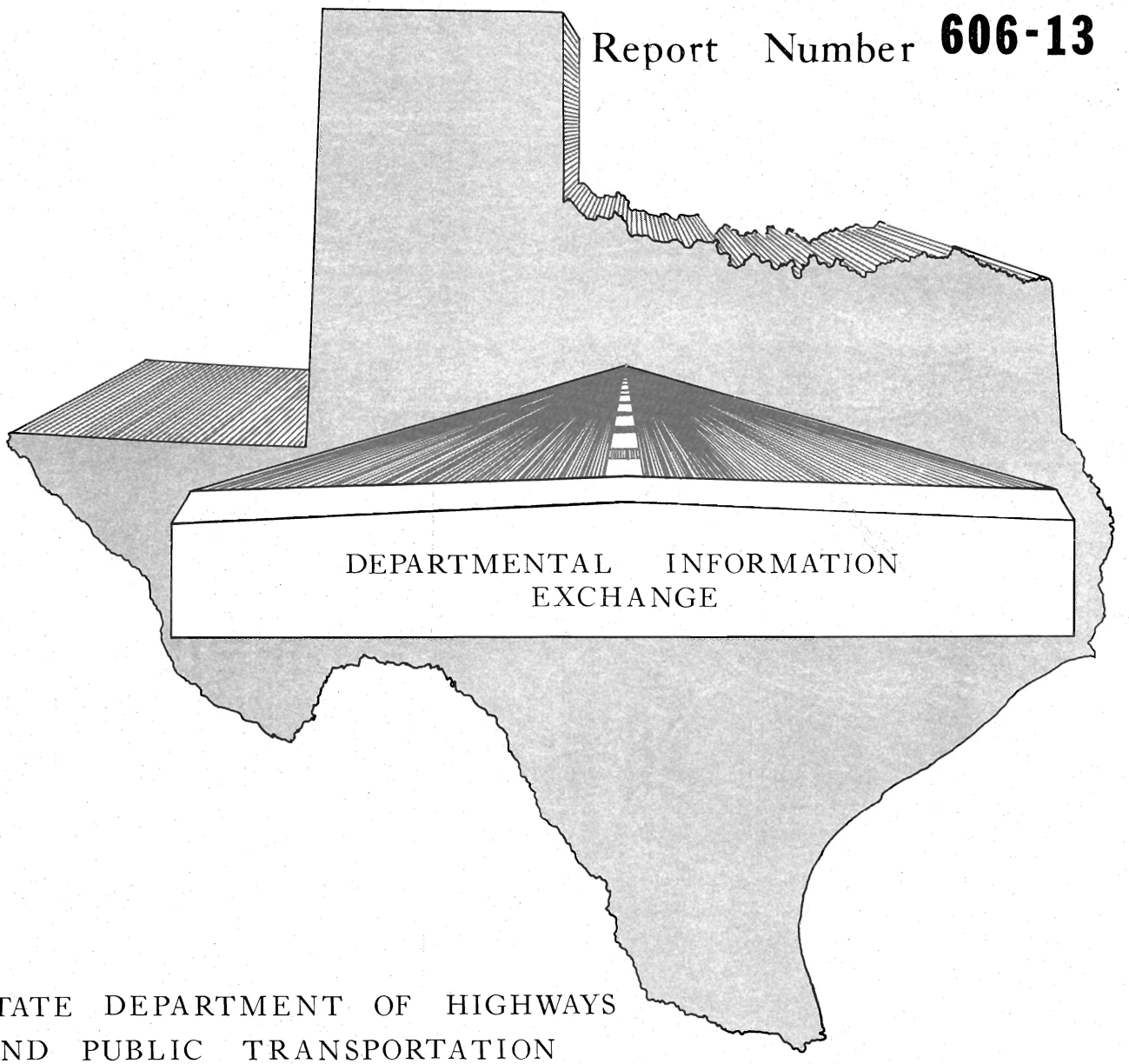
EXPERIMENTAL PROJECTS

USE OF PAVEMENT INTERLAYERS TO RETARD REFLECTIVE CRACKING OF SOIL CEMENT BASES

Report Number **606-13**



STATE DEPARTMENT OF HIGHWAYS
AND PUBLIC TRANSPORTATION

USE OF PAVEMENT INTERLAYERS TO RETARD REFLECTIVE CRACKING OF SOIL CEMENT BASES

BY

STATE DEPARTMENT OF HIGHWAYS
AND
PUBLIC TRANSPORTATION

DISTRICT 11

TECHNICAL REPORT STANDARD TITLE PAGE

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
Experimental Project 606-13		

4. Title and Subtitle	5. Report Date
"Use of Pavement Interlayers to Retard Reflective Cracking of Soil Cement Bases"	October, 1984
	6. Performing Organization Code

7. Author(s)	8. Performing Organization Report No.
J.L. Beaird	

9. Performing Organization Name and Address	10. Work Unit No.
State Department of Highways and Public Transportation District 11 Lufkin, Texas	11. Contract or Grant No.
	13. Type of Report and Period Covered
12. Sponsoring Agency Name and Address State Department of Highways and Public Transportation District 11 Lufkin, Texas	14. Sponsoring Agency Code

15. Supplementary Notes

16. Abstract

District 11 has a severe shortage of locally available materials suitable for building road bases for the heavily trafficked highway system. Locally available materials, such as iron ore gravel, topsoil or select sandy soils, must often be chemically stabilized with cement or other additives to provide adequate structural support. A normal consequence of cement stabilization is pavement cracking. These base cracks typically reflect through HMAC overlay base and surfacing of up to 5 inches in depth in as short a time period as 3 months.

In a concerted effort to design a pavement system that would either eliminate, retard or protect reflective cracking of the base, a series of research projects were initiated. This report discusses the use of pavement interlayers to retard reflective cracking.

17. Key Words	18. Distribution Statement
Pavement Reflective Cracking Cement	This report is available from: State Department of Highways and Public Transportation Transportation Planning Division P.O. Box 5051, Austin, Texas 78763

