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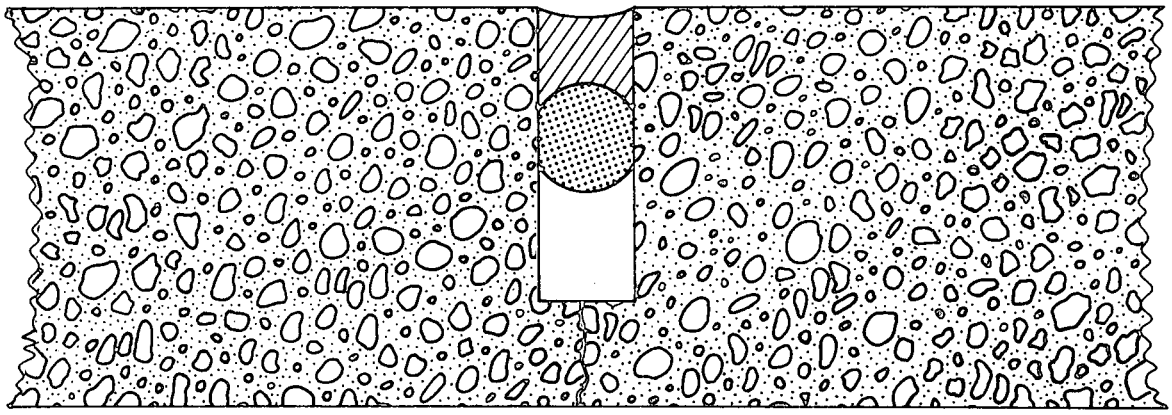
Progress Report
for
Iowa Highway Research Board
Project HR 203

Transverse Joint Sealing with Various Sealants



DEPARTMENT OF TRANSPORTATION
IOWA

Highway Division
July 1979

in cooperation with
Dallas County
Secondary Road Department

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Final Report

~~PROGRESS REPORT~~

FOR

IOWA HIGHWAY RESEARCH BOARD

PROJECT HR-203

TRANSVERSE JOINT SEALING WITH VARIOUS SEALANTS

BY

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THE DALLAS COUNTY
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INTRODUCTION

Iowa's first PC Concrete pavement was constructed in 1904 in the City of LeMars. A portion of that pavement served traffic until 1974 at which time it was resurfaced. The first rural Iowa PCC pavement (16' wide, 6" to 7" thick) was constructed under the direction of the Iowa State Highway Commission in 1913. Some of Iowa's early pavements had transverse joints at 25 foot spacings. At that time, joint spacings across the nation ranged from 24 to 100 ft.[1] There have been many changes in joint design over the years with some pavements being constructed without transverse joints.

Joint spacing on Iowa primary pavements has generally remained around 20 feet with this spacing having been adopted as an Iowa standard in 1954. Until recently, it was common to specify a 40 foot joint spacing on secondary pavements.

The performance of the pavements with joint spacings greater than 20 feet, and in some cases no contraction joints, generated a 1955 research project on joint spacing.[2] This project was 16 miles long containing sections without contraction joints and sections with joints sawed at intervals of 20, 50 and 80 feet. Approximately half of the sawed joints were left unsealed. The results of this research supported the

20 foot spacing, but were inconclusive regarding the benefits of sealing.

One of the desired characteristics of joint sealing material is that it should act as a moisture barrier and prevent the intrusion of surface water. It was generally accepted from past experience that the hot poured-type joint seals did not provide this effective moisture barrier.

In an effort to identify an effective joint sealing system, research project HR-125 was initiated in 1966 to evaluate the use of performed neoprene joints.

Over the years, Iowa has maintained a standard practice of sealing joints on new PCC pavement construction. The standards have required hot poured bituminous materials. Prior to 1948, the materials were unmodified asphalt cements. From 1948 though 1964, the sealant material was an asphalt cement product with a mineral filler. A blend of recycled rubber and asphalt cement was used from 1964 through 1977. From through 1981. In 1977, the present specification was adopted requiring a blend of virgin rubber and asphalt cement meeting Federal Standard Specification SS-S-1401. Add 11

Some transverse joints in Iowa have been formed utilizing parting strips, but for the most part have been imparted by sawing. Prior to 1951, Specifications ~~have~~ required a minimum width of 1/8" and a minimum depth of one fourth the slab thickness. In recent The minimum width of saw cut is now 1/4 inch.

years, the common practice has been to make that saw cut with a 3/16" or 7/32" abrasive blade.

There is no record of the use of filler or backing material beneath the hot poured sealant on any Iowa project prior to 1978.

Highway engineers over the years have been concerned with joint sealing materials and procedures. A small experimental study utilizing a one component, polyvinyl chloride coal tar elastomeric type, hot poured sealer was incorporated into a US 30 project at the southwest corner of Ames in 1972. The sealant reservoir was cut ½ inch wide and cleaned by sandblasting prior to hot pour sealing.

PROBLEM

Deterioration of joints and joint related distress of PCC pavements continues to be a major maintenance problem. These joints are constructed to control cracking and provide for movement due to variation in temperature. The difficulty of maintaining these joints in a sealed condition is primarily caused by the opening and closing of the joint, but movement produced by traffic is a contributing factor. Unfortunately the poured sealants and present joint design and construction practices have not been able to adequately provide for this movement. Even under ideal conditions, the life of most poured

sealants rarely exceeds three years.[1] The bond between the sealant and the concrete fails and allows the joint to leak. (Figure 1).

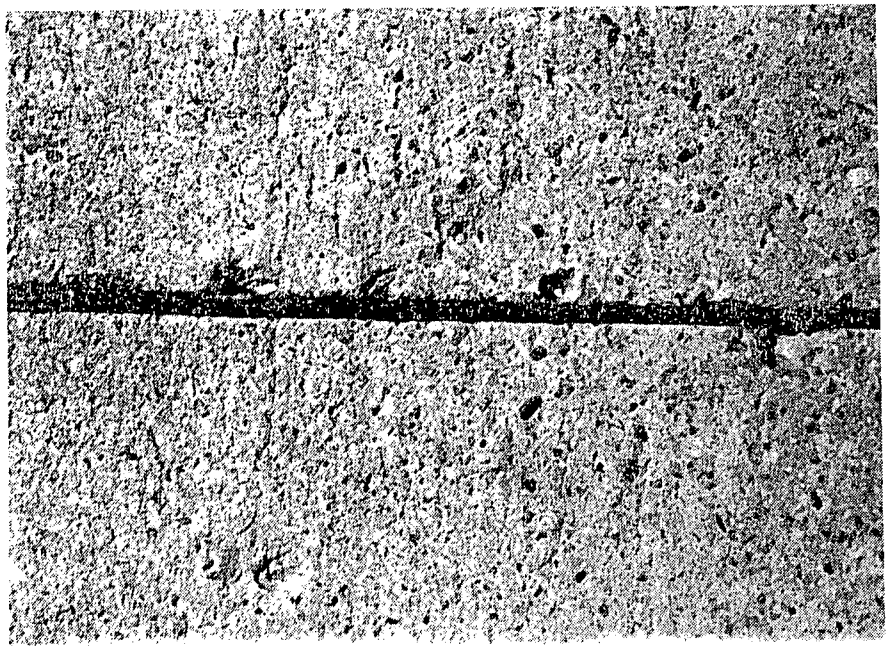


Figure 1 - Bond Failure of Sealant Material

Failure of the joint seal results in additional problems. Surface water is allowed to enter the joint. This additional water detracts from the stability of the base material. It further causes erosion of the base both from gravity and by pumping. The freezing of this concentration of water during winter months causes joint heaving resulting in poor riding quality.

Blowups are the most dramatic of the joint failures. The generally accepted major contributing factor to blowups is

incompressibles deposited in the joints (Figure 2) during the winter months.

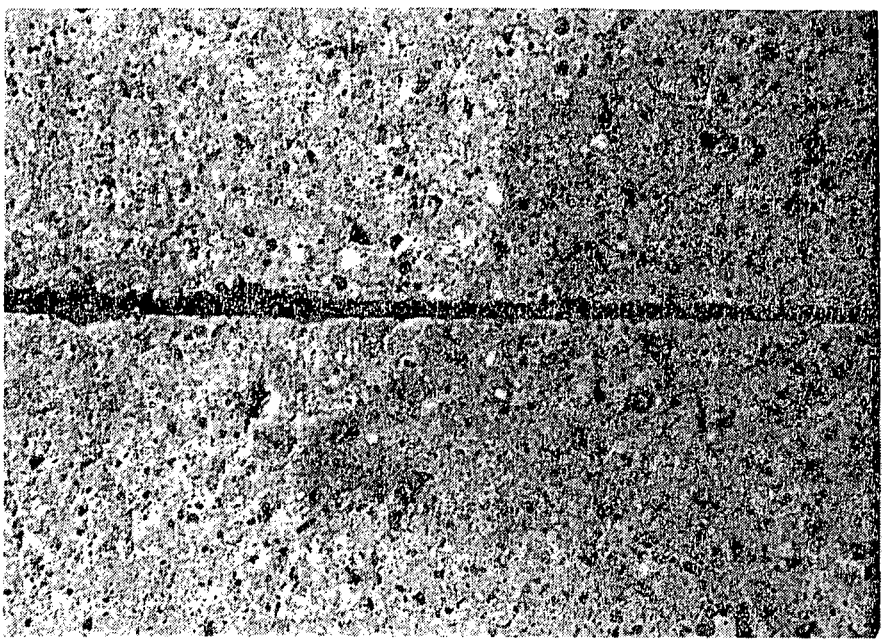


Figure 2 - Incompressibles in Transvere Joint

A combination of thermal expansion during the hot summer months, high moisture conditions and joints plugged with incompressibles results in numerous blowups. To alleviate this problem, the Iowa DOT initiated an extensive program of cutting pressure relief joints. The four inch wide cuts are placed at 1000 foot intervals. It has been typical for these pressure relief joints to close up rapidly. The four inches have closed to less than one inch within two years in many instances.

There has been a considerable amount of research on joint

sealing. The New York State Department of Public Works has researched preformed neoprene and a variety of poured sealants.[3] Their results from this 1955 to 1963 research demonstrated the short effective life of poured sealants and supported the superior performance of preformed neoprene. Economics, labor requirements and joint restrictions have continued to be a detriment to the use of preformed neoprenes.

A recent HRIS literature search (5-10-78) cited many abstracts on joint sealing. The Pennsylvania DOT has an active project in the use of various sealant materials with various sealant reservoirs. The Wisconsin DOT has a current project comparing sealed versus unsealed, sealant type and joint spacing.

OBJECTIVE

The objective of this research is to evaluate the performance of PCC pavement contraction joints utilizing a variety of sealants and joint preparations and to identify an effective sealant system. The variables to be evaluated are:

1. Sealant material
2. Joint preparation
3. Size of saw cut (sealant reservoir)
4. The use of backing material

PROJECT SELECTION AND LOCATION

The decision to pursue joint sealant research was made in March of 1978. By that time, most PCC paving projects were either let or in the process of being let. As the joint seal

performance is a long term evaluation (minimum of three years) and the winter period presents the severe test condition, it was considered desirable to incorporate the research into 1978 construction. Joint movement is greater on pavement with 40 foot spacing and was, therefore, one of the selection criteria to subject the joint seal to the most severe condition. This immediately eliminiated primary roadways as a 20 foot spacing is standard. A majority of secondary PCC pavement has 20 foot spacing, but Dallas County project FM-25(2)--55-25 designed with a 40 foot spacing was selected. The project on Secondary Road R-30 begins 1¼ mile west of Granger and extends southerly approximately 8½ miles.

PAVING DESIGN

The paving was 22' wide and 6" thick using Iowa DOT Standard Specification B-6 mix proportions. It had a 2" crown and the only reinforcing was 3' long #4 tie bars across the centerline at 48" centers.

CONTRACTOR AND PERSONNEL

The successful bidder on this paving project was Central Paving Corporation. Their project Superintendent on this project was Mack Capper. The jobber for most of the Central Paving Corporation miscellaneous supplies is Pittsburg-Des Moines Steel. The jobber cooperated with the research in providing all sealant and backer materials at invoiced cost and providing this cost information.

PAVING MATERIALS

The materials and proportions of the Standard Specification B-6 mix used for this paving were:

B-6 Mix Proportion

Material	Absolute Volume	Batch Quantities pounds per cu.yd.
Cement	0.098936	523
Fine Agg.	0.404409	1819
Coarse Agg.	0.269606	1204
Water	0.176049	297
Air	0.060000	

The cement was a Type I from the Penn-Dixie Cement Company of Des Moines, Iowa.

The fine aggregates (Sp.Gr. = 2.67) were produced from the Hallett Construction Company sand pit in West Des Moines (Polk County 7 & 8-79-24).

The coarse aggregate was a crushed limestone (100% passing 1½" screen) from the Hallett Construction Company Quarry near Gilmore City, Iowa (Pocahontas County NE¼ 36-92-31).

The air entraining agent was CSC from Contractor Steel Corporation of Des Moines, Iowa and the white pigmented curing compound was produced by Carter-Waters Corporation of Kansas City, Missouri.

JOINT LAYOUT AND IDENTIFICATION

The research proposal was developed to place groups of five joints with the same combination of variables. A repetitive group of five joints with the same combination of variables was to be placed at another location. The joint sealing variables to be considered were:

TABLE 1

Sealant Materials

A- W. R. Meadows, "Hi-Spec" (Iowa Standard Specification 4136)
B- Lion Oil Division, "Lion D-200" (Two Comp. Urethane)
C- W. R. Meadows, "Gardox" (Two Comp. Neoprene)
D- W. R. Meadows, "Poly-Jet Highway" (Polyvinyl Chloride)
E- Dow Corning, "Dow Corning 888" (Silicone Rubber)
F- W. R. Grace, "Para Plastic" (Iowa Standard Spec. 4136)

Cleaning	Saw Cut
1. Air Jet	1. Nominal 1/8"
2. Sand Blast	2. Nominal 1/4"
3. Water Blast	3. Nominal 3/8" x 1/2" deep
	4. Nominal 3/8" x 1" deep
	5. Nominal 1/2" x 1/2" deep
	6. Nominal 1/2" x 1-1/4" deep

Backing Materials	Size of Backing
N- No Backing Materials	3- 3/8"
T- Tape	4- 1/2"
BH- Backer Rope (Hot Material)	5- 5/8"
BC- Backer Rod (Cold Material)	

An installation code designation was established for ease of documentation. The variables for 581 joints were tabulated and are included in Appendix A. The research was to include at

least ten joints of each possible combination of the variables previously noted. Some alterations in placement were necessary to be compatible with the contractor's operation. Limitation of material or equipment reduced or eliminated the use of some combinations. No nominal 1/8" wide joints were used.

JOINT SAWING

The initial cutting was a typical operation of cutting joints 1½" deep (¼ of slab thickness) using a 3/16" thick carborundum blade to prevent random cracking. The required depth and width for each group of five joints were spray painted on the pavement. Dual 3/16" blades were used to obtain the 3/8" wide joints. Dual ¼" blades were used for the ½" wide joints.

JOINT PREPARATION

Many engineers have the opinion that one major factor in the failure of joint seals is inadequate cleaning. Three types of cleaning were utilized for this research. The standard for years has been air jet removal of the cutting dust.

The second method of cleaning was sand blasting. For this operation, the contractor rented a small Clemco Mighty-mite Sandblaster (Figure 3) and used bagged silica sand. A specially designed wand would have improved this operation. To effectively sand blast the joint, the operator had to hold the short metal section with the nozzle very close to the pavement.

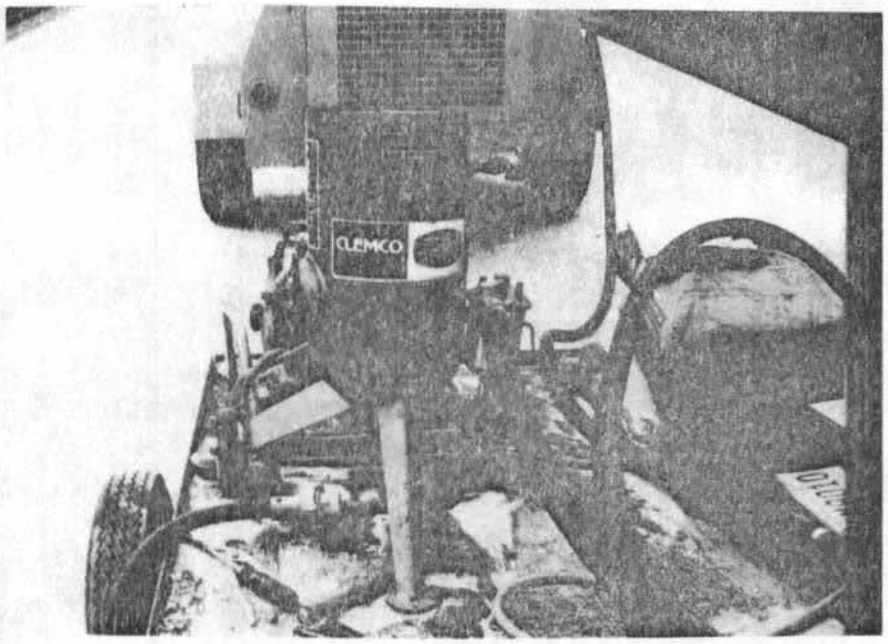


Figure 3 - Sand Blast Equipment

A portable car wash unit (figure 4) that would supply about 500 psi of pressure was used for water blast removal of dust and dirt. This unit was operated from the roadway shoulder and, therefore, could not be used when the rainy weather produced impassible conditions.

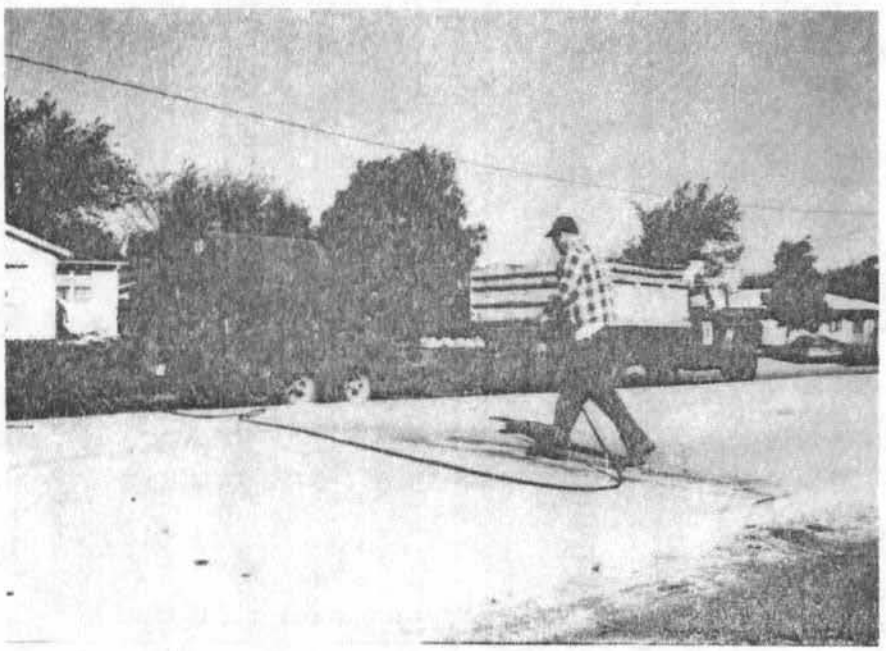


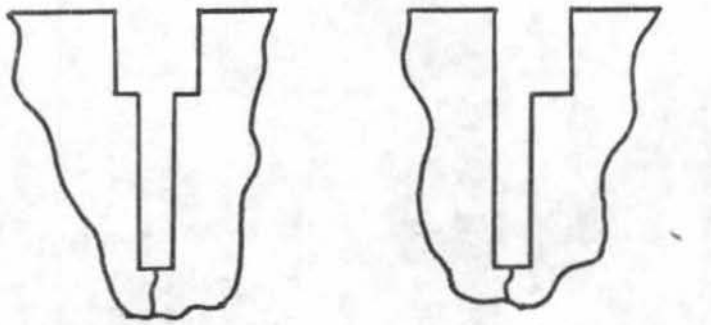
Figure 4 - Water Blast Equipment

INSERTING BACKING MATERIAL

Standard Iowa DOT joint sealing procedures do not include backing material. A number of the research joints were sealed without backing material. The most inexpensive type of backing material utilized in this research was tape. Another economical feature was that it required less depth on the step joints. The fiber backing tape requires only ½" of depth where as the backer rod or backer rope requires 1" to 1¼" depending on their diameter. Proper placement of the fiber reinforced tape was very difficult. The shoulders of the step joint were generally not equally distributed or wear of the corborundum blade did not produce distinct shoulders for a bearing surface. (Figure 5). Due to difficulty in tape placement, the ½" deep step joints were soon discontinued.

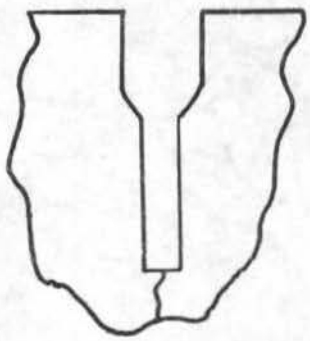
The backer rod material (Figure 6) comes in three sizes (3/8", 1/2" and 5/8" diameter) that are matched to joint widths. It must be properly centered over the joint and rolled to the proper depth with a special tool (Figure 7). To obtain the desired ½ inch reservoir for the sealant, the knife edge on the roller had to be 5/8" deep for the ½" and 5/8" diameter backer rod while a ½" knife edge depth was sufficient to place the 3/8" diameter backer rod.

The 3/8", 1/2" and 5/8" diameter sizes of backer rope, for use with the hot applied sealants, were installed with the same special tool.



(a) Step joint cut as designed

(b) Step joint with no shoulder on one side



(c) Step joint without distinct shoulders (rounded)

Figure 5 - Step Joints for Tape Backing

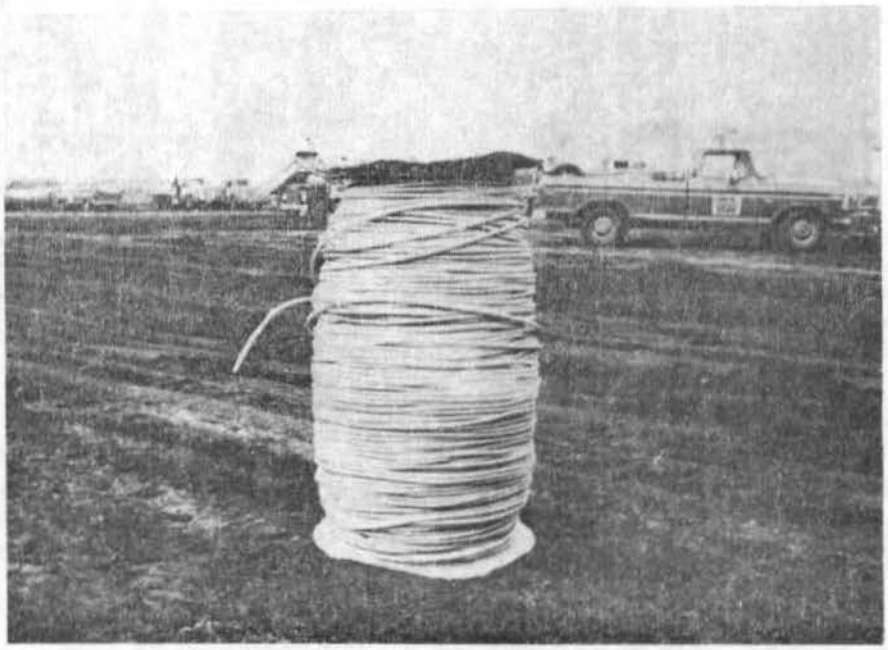


Figure 6 - Backer Rod Material

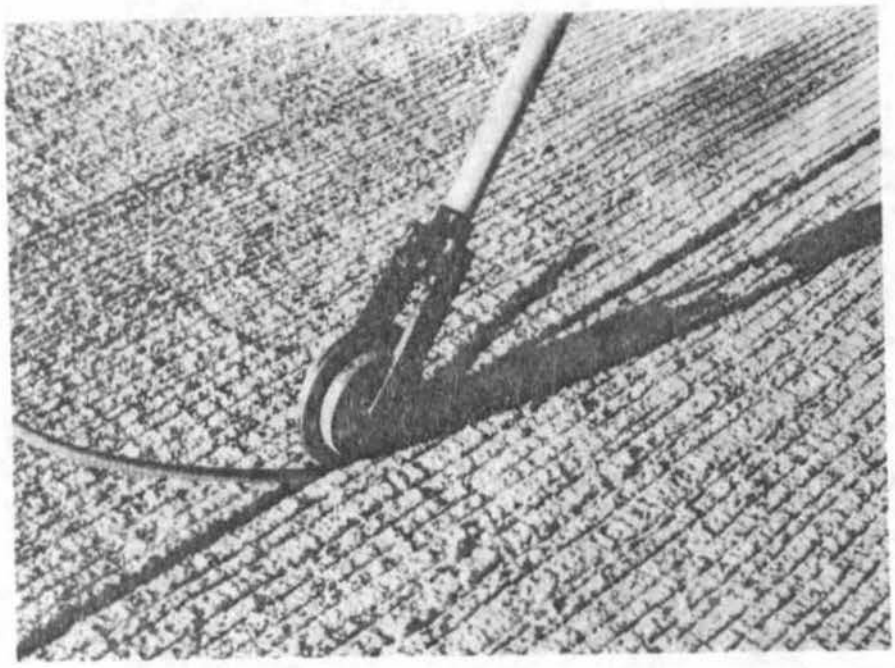


Figure 7 - Inserting Backer Rod Material

JOINT SEALING OPERATION

A. W. R. Meadows "Hi Spec"

The contractor's standard operation includes a specially constructed, hydraulically driven joint sealing unit (Figure 8) that spans the slab for ease in applying the standard sealant material. It was equipped to heat the sealant to the recommended pouring temperature of 390°F. The material was pumped through a wand with a special applicator tip.

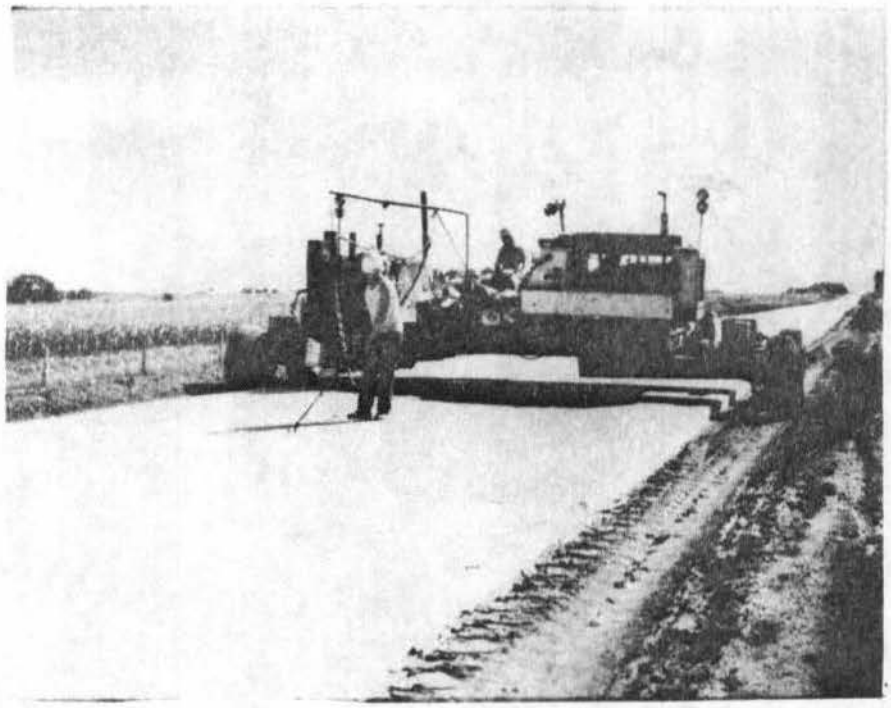


Figure 8 - Contractor's Joint Sealing Unit

B e. Lion Oil Company "Lion D-200"

The two component material was mixed per the manufacturer's instruction. The contractor made a mixing agitator by welding a 6" hinge onto ¼" diameter round stock. After component two was poured into component one, the contractor's personnel mixed the material thoroughly for 3 to 5 minutes. The viscosity of this material would not allow it to flow by gravity through the small orifice of an Iowa DOT crack sealing pot. All joints were hand poured using a five gallon bucket with one side bent to form a pouring spout (Figure 9).

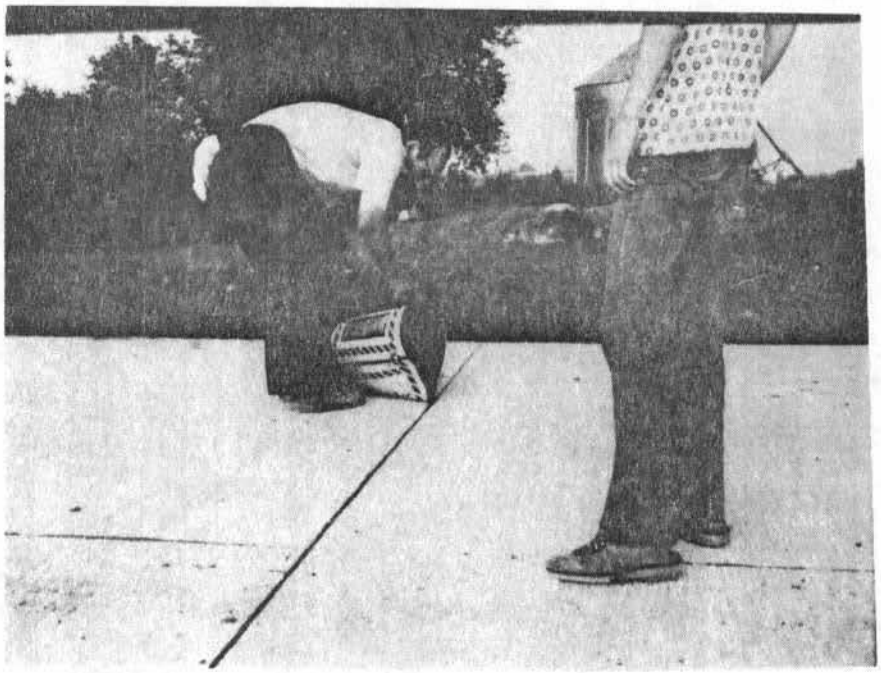


Figure 9 - Manual Pouring of Joint Sealant

Operator experience and technique are very important in obtaining properly filled joints. The pot life of this sealant is one to two hours. Better joints are obtained if the sealant is used soon after mixing while very fluid. If only the right amount of sealant is added to the pouring bucket to complete one joint at a time, a better sealing job is obtained. The operator must proceed at a speed that is coordinated with the viscosity of the sealant. With hand operation, it is very difficult and near impossible to under fill the joint 1/8" as desired. With some operator experience, reasonably neat appearing joints were obtained. Production type equipment could be developed to improve this sealing procedure and make it compatible with the contractor's operation.

C. W. R. Meadow's "Gardox"

Mixing and applying this two component material was very similar to product "B" above. The mixing time was normally in excess of five minutes. The viscosity and pouring techniques were very similar to the Lion D-200. The manufacturer claims a pot life of 2 to 3 hours, but it exhibits far better pouring characteristics immediately after mixing. The length of time after mixing is directly related to the adverse pouring characteristics.

D. W. R. Meadows "Poly-Jet Highway"

This hot pour material was applied with the contractor's normal sealing equipment. Even though the application of this material is very similar to that for the Standard Specification rubber asphalts, there are some additional limitations and precautions. This polyvinyl chloride coal tar is not compatible with the rubber asphalt, therefore, it was necessary to completely clean the sealing equipment before and after using Poly-Jet Highway. Furthermore, the materials cannot be used in contact with each other in the joints, so when the transverse joints were Poly-Jet Highway, the longitudinal joint was also Poly-Jet Highway.

Poly-Jet Highway cannot be reheated, as after heating, it gels. Any material remaining in the kettle at the end of the day's application must be discarded. Personnel must avoid the

the vapor produced while heating as it can cause irritation to the skin. The control of the heat must be precise with a recommended pouring temperature of 280°F and a maximum safe temperature of 300°F. Overheating causes the material to gel and additional heating will assure gelation.

The contractor was made aware of these precautions and the Poly-Jet Highway was installed without problems.

E9. Dow Corning "Dow Corning 888"

A representative of the Dow Corning Corporation supplied the sealant and application equipment in addition to supervising the installation. The sealant for this research was supplied in 4.5 gallon pails and 11 ounce caulking tube samples. The "888" sealant is to be tooled in and, therefore, the manufacturer recommends the use of backer materials. A few of the ¼" wide joints were sealed using the caulking gun (Figure 10). Most of the research joints were sealed using the air operated bucket pump supplied by Dow Corning (Figure 11). The "888" sealant does not flow readily and, therefore, must be "tooled" into the joint. This tooling was done immediately after depositing the sealant. Round steel rods compatible with the width of joints were used in much the same manner as one would "strike" off the joints of a concrete block wall.

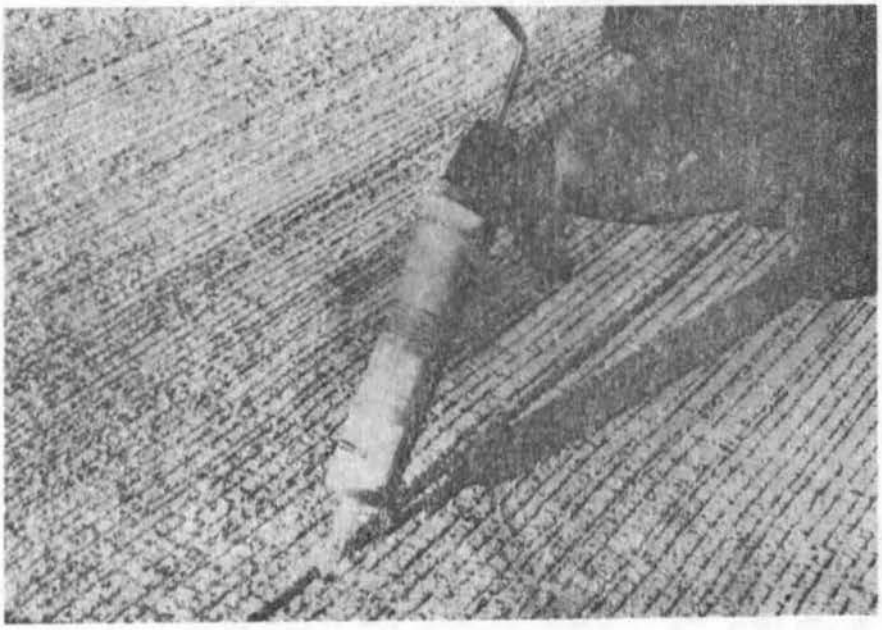


Figure 10 - Dow Corning 888 Sealing with a Caulking Gun

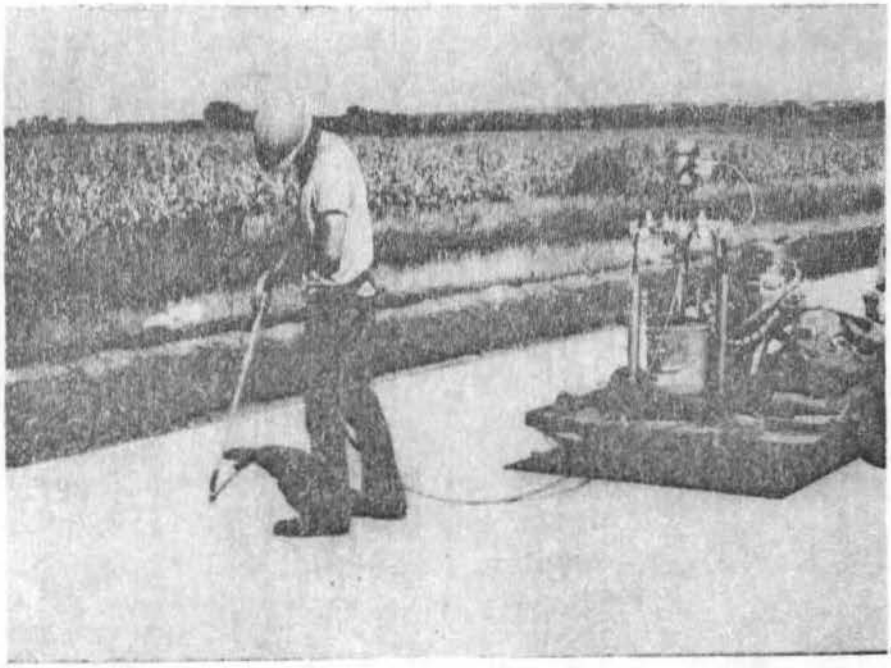


Figure 11 - Dow Corning 888 Sealing with Bucket Pump

This was the first paving project where the Dow Corning personnel had assisted in the field application. It was a relatively slow process and the Dow-Corning representative recognized that equipment modifications would improve the operation. A more efficient sealing system can be developed to increase the speed of application.

F. W. R. Grace "Para Plastic"

The contractor used his normal sealing equipment for this Standard Specification rubber asphalt sealant. There was no problems and the application was exactly the same as for the W. R. Meadows "Hi-Spec" sealant.

COST COMPARISON

It would be difficult if not impossible and not entirely fair or realistic to try to determine the true cost of the total sealing operation for each sealant. Some sealants were applied with readily available equipment while others were applied by crude hand equipment or equipment in the developmental stage.

The costs presented for comparison will be the contractor's cost of materials only (Table I).

Table I

Backer Rod - 3/8" diam. = $0.015/lin.ft.
- 1/2" diam. = 0.021/lin.ft.
- 5/8" diam. = 0.030/lin.ft.

Backer Rope- 3/8" diam. = 0.04/lin.ft.*
- 1/2" diam. = 0.029/lin.ft.
- 5/8" diam. = 0.033/lin.ft.

*Purchased from another company on a small lot basis.

Sealant cost (Table II) presented is estimated for a ¼" wide ½" deep joint. This joint is selected to provide a definite volume for the cost comparison.

Table II

Sealant	Contractors Cost Per/lb.	Per/gal.	Quantity for ¼" x ½" joint	Price per lineal ft.
Hi-Spec	$0.2415	$ 2.16	5.85 lb per 100 lineal feet	$0.015
Lion D-200	0.8211	7.80	154 lineal feet per gallon	0.051
Gardox	1.8907	19.38	0.7 gallon per 100 lin. ft.	0.136
Poly-Jet Hwy	0.5558**	5.89	6.888 lb/100 lin. ft.	0.038
Dow Corning 888	---	23.00	154 lineal ft. per gallon	0.149
Para Plastic	0.2415	2.16	5.85 lb. per 100 lin. ft.	0.015

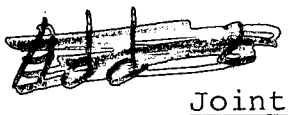
**Includes cost of flushing oil

PERFORMANCE EVALUATION

Visual Inspection

Visual observations of the entire project were made in February and April 1979. In general, all joints appeared to be tight and sealed. One joint seal had apparently been ripped

out and was missing entirely. Inspection of some joints was difficult due to a large amount of sand from winter ice control remaining on top of the sealant.



Joint Heave

The riding quality of the pavement was determined using the Bureau of Public Roads type roughometer. Testing of both lanes soon after construction (11-30-78) resulted in an average of 71 inches per mile.

Evaluation of the joint heaving was conducted in February 1979 using a 25 foot profilometer. The profilometer is supported on each end by an assembly with six averaging wheels and the profile is determined by a large bicycle wheel. This bicycle wheel powers a chart drive and produces a chart plotted profile to a true verticle scale and a $1\frac{1}{4}$ = 25' horizontal scale. The profile was obtained for the outside wheel track of both lanes. It does not show any joint heave at this time. This profile trace exhibiting no joint heave will serve as original data for comparison with subsequent profiles.

Core Drilling and Testing

One 4 inch diameter core was drilled from each combination of the joint sealing variables. A total of 68 cores (Appendix B) were drilled on April 16, 1979. One interesting and significant feature was noted while drilling. The cores were drilled with

an Acker drill which supplies cooling and flushing water through a Moyno pump. When drilling the Dow Corning 888 joints, the water was pumped to both edges of the slab where it spurted up in a small stream. This emphasized the tight seal of this joint. This type of spurting was not noted on joints with other types of sealant.

All cores were drilled between the wheel paths of the north-bound lane. The intent was to center the core over the transverse joint yielding a 4 inch length of joint seal for inspection and testing.

The cores were visually inspected and rated on the basis of their condition after drilling and transportation. Cores were classified as:

1. No Visible Failure - The bond was apparently tight on both interfaces for the entire 4 inch length.

2. Partial Seal Failure - There was a loss of bond on one interface for even a short length.

3. Broken Seal - The bond had completely failed on one interface and the core was no longer held together.

Using this criteria, the cores were rated and summarized in respect to sealant material, cleaning and saw cut (Appendix C). When considering the sealant and disregarding other variables, the Poly-Jet Highway and Dow Corning 888 exhibited no visible failures. The visual rating with respect to cleaning did not

yield results that would favor any one procedure. The water blast cleaning exhibited the poorest results. The ½ inch deep joints with tape backing had no visual failures in the saw cut summary.

The cores were grouped by sealant type and color slide photographs were taken (Figure 12).

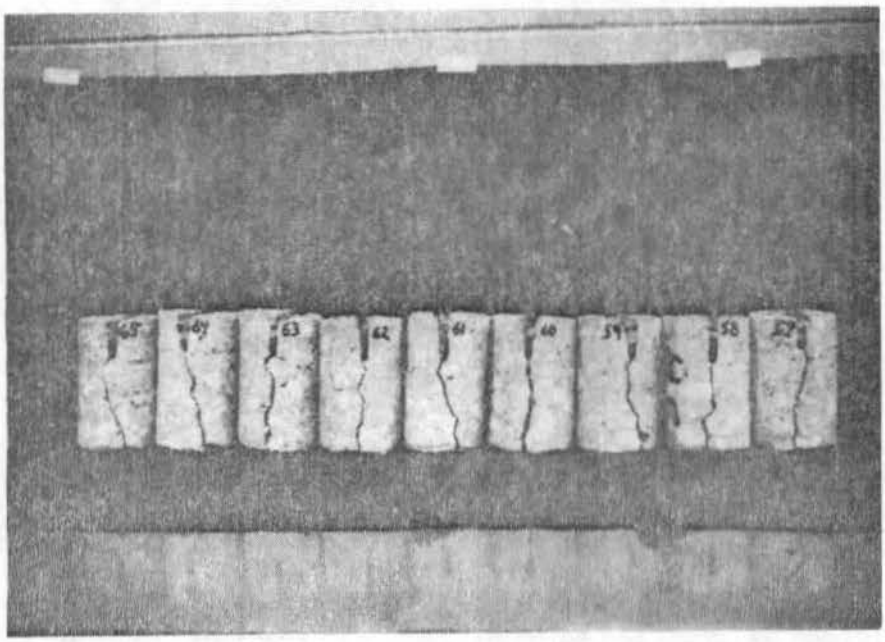


Figure 12 - Cores From Dow Corning 888 Joints

The top portion (approximately 2") of the cores including the joint seal was cut off for the final test of the cores. Two C-Clamps were fitted with pull rods to be used in a Tinius Ohlsen testing machine (Figure 13). The C-Clamps were secured to the rod so they were not free to rotate. The rods were free

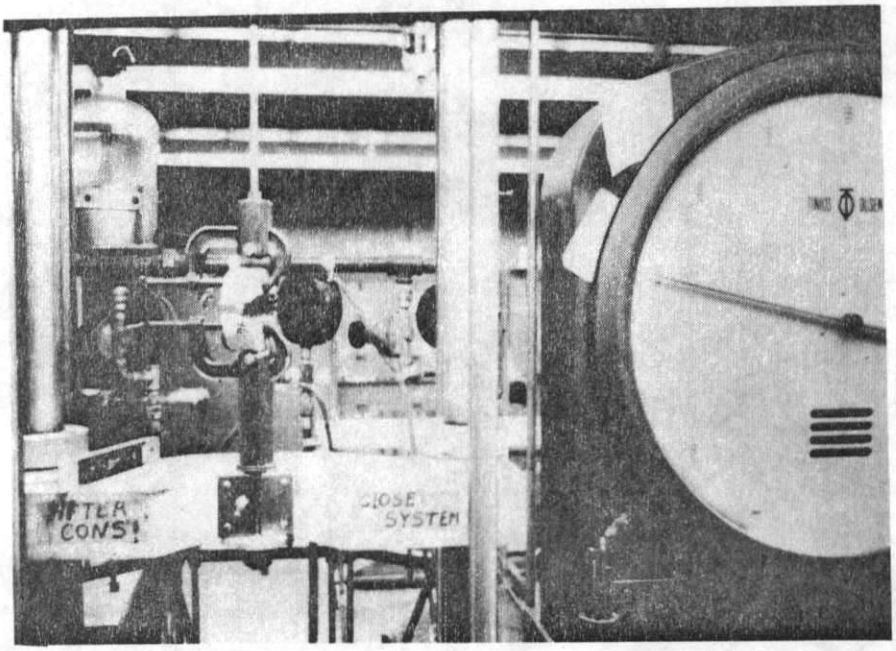


Figure 13 - Joint Seal Testing Apparatus

to move for alignment. All cores that were bonded sufficiently to transmit load were tested. Even some that were rated "partial seal failure" yielded a significant maximum load at failure. The load was applied at the rate of 0.3 inch per minute. The maximum load, elongation at maximum load (not available for all cores) and elongation at failure are tabulated in Appendix B. The Dow Corning 888 exhibited outstanding elongation (Figure 14). Some Para Plastic joints had a very deep seal that resulted in high maximum load (Figure 15). A maximum load of 89.5 pounds was obtained on a Para Plastic joint. The point of failure was somewhat arbitrary, but certain criteria were established for this determination. First, if the bond was destroyed on 80% of the 4" length on either

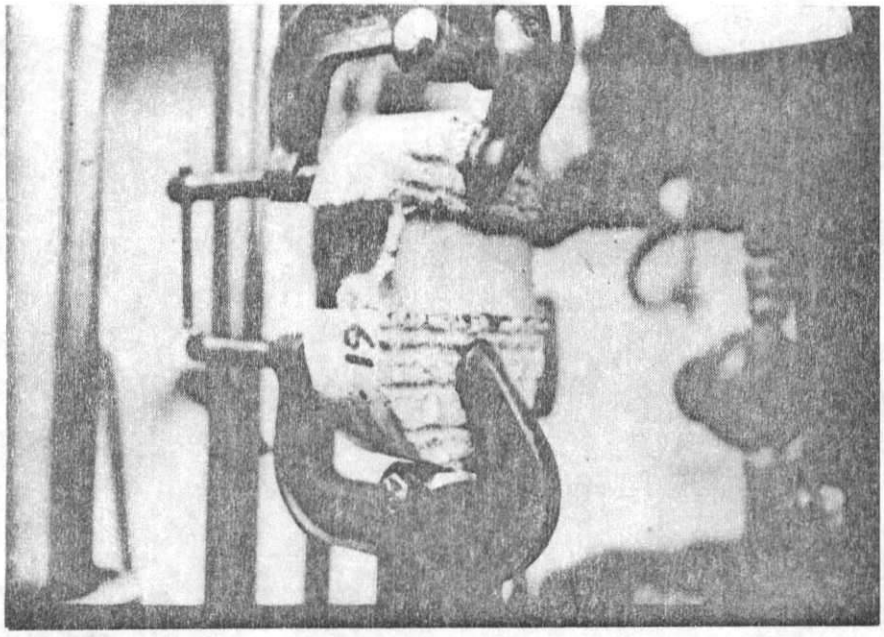


Figure 14 - Elongation of Dow Corning 888

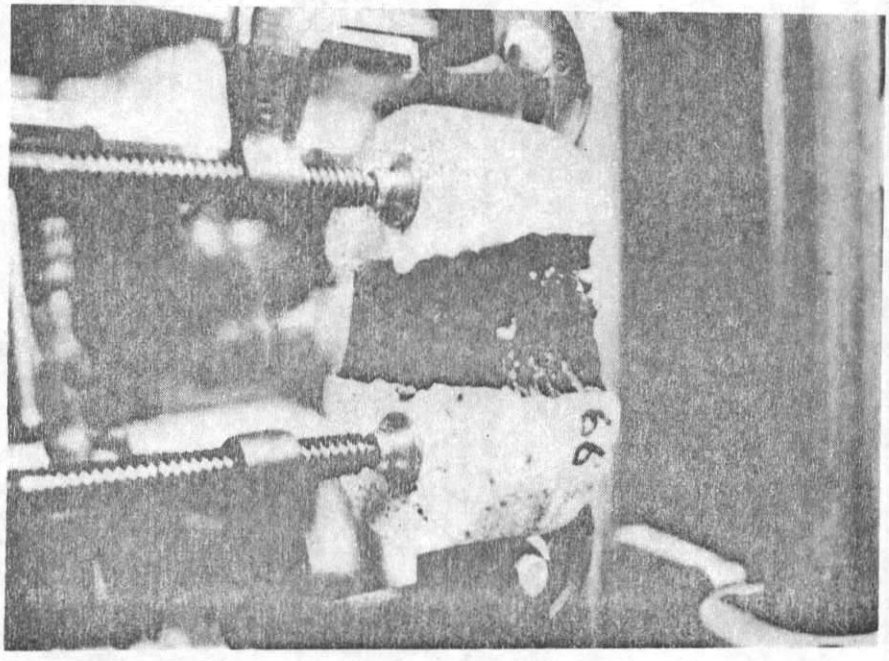


Figure 15 - Deep Seal of a Para Plastic Joint

interface, it had failed. Second, it failed if a load greater than 20 lbs. had been obtained followed by a reduction below 10 lbs.

The maximum loads and maximum elongations were summarized with respect to the same variables as the visual rating (Appendix C). This testing exhibited poor strength and elongation for the Lion D-200 and Hi-Spec sealants. There was no significant difference due to the cleaning procedure. As expected, the ¼" saw cut yielded the poorest elongation capabilities.

ACKNOWLEDGEMENTS

We wish to express our appreciation to Gene Hardy and the Dallas County Secondary Road Department for their participation in this research. We also wish to thank Central Paving Corporation for their cooperation with a special thanks to Mac Capper and Jim Draper. We also wish to thank Gary Hankins and Pittsburg-Des Moines Steel Company for their cooperation.

Hossein Foadian of the Iowa Department of Transportation contributed much to the success of the research by providing direction, inspection and documentation.

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1. "Joint-Related Distress in P.C.C. Pavement Cause, Prevention and Rehabilitation" NCHRP Synthesis 56 (January 1979) 36 pp.

2. DeYoung, Clarence "Spacing of Undoweled Joints in Plain Concrete Pavement" Highway Research Record No. 112 (1966) pp 46-54.

3. Graham, M.C. et al "New York State Experience with Concrete Pavement Joint Sealers" Highway Research Record No. 80 (1965) pp 42-48.

APPENDIX A:

JOINT VARIABLE TABULATION

HR-203, "Joint Sealing with Various Sealants"

Installation Code Designations

A- 3- 5- B 3
- - - - -
Material
Cleaning
Saw Cut
Backing Materials
Size of Backing

Sealant Materials

A- W. R. Meadows, "Hi-Spec" (Iowa Standard Specification 4136)
B- Lion Oil Division,"Lion D-200" (Two Comp. Urethane)
C- W. R. Meadows, "Gardox" (Two Comp. Neoprene)
D- W. R. Meadows, "Poly-Jet Highway" (Polyvinyl Chloride)
E- Dow Corning, "Dow Corning 888" (Silicone Rubber)
F- W. R. Grace, "Para Plastic" (Iowa Standard Spec. 4136)

Cleaning

1. Air Jet
2. Sand Blast
3. Water Blast

Saw Cut

1. Nominal 1/8"
2. Nominal 1/4"
3. Nominal 3/8" x 1/2" deep
4. Nominal 3/8" x 1" deep
5. Nominal 1/2" x 1/2" deep
6. Nominal 1/2" x 1-1/4" deep

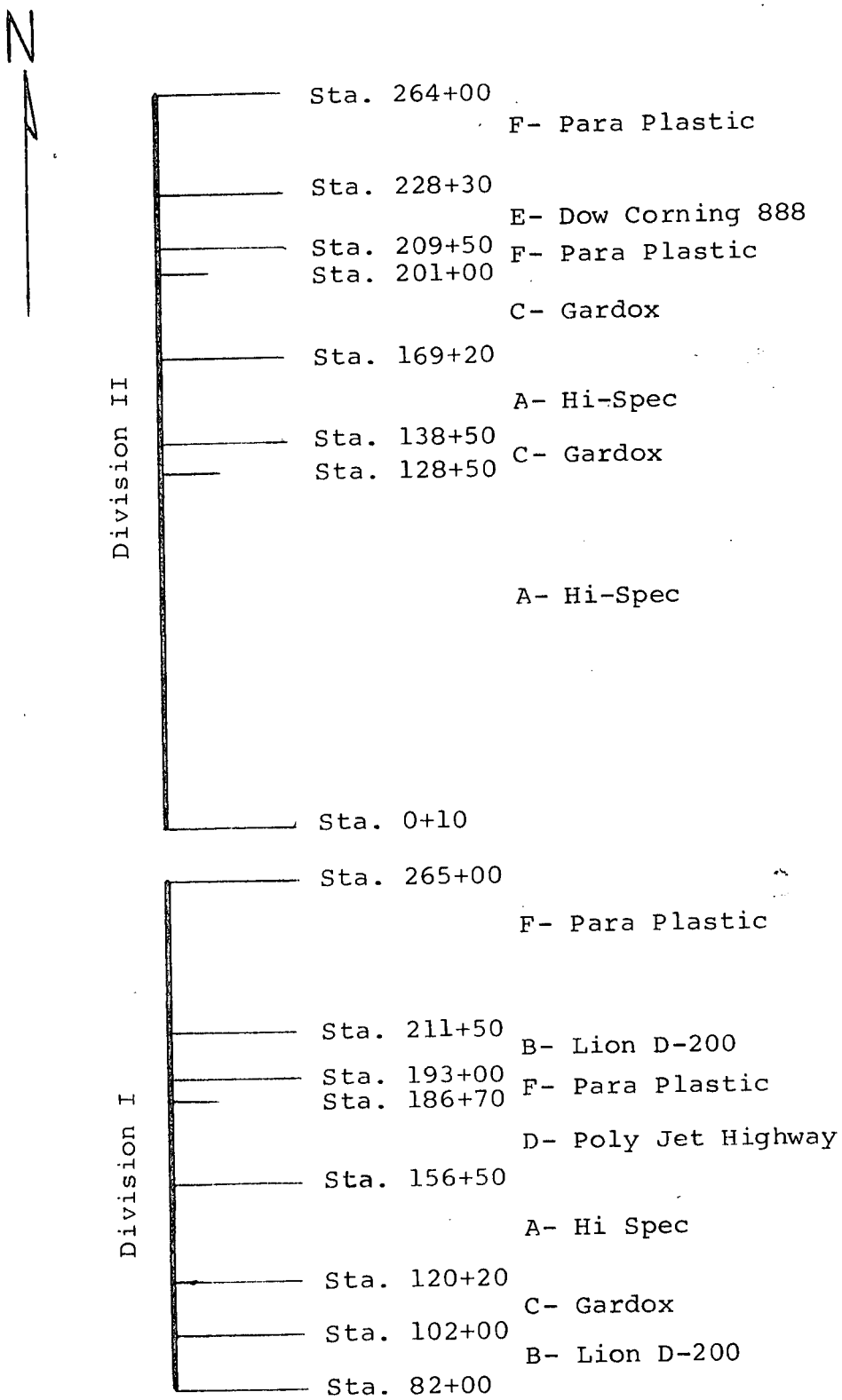
Backing Material

N- No Backing Materials
T- Tape
BH- Backer Rope (Hot Sealant)
BC- Backer Rod (Cold Sealant)

Size of Backing

3- 3/8"
4- 1/2"
5- 5/8"

SCHEMATIC JOINT SEALANT LAYOUT



Visual Rating 1 good
2 3' or less broken seal
3 3' or more broken seal

A-4

410 of

APPENDIX A

Joint Variable Tabulation and Visual Evaluation

All stations were determined by pacing and, therefore, are approximate.

Joint Number	Station	Installation Code Designation	Visual Evaluation 3-16-83
1	3 82+52	B-3-2-BC3	
2	3 82+88	"	
3	3 83+25	"	
4	3 83+70	"	
5	3 84+02	"	
	3 84+50	Broken	
6	3 84+85	B-3-4-BC4	
7	3 85+34	"	
8	3 85+70	"	
9	3 86+15	"	
10	3 86+56	"	
11	3 86+88	B-3-6-BC5	
12	3 87+35	"	
13	3 87+75	"	
14	3 88+20	"	
15	2 / 88+62 2	"	
16	3 88+98	B-1-2-BC3	
17	3 89+50	"	
18	2 89+85 3	"	
19	3 90+35	"	
20	3 / 90+70 2	"	
21	2 91+96 3	B-1-4-BC4	
22	/ / 91+52 / C	"	
23	3 91+85	"	
24	/ 92+35 2	"	
25	3 92+70	"	
26	/ 93+15 /	B-1-6-BC5	
27	2 93+55 3	"	
28	2 93+88 3	"	
29	/ 94+34 3	"	
30	2 94+67 3	"	
31	2 95+00 3	B-2-2-BC3	
32	3 95+45	"	
	3 95+85	Broken	
33	2 96+15 3	B-2-2-BC3	
34	3 96+62	"	
35	2 96+97 3	"	
	3 97+40	Broken	

Joint Number	Station	Installation Code Designation	Visual Evaluation 1-27-83 2-26-81 3-16-83
36 /	/ 97+80 / C	B-2-4-BC4	
37 2	/ 98+23 /	"	
38 3	2 98+65	"	
39	/ 99+09 /	"	
40	2 99+49 3	"	
41 3	/ 99+90 /	B-2-6-BC5	
42 3	2 100+30 2	"	
43	2 100+75 3	"	
~~44 /~~	~~/ 101+35~~	~~"~~	
45	/ 101+65 2 3	"	
46	3 102+02	C-3-2-BC3	
47	3 102+45	"	
48	3 102+90	"	
49	3 103+40	"	
50	3 103+85	"	
51	3 104+25	C-3-4-BC4	
52	3 104+75	"	
53 3	/ 105+25 /	"	
54	2 105+65 3	"	
55	3 105+94	"	
56	3 106+45	C-3-6-BC5	
57	2 106+85 3	"	
58	3 107+20	"	
59	3 107+60	"	
60	3 108+01	"	
61	3 108+37	C-1-2-BC3	
62	3 108+79	"	
63	3 109+25	"	
64	/ 109+60 2	"	
65	3 110+10	"	
66	/ 110+55 2	C-1-4-BC4	
67	3 110+90	"	
68	3 111+42	"	
69 2	/ 111+75 /	"	
70	3 112+10	"	
71 3	/ 112+58 /	C-1-6-BC5	
72 2	/ 112+88 /	"	

APPENDIX A Cont.

Joint Number	Station	Installation Code Designation
73	113+33	C-1-6-BC5
74	113+72	"
75	114+03	"
76	114+51	C-2-2-BC3
77	114+85	"
78	115+27	"
79	115+69	"
80	116+03	"
81	116+36	C-2-4-BC4
82	116+78	"
83	117+15	"
84	117+55	"
85	118+02	"
86	118+40	C-2-6-BC5
87	118+90	"
88	119+28	"
89	119+60	"
90	120+05	"
91	120+40	A-3-2-N
92	120+80	"
93	121+22	"
94	121+62	"
95	121+98	"
96	122+33	A-3-4-BH3
97	122+80	"
98	123+25	"
99	123+60	"
100	124+00	"
101	124+36	A-3-6-BH5
102	124+78	"
103	125+20	"
104	125+55	"
105	126+00	"
106	126+40	A-1-2-N
107	126+80	"
108	127+20	"
109	127+60	"
110	128+00	"
111	128+45	A-1-4-BH3
112	128+90	"
113	129+30	"
114	129+72	"
115	130+18	"
116	130+70	A-1-6-BH5
117	131+10	"

Joint Number	Station	Installation Code Designation
118	131+66	A-1-6-BH5
119	132+05	"
120	132+50	"
121	132+90	A-2-2-N
122	133+30	"
123	133+75	"
124	134+20	"
125	134+58	"
126	134+97	A-2-4-BH3
127	135+38	"
128	135+75	"
129	136+15	"
130	136+50	"
131	136+90	A-2-6-BH5
132	137+30	"
133	137+70	"
134	138+10	"
135	138+45	"
~~136~~	~~138+85~~	~~A-3-2-N~~
137	139+30	"
138	139+70	"
139	140+00	"
140	140+35	"
141	140+80	A-3-4-BH3
142	141+15	"
143	141+60	"
144	141+97	"
145	142+30	"
146	142+65	A-3-6-BH5
147	143+10	"
148	143+43	"
149	143+82	"
150	144+20	"
151	144+60	A-1-2-N
152	145+05	"
153	145+45	"
154	145+78	"
155	146+20	"
156	146+65	A-1-4-BH3
157	147+00	"
158	147+40	"
159	147+80	"
160	148+20	"
161	148+60	A-1-6-BH5
162	148+95	"

APPENDIX A Cont.

Joint Number	Station	Installation Code Designation
163	149+35	A-1-6-BH5
164	149+70	"
165	150+10	"
166	150+50	A-2-2-N
167	150+90	"
168	151+30	"
169	152+03	"
170	152+48	"
171	152+83	A-2-4-BH3
172	153+25	"
173	153+65	"
174	154+00	"
175	154+40	"
176	154+80	A-2-6-BH5
177	155+20	"
178	155+60	"
179	155+91	"
180	156+30	"
181	156+70	D-3-2-BH3
182	157+10	"
183	157+50	"
184	157+90	"
185	158+30	"
186	158+70	D-3-4-BH4
187	159+05	"
188	159+43	"
189	159+80	"
190	160+20	"
191	160+60	D-3-6-BH5
192	161+00	"
193	161+40	"
194	161+75	"
195	162+15	"
196	162+55	D-3-2-BH3
197	162+93	"
198	163+30	"
199	163+70	"
200	164+10	"
201	164+50	D-3-4-BH4
202	164+85	"
203	165+30	"
204	165+70	"
205	166+06	"
206	166+46	D-3-6-BH5

Joint Number	Station	Installation Code Designation
207	166+86	D-3-6-BH5
208	167+25	"
209	167+67	"
210	168+10	"
211	168+50	D-2-2-BH3
212	168+92	"
213	169+30	"
214	169+70	"
215	170+15	"
216	170+55	D-2-4-BH4
217	170+95	"
218	171+35	"
219	171+75	"
220	172+20	"
221	172+60	D-2-6-BH5
222	173+04	"
223	173+45	"
224	173+85	"
225	174+35	"
226	174+75	D-2-2-BH3
227	175+18	"
228	175+63	"
229	176+08	"
230	176+50	"
231	176+88	D-2-4-BH4
232	177+30	"
233	177+70	"
234	178+10	"
235	178+50	"
236	178+94	D-2-6-BH5
237	179+35	"
238	179+75	"
239	180+10	"
240	180+50	"
241	180+90	D-1-2-BH3
242	181+30	"
243	181+70	"
244	182+10	"
245	182+50	"
246	182+85	D-1-4-BH4
247	183+25	"
248	183+65	"
249	184+10	"
250	184+50	"

APPENDIX A Cont.

Joint Number	Station	Installation Code Designation
251	184+90	D-1-6-BH5
252	185+10	"
253	185+65	"
254	186+10	"
255	186+50	"
256	186+88	F-1-2-BH3
257	187+30	"
258	187+70	"
259	188+08	"
260	188+48	"
261	188+88	F-1-4-BH4
262	189+30	"
263	189+70	"
264	190+10	"
265	190+50	"
266	191+10	F-1-6-BH5
267	191+50	"
268	191+95	"
269	192+40	"
270	192+80	"
271	193+28	B-3-2-BC3
272	193+70	"
273	194+20	"
274	194+75	"
275	195+08	"
276	195+48	B-3-4-BC4
277	195+88	"
278	196+30	"
279	196+70	"
280	197+12	"
281	197+52	B-3-6-BC5
282	197+95	"
283	198+35	"
284	198+80	"
285	199+25	"
286	199+70	B-2-2-BC3
287	200+15	"
288	200+60	"
289	201+03	"
290	201+40	"
291	201+80	B-2-4-BC4
292	202+20	"
293	202+60	B-2-4-BC4
294	203+00	"
295	203+40	"
296	203+80	B-2-6-BC5
297	204+20	"
298	204+60	"
299	204+98	"
300	205+38	"
301	205+75	B-1-2-BC3
302	206+12	"
303	206+53	"
304	206+94	"
305	207+32	"
306	207+68	B-1-4-BC4
307	208+09	"
308	208+50	"
309	208+88	"
310	209+25	"
311	209+65	B-1-6-BC5
312	210+03	"
313	210+43	"
314	210+85	"
315	211+20	"
316	211+67	F-1-2-BH3
317	212+07	"
318	212+47	"
319	212+86	"
320	213+25	"

From Sta. 213+25 to Hwy 44, all the joints are under the following code: F-1-2-N. The longitudinal joint material is "F".

From Hwy. 44 to Sta. 128+65 all the joints including the longitudinal joint up to Sta. 201+36 are under the following code: A-1-2-N.

321	128+65	C-1-3-BC3
322	129+05	"
323	129+45	"

APPENDIX A Cont.

Joint Number	Station	Installation Code Designation
324	129+85	C-1-3-BC 3
325	130+25	"
326	130+65	C-1-4-BC4
327	131+09	"
328	131+40	"
329	131+75	"
330	132+25	"
331	132+65	C-1-5-BC4
332	133+06	"
333	133+40	"
334	133+75	"
335	134+30	"
336	134+65	C-1-6-BC5
337	135+12	"
338	135+48	"
339	135+90	"
340	136+35	"
341	136+70	C-1-2-BC3
342	137+09	"
343	137+44	"
344	137+80	"
345	138+25	"
346	138+60	A-1-3-N
347	139+00	"
348	139+36	"
349	139+70	"
350	140+15	"
351	140+60	A-1-4-N
352	141+30	"
353	141+70	"
354	142+22	"
355	142+60	"
356	143+09	A-1-5-N
357	143+45	"
358	143+90	"
359	144+35	"
360	144+75	"
361	145+10	A-1-6-BH5
362	145+52	"
363	145+88	"
364	146+30	"
365	146+65	"
366	147+00	A-1-2-N
367	147+45	"
368	147+80	A-1-2-N
369	148+30	"
370	148+60	"
371	148+99	A-1-3-N
372	149+40	"
373	149+75	"
374	150+25	"
375	150+60	"
376	150+90	A-1-4-N
377	151+30	"
378	151+70	"
379	152+10	"
380	152+55	"
381	152+80	A-1-5-N
382	153+12	"
383	153+45	"
384	153+90	"
385	154+35	"
386	154+75	A-1-6-N
387	155+20	"
388	155+60	"
389	156+00	"
400	156+35	"
401	156+75	A-1-2-N
402	157+30	"
403	157+70	"
404	158+20	"
405	158+50	"
406	158+90	A-1-3-N
407	159+30	"
408	159+75	"
409	160+20	"
410	160+60	"
411	161+03	A-1-4-N
412	161+40	"
413	161+83	"
414	162+30	"
415	162+70	"
416	163+10	A-1-5-N
417	163+55	"
418	163+95	"
419	164+40	"
420	164+83	"
421	165+20	A-1-6-N

APPENDIX A Cont.

Joint Number	Station	Installation Code Designation
422	165+65	A-1-6-N
423	166+01	"
424	166+39	"
425	166+77	"
426	167+35	A-1-2-N
247	167+75	"
428	168+15	"
429	168+65	"
430	169+02	"
431	169+40	C-1-3-BC3
432	169+85	"
433	170+25	"
434	170+75	"
435	171+09	"
436	171+60	C-1-4-BC4
437	171+96	"
438	172+43	"
439	172+80	"
440	173+25	"
441	173+65	C-1-5-BC4
~~442~~	174+02	"
443	174+38	"
444	174+75	"
445	175+20	"
446	175+73	C-1-6-BC5
447	176+15	"
448	176+58	"
449	176+91	"
450	177+30	"
451	177+80	C-1-2-BC3
452	178+17	"
453	178+65	"
454	179+04	"
455	179+50	"
456	179+94	C-2-3-BC3
457	180+35	"
458	180+75	"
459	181+17	"
460	181+60	"
461	181+99	C-2-4-BC4
462	182+40	"
463	182+80	"
464	183+30	"
465	183+70	"
466	184+42	C-2-5-BC4

Joint Number	Station	Installation Code Designation
467	184+80	C-2-5-BC4
468	185+20	"
469	185+60	"
470	186+10	"
471	186+55	C-2-6-BC5
472	186+94	"
473	187+35	"
474	187+75	"
475	188+20	"
476	188+60	C-2-2-BC3
477	189+09	"
478	189+40	"
~~479~~	189+85	~~C-2-2-N~~
~~480~~	190+35	~~"~~
481	190+76	C-3-3-BC4
482	191+16	"
483	191+56	"
484	192+01	"
485	192+43	"
486	192+90	C-3-4-BC4
487	193+30	"
488	193+70	"
489	194+15	"
490	194+55	"
491	194+96	C-3-5-BC4
492	195+40	"
493	195+80	"
494	196+22	"
~~495~~	196+62	~~"~~
496	197+04	C-3-6-BC5
497	197+44	"
498	197+82	"
499	198+30	"
500	198+75	"
501	199+25	C-3-2-BC3
502	199+70	"
503	200+09	"
504	200+50	"
505	200+97	"
506	201+36	F-3-3-N
507	201+80	"
508	202+20	"
509	202+60	"
510	203+06	"
511	203+46	F-3-4-N

APPENDIX A Cont.

Joint Number	Station	Installation Code Designation
512	203+86	F-3-4-N
513	204+33	"
514	204+73	"
515	205+17	"
516	205+56	F-3-5-N
517	206+02	"
518	206+42	"
519	206+82	"
520	207+22	"
521	207+62	F-3-6-N
522	208+05	"
523	208+45	"
524	208+85	"
525	209+36	"
526	209+67	E-3-2-BC3
527	210+08	"
528	210+60	"
529	211+03	"
530	211+43	"
531	211+90	F-1-2-N
532	212+36	E-1-2-BC3
533	212+73	"
534	213+20	"
535	213+62	"
536	214+03	"
537	214+42	E-1-6-BC5
538	214+85	"
539	215+26	"
540	215+67	"
541	216+06	"
542	216+46	E-1-5-T
543	217+05	"
544	217+42	"
545	217+82	"
546	218+25	"
547	218+63	E-1-4-BC4
548	219+03	"
549	219+36	"
550	219+78	"
551	220+21	"
552	220+55	E-1-3-T
553	220+95	"
554	221+40	"
555	221+82	"
556	222+13	"

Joint Number	Station	Installation Code Designation
557	222+58	E-2-2-BC3
558	222+88	"
559	223+30	"
560	223+70	"
561	224+09	"
562	224+50	E-2-6-BC5
563	224+82	"
564	225+24	"
565	225+64	"
566	226+00	"
567	226+40	E-2-5-T
568	226+80	"
569	227+20	"
570	227+60	"
571	228+10	"
572	228+50	F-1-4-N
573	228+90	"
574	229+30	"
575	229+70	"
576	230+10	"
577	230+50	F-1-3-N
578	230+90	"
579	231+33	"
580	231+72	"
581	232+15	"

Remarks:

From Sta. 82+00 to Sta. 156+30 the longitudinal joint material is "A"

From Sta. 156+30 to Sta. 186+50 the longitudinal joint material is "D"

From Sta. 186+50 to Sta. 213+25 the longitudinal joint material is "F"

From Hwy. 44 to Sta. 201+36 the longitudinal joint material is "A"

From Sta. 201+36 to F-31 the longitudinal joint material is "F"

From Sta. 232+15 to F-31 all the joints including the longitudinal joint are under the following code:
F-1-2-N

APPENDIX B - CORE DRILLING AND TESTING TABULATION

(From cores drilled 4-16-79)

Core No.	Station	Installation Code Designation	Visual Rating *	CORE TESTING Maximum Load	Elongation at Maximum Load	Elongation at Failure
1	139+70	A-3-2-N	P	4.0	---	0.19
2	141+60	A-3-4-BH3	B	0.0		
3	143+43	A-3-6-BH5	B	4.3	---	0.19
4	147+40	A-1-4-BH3	N	19.3	0.64	1.34
5	151+30	A-2-2-N	N	10.0	0.45	0.55
6	153+65	A-2-4-BH3	B	0.0		
7	155+60	A-2-6-BH5	N	13.2	0.83	1.21
8	163+30	D-3-2-BH3	N	11.6	0.38	0.50
9	165+30	D-3-4-BH4	N	26.1	0.71	2.00
10	167+25	D-3-6-BH5	N	--	---	
11	175+63	D-2-2-BH3	N	15.1	0.50	0.70
12	177+70	D-2-4-BH4	N	24.1	---	1.45
13	179+75	D-2-6-BH5	N	20.3	---	1.32
14	181+70	D-1-2-BH3	N	15.5	0.51	0.71
15	183+65	D-1-4-BH4	N	11.9	0.51	0.79
16	185+65	D-1-6-BH5	N	20.2	0.72	1.59
17	187+70	F-1-2-BH3	N	0.0		
18	189+70	F-1-4-BH4	P	3.7	0.83	0.91
19	191+95	F-1-6-BH5	N	2.3	0.57	0.60
20	194+20	B-3-2-BC3	P	0.0		
21	196+75	B-3-4-BC4	P	6.1		0.56
22	198+35	B-3-6-BC5	N	12.2	0.93	1.31
23	200+60	B-2-2-BC3	B	0.0		
24	203+00	B-2-4-BC4	N	21.6	---	1.24
25	204+60	B-2-6-BC5	N	9.3	0.89	1.57
26	206+53	B-1-2-BC3	P	2.3	---	0.13
27	208+50	B-1-4-BC4	N	14.2	---	0.89
28	210+43	B-1-6-BC5	N	18.9	1.74	1.97
29	212+47	F-1-2-BH3	B	0.0		
30	145+88	A-1-6-BH5	B	0.0		
31	147+80	A-1-2-N	N	7.4	0.55	0.73
32	149+75	A-1-3-N	N	35.6	0.36	1.45
33	151+70	A-1-4-N	N	48.4	1.40	2.17
34	153+45	A-1-5-N	N	13.5	1.77	2.12

*N-No Visible failure; P- Partial Seal Failure; B- Broken Seal

APPENDIX B
Continued

CORE TESTING

Core No.	Station	Installation Code Designation	Visual Rating *	Maximum Load	Elongation At Maximum Load	Elongation at Failure
35	166+01	A-1-6-N	N	7.8	0.64	3.10
36	168+15	A-1-2-N	N	14.9	0.92	1.28
37	170+25	C-1-3-BC3	N	60.8	0.62	1.19
38	172+43	C-1-4-BC4	N	82.0	0.57	18.2
39	174+38	C-1-5-BC4	N	25.4	---	0.80
40	176+58	C-1-6-BC5	N	38.0	0.47	0.99
41	178+65	C-1-2-BC3	N	27.2	0.57	1.04
42	180+75	C-2-3-BC3	N	63.0		2.36
43	182+80	C-2-4-BC4	P	9.9	0.47	0.61
44	185+20	C-2-5-BC4	N	27.0	---	1.02
45	187+35	C-2-6-BC5	P	11.2	0.38	0.65
46	189+09	C-2-2-BC3	N	43.0	1.11	1.56
47	189+85	C-2-2-N	N	41.7	0.42	0.89
48	191+56	C-3-3-BC4	N	77.0	0.73	1.94
49	193+70	C-3-4-BC4	P	16.9	0.58	1.47
50	195+80	C-3-5-BC4	N	41.2	0.45	0.80
51	197+82	C-3-6-BC5	P	2.7		0.22
52	200+09	C-3-2-BC3	P	52.5	0.91	1.21
53	202+20	F-3-3-N	N	22.6	1.37	1.72
54	204+33	F-3-4-N	N	24.6	1.58	1.94
55	206+42	F-3-5-N	N	35.2	0.93	1.92
56	208+45	F-3-6-N	N	40.9	1.50	2.91
57	210+60	E-3-2-BC3	N	43.3	1.21	1.97
58	213+20	E-1-2-BC3	N	24.2	1.01	1.72
59	215+26	E-1-6-BC5	N	14.9	0.79	1.22
60	217+42	E-1-5-T	N	44.5	1.95	2.18
61	219+36	E-1-4-BC4	N	30.1		2.44
62	221+40	E-1-3-T	N	28.0	1.82	2.10
63	223+30	E-2-2-BC3	N	19.3	---	1.05
64	225+24	E-2-6-BC5	N	25.3	---	1.71
65	227+20	E-2-5-T	N	22.9	---	1.50
66	229+30	F-1-4-N	N	73.3	1.54	1.78
67	231+33	F-1-3-N	N	89.5	1.32	2.13
68	242+03	F-1-2-N	N	57.7	1.41	2.70

* N- No Visible failure; P- Partial Seal Failure; B- Broken Seal

APPENDIX C - JOINT SEAL EVALUATION SUMMARY

(From cores drilled 4-16-79)

Sealant Material	VISUAL RATING: No Visible Failure	VISUAL RATING: Partial Seal Failure	VISUAL RATING: Broken Seal	CORE TESTING SUMMARY: Average Maximum Load, pounds	CORE TESTING SUMMARY: Average Maximum elongation, inches
A. W. R. Meadows "Hi-Spec"	9	1	4	12.7	1.0
B. "Lion D-200"	5	3	1	9.4	0.9
C. W. R. Meadows "Gardox"	11	5	0	38.7	1.2
D. W. R. Meadows "Poly-Jet Highway"	9	0	0	18.1	1.1
E. "Dow Corning 888"	9	0	0	28.1	1.8
F. W. R. Grace "Para Plastic"	9	1	1	31.8	1.5
Cleaning					
1. Air Jet	27	2	2	26.8	1.4
2. Sand Blast	14	2	2	20.9	1.1
3. Water Blast	11	6	2	23.4	1.2
Saw Cut					
2. Nominal 1/4"	14	4	2	19.5	0.8
3. Nominal 3/8" x 1/2" deep	7	0	0	43.2	1.8
4. Nominal 3/8" x 1" deep	11	4	2	24.2	1.3
5. Nominal ½" x ½" deep	7	0	0	30.0	1.5
6. Nominal ½" x 1¼" deep	13	2	2	15.1	1.3

Summary Tabulation of Joint Variables and Their Ratings

A-1-2-N	25 @ 2.68		
A-1-3-N	15 @ 2.00		
A-1-4-N	15 @ 2.00		
A-1-4-BH3	10 @ 2.90	49 @ 2.80	
A-1-5-N	15 @ 2.20		
A-1-6-N	10 @ 2.00		
A-1-6-BH5	14 @ 2.93		
A-2-2-N	10 @ 2.80		
A-2-4-BH3	10 @ 2.90	30 @ 2.80	
A-2-6-BH5	10 @ 2.70		
A-3-2-N	9 @ 2.40		
A-3-4-BH3	10 @ 2.90	29 @ 2.78	
A-3-6-BH5	10 @ 3.00		

163 @ 2.54

1 - 19
2 - 34
3 - 110
163

581 - 10 - 10 = 561

560

89

B-1-2-BC3	10 @ 3.00	30 @ 2.93
B-1-4-BC4	10 @ 2.80	
B-1-6-BC5	10 @ 3.00	
B-2-2-BC3	10 @ 3.00	29 @ 2.90
B-2-4-BC4	10 @ 2.70	
B-2-6-BC5	9 @ 3.00	
B-3-2-BC3	10 @ 3.00	30 @ 2.97
B-3-4-BC4	10 @ 3.00	
B-3-6-BC5	10 @ 2.90	

89 @ 2.93

1 - -
2 - 2
3 - 85

yy

C-1-2-BC3	15 @	2.87	
C-1-3-BC3	10 @	2.50	
C-1-4-BC4	15 @	2.67	45 @ 2.76
C-1-5-BC4	10 @	2.80	
C-1-6-BC5	15 @	2.73	
C-2-2-BC3	8 @	2.75	
C-2-3-BC3	5 @	2.80	
C-2-4-BC4	10 @	2.70	28 @ 2.50
C-2-5-BC4	5 @	2.40	
C-2-6-BC5	10 @	2.10	
C-3-2-BC3	10 @	2.80	
C-3-3-BC4	5 @	2.80	
C-3-4-BC4	10 @	2.50	30 @ 2.77
C-3-5-BC4	4 @	2.75	
C-3-6-BC5	10 @	3.00	

142 @ 2.68

45

1 - 10
2 - 25
3 - 107
142

D-1-2-BH3	5 @ 2.80		
D-1-4-BH4	5 @ 3.00	15 @ 2.93	
D-1-6-BH5	5 @ 3.00		
D-2-2-BH3	10 @ 2.20		
D-2-4-BH4	10 @ 2.20	30 @ 2.33	
D-2-6-BH5	10 @ 2.60		
D-3-2-BH3	10 @ 3.00		
D-3-4-BH4	10 @ 2.70	30 @ 2.87	
D-3-6-BH5	10 @ 2.90		

75 @

1 - 5
2 - 15
3 - 55
70

75

E-1-2-BC3	5 @	1.20
E-1-3-T	5 @	1.20
E-1-4-BC4	5 @	1.00
E-1-5-T	5 @	1.40
E-1-6-BC5	5 @	1.00
E-2-2-BC3	5 @	1.00
E-2-5-T	5 @	1.20
E-2-6-BC5	5 @	1.00
E-3-2-BC3	5 @	1.40
	45 @	1.16

1	39
2	5
3	1
	45

F-1-2-N	1	@	1.00
F-1-2-BH3	10	@	3.00
F-1-3-N	5	@	1.60
F-1-4-N	5	@	1.80
F-1-4-BH4	5	@	3.00
F-1-6-BH5	5	@	3.00
F-3-3-N	5	@	2.00
F-3-4-N	5	@	2.20
F-3-5-N	5	@	3.00
F-3-6-N	5	@	2.60
	51	@	2.49

1 - 7
2 - 12
3 - 32
51

A-1-2-N 1 1
2 ||||| 1
3 ||||| ||||| ||||| |||

A-1-4-BH3 1
2 1
3 ||||| ||||

A-1-6-BH5 1
2 1
3 ||||| ||||| |||

A-2-2 N 1
2 11
3 ||||| |||

A-2-4-BH3 1
2 1
3 ||||| ||||

A-2-6-BH5 1 1
2 1
3 ||||| |||

A-3-2-N 1
2 111
3 ||||| 1

A-3-4-BH3 1
2 1
3 ||||| ||||

A-3-6-BH5 1
2
3 ||||| |||||

A-1-3-N 1 ||||| 1
2 111
3 ||||| 1

A-1-4-N 1 |||||
2 |||||
3 |||||

A-1-5-N 1 111
2 ||||| 1
3 ||||| 1

A-1-6-N 1 111
2 1111
3 111

A-1-2-N	1	B-3-4-BC4 1
	2	2
	3	3										
B-1-4-BC3	1	B-1-2-BC3 1
	2	2
	3	3										
B-1-6-BC5	1	B-1-4-BC4 1 1
	2	2
	3											3									
B-2-2 N	1	B-2-2-BC3 1
	2	2
	3	3										
B-2-4-BC3	1	B-2-4-BC4 1 1
	2	2 1
	3	3								
B-2-6-BC5	1	
	2	
	3										
B-3-2-N	1	
	2	
	3	
B-3-4-BC3	1	
	2	
	3	
B-3-6-BC5	1	
	2 1	
	3										
B-3-2-BC3	1	
	2	
	3											

C-1-2-N	1	C-3-2-BC3	1 1
	2		2
	3		3 (IIII) IIII
C-1-4-BH3	1	C-3-4-BC4	1 11
	2		2 1
	3		3 (IIII) II
C-1-6-BH5	1	C-1-2-BC3	1
	2 IIII		2 II
	3 IIII IIII I		3 (IIII) (IIII) III
C-2-2 N	1	C-1-4-BC4	1 1
	2		2 III
	3		3 (IIII IIII) I
C-2-4-BH3	1	C-2-2-BC3	1 1
	2		2
	3		3 (IIII) II
C-2-6-BH5	1 II	C-2-4-BC4	1
	2 IIII		2 III
	3 III		3 (IIII) II
C-3-2-N	1	C-1-3-BC3	1 II
	2		2 1
	3		3 (IIII) II
C-3-4-BH3	1	C-1-5-BC4	1
	2		2 II
	3		3 (IIII) III
C-3-6-BH5	1	[illegible]	1
	2	C-1-3-BC3	2 1
	3 (IIII) IIII		3 IIII
[illegible]	1	[illegible]	1 1
C-3-3-BC4	2 1	C-2-5-BC4	2 1
	3 IIII		3 III

C-3-5-BC4
[illegible] 1
2 1
3 III

D
A-1-2-N
1
2
3

D
A-1-4-BH3
1
2
3

D
A-1-6-BH5
1
2
3 IIII

D
A-2-2 N
1
2
3

D
A-2-4-BH3
1
2
3

D
A-2-6-BH5
1
2 IIII
3 IIII 1

D
A-3-2-N
1
2
3

D
A-3-4-BH3
1
2
3

D
A-3-6-BH5
1
2 1
3 IIII IIII

D-3-2-BH3 1
2
3 IIII IIII

D-3-4-BH4 1
2 III
3 IIII II

D-2-2-BH3 1 1 1 7
2 IIII 4
3 IIII 4

D-2-4-BH4 1 IIII
2 II
3 IIII

D-1-2-BH3 1
2 1
3 IIII

D-1-4-BH4 1
2
3 IIII

E
A-1-2-N | 1
2
3

E
A-1-4-BH3 | 1
2
3

E
A-1-6-BH5 | 1 IIII
2
3

E
A-2-2 N | 1
2
3

E
A-2-4-BH3 | 1
2
3

E
A-2-6-BH5 | 1 IIII
2
3

E
A-3-2-N | 1
2
3

E
A-3-4-BH3 | 1
2
3

E
A-3-6-BH5 | 1
2
3

E-3-2-BC3 | 1 IIII
2
3 1

E-1-2-BC3 | 1 IIII
2 1
3

E-1-5-T | 1 III
2 11
3

E-1-4-BC4 | 1 IIII
2
3

E-1-3-T | 1 IIII
2 1
3

E-2-2-BC3 | 1 IIII
2
3

E-2-5-T | 1 IIII
2 1
3

F
A-1-2-N 1 1
2
F 3
A-1-4-BH3 1
2
3
F
A-1-6-BH5 1
2
3 ||||
F
A-2-2 N 1
2
3
F
A-2-4-BH3 1
2
3
F
A-2-6-BH5 1
2
3
F
A-3-2-N 1
2
3
F
A-3-4-BH3 1
2
3
F
A-3-6-BH5 1
2
3

F-1-2-BH3 1
2
3 |||| ||||
F-1-4-BH4 1
2
3 ||||
F-3-3-N 1
2 ||||
3
F-3-4-N 1 1
2 11
3 11
F-3-5-N 1
2
3 ||||
F-3-6-N 1
2 11
3 111
F-1-4-N 1 11
2 11
3 1
F-1-3-N 1 111
2 1
3 1

2 3 or less broken seal
3 3 or more broken seal

APPENDIX A

Joint Variable Tabulation

All stations were determined by pacing and, therefore, are approximate.

Joint Number	Station	Installation Code Designation
1	82+52	B-3-2-BC3
2	82+88	"
3	83+25	"
4	83+70	"
5	84+02	"
	84+50	Broken
6	84+85	B-3-4-BC4
	85+34	"
8	85+70	"
9	86+15	"
10	86+56	"
11	86+88	B-3-6-BC5
12	87+35	"
13	87+75	"
14	88+20	"
15	88+62	"
16	88+98	B-1-2-BC3
17	89+50	"
18	89+85	"
19	90+35	"
20	90+70	"
21	91+96	B-1-4-BC4
22	91+52	"
23	91+85	"
24	92+35	"
25	92+70	"
26	93+15	B-1-6-BC5
27	93+55	"
28	93+88	"
29	94+34	"
30	94+67	"
31	95+00	B-2-2-BC3
32	95+45	"
	95+85	Broken
33	96+15	B-2-2-BC3
34	96+62	"
35	96+97	"
	97+40	Broken

Joint Number	Station	Installation Code Designation
36	97+80 (2) C	B-2-4-BC4
37	98+23	"
38	98+65	"
39	99+09	"
40	99+49	"
41	99+90	B-2-6-BC5
42	100+30	"
43	100+75	"
44	101+35	"
45	101+65	"
46	102+02	C-3-2-BC3
47	102+45	"
48	102+90	"
49	103+40	"
50	103+85	"
51	104+25	C-3-4-BC4
52	104+75	"
53	105+25	"
54	105+65	"
55	105+94	"
56	106+45	C-3-6-BC5
57	106+85	"
58	107+20	"
59	107+60	"
60	108+01	"
61	108+37	C-1-2-BC3
62	108+79	"
63	109+25	"
64	109+60	"
65	110+10	"
66	110+55	C-1-4-BC4
67	110+90	"
68	111+42	"
69	111+75	"
70	112+10	"
71	112+58	C-1-6-BC5
72	112+88	"

APPENDIX A Cont.

Joint Number	Station	Installation Code Designation
73	113+33	C-1-6-BC5
74	113+72	"
75	114+03	"
76	114+51	C-2-2-BC3
77	114+85	"
78	115+27	"
79	115+69	"
80	116+03	"
81	116+36	C-2-4-BC4
82	116+78	"
83	117+15	"
84	117+55	"
85	118+02	"
86	118+40	C-2-6-BC5
87	118+90	"
88	119+28	"
89	119+60	"
90	120+05	"
91	120+40	A-3-2-N
92	120+80	"
93	121+22	"
94	121+62	"
95	121+98	"
96	122+33	A-3-4-BH3
97	122+80	"
98	123+25	"
99	123+60	"
100	124+00	"
101	124+36	A-3-6-BH5
102	124+78	"
103	125+20	"
104	125+55	"
105	126+00	"
106	126+40	A-1-2-N
107	126+80	"
108	127+20	"
109	127+60	"
110	128+00	"
111	128+45	A-1-4-BH3
112	128+90	"
113	129+30	"
114	129+72	"
115	130+18	"
116	130+70	A-1-6-BH5
117	131+10	"

Joint Number	Station	Installation Code Designation
118	131+66	A-1-6-BH5
119	132+05	"
120	132+50	"
121	132+90	A-2-2-N
122	133+30	"
123	133+75	"
124	134+20	"
125	134+58	"
126	134+97	A-2-4-BH3
127	135+38	"
128	135+75	"
129	136+15	"
130	136+50	"
131	136+90	A-2-6-BH5
132	137+30	"
133	137+70	"
134	138+10	"
135	138+45	"
136	138+85	A-3-2-N
137	139+30	"
138	139+70	"
139	140+00	"
140	140+35	"
141	140+80	A-3-4-BH3
142	141+15	"
143	141+60	"
144	141+97	"
145	142+30	"
146	142+65	A-3-6-BH5
147	143+10	"
148	143+43	"
149	143+82	"
150	144+20	"
151	144+60	A-1-2-N
152	145+05	"
153	145+45	"
154	145+78	"
155	146+20	"
156	146+65	A-1-4-BH3
157	147+00	"
158	147+40	"
159	147+80	"
160	148+20	"
161	148+60	A-1-6-BH5
162	148+95	"

APPENDIX A Cont.

Joint Number	Station	Installation Code Designation
163	149+35	A-1-6-BH5
164	149+70	"
165	150+10	"
166	150+50	A-2-2-N
167	150+90	"
168	151+30	"
169	152+03	"
170	152+48	"
171	152+83	A-2-4-BH3
172	153+25	"
173	153+65	"
174	154+00	"
175	154+40	"
176	154+80	A-2-6-BH5
177	155+20	"
178	155+60	"
179	155+91	"
180	156+30	"
181	156+70	D-3-2-BH3
182	157+10	"
183	157+50	"
184	157+90	"
185	158+30	"
186	158+70	D-3-4-BH4
187	159+05	"
188	159+43	"
189	159+80	"
190	160+20	"
191	160+60	D-3-6-BH5
192	161+00	"
193	161+40	"
194	161+75	"
195	162+15	"
196	162+55	D-3-2-BH3
197	162+93	"
198	163+30	"
199	163+70	"
200	164+10	"
201	164+50	D-3-4-BH4
202	164+85	"
203	165+30	"
204	165+70	"
205	166+06	"
206	166+46	D-3-6-BH5
207	166+86	D-3-6-BH5
208	167+25	"
209	167+67	"
210	168+10	"
211	168+50	D-2-2-BH3
212	168+92	"
213	169+30	"
214	169+70	"
215	170+15	"
216	170+55	D-2-4-BH4
217	170+95	"
218	171+35	"
219	171+75	"
220	172+20	"
221	172+60	D-2-6-BH5
222	173+04	"
223	173+45	"
224	173+85	"
225	174+35	"
226	174+75	D-2-2-BH3
227	175+18	"
228	175+63	"
229	176+08	"
230	176+50	"
231	176+88	D-2-4-BH4
232	177+30	"
233	177+70	"
234	178+10	"
235	178+50	"
236	178+94	D-2-6-BH5
237	179+35	"
238	179+75	"
239	180+10	"
240	180+50	"
241	180+90	D-1-2-BH3
242	181+30	"
243	181+70	"
244	182+10	"
245	182+50	"
246	182+85	D-1-4-BH4
247	183+25	"
248	183+65	"
249	184+10	"
250	184+50	"

APPENDIX A Cont.

Joint Number	Station	Installation Code Designation
251	184+90	D-1-6-BH5
252	185+10	"
253	185+65	"
254	186+10	"
255	186+50	"
256	186+88	F-1-2-BH3
257	187+30	"
258	187+70	"
259	188+08	"
260	188+48	"
261	188+88	F-1-4-BH4
262	189+30	"
263	189+70	"
264	190+10	"
265	190+50	"
266	191+10	F-1-6-BH5
267	191+50	"
268	191+95	"
269	192+40	"
270	192+80	"
271	193+28	B-3-2-BC3
272	193+70	"
273	194+20	"
274	194+75	"
275	195+08	"
276	195+48	B-3-4-BC4
277	195+88	"
278	196+30	"
279	196+70	"
280	197+12	"
281	197+52	B-3-6-BC5
282	197+95	"
283	198+35	"
284	198+80	"
285	199+25	"
286	199+70	B-2-2-BC3
287	200+15	"
288	200+60	"
289	201+03	"
290	201+40	"
291	201+80	B-2-4-BC4
292	202+20	"
293	202+60	B-2-4-BC4
294	203+00	"
295	203+40	"
296	203+80	B-2-6-BC5
297	204+20	"
298	204+60	"
299	204+98	"
300	205+38	"
301	205+75	B-1-2-BC3
302	206+12	"
303	206+53	"
304	206+94	"
305	207+32	"
306	207+68	B-1-4-BC4
307	208+09	"
308	208+50	"
309	208+88	"
310	209+25	"
311	209+65	B-1-6-BC5
312	210+03	"
313	210+43	"
314	210+85	"
315	211+20	"
316	211+67	F-1-2-BH3
317	212+07	"
318	212+47	"
319	212+86	"
320	213+25	"

From Sta. 213+25 to Hwy 44, all the joints are under the following code: F-1-2-N. The longitudinal joint material is "F".

From Hwy. 44 to Sta. 128+65 all the joints including the longitudinal joint up to Sta. 201+36 are under the following code: A-1-2-N.

321	128+65	C-1-3-BC3
322	129+05	"
323	129+45	"

APPENDIX A Cont.

Joint Number	Station	Installation Code Designation
324	129+85	C-1-3-BC 3
325	130+25	"
326	130+65	C-1-4-BC4
327	131+09	"
328	131+40	"
329	131+75	"
330	132+25	"
331	132+65	C-1-5-BC4
332	133+06	"
333	133+40	"
334	133+75	"
335	134+30	"
336	134+65	C-1-6-BC5
337	135+12	"
338	135+48	"
339	135+90	"
340	136+35	"
341	136+70	C-1-2-BC3
342	137+09	"
343	137+44	"
344	137+80	"
345	138+25	"
346	138+60	A-1-3-N
347	139+00	End survey 4/14/82
348	139+36	"
349	139+70	"
350	140+15	"
351	140+60	C6 A-1-4-N
352	141+30	"
353	141+70	"
354	142+22	"
355	142+60	"
356	143+09	C7 A-1-5-N
357	143+45	"
358	143+90	"
359	144+35	"
360	144+75	"
361	145+10	A-1-6-BH5
362	145+52	"
363	145+88	"
364	146+30	"
365	146+65	"
366	147+00	A-1-2-N
367	147+45	"
368	147+80	A-1-2-N
369	148+30	"
370	148+60	"
371	148+99	A-1-3-N
372	149+40	"
373	149+75	"
374	150+25	"
375	150+60	"
376	150+90	A-1-4-N
377	151+30	"
378	151+70	"
379	152+10	"
380	152+55	"
381	152+80	A-1-5-N
382	153+12	"
383	153+45	"
384	153+90	"
385	154+35	"
386	154+75	A-1-6-N
387	155+20	"
388	155+60	"
389	156+00	C8 "
400	156+35	"
401	156+75	A-1-2-N
402	157+30	"
403	157+70	"
404	158+20	"
405	158+50	"
406	158+90	A-1-3-N
407	159+30	"
408	159+75	"
409	160+20	"
410	160+60	"
411	161+03	A-1-4-N
412	161+40	"
413	161+83	"
414	162+30	"
415	162+70	"
416	163+10	A-1-5-N
417	163+55	"
418	163+95	"
419	164+40	"
420	164+83	"
421	165+20	A-1-6-N

APPENDIX A Cont.

Joint Number	Station	Installation Code Designation
422	165+65	A-1-6-N
423	166+01	"
424	166+39	"
425	166+77	"
426	167+35	A-1-2-N
247	167+75	"
428	168+15	"
429	168+65	"
430	169+02	"
431	169+40	C-1-3-BC3
432	169+85	"
433	170+25	" C 9
434	170+75	"
435	171+09	"
436	171+60	C-1-4-BC4
437	171+96	"
438	172+43	"
439	172+80	"
440	173+25	"
441	173+65	C-1-5-BC4
442	174+02	"
443	174+38	"
444	174+75	"
445	175+20	"
446	175+73	C-1-6-BC5
447	176+15	"
448	176+58	"
449	176+91	"
450	177+30	"
451	177+80	C-1-2-BC3
452	178+17	"
453	178+65	"
454	179+04	"
455	179+50	"
456	179+94	C-2-3-BC3
457	180+35	"
458	180+75	"
459	181+17	"
460	181+60	"
461	181+99	C-2-4-BC4
462	182+40	"
463	182+80	"
464	183+30	"
465	183+70	"
466	184+42	C-2-5-BC4
467	184+80	C-2-5-BC4
468	185+20	"
469	185+60	"
470	186+10	"
471	186+55	C-2-6-BC5
472	186+94	"
473	187+35	"
474	187+75	"
475	188+20	" C 10
476	188+60	C-2-2-BC3
477	189+09	"
478	189+40	"
479	189+85	C-2-2-N
480	190+35	"
481	190+76	C-3-3-BC4
482	191+16	"
483	191+56	"
484	192+01	"
485	192+43	"
486	192+90	C-3-4-BC4
487	193+30	"
488	193+70	"
489	194+15	"
490	194+55	" C 11
491	194+96	C-3-5-BC4
492	195+40	"
493	195+80	"
494	196+22	"
495	196+62	"
496	197+04	C-3-6-BC5
497	197+44	"
498	197+82	"
499	198+30	"
500	198+75	"
501	199+25	C-3-2-BC3 C 12
502	199+70	"
503	200+09	"
504	200+50	"
505	200+97	"
506	201+36	F-3-3-N
507	201+80	"
508	202+20	"
509	202+60	"
510	203+06	"
511	203+46	F-3-4-N

APPENDIX A Cont.

Joint Number	Station	Installation Code Designation
512	203+86	F-3-4-N
513	204+33	"
514	204+73	"
515	205+17	"
516	205+56	F-3-5-N
517	206+02	"
518	206+42	"
519	206+82	"
520	207+22	"
521	207+62	F-3-6-N
522	208+05	"
523	208+45	"
524	208+85	"
525	209+12	"
526	209+67	E-3-2-BC3
527	210+08	"
528	210+60	C13 "
529	211+03	"
530	211+43	"
531	211+90	F-1-2-N
532	212+36	E-1-2-BC3
533	212+73	"
534	213+20	C14 "
535	213+62	"
536	214+03	"
537	214+42	E-1-6-BC5
538	214+85	"
539	215+26	"
540	215+67	"
541	216+06	"
542	216+46	E-1-5-T
543	217+05	"
544	217+42	"
545	217+82	"
546	218+25	"
547	218+63	E-1-4-BC4
548	219+03	C15 "
549	219+36	"
550	219+78	"
551	220+21	"
552	220+55	E-1-3-T
553	220+95	"
554	221+40	"
555	221+82	"
556	222+13	"

Joint Number	Station	Installation Code Designation
557	222+58	E-2-2-BC3
558	222+88	"
559	223+30	C16 "
560	223+70	"
561	224+09	"
562	224+50	E-2-6-BC5
563	224+82	"
564	225+24	C17 "
565	225+64	"
566	226+00	"
567	226+40	E-2-5-T
568	226+80	"
569	227+20	"
570	227+60	C18 "
571	228+10	"
572	228+50	F-1-4-N
573	228+90	"
574	229+30	C19 "
575	229+70	"
576	230+10	"
577	230+50	F-1-3-N
578	230+90	"
579	231+33	"
580	231+72	C20 "
581	232+15	"

Remarks:

From Sta. 82+00 to Sta. 156+30 th longitudinal joint material is "A

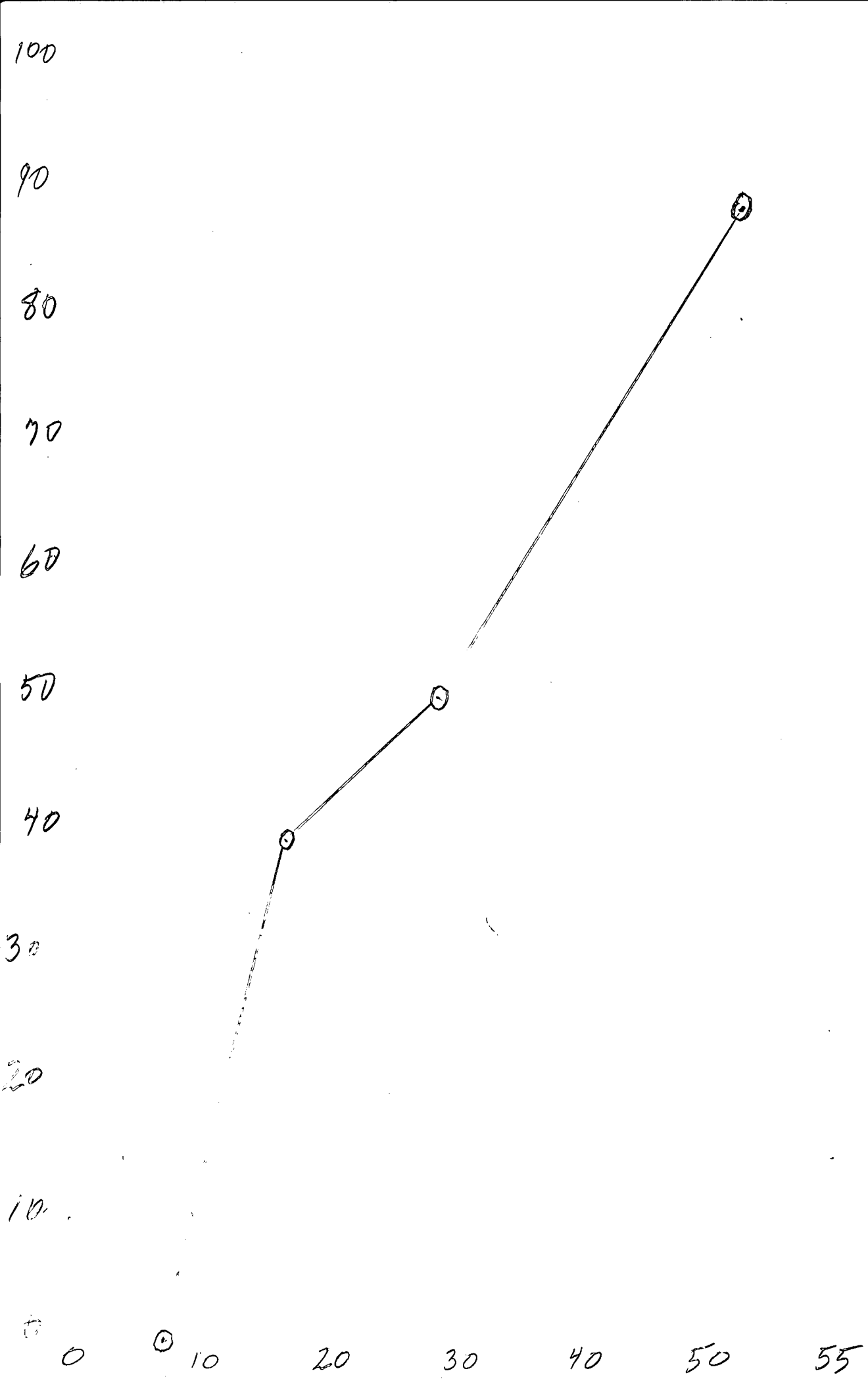
From Sta. 156+30 to Sta. 186+50 t longitudinal joint material is "D

From Sta. 186+50 to Sta. 213+25 t longitudinal joint material is "F

From Hwy. 44 to Sta. 201+36 the longitudinal joint material is "A

From Sta. 201+36 to F-31 the lon tudinal joint material is "F"

From Sta. 232+15 to F-31 all the joints including the longitudina joint are under the following co F-1-2-N


100
90
80
70
60
50
40
30
20
10
0
0
10
20
30
40
50
55

Joint

Variables	A - "Hi-S" 9888	F-Para Plastic
X-1-2-BX.3	25 @ 2.20	10 @ 3.00
X-1-4-BX4	10 @ 2.00	5 @ 3.00
X-1-6-BX.5	14 @ 2.00	5 @ 3.00
	49 @ 2.07	20 @ 3.00
X-2-2-BX.3	10 @ 2.00	N. P.
X-2-4-BX.4	10 @ 2.	N. P.
X-2-6-BX.5	10 @ 2.00	N. P.
	30 @ 4.00	N. P.
X-3-2-BX.3	9 @ 2.40	N. P.
X-3-4-BX.4	10 @ 2.	5 @ 2.20
X-3-6-BX.5	10 @ 3	5 @ 2.60
	29 @ 2.40	10 @ 2.40
A[illegible]	2.1.16	2.70

1. No k
2, 3 fe
3. Mor
N. P. - No
X - inser
a - no bac