             | 48.5 |
| E. Within Inside Lane                          | 4                                  | 11.8 | 6                              | 17.7 | 24             | 70.5 |
| F. Total of C + D + E                          | 17                                 | 16.5 | 14                             | 13.6 | 72             | 69.9 |

COMMENTS: The low readings in the outside lane were in the wheelpath.  
 Opened to traffic June 2, 1975. Grid: 10'.







Distress in A. C. Overlay resulting from blister formation under Royston membrane.

## SUPER SEAL 4000

### Project Data

Construction Project Number: RF-236-(35)

Number of Bridges: 6

County: Pontotoc

Bridge Numbers: A through F

Expressway: State Highway 3 and 99

Location of Project: Southeast of Ada, OK

### Bridge Design Data

Bridge Number: A

Type of Structure: Continuous Plate Girder

Span Lengths: 109' and 139'

Overall Length: 255.70'

Width: 23' 9"

Skew: 51° 09' 39"

Horizontal Curvature: None

Vertical Curvature: None

Super Elevation: None

Concrete Cover over Steel: 2"

Bridge Number: B

Type of Structure: Continuous Plate Girder

Span Lengths: 2 - 103'

Overall Length: 208.5'

Width: 29'

Skew: None

Horizontal Curvature: 0° 24'

Vertical Curvature: None

Super Elevation: 1/8"/foot

Concrete Cover over Steel: 2"

**SUPER SEAL 4000**

003-62-42

Bridge Number: C & D

EX0126

WX0126

Type of Structure: Pre-Stressed Concrete Beams

Span Lengths: 3 - 44'

Overall Length: 134.71'

Width: 48' 9"

Skew: 65°

Horizontal Curvature: None

Vertical Curvature: 0° 28'

Super Elevation: None

Concrete Cover over Steel: 2"

Bridge Number: E

Type of Structure: Simple - Continuous - Simple Plate Girder Spans

Span Lengths: 50', (2-130'), 50'

Overall Length: 365.68'

Width: 46' 9"

Skew: 42° 41' 24"

Horizontal Curvature: None

Vertical Curvature: None

Super Elevation: None

Concrete Cover over Steel: 2"

Bridge Number: F

Type of Structure: Pre-Stressed Concrete Beams

Span Lengths: 3 - 46'

Overall Length: 138.5'

Width: 29'

Skew: 42° 41' 24"

Horizontal Curvature: None

Vertical Curvature: None

Super Elevation: None

Concrete Cover over Steel: 2"

## SUPER SEAL 4000

### Deck Construction Data

| Bridge No. | Date of Last Bridge Deck Pour |
|------------|-------------------------------|
| A          | 3-12-73                       |
| B          | 5-18-72                       |
| C          | 2-13-73                       |
| D          | 12-27-72                      |
| E          | 9-07-72                       |
| F          | 10-03-72                      |

Concrete Type: AA(AE)

Cement Type: I

Fine Aggregate Source: Sooner, Ada, OK

Coarse Aggregate Source: Bridges A, B, & E - Dolese, Bromide, OK  
Bridges C, D, & F - Dolese, Konawa, OK

Method of Surface Texturing: Broom

Curing Type: Linseed oil emulsion

### Protective Treatment

Description of Product: A polymer type, hot poured elastomeric membrane.

Manufacturer's Recommended Application Procedure: The blocks of membrane material shall be heated in a double boiler type kettle to 275°F and applied to the sandblasted concrete deck at a rate to obtain a film thickness of approximately 90 mils. Sixty-five pound grade asphalt roofing paper shall be rolled into the still fluid membrane. A wearing course of asphaltic concrete shall be placed and compacted over the roofing paper.

Deck Preparation Prior to Application of Protective Treatment: Sand blast and blow the deck clean.

Dates of Membrane Application and Comments:

|                     |                                                                             |
|---------------------|-----------------------------------------------------------------------------|
| 7-30 through 8-1-75 | Membrane applied to Structures A & B<br>Temperature in mid to high 90's.    |
| 8-8 through 8-10-75 | Membrane applied to Structures C, D,<br>E, and F. Temperature in high 90's. |

### Asphaltic Concrete

Type: C

Thickness: 2"

## SUPER SEAL 4000

### Date of Application and Comments:

|                      |                                                                                                          |
|----------------------|----------------------------------------------------------------------------------------------------------|
| 8-6-75               | Attempt to lay asphaltic concrete aborted because of problems encountered with lifting of roofing paper. |
| 8-7-75               | Asphaltic concrete laid on Structures A and B.                                                           |
| 8-11 through 8-13-75 | Asphaltic concrete laid on Structures C, D, E, and F.                                                    |

### Cost of Protective System

Membrane Treatment: \$8.50/sq. yd.

Asphaltic Concrete: \$24.00/ton

### Discussion

The initial installations were made on Structures A and B. Since construction procedures were essentially the same for all structures only, Structures A and B will be discussed with references to other structures where warranted. The procedure first called for sand blasting the deck and blowing it clean. Then, the double boiler kettle was filled with chunks of the solid membrane and brought up the required temperature for melting (275°F). The fluid membrane was then dispensed into five gallon buckets, that were carried to the desired location and poured onto the deck. The liquid was spread by squeegee to the required thickness of 90 mils. A gauge was used to determine when the required thickness was achieved. The workmen quickly learned to obtain the correct thickness with less and less measuring required. This ability was almost a requirement because the working time for the liquid membrane was never over one minute before it took a set. Initially, a number of areas of solidified membrane had to be scraped from the deck because of improper thickness. As soon as the membrane was spread to the required

## SUPER SEAL 4000

thickness, 65 pound asphalt roofing paper was rolled onto the still tacky membrane. The roofing paper was then rolled with a water filled drum roller to assure good adhesion to the membrane. Initially, the adhesion appeared to be quite good with virtually no wrinkles or bubbles, a near perfect job. However, several days later, the roofing paper began to wrinkle and pull away from the membrane. There was never any indication of blistering or bubbling of the membrane. The overlay placement was attempted on the afternoon of August 6, 1975. The air temperature was approximately 95°F and the deck temperature was approximately 135°F. When the paver pulled onto the membrane its pads began to tear and lift the roofing paper. After removing a section of the paper it was discovered that the paver's pads were squeezing the membrane and extruding it up between the pads. The concrete was never exposed so it was assumed that the membrane was still intact. The paving operation was postponed until the next morning when the air temperature was about 80°F. and the deck temperature was the same. A layer of hot mix was spread in front of the paver's tracks and the paving operation began. The only problem encountered in the paving operation was one that was to remain with the operation on all six bridges. The roofing paper had a tendency to form a rolling wrinkle ahead of the paver and occasionally it would become so large that it would have to be cut and laid flat. The cause of this wrinkle was not clear but it appeared to be the summing of the individual small wrinkles because it appeared more frequently in badly wrinkled strips than in smoother strips. There were no blisters in any of the six bridges and very few visual defects of any kind.

It should be pointed out to potential users that low temperature Super Seal 4000 apparently gives off an irritating vapor upon

heating. Many of the workmen were affected by this irritation that manifested itself as a swelling and reddening of the skin of the face, particularly around the nose and eyes. After these workmen were absent from the irritant for a few days these symptoms disappeared.



# SUPER SEAL 4000

## RESULT OF RESISTIVITY TESTING

MEMBRANE TYPE Super Seal 4000 PROJECT NO. RF-236 (35)  
 BRIDGE NO. A EXPRESSWAY SH 3 & 99  
 DATE MEMBRANE INSTALLED 7-30-75 TESTED 9-9-75  
 CUMULATIVE VEHICULAR PASSES 63,000 SOAK TIME 5 hours

| Area Tested                                    | Readings Within Resistivity Ranges |   |                                |   |                |     |
|------------------------------------------------|------------------------------------|---|--------------------------------|---|----------------|-----|
|                                                | <100K $\Omega$                     |   | 100K $\Omega$ to 500K $\Omega$ |   | >500K $\Omega$ |     |
|                                                | No.                                | % | No.                            | % | No.            | %   |
| A. Within 2.5 Ft. of Curb                      | 0                                  | 0 | 0                              | 0 | 14             | 100 |
| B. Near Transverse Joints<br>(Excluding Above) | 0                                  | 0 | 0                              | 0 | 10             | 100 |
| C. Within Shoulder Area<br>(Excluding Above)   | 0                                  | 0 | 0                              | 0 | 50             | 100 |
| D. Within Outside Lane                         | 0                                  | 0 | 0                              | 0 | 75             | 100 |
| E. Within Inside Lane                          | 0                                  | 0 | 0                              | 0 | 24             | 100 |
| F. Total of C + D + E                          | 0                                  | 0 | 0                              | 0 | 149            | 100 |

COMMENTS: Opened to traffic August 25, 1977. Grid 10'.

MEMBRANE TYPE Super Seal 4000 PROJECT NO. RF-236 (35)  
 BRIDGE NO. A EXPRESSWAY SH 3 & 99  
 DATE MEMBRANE INSTALLED 7-30-75 TESTED 7-9-76  
 CUMULATIVE VEHICULAR PASSES 1,548,000 SOAK TIME 4 Hours

| Area Tested                                    | Readings Within Resistivity Ranges |      |                                |      |                |      |
|------------------------------------------------|------------------------------------|------|--------------------------------|------|----------------|------|
|                                                | <100K $\Omega$                     |      | 100K $\Omega$ to 500K $\Omega$ |      | >500K $\Omega$ |      |
|                                                | No.                                | %    | No.                            | %    | No.            | %    |
| A. Within 2.5 Ft. of Curb                      | 2                                  | 14.3 | 0                              | 0    | 12             | 35.7 |
| B. Near Transverse Joints<br>(Excluding Above) | 0                                  | 0    | 0                              | 0    | 10             | 100  |
| C. Within Shoulder Area<br>(Excluding Above)   | 0                                  | 0    | 0                              | 0    | 50             | 100  |
| D. Within Outside Lane                         | 12                                 | 16.2 | 11                             | 14.9 | 51             | 68.9 |
| E. Within Inside Lane                          | 0                                  | 0    | 0                              | 0    | 24             | 100  |
| F. Total of C + D + E                          | 12                                 | 8.1  | 11                             | 7.4  | 125            | 84.5 |

COMMENTS: The low readings in the outside lane were in the wheelpaths. Opened to traffic August 25, 1975. Grid: 10'.

**SUPER SEAL 4000**

**RESULT OF RESISTIVITY TESTING**

MEMBRANE TYPE Super Seal 4000 PROJECT NO. RF-236(35)  
 BRIDGE NO. B EXPRESSWAY SH 3 & 99  
 DATE MEMBRANE INSTALLED 8-1-75 TESTED 9-8-75  
 CUMULATIVE VEHICULAR PASSES 59,800 SOAK TIME 5 hours

| Area Tested                                    | Readings Within Resistivity Ranges |   |                                |   |                |     |
|------------------------------------------------|------------------------------------|---|--------------------------------|---|----------------|-----|
|                                                | <100K $\Omega$                     |   | 100K $\Omega$ to 500K $\Omega$ |   | >500K $\Omega$ |     |
|                                                | No.                                | % | No.                            | % | No.            | %   |
| A. Within 2.5 Ft. of Curb                      | 0                                  | 0 | 0                              | 0 | 20             | 100 |
| B. Near Transverse Joints<br>(Excluding Above) | 0                                  | 0 | 0                              | 0 | 14             | 100 |
| C. Within Shoulder Area<br>(Excluding Above)   | 0                                  | 0 | 0                              | 0 | 13             | 100 |
| D. Within Outside Lane                         | 0                                  | 0 | 0                              | 0 | 26             | 100 |
| E. Within Inside Lane                          | 0                                  | 0 | 0                              | 0 | 26             | 100 |
| F. Total of C + D + E                          | 0                                  | 0 | 0                              | 0 | 65             | 100 |

COMMENTS: Four cracks of approximately 2' long were found. Opened to traffic August 25, 1975. Grid: 10'.

MEMBRANE TYPE Super Seal 4000 PROJECT NO. RF-236(35)  
 BRIDGE NO. B EXPRESSWAY SH 3 & 99  
 DATE MEMBRANE INSTALLED 8-1-75 TESTED 7-7-76  
 CUMULATIVE VEHICULAR PASSES 1,539,000 SOAK TIME 4 Hours

| Area Tested                                    | Readings Within Resistivity Ranges |     |                                |     |                |      |
|------------------------------------------------|------------------------------------|-----|--------------------------------|-----|----------------|------|
|                                                | <100K $\Omega$                     |     | 100K $\Omega$ to 500K $\Omega$ |     | >500K $\Omega$ |      |
|                                                | No.                                | %   | No.                            | %   | No.            | %    |
| A. Within 2.5 Ft. of Curb                      | 1                                  | 2.5 | 1                              | 2.5 | 18             | 95.0 |
| B. Near Transverse Joints<br>(Excluding Above) | 0                                  | 0   | 0                              | 0   | 14             | 100  |
| C. Within Shoulder Area<br>(Excluding Above)   | 0                                  | 0   | 0                              | 0   | 13             | 100  |
| D. Within Outside Lane                         | 0                                  | 0   | 0                              | 0   | 26             | 100  |
| E. Within Inside Lane                          | 0                                  | 0   | 0                              | 0   | 26             | 100  |
| F. Total of C + D + E                          | 0                                  | 0   | 0                              | 0   | 65             | 100  |

COMMENTS: Grid 10'. Opened to traffic August 25, 1975.

# SUPER SEAL 4000

## RESULT OF RESISTIVITY TESTING

MEMBRANE TYPE Super Seal 4000 PROJECT NO. RF-236 (35)  
 BRIDGE NO. C EXPRESSWAY SH 3 & 99  
 DATE MEMBRANE INSTALLED 8-6-75 TESTED 9-10-77  
 CUMULATIVE VEHICULAR PASSES 67,200 SOAK TIME 5 Hours

| Area Tested                                    | Readings Within Resistivity Ranges |   |                                |   |                |     |
|------------------------------------------------|------------------------------------|---|--------------------------------|---|----------------|-----|
|                                                | <100K $\Omega$                     |   | 100K $\Omega$ to 500K $\Omega$ |   | >500K $\Omega$ |     |
|                                                | No.                                | % | No.                            | % | No.            | %   |
| A. Within 2.5 Ft. of Curb                      | 0                                  | 0 | 0                              | 0 | 30             | 100 |
| B. Near Transverse Joints<br>(Excluding Above) | 0                                  | 0 | 0                              | 0 | 33             | 100 |
| C. Within Shoulder Area<br>(Excluding Above)   | 0                                  | 0 | 0                              | 0 | 18             | 100 |
| D. Within Outside Lane                         | 0                                  | 0 | 0                              | 0 | 46             | 100 |
| E. Within Inside Lane                          | 0                                  | 0 | 0                              | 0 | 54             | 100 |
| F. Total of C + D + E                          | 0                                  | 0 | 0                              | 0 | 118            | 100 |

COMMENTS: Opened to traffic August 25, 1975. Grid 10'.

MEMBRANE TYPE Super Seal 400 PROJECT NO. RF-236 (35)  
 BRIDGE NO. C EXPRESSWAY SH 3 & 99  
 DATE MEMBRANE INSTALLED 8-6-75 TESTED 7-8-76  
 CUMULATIVE VEHICULAR PASSES 1,453,500 SOAK TIME 4 Hours

| Area Tested                                    | Readings Within Resistivity Ranges |     |                                |     |                |      |
|------------------------------------------------|------------------------------------|-----|--------------------------------|-----|----------------|------|
|                                                | <100K $\Omega$                     |     | 100K $\Omega$ to 500K $\Omega$ |     | >500K $\Omega$ |      |
|                                                | No.                                | %   | No.                            | %   | No.            | %    |
| A. Within 2.5 Ft. of Curb                      | 0                                  | 0   | 1                              | 3.5 | 28             | 96.5 |
| B. Near Transverse Joints<br>(Excluding Above) | 0                                  | 0   | 0                              | 0   | 33             | 100  |
| C. Within Shoulder Area<br>(Excluding Above)   | 0                                  | 0   | 0                              | 0   | 18             | 100  |
| D. Within Outside Lane                         | 3                                  | 6.5 | 3                              | 6.5 | 40             | 87.0 |
| E. Within Inside Lane                          | 2                                  | 3.6 | 1                              | 1.8 | 52             | 94.6 |
| F. Total of C + D + E                          | 5                                  | 4.2 | 4                              | 3.4 | 110            | 92.4 |

COMMENTS: Grid 10'. Opened to traffic August 25, 1975.

# SUPER SEAL 4000

## RESULT OF RESISTIVITY TESTING

MEMBRANE TYPE Super Seal 4000 PROJECT NO. RF-236 (35)  
 BRIDGE NO. D EXPRESSWAY SH 3 & 99  
 DATE MEMBRANE INSTALLED 8-12-75 TESTED 9-11-75  
 CUMULATIVE VEHICULAR PASSES 71,600 SOAK TIME 5 Hours

| Area Tested                                    | Readings Within Resistivity Ranges |   |                                |   |                |     |
|------------------------------------------------|------------------------------------|---|--------------------------------|---|----------------|-----|
|                                                | <100K $\Omega$                     |   | 100K $\Omega$ to 500K $\Omega$ |   | >500K $\Omega$ |     |
|                                                | No.                                | % | No.                            | % | No.            | %   |
| A. Within 2.5 Ft. of Curb                      | 0                                  | 0 | 0                              | 0 | 24             | 100 |
| B. Near Transverse Joints<br>(Excluding Above) | 0                                  | 0 | 0                              | 0 | 36             | 100 |
| C. Within Shoulder Area<br>(Excluding Above)   | 0                                  | 0 | 0                              | 0 | 50             | 100 |
| D. Within Outside Lane                         | 0                                  | 0 | 0                              | 0 | 47             | 100 |
| E. Within Inside Lane                          | 0                                  | 0 | 0                              | 0 | 23             | 100 |
| F. Total of C + D + E                          | 0                                  | 0 | 0                              | 0 | 120            | 100 |

COMMENTS: Grid 10'.

MEMBRANE TYPE Super Seal 4000 PROJECT NO. RF-236 (35)  
 BRIDGE NO. D EXPRESSWAY SH 3 & 99  
 DATE MEMBRANE INSTALLED 8-12-75 TESTED 7-8-76  
 CUMULATIVE VEHICULAR PASSES 1,525,500 SOAK TIME 4 Hours

| Area Tested                                    | Readings Within Resistivity Ranges |     |                                |     |                |      |
|------------------------------------------------|------------------------------------|-----|--------------------------------|-----|----------------|------|
|                                                | <100K $\Omega$                     |     | 100K $\Omega$ to 500K $\Omega$ |     | >500K $\Omega$ |      |
|                                                | No.                                | %   | No.                            | %   | No.            | %    |
| A. Within 2.5 Ft. of Curb                      | 0                                  | 0   | 0                              | 0   | 24             | 100  |
| B. Near Transverse Joints<br>(Excluding Above) | 0                                  | 0   | 1                              | 2.8 | 35             | 97.2 |
| C. Within Shoulder Area<br>(Excluding Above)   | 0                                  | 0   | 0                              | 0   | 50             | 100  |
| D. Within Outside Lane                         | 2                                  | 5   | 4                              | 10  | 40             | 85   |
| E. Within Inside Lane                          | 0                                  | 0   | 0                              | 0   | 23             | 100  |
| F. Total of C + D + E                          | 2                                  | 1.7 | 4                              | 3.3 | 113            | 95.0 |

COMMENTS: Grid 10'. Opened to traffic August 25, 1975.

# SUPER SEAL 4000

## RESULT OF RESISTIVITY TESTING

MEMBRANE TYPE Super Seal 4000 PROJECT NO. RF-236(35)  
 BRIDGE NO. E EXPRESSWAY SH 3 & 99  
 DATE MEMBRANE INSTALLED 7-30-75 TESTED 9-9-75  
 CUMULATIVE VEHICULAR PASSES 63,000 SOAK TIME 5 Hours

| <u>Area Tested</u>                             | <u>Readings Within Resistivity Ranges</u> |          |                                                             |          |                                     |          |
|------------------------------------------------|-------------------------------------------|----------|-------------------------------------------------------------|----------|-------------------------------------|----------|
|                                                | <u>&lt;100K <math>\Omega</math></u>       |          | <u>100K <math>\Omega</math> to 500K <math>\Omega</math></u> |          | <u>&gt;500K <math>\Omega</math></u> |          |
|                                                | <u>No.</u>                                | <u>%</u> | <u>No.</u>                                                  | <u>%</u> | <u>No.</u>                          | <u>%</u> |
| A. Within 2.5 Ft. of Curb                      | 0                                         | 0        | 1                                                           | 1.4      | 73                                  | 98.6     |
| B. Near Transverse Joints<br>(Excluding Above) | 0                                         | 0        | 0                                                           | 0        | 44                                  | 100      |
| C. Within Shoulder Area<br>(Excluding Above)   | 0                                         | 0        | 0                                                           | 0        | 112                                 | 100      |
| D. Within Outside Lane                         | 10                                        | 12.1     | 8                                                           | 9.1      | 65                                  | 78.3     |
| E. Within Inside Lane                          | 0                                         | 0        | 0                                                           | 0        | 75                                  | 100      |
| F. Total of C + D + E                          | 10                                        | 3.7      | 8                                                           | 3.0      | 252                                 | 93.3     |

COMMENTS: 225 ft.<sup>2</sup> of instant low readings in the outside lane. Grid: 10'.  
 Opened to traffic August 25, 1975.

**SUPER SEAL 4000**

**RESULT OF RESISTIVITY TESTING**

MEMBRANE TYPE Super Seal 4000 PROJECT NO. RF-236 (35)  
 BRIDGE NO. F EXPRESSWAY SH 3 & 99  
 DATE MEMBRANE INSTALLED 8-13-75 TESTED 9-12-75  
 CUMULATIVE VEHICULAR PASSES 71,400 SOAK TIME \_\_\_\_\_

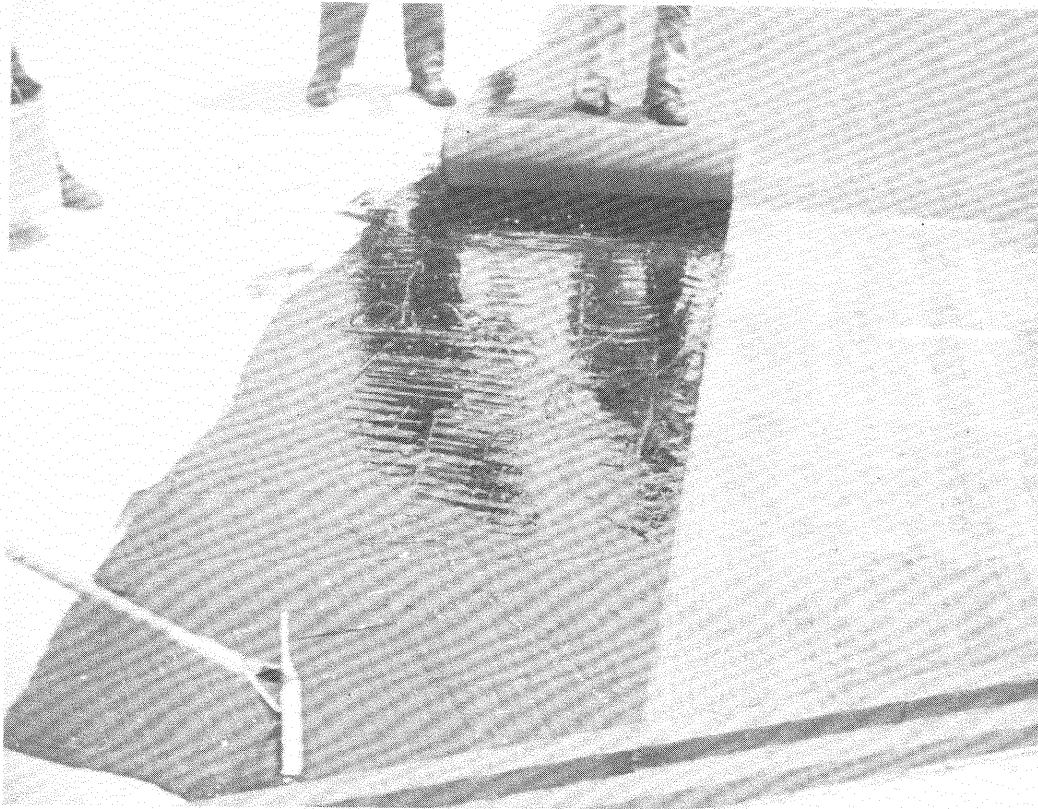
| Area Tested                                    | Readings Within Resistivity Ranges |   |                                |   |                |     |
|------------------------------------------------|------------------------------------|---|--------------------------------|---|----------------|-----|
|                                                | <100K $\Omega$                     |   | 100K $\Omega$ to 500K $\Omega$ |   | >500K $\Omega$ |     |
|                                                | No.                                | % | No.                            | % | No.            | %   |
| A. Within 2.5 Ft. of Curb                      | 0                                  | 0 | 0                              | 0 | 24             | 100 |
| B. Near Transverse Joints<br>(Excluding Above) | 0                                  | 0 | 0                              | 0 | 17             | 100 |
| C. Within Shoulder Area<br>(Excluding Above)   | 0                                  | 0 | 0                              | 0 | 24             | 100 |
| D. Within Outside Lane                         | 0                                  | 0 | 0                              | 0 | 31             | 100 |
| E. Within Inside Lane                          | 0                                  | 0 | 0                              | 0 | 30             | 100 |
| F. Total of C + D + E                          | 0                                  | 0 | 0                              | 0 | 85             | 100 |

COMMENTS: Opened to Traffic August 25, 1975. Grid: 10'.

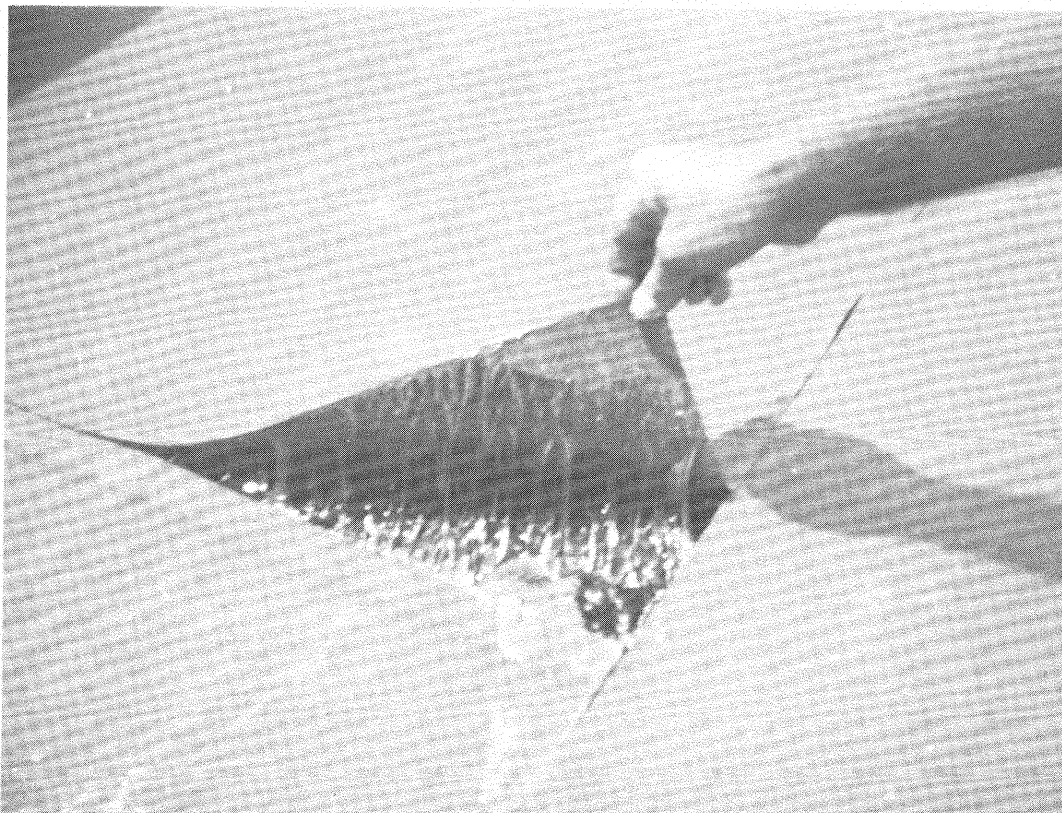
MEMBRANE TYPE Super Seal 4000 PROJECT NO. RF-236 (35)  
 BRIDGE NO. F EXPRESSWAY SH 3 & 99  
 DATE MEMBRANE INSTALLED 8-13-75 TESTED 7-13-76  
 CUMULATIVE VEHICULAR PASSES 1,485,000 SOAK TIME 4 Hours

| Area Tested                                    | Readings Within Resistivity Ranges |   |                                |   |                |     |
|------------------------------------------------|------------------------------------|---|--------------------------------|---|----------------|-----|
|                                                | <100K $\Omega$                     |   | 100K $\Omega$ to 500K $\Omega$ |   | >500K $\Omega$ |     |
|                                                | No.                                | % | No.                            | % | No.            | %   |
| A. Within 2.5 Ft. of Curb                      | 0                                  | 0 | 0                              | 0 | 22             | 100 |
| B. Near Transverse Joints<br>(Excluding Above) | 0                                  | 0 | 0                              | 0 | 18             | 100 |
| C. Within Shoulder Area<br>(Excluding Above)   |                                    |   |                                |   |                |     |
| D. Within Outside Lane                         | 0                                  | 0 | 0                              | 0 | 22             | 100 |
| E. Within Inside Lane                          | 0                                  | 0 | 0                              | 0 | 22             | 100 |
| F. Total of C + D + E                          | 0                                  | 0 | 0                              | 0 | 44             | 100 |

COMMENTS: No shoulder area. Grid 10'. Opened to traffic August 25, 1975.



Rolling asphalt roofing sheet into freshly placed membrane.

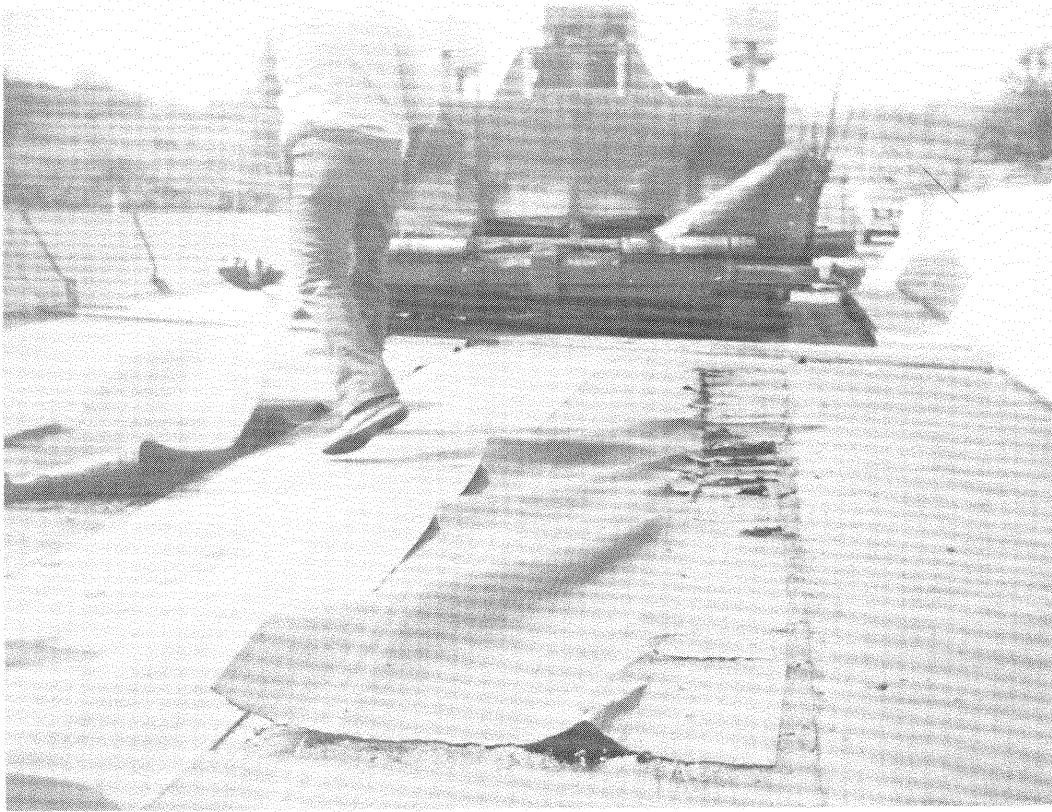


Adhesion of **roofing** sheet to membrane.





SUPER SEAL 4000



Damage caused to asphalt roofing sheet and membrane by paver's tracks.

## UNIROYAL

### Project Data

Construction Project Number: RFI-I-35-4(75)192

Number of Bridges: 1

County: Noble

Bridge Number(s): Northbound

Expressway: Northbound - I-35

Location of Project: Approximately 3.5 miles north of Perry, Oklahoma.  
Over Black Bear Creek on I-35

### Bridge Design Data

Type of Structure: Simple I Beam

Span Length(s): 4-85'

Overall Length: 341'

Width: 39' - 4½"

Skew: 45°

Horizontal Curvature: None

Vertical Curvature: None

Super Elevation: None

Concrete Cover Over Steel: 2"

### Deck Construction Data

Date of Last Bridge Deck Pour: 5-8-75

Concrete Type: AA (AE)

Cement Type: I

Fine Aggregate Sources: Sober Sand Company, Ponca City, OK

Coarse Aggregate Source: Quapaw, Drumright, OK  
Stewart, Pawnee, OK

Method of Surface Texturing: Broom

Curing Type: Linseed Oil Emulsion

## UNIROYAL

### Protective treatment

Description of Product: A pourable hot applied rubberized asphalt.

Manufacturer's Recommended Application Procedure: Deck should be dry and free of dust laitance or oil films. Uniroyal conditioner shall be applied to the cleaned deck at a rate of 300 to 600 ft.<sup>2</sup>/gal. After the conditioner has dried tack free, the melted membrane shall be applied evenly at a rate to achieve a thickness of 1/8" to 3/16". At all construction joints a strip of Uniroyal Elastosheet is rolled into the still hot membrane and a second coat of membrane placed over this sheet. After cooling of the membrane, it shall be dusted with cement at a rate of one bag per 1,000 ft.<sup>2</sup>. Asphaltic concrete shall be placed as a wearing course.

Deck Preparation Prior to Application of Protective Treatment: Sand Blast and blow the deck clean.

Dates of membrane Application and Comments:

|              |                                                                            |
|--------------|----------------------------------------------------------------------------|
| May 27, 1975 | Membrane placed on entire structure<br>Temperature 80°.                    |
| June 4, 1975 | 1½" of type "C" asphaltic concrete laid<br>over membrane, Temperature 80°. |
| June 6, 1975 | Asphalt concrete and membrane were<br>removed.                             |

### Asphaltic Concrete

Type: "C"

Thickness: 1½"

Date of Application and Comments:

|              |                                                          |
|--------------|----------------------------------------------------------|
| June 4, 1975 | 1½" type "C" Asphalt Concrete laid over<br>the membrane. |
| June 6, 1975 | The membrane and Asphaltic Concrete<br>removed.          |

### Cost Of Protective System

Membrane Treatment: \$8.00/sq. yd

Asphaltic Concrete: \$25.00/Ton

## UNIROYAL

### Discussion

The deck was sand blasted on May 26, 1975. On the morning of May 27 the deck was air cleaned and the deck was primed with Uniroyal surface conditioner. The blocks of Uniroyal membrane were heated in a double shelled pot to a pourable consistence and then squeegeed to the 1/8" to 3/16" thickness. Thickness control was good with very few thick or thin spots. At the joints and downspouts a layer of Uniroyal Elastosheet was rolled into the hot membrane and then coated with another layer of membrane 1/8" thick. Fifteen to 25 minutes after the membrane was applied the membrane was dusted with dry cement. On June 4 the membrane was overlaid with Type "C" asphaltic concrete. During the overlay operation the membrane began to stick to the tires of the asphalt trucks and to the rubber pads of the paving machine. This problem was alleviated by spreading additional cement in the area where the truck tires and paver pads would traverse. But, the problem was not eliminated until a thin layer of asphaltic concrete was spread in these areas. During the rolling operation the asphalt began to shove in front of the roller. The temperature of the A.C. was allowed to drop, but when rolling commenced there was still considerable shoving. Eventually a small 5 ton roller was applied to the A.C. and the rolling completed. The resulting A.C. surface was very open and appeared to have poor density. Additionally, there were a number of areas where the fluid membrane had pumped up through the overlay. Air temperature during the lay down operation was in the 80's. On June 5 the A. C. surface was still soft enough that a man standing on the surface left a footprint. A decision was made to remove this unstable surfacing. During removal it was observed that the membrane had migrated as much as 3/4" into the asphaltic concrete and was quite soft perhaps accounting for the instability of the A.C. With a pourable type membrane it

## UNIROYAL

is very difficult to remove all of the membrane. The removal was accomplished with a motor grader and some membrane was left on the deck in all but the occasional high spot where the grader blade would scrape the Portland Cement concrete deck. Because to get approval to place another membrane would have created a long delay, the structure was overlaid with Type "C" and left without membrane. It is somewhat of an irony that the small layer of membrane material left on the structure seems to be waterproofing reasonably well.

## UNIROYAL

## RESULT OF RESISTIVITY TESTING

MEMBRANE TYPE Uniroyal PROJECT NO. RFI-35-4(75)192  
 BRIDGE NO. Northbound EXPRESSWAY I-35  
 DATE MEMBRANE INSTALLED 5-27-75 TESTED 9-23-75  
 CUMULATIVE VEHICULAR PASSES 888,800 SOAK TIME 3 Hours

| Area Tested                                    | Readings Within Resistivity Ranges |      |                                |     |                |      |
|------------------------------------------------|------------------------------------|------|--------------------------------|-----|----------------|------|
|                                                | <100K $\Omega$                     |      | 100K $\Omega$ to 500K $\Omega$ |     | >500K $\Omega$ |      |
|                                                | No.                                | %    | No.                            | %   | No.            | %    |
| A. Within 2.5 Ft. of Curb                      | 5                                  | 14.7 | 1                              | 2.9 | 28             | 82.4 |
| B. Near Transverse Joints<br>(Excluding Above) | 0                                  | 0    | 0                              | 0   | 0              | 0    |
| C. Within Shoulder Area<br>(Excluding Above)   | 1                                  | 1.5  | 1                              | 1.5 | 66             | 97.0 |
| D. Within Outside Lane                         | 0                                  | 0    | 0                              | 0   | 0              | 0    |
| E. Within Inside Lane                          | 0                                  | 0    | 0                              | 0   | 0              | 0    |
| F. Total of C + D + E                          | 1                                  | 1.5  | 1                              | 1.5 | 66             | 97.0 |

COMMENTS: Only outside shoulder tested. Opened to traffic June 12, 1975.  
 Grid: 10'.

MEMBRANE TYPE Uniroyal PROJECT NO. RFI-35-4(75)192  
 BRIDGE NO. Northbound EXPRESSWAY I-35  
 DATE MEMBRANE INSTALLED 5-27-75 TESTED 9-23-75  
 CUMULATIVE VEHICULAR PASSES 6,978,400 SOAK TIME 4 Hours

| Area Tested                                    | Readings Within Resistivity Ranges |      |                                |      |                |      |
|------------------------------------------------|------------------------------------|------|--------------------------------|------|----------------|------|
|                                                | <100K $\Omega$                     |      | 100K $\Omega$ to 500K $\Omega$ |      | >500K $\Omega$ |      |
|                                                | No.                                | %    | No.                            | %    | No.            | %    |
| A. Within 2.5 Ft. of Curb                      | 6                                  | 9.0  | 11                             | 16.4 | 50             | 94.6 |
| B. Near Transverse Joints<br>(Excluding Above) | 3                                  | 16.7 | 2                              | 11.1 | 13             | 72.2 |
| C. Within Shoulder Area<br>(Excluding Above)   | 0                                  | 0    | 14                             | 14.1 | 85             | 85.9 |
| D. Within Outside Lane                         | 1                                  | 15   | 0                              | 0    | 67             | 98.5 |
| E. Within Inside Lane                          | 5                                  | 7.3  | 5                              | 7.3  | 59             | 85.5 |
| F. Total of C + D + E                          | 6                                  | 25   | 19                             | 8.1  | 211            | 89.4 |

COMMENTS: Length of cracks in overlay were three feet.  
 Opened to traffic June 12, 1975. Grid: 10'.



## LATEX MODIFIED CONCRETE OVERLAY

Construction Project Number: I-40-4(67)147

Number of Bridges: 4

County: Oklahoma

Bridge Numbers: B, C, D, E

Expressway: I-240

Location of Project: I-40, I-240 interchange (Interchange K)

### Bridge Design Data

Type of Structure: B - 80', 2-98', 70' Continuous plate girder  
C - 70', 2-98', 80' Continuous plate girder  
D - (64'-84'-64'), (123', 2-109', 86'), (95'-135'-113'-99')  
Continuous plate girder  
E - (81'-110'-81'), (126', 2-112', 92'), (109', 2-128', 109')  
Continuous plate girder

Span Lengths: See "Type of Structure"

Overall Length: 348.5', 348.5', 1131.9', 1236.9' (B, C, D, E)

Width: B - 40' 9", C - 40' 9" D - 25' 9", E - 25' 9"

Skew: B - None, C - None, D - Variable, E - Variable

Horizontal Curvature: None      Vertical Curvature: None

Super Elevation: B and C - None, D and E - 6%

Concrete Cover Over Steel: 2"

### Deck Construction Data

Date of Last Bridge Deck Pour: 8-13-75

Concrete Type: AA(AE)

Cement Type: I

Fine Aggregate Source: Shoffner Sand Co., Oklahoma City, OK

Course Aggregate Source: Sooner Rock, Davis, OK

Method of Surface Texturing: Burlap drag

Curing Type: Wet burlap

## LATEX MODIFIED CONCRETE OVERLAY

### Protection Treatment

Description of Product: Latex modified Portland Cement concrete overlay.

### Overlay Construction Data

Construction Dates: October 21 through December 11, 1975

Concrete Type: Latex modified

Cement Type: I

Fine Aggregate Source: Corff Construction Co., Asher, OK

Coarse Aggregate Source: Sooner Rock, Davis OK

Method of Surface Texturing: Transverse broom and wire tine

Curing Type: Wet burlap covered with polyethylene sheeting

Dates of Application and Comments:

#### Structure D

|          |                                                                                                                                                  |
|----------|--------------------------------------------------------------------------------------------------------------------------------------------------|
| 10-21-75 | Overlaid south part of right lane from abutment No. 1 to Pier No. 3. Air temperature ranged from 70° to 83° F, wind from south at 10 to 15 mph.  |
| 10-30-75 | Overlaid remainder of right lane from Pier No. 3 to Abutment No. 2. Air temperature was in high 60's, wind was 5 to 10 mph from southwest.       |
| 10-31-75 | Sawed joints in overlay.                                                                                                                         |
| 11-13-75 | Overlaid south portion of left lane from Abutment No. 1 to Pier No. 7, air temperature in the low 50's, wind was from the north at 3 to 7 mph.   |
| 11-14-75 | Overlaid north portion of left lane from Pier No. 7 to Abutment No. 2. Air temperature in the high 60's, wind was from the south at 8 to 12 mph. |

#### Structure C

|         |                                                                                                             |
|---------|-------------------------------------------------------------------------------------------------------------|
| 11-5-75 | Overlaid left half of deck, air temperature in the low 60's, wind was 5 to 7 mph from the north, northwest. |
|---------|-------------------------------------------------------------------------------------------------------------|

## LATEX MODIFIED CONCRETE OVERLAY

11-17-75 Overlaid right half of deck, air temperature in the high 60's, wind was 10 to 15 mph from the south.

11-20-75 Cut saw joints.

### Structure B

11-10-75 Overlaid right half of structure, air temperature in the 60's, wind velocity from 2 to 5 mph, from the south.

11-18-75 Overlaid left half of structure, air temperature in high 60's, wind 12 to 18 mph from south, southeast.

11-21-75 Cut saw joints.

### Structure E

12-2-75 Overlaid left half of structure from Abutment 2 (north abutment) to Pier 2. Air temperature in mid 70's.

12-3-75 Overlaid left half of structure from Abutment 1 to Pier No. 2. Air temperature in low 70's.

12-5-75 Overlaid right half of structure from Abutment 2 (north abutment) to Pier 5. Air temperature in mid 70's.

12-8-75 Overlaid right half of structure from Pier 5 to Abutment 1. Air temperature in high 50's.

12-11-75 Sawed joints in roadway.

### Cost of Protective System

Overlay: \$20/sq. yd. (including sand blasting)

### Discussion

#### Structure D

Placement of the latex modified concrete began on October 21, 1975 on the south side of the outside lane. The pour began at approximately 10:00 a.m. and was completed at 3:00 p.m. The air temperature ranged from 70°F to 83°F with wind from the south at 10 to 15 mph. The relative humidity was

## LATEX MODIFIED CONCRETE OVERLAY

quite low. Deck temperatures were as high as 102°F. These factors contributed to a high evaporation rate. Difficulty was encountered in finishing and covering the overlay prior to its "skinning over", which is a characteristic of this type of overlay where high evaporation rates are present. After the curing period was over and the overlay exposed, several areas of shrinkage cracking were found as well as areas where the surface texture appeared to be "washed out." Cores were taken in these areas and then the cores were broken to determine the degree of adhesion to the substrata. The broken sections were then sliced to determine the extent of these surface defects. The shrinkage cracks were found to be approximately 1/8 inch deep and the areas of washed out texture appeared to be a surface defect only. The cores were broken by three point loading. Each core was broken twice with one break made to occur at the overlay - substrata interface and the other made to occur at another point entirely within the substrata (original deck concrete). The results of these loadings follow.

### RESULTS OF THIRD POINT LOADING

| <u>Core Number<br/>&amp; Number</u> | <u>Total Load to<br/>Break Core at Interface</u> | <u>Comments</u>                                           | <u>Total load to<br/>Break Core in<br/>Parent Deck</u> |
|-------------------------------------|--------------------------------------------------|-----------------------------------------------------------|--------------------------------------------------------|
| Interchange K<br>No. 1              | 3,900 lbs.                                       | Broke mostly along<br>interface but took<br>some overlay. | 10,160 lbs.                                            |
| Interchange K<br>No. 2              | 5,060 lbs.                                       | Broke smoothly<br>along interface.                        | 7,400 lbs.                                             |

At the time of loading, the overlay was 30 days old. These results compared favorably with other similar tests performed on cores from thin bonded concrete overlays and from a latex modified overlay placed in 1972. Data on slump, air content, and cylinder breaks are unavailable on this pour.

## LATEX MODIFIED CONCRETE OVERLAY

The second pour on structure D was made on October 30, 1975 and completed the overlay on the outside lane. The pour began at 8 a.m. and was completed about 4:30 p.m. Air temperature was in the low to high 60's with wind velocities varying from 5 to 10 mph. The pour proceeded uneventfully. It was observed that the slump varied widely from batch to batch although it all appeared to work well. This phenomena was to be evident throughout this job. The burlap used for curing was new and its water absorbing character was somewhat lacking. On future jobs the mats should be washed or soaked in water containing a fabric softener prior to their use. The wet mats were covered with 6 mil polyethylene (P.E.) sheeting which was weighted down with 1" x 6" timbers. Soon after placement water vapor condensed on the underside of the P.E. Sheeting and remained there for the entire 24 hours curing period. Results of physical tests on this days pour are as follows: Slump - 5 1/2" and 5 3/8", air content - 3.5 and 3.5 percent 28 day compressive strength (P.S.I.) - 5160, 4990, 5130, 5240, 4950, and 5090.

The third pour on Structure D was made on November 13, 1975 on the south portion of the inside lane. Air temperature was cool from mid 40's to low 50's. The day was overcast with a northerly wind at 3 to 7 mph. The pour went uneventfully. No air content or slump tests were made. One set of cylinders was cast with 28 day breaks of 6120, 6190, and 6260 P.S.I. The fourth and final pour was made November 14, 1975 on the northern portion of the inside lane. Air temperature ranged from low to high 60's. The sky was clear with a southerly wind of 10 to 15 mph. Some difficulty was encountered in keeping the P.E. sheeting in place with these brisk winds but the problem was over come by the use of more 1" x 6" timber to weight down the edges of the sheet. No slump or air content tests were made. One

## LATEX MODIFIED CONCRETE OVERLAY

set of cylinders was cast with 28 day breaks of 4950, 5130, and 4850 P.S.I.

### Structure C

The inside lane of structure C was overlaid on November 5, 1975. The air temperature was in the low 60's. The wind was from the north, northwest at 5 to 7 mph and the day was overcast with occasional light mist. Weather conditions were nearly ideal for the overlay placement and the operation went smoothly. Test results are as follows: Slump - 4"; air content - 3.8%; 28 day compressive strengths were 5520, 5730, and 5620 P.S.I.

The outside lane was poured on November 17, 1975. The day was clear with temperatures in the mid to high 60's, wind was from the south at 10 to 15 mph. Test results are: Slump - 4 1/4"; air content - 3/4%; 28 day compressive strengths - 4950, 4990, and 5090 P.S.I. Two flexural beams were cast this day and their 28 day flexural strengths were 866 and 833 P.S.I.

### Structure B

The inside lane of structure B was overlaid on November 10, 1975. The day was clear, air temperature was in the 60's with wind velocity of 2 to 5 mph from the south. Relative humidity was 32-38 percent and the pour was relatively uneventful except for a purposely long delay in placing the P.E. sheeting over the wet burlap (as much as 45 minutes). This was done in an effort to eliminate some of the marking of the deck by the 1" x 6" timbers used to weight down the sheet in these brisk winds. This delay was successful to the extent that the marking, although still evident, was not as pronounced as on previous decks. A finish obtained by a metal tined rake was used on the northern section of this pour as opposed to the burlap drag used on previous structures. This finish procedure was quite disruptive to

## LATEX MODIFIED CONCRETE OVERLAY

the very plastic surface because it lifted a lot of the angular fine aggregate. The contractor did not like the appearance but it presented what appeared to be a very skid resistant surface. Test results are: Slump - 4"; air content - 3.7%; 28 day compressive strength - 5940, 6050, and 6120 P.S.I.

### Structure E

The northern portion of the outside lane from the north abutment to Pier 2 was overlaid on December 2, 1975. The day was clear with air temperature from 55° to 73°F, wind was from the south at 5 to 7 mph. The pour was relatively uneventful. Physical test results: Slump - 4 1/4"; air content - 4%; 28 day compressive strength - 4880 P.S.I.

The southern portion of the outside lane was poured on December 3, 1975, from Pier 2 to Abutment 1. The day was clear with a southerly wind of 7 to 10 mph and air temperature in the low '70's. Physical test results were: Slump - 4 3/8"; air content - 3 3/4%; and 28 day cylinder breaks were 5520, 5520, and 5590 P.S.I.

The southern portion of the inside lane was poured on December 8, 1975 from Pier 5 to Abutment 1. The day was overcast with temperature in the low to high 50's, and winds from the north, northwest at 10 to 15 mph. Physical test results were: Slump - 4 1/4"; air content 3 3/4%; 28 day compressive strengths 5160, 5240, 5090 P.S.I.

After all structures were completed, a visual examination of the structures found a very nearly flawless job except for the first day's pour on structure D that contained the previously mentioned shrinkage cracks and washed out surface texture. No cracking of any kind was found on the remainder of structure D or any of the other structures. The only flaws found were marks left by the 1" x 6" weight timbers.



## LATEX MODIFIED CONCRETE OVERLAY

### Project Data

Construction Project Number: I-240-4(88)162 BR

Number of Bridges: 1

County: Oklahoma

Bridge Number: STR 18

Expressway: I-240 eastbound

Location of Project: Douglas Boulevard Overpass

### Bridge Design Data

Type of Structure: Continuous concrete slab span

Span Length: 32-43-43-32

Overall Length: 151' 6"

Width: 48'

Skew: None

Horizontal Curvature: None

Vertical Curvature: None

Super Elevation: None

Concrete Cover Over Steel: 1 and 1/2"

### Deck Construction Data

Construction Dates: Super structure - 4-18-72

Concrete Type: AA(AE)

Cement Type: I

Fine Aggregate Source: Poage, Guthrie, OK

Coarse Aggregate Source: Sooner Rock, Davis OK

Method of Surface Texturing: Burlap drag

Curing Type: None

## LATEX MODIFIED CONCRETE OVERLAY

### Protective Treatment

Description of Protective Treatment: Dow Latex modified concrete overlay (mortar mix with Type B modifier).

### Overlay Construction Data

Construction Dates: May 4, 1972 and May 8, 1972

Concrete Type: Latex modified mortar (Type B modifier)

Cement Type: I

Fine Aggregate Source: Perryman Sand Company, Cromwell, OK

Coarse Aggregate Source: None

Method of Surface Texturing: Burlap drag

Curing Type: Wet burlap mats with a polyethylene backing

### Date of Application and Comments

5-4-72

Inside one-half of structure was overlaid. Temperature 52° to 67°F, relative humidity was 80 percent.

5-8-72

Outside one-half of structure was overlaid. Temperature 55 to 72°F, relative humidity 60 percent.

### Cost of Protective System

Concrete Removal

Overlay: \$25/yd<sup>2</sup> (including sand blast)

### Discussion

The inside lanes of the structure were overlaid on May 4, 1972. The day was overcast with an 80 percent relative humidity. The air temperature varied from 52° to 67°F with southerly winds from 5 to 10 mph. The pour progressed uneventfully. The mortar mix worked very smoothly with these weather conditions. Results of tests taken during the pour were: slump - 3 1/4"; air content - 8%; 28 day cylinder breaks - 5540, 5470, 5030 P.S.I. The outside lanes were poured on May 8, 1972. The day was overcast with air

## LATEX MODIFIED CONCRETE OVERLAY

temperature of 55<sup>0</sup> to 72<sup>0</sup>F and a relative humidity of 60 percent. The pour was uneventful. The results of the physical testing are unavailable. The finished appearance of the overlay was quite good with no cracking or other surface defects with the exception of some very slight surface marking as a result of the timbers used as weight.

### Results of periodic surveys

Surveys were taken of the structure in 1973, 1974, 1975, and 1977. These surveys included visual examination, copper/copper sulfate half-cell survey, chain drag survey, and in 1975 a chloride analysis survey. The following is a brief synopsis of each yearly survey.

1973 - The visual survey noted no defects, the chain drag survey found no areas of delamination, and all half-cell potential readings were more positive than a -200 mV.

1974 - The visual survey noted no defects, the chain drag survey found no areas of delamination, all half-cell potential readings were more positive than -100 mV.

1975 - The visual noted several small areas of very fine random cracks, no other defects. The chain drag survey located one area of delamination of approximately five square feet. The half-cell potential survey located five isolated readings more negative than -300 mV and four areas that contained high half-cell readings ranging in size from an area approximately 2 ft.<sup>2</sup> to one approximately 75 ft.<sup>2</sup>

Seven areas were sampled for chloride analysis during this survey. The following is a list of chloride contents at the level of the upper mat of reinforcing and the corresponding half-cell potential at that location.

## LATEX MODIFIED CONCRETE OVERLAY

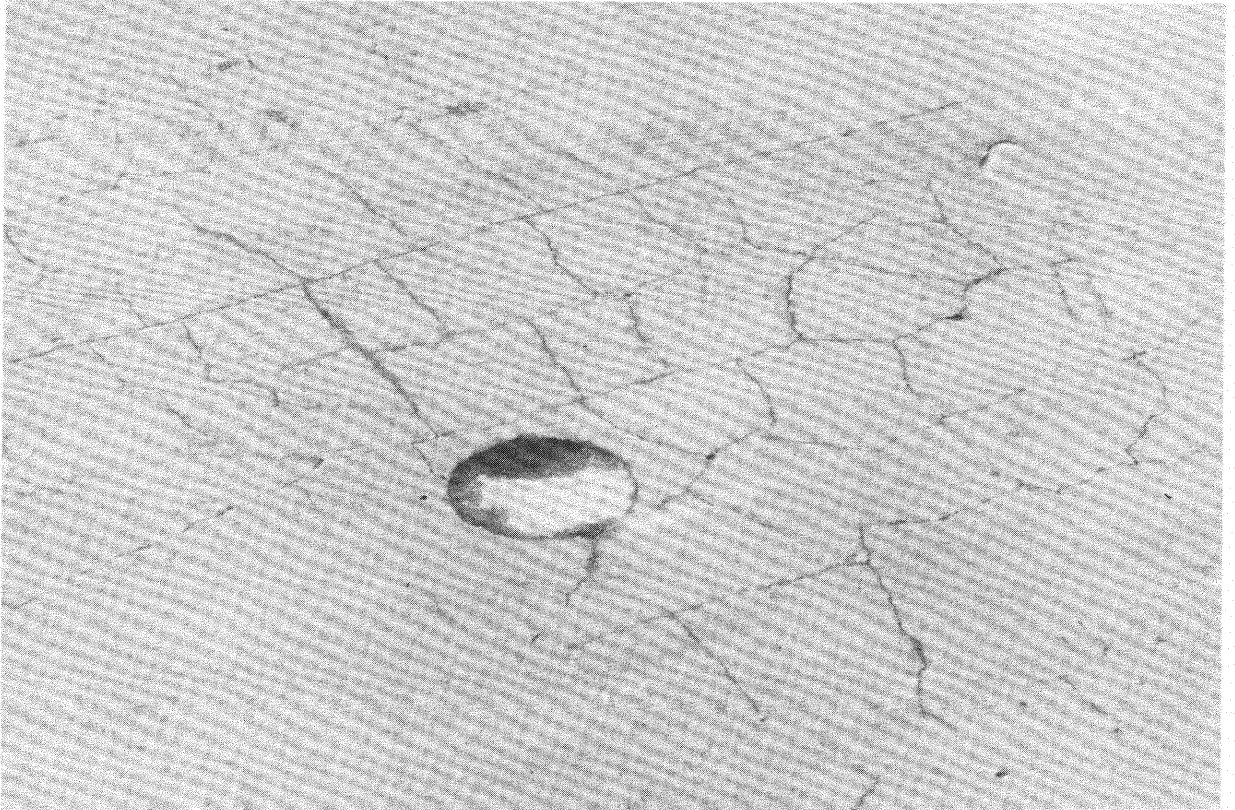
| Sample No. | Chloride Content<br>At the Rebar Level Lbs./yd. <sup>3</sup> | Half-Cell Readings (mV) |
|------------|--------------------------------------------------------------|-------------------------|
| 1          | 5.50                                                         | 460                     |
| 2          | 10.04                                                        | 280                     |
| 3          | 1.73                                                         | 130                     |
| 4          | 3.48                                                         | 230                     |
| 5          | 4.67                                                         | 200                     |
| 6          | 2.46                                                         | 380                     |
| 7          | 2.04                                                         | 190                     |

1977 - The visual survey noted much more cracking than in previous surveys.

About 1/8 of the total surface was marred by numerous random interconnected cracks. The cracks reported in the 1975 survey were much wider in 1977.

The chain drag survey found seven delaminated areas ranging in size from 2 ft.<sup>2</sup> to two areas of approximately 40 ft.<sup>2</sup> each. The half-cell potential survey found 1/8 to 1/6 of the potential readings were more negative than -300 mV.

LATEX MODIFIED CONCRETE OVERLAY



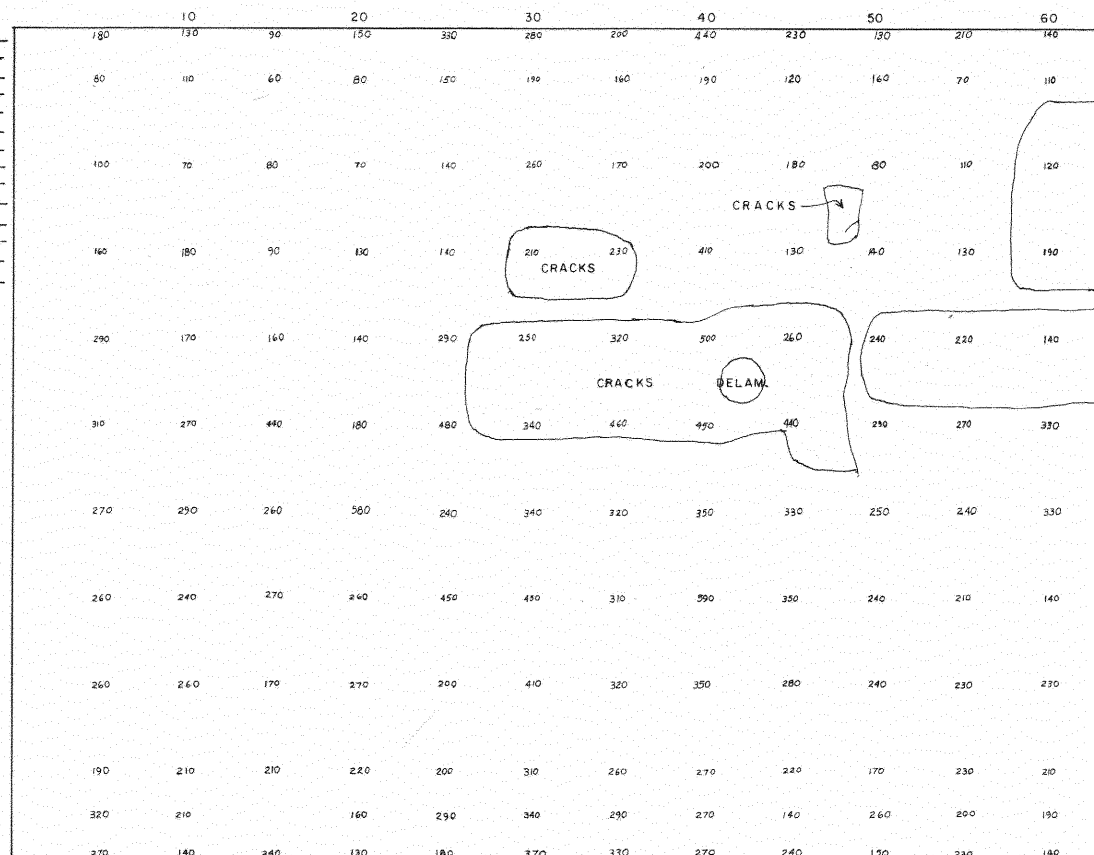
Cracking pattern on deck of I-240 bridge over  
Douglas Blvd.



LATEX MODIF

PROJECT NO. I-240-4(88)162  
 COUNTY OKLAHOMA  
 EXPRESSWAY I-240  
 BRIDGE NO. STR 18  
 DIRECTION OF TRAFFIC EAST  
 DATES OF SURVEY MAY 1977  
 TESTED BY B. Cole & G. Fugler  
 COMMENTS

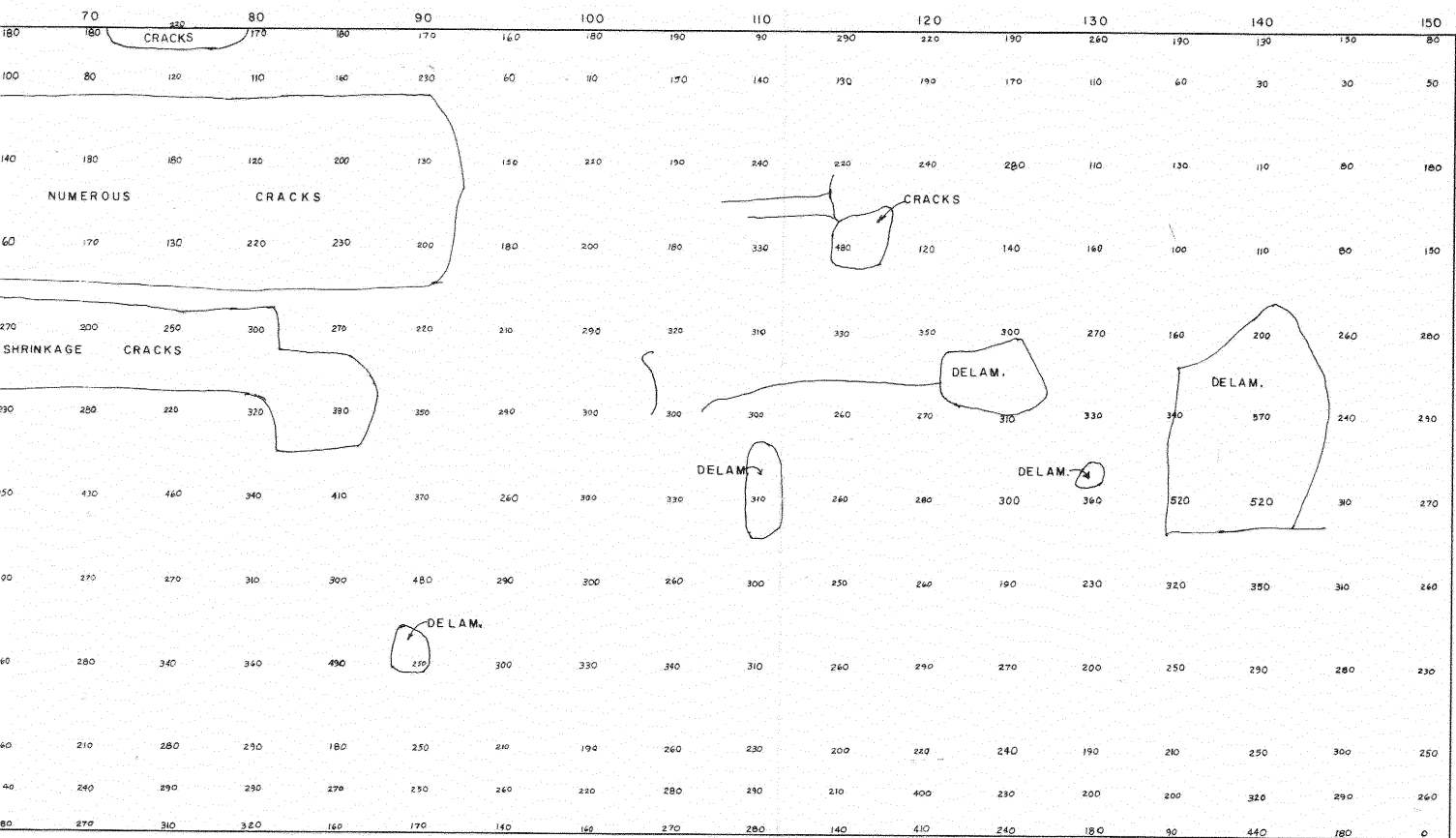
DELAM. = DELAMINATED AREA



Delaminated Area on I-240 Structure over Douglas Boulevard



# ND CONCRETE OVERLAY



## PRELIMINARY FINDINGS AND CONCLUSIONS

The reader should be cautioned that this section is as the title implies "preliminary." The findings and conclusions about to be presented are based to a large extent on visual observations of construction techniques and on the finished product. These observations are necessarily subjective, although every effort has been taken to make them as objective as possible. These observations are also incomplete from the standpoint that few of the protection systems have failed in service and that provides the only real test of the ultimate worth of a system. Another reason for reading this account judiciously stems from the fact that the method used to assess the waterproofing ability of a membrane, the so-called "wet mop" resistance test, has been the subject of much controversy concerning its dependability and accuracy. With these words of caution "Preliminary Findings and Conclusions" will be presented in two parts (1) concerning waterproof membranes and (2) latex modified Portland Cement concrete overlays.

### Waterproof Membranes

The following is a comparison of the nine membrane types that Oklahoma Department of Transportation has now had experience with. The comparison will be based upon seven critical parameters that determine the relative worth of a membrane as a successful waterproofing agent. Some parameters are more critical than others but all serve to describe the total character of the system. These parameters are:

1. Ease of application.
2. Likelihood of problems occurring if not overlayed soon after placement.
3. Resistance to damage by the overlay operation.

4. Extent and severity of problems expected in the overlay operation.
5. Degree of blister or bubble formation.
6. Performance from the standpoint of electrical resistivity.
7. Performance (appearance & integrity) of asphaltic concrete wearing course at the time of reporting.

Where possible, short one word or one sentence assessments will be made. However, in the interest of fairness, some explanations may be required where situations or conditions varying from the norm created a performance that would not be indicative of the normal performance of the product.

### Bituthene

1. Ease of Application: More difficult than most.
2. Likelihood of problems occurring if not overlayed soon after placement: Much more likely than most.
3. Resistance to damage by the overlay operation: Better than most.
4. Extent and severity of problems expected in the overlay operation: Fewer than most if fabric shrinkage has been overcome and it appears than it has been.
5. Performance from the standpoint of degree of blister or bubble formation: Average for sheet membranes.
6. Performance from the standpoint of electrical resistivity: Average.
7. Performance (appearance & integrity) of asphaltic concrete wearing course at the time of reporting: Better than average.

### Kopper's Super Pavement Sealer

1. Ease of application: Easier to apply than most but requires much more time to apply.
2. Likelihood of problems occurring if not overlayed soon after placement: Lower likelihood of problems than most.
3. Resistance to damage by the overlay operation: Much better than most.
4. Extent and severity of problems expected in the overlay operation: Much better than most.
5. Performance from the standpoint of degree of blister or bubble formation: Much more severe than most.
6. Performance from the standpoint of electrical resistivity: Better than most.
7. Performance (appearance & integrity) of asphaltic concrete wearing course at the time of reporting: Better than most.

### Petromat

1. Ease of application: Average if emulsion is stable.
2. Likelihood of problems occurring if not overlayed soon after placement: Lower than most.

3. Resistance to damage by the overlay operation: Poorer than most.
4. Extent and severity of problems expected in the overlay operation: Much worse than most.
5. Performance from the standpoint of degree of blister or bubble formation: Better than most.
6. Performance from the standpoint of electrical resistivity: Much worse than most.
7. Performance (appearance & integrity) of asphaltic concrete wearing course at the time of reporting: Much worse than most.

#### Polyguard

1. Ease of application: Much easier than most.
2. Likelihood of problems occurring if not overlayed soon after placement: Average.
3. Resistance to damage by the overlay operation: Better than most.
4. Extent and severity of problems expected in the overlay operation: Fewer than most.
5. Performance from the standpoint of degree of blister or bubble formation: Better than most.
6. Performance from the standpoint of electrical resistivity: Much better than most. This must be weighted by the fact that this membrane has had relatively low traffic volume at the time of testing.
7. Performance (appearance & integrity) of asphaltic concrete wearing course at the time of reporting: Much better than most.

#### Polytok

1. Ease of application: Much more difficult than most.
2. Likelihood of problems occurring if not overlayed soon after placement: Much more likely than most.
3. Resistance to damage by the overlay operation: Poorer resistance to damage than most.
4. Extent and severity problems expected in the overlay operation: Much worse than most.

5. Performance from the standpoint of degree of blister or bubble formation: Better than most.
6. Performance from the standpoint of electrical resistivity: Worse than most.
7. Performance (appearance & integrity) of asphaltic concrete wearing course at the time of reporting: Much worse than most.

#### Protecto Wrap

1. Ease of application: Average.
2. Likelihood of problems occurring if not overlayed soon after placement: Average.
3. Resistance to damage by the overlay operation: Average.
4. Extent and severity of problems expected in the overlay operation: Fewer than average.
5. Performance from the standpoint of degree of blister or bubble formation: Average.
6. Performance from the standpoint of electrical resistivity: Average.
7. Performance (appearance & integrity) of asphaltic concrete wearing course at the time of reporting: Average.

#### Royston

1. Ease of application: Better than most.
2. Likelihood of problems occurring if not overlayed soon after placement: Much less than most.
3. Resistance to damage by the overlay operation: Better than most.
4. Extent and severity of problems expected in the overlay operation: More than most. See "DISCUSSION."
5. Performance from the standpoint of degree of blister or bubble formation: Much worse than most.
6. Performance from the standpoint of electrical resistivity: Worse than most.
7. Performance (appearance & integrity) of asphaltic concrete wearing course at the time of reporting: Worse than most.

### Super Seal 4000

1. Ease of application: Worse than most.
2. Likelihood of problems occurring if not overlayed soon after placement: Average.
3. Resistance to damage by the overlay operation: Worse than most. This rating based largely on the vulnerability of the roofing sheet.
4. Extent and severity of problems expected in the overlay operation: Average
5. Performance from the standpoint of degree of blister or bubble formation: Much better than most.
6. Performance from the standpoint of electrical resistivity: Much better than most.
7. Performance (appearance & integrity) of asphaltic concrete wearing course at the time of reporting: Much better than most.

### Uniroyal

1. Ease of application: Easier to apply than most.
2. Likelihood of problems occurring if not overlayed soon after placement: Much less than most.
3. Resistance to damage by the overlay operation: Much worse than most.
4. Extent and severity of problems expected in the overlay operation: Much worse than most.
5. Performance from the standpoint of degree of blister or bubble formation: Worse than most.
6. Performance from the standpoint of electrical resistivity: Better than most. See "DISCUSSION."
7. Performance (appearance & integrity) of asphaltic concrete wearing course at the time of reporting: Much worse than most. See "DISCUSSION."

### Latex Modified Portland Cement Concrete Overlays

The overlay placed in 1972 on I-240 over Douglas Boulevard appears to be deteriorating quite rapidly as the surveys of 1975 and 1977 attest. This same sort of progressive deterioration was exhibited by two structures that were rehabilitated using a latex modified overlay also in 1972. These two structures had large areas of delamination by 1976 and virtually every square yard of surface was



marred by random cracking at that same time. In 1976 one area of delamination was removed by traffic. This precipitated a decision to remove and repair all delaminated areas on both structures. Approximately 680 square yards of overlay was removed and repoured at this time. Surface cracking appears to be of prime importance in this deterioration cycle. The deterioration process progresses much more rapidly after the cracking becomes evident. In all likelihood the I-240 overlay will not last the decade without extensive repair.

The structures at the I-240, I-40 interchange have not received a complete survey at this time although a visual survey conducted in the spring of 1978 revealed no apparent defects.