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified	38	

Form DOT F 1700.7 (8-69)

DISCLAIMER STATEMENT

The contents of this report reflect the views of the authors who are responsible for the facts and the accuracy of the data presented herein. The contents do not necessarily reflect the official views or policies of the Federal Highway Administration. This report does not constitute a standard, specification, or regulation.

TABLE OF CONTENTS

ADDENDA

Introduction and Background

The Lufkin District (District 11) of the Texas State Department of Highways and Public Transportation is located in the eastern part of Texas. It is predominately forested with scattered agricultural farms. There is a severe shortage of locally available materials suitable for building road bases for the heavily trafficked highway system. Materials that are locally available, such as iron ore gravel, topsoil or select sandy soils, must often be chemically stabilized with cement or other additives to provide adequate structural support. A normal consequence of cement stabilization is pavement cracking. These base cracks typically reflect through HMAC overlay base and surfacing of up to 5 inches in depth in as short a time period as 3 months. These cracks are especially critical in the East Texas area where normal rainfall averages 50± inches per year.

In a concerted effort to design a pavement system that would either eliminate, retard or protect reflective cracking of the base, a series of research projects were initiated. This report discusses the use of pavement interlayers to retard reflective cracking.

Project Location

US 59 is the major highway system in District 11 and, as it skirts the central business district of Nacogdoches, Texas, carries the dual designation of US 59/Lp 224. This particular section of roadway was an existing two lane facility with paved shoulders. It carried an estimated 1980 average daily traffic (ADT) of 7,010 vehicles per day (VPD) and a projected year 2000 ADT of 15,400 VPD with 28 percent trucks and a one direction, 20-year accumulated number of 7,761,000 18kip equivalent single axle loadings. The proposed project was to widen to four lanes with paved shoulders.

Test Section Summary

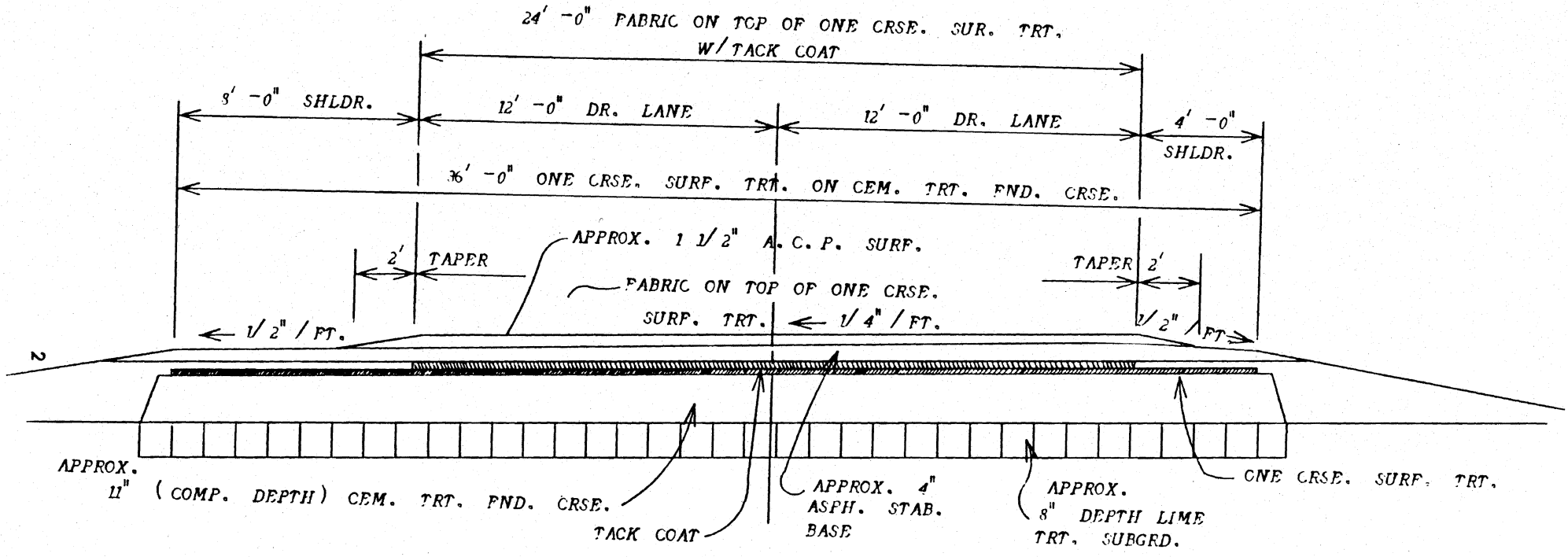
During the Spring of 1982, the Lufkin District placed three (3) short (±1200 feet) test sections on US 59/Lp 224 in Nacogdoches, Texas, to evaluate potential benefits (if any) of the use of pavement interlayers to retard reflective cracking of soil cement-treated bases.

The US 59/Lp 224 project was under contract with Marvis Construction, Inc., and J. W. Payne Construction Co., Inc. Therefore, a supplemental agreement and field change request were needed to perform the desired research.

The three test sections and the intended work were as follows:

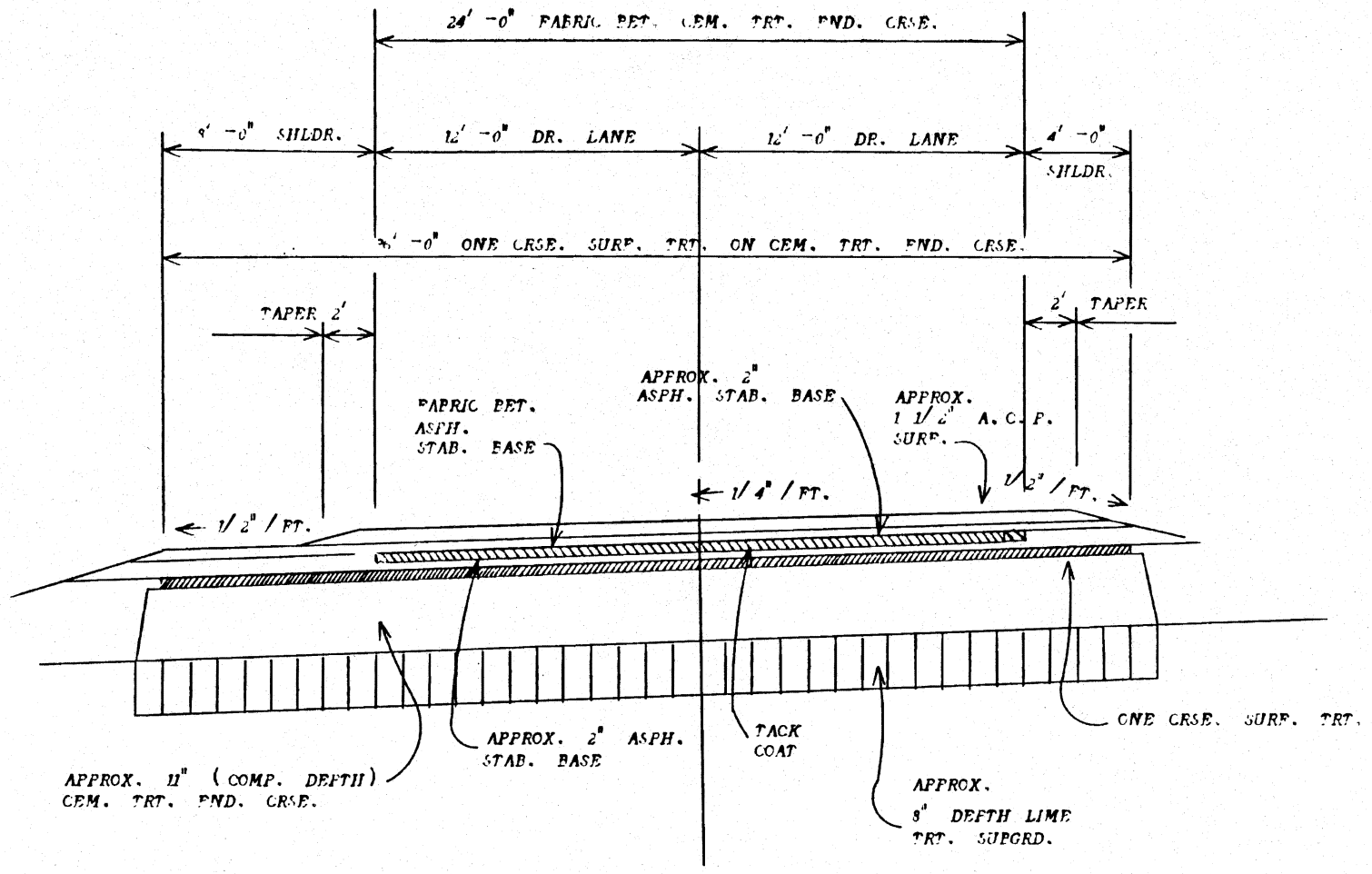
1) To place a 1,200 foot section of fabric underseal immediately over the one course surface treatment which sealed the soil cement-treated base (See Figure 1);

2) To place a 1,200 foot section of fabric between two, 2-inch depth courses of asphalt stabilized base (See Figure 2);



SECTION 1

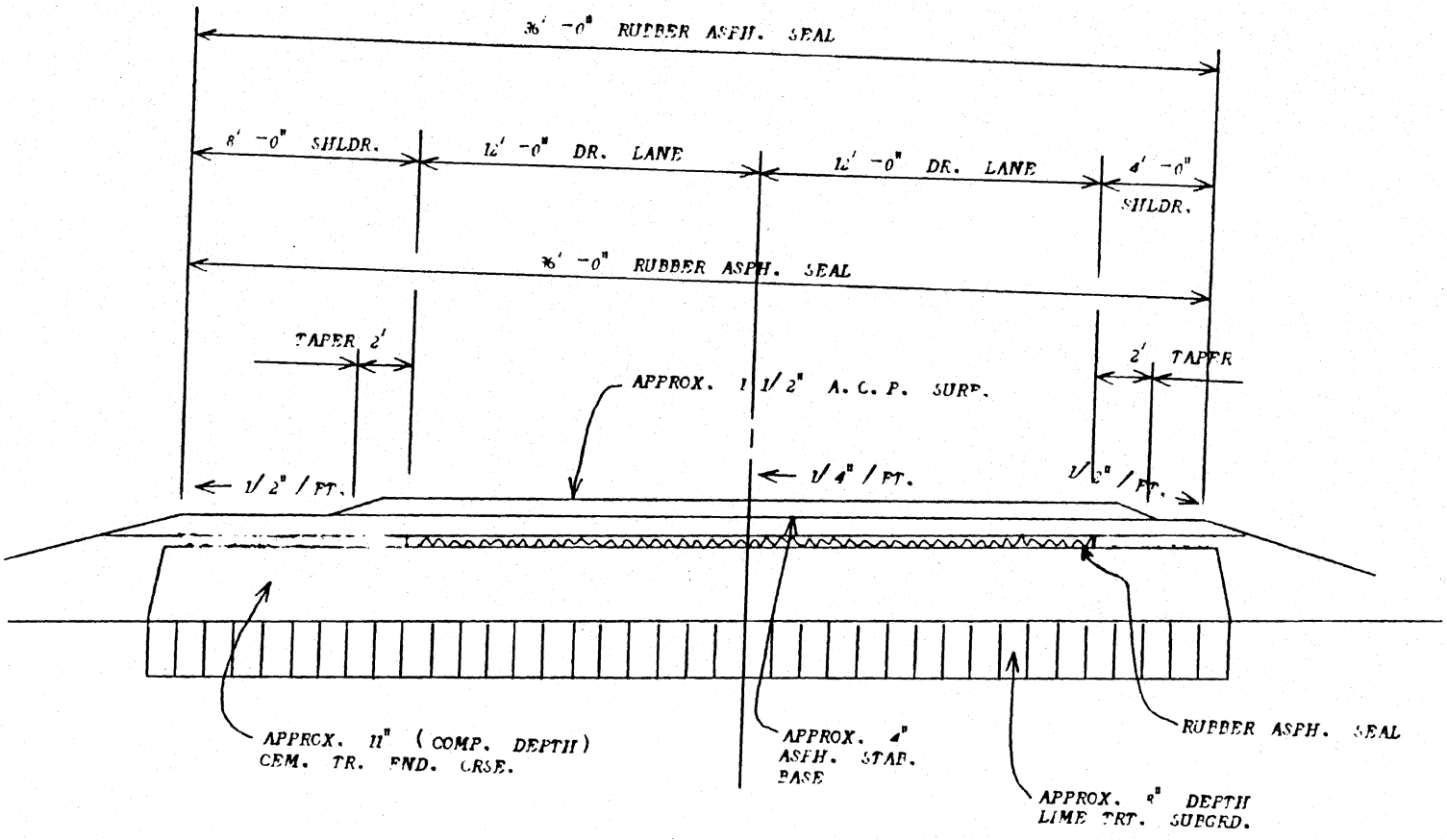
NAC. COUNTY
CONT. 2560-1-28
LOOP 224



SECTION 2

NAC. COUNTY
CONT. 2560-1-28
LOOP 224

ICDS-DISTLAB. DGN


36' -0" RUBBER ASPH. SEAL
8' -0" SHLDR.
12' -0" DR. LANE
12' -0" DR. LANE
4' -0" SHLDR.
36' -0" RUBBER ASPH. SEAL
TAPER 2'
2' TAPER
APPROX. 1 1/2" A. C. P. SURF.
1/2" / FT.
1/4" / FT.
1/2" / FT.
APPROX. 11" (COMP. DEPTH) CEM. TR. FND. CRSE.
APPROX. 4" ASPH. STAB. BASE
RUBBER ASPH. SEAL
APPROX. 8" DEPTH LIME TRT. SUBGRD.

SECTION 3

3) To place a 1,540 foot section of hot asphalt-rubber directly on the soil cement-treated base. The cover rock used in conjunction with the hot asphalt-rubber interlayer was to be placed at a rate that would result in a two layer depth. (See Figure 3).

Construction Procedures

A. The first test section consisted of placing a 1,200 foot long by 24 foot wide strip of Petromat (Phillips Petroleum Co.) directly over the seal-coated, cement-treated soil base. A tack coat of 0.28 gal/sy AC-20 was placed directly on the one course surface treatment and the fabric was then rolled onto the roadway. Each roll was 12.5 feet wide and 300 feet long. The two southbound driving lanes were covered from Engineer Stations 122+00 to 134+00. A longitudinal and transverse lap was provided at the joints. A light pneumatic-tired roller was used to set the fabric in the tack coat. The AC-20 tack coat at 0.28 gal/sy was sufficient to soak through to the top of the fabric as per recommended procedure.

Four inches of an asphalt stabilized base (ASB), Item 292 Type A, was placed in 2-inch lifts immediately after completion of the fabric placement. A 1½-inch ACP surface course, Item 340 Type D, was placed as a finish course approximately 24 months later. This final course placed the fabric 5½ inches below the finished surface.

B. Test section number two consisted of placing a 1,200 foot long by 24 foot wide strip of the Petromat between the two, 2-inch asphalt stabilized base layers. Again an AC-20 tack was placed on the first 2-inch layer of ASB at a rate of 0.22 gal/sy. The fabric was then rolled onto the roadway, covering the two southbound lanes between Engineer Stations 182+00 to 194+00. The light pneumatic-tired roller was then used to set the fabric in the tack which was sufficient to allow asphalt to soak through to the top of the fabric without excess. The second 2-inch layer of ASB was placed immediately after completion of fabric placement. A 1½-inch ACP surface was placed approximately 24 months later which then placed the fabric interlayer 3½ inches beneath the finish surface. It was believed that placement of the interlayer at this level in the pavement would prove to be the most successful. This belief was based on the premise that as the crack propagated through the first 2-inch ASB layer, it would dissipate to a smaller crack width which the interlayer could then effectively retard.

C. Test section number three was comprised of a 1,540 foot long by 24 foot wide strip of asphalt-rubber (Sahuaro Petroleum Co.*) placed directly on the cement-treated soil base in lieu of the standard one course surface treatment. Ground rubber was mixed with an AC-20 asphalt at 425°F. The viscosity of the asphalt-rubber was adjusted from 7,500 to 6,000 centipoises via kerosene (2% by wt) additive. The mixture temperature was reduced to 350°F and applied to the cement-stabilized soil base at a rate of 0.63 gal/sy. Coverstone was applied immediately at a rate of 1 cy per 75 sy. Transverse distribution of the asphalt-rubber was unacceptable with the 13-foot spray bar, but a reduction to an 11-foot spray bar width corrected the problem.

*Now a subsidiary of Craftco, Inc.

A Grade 4 non-precoated limestone cover rock proved too dusty and would not adhere properly. A Grade 4 precoated coverstone resulted in an excellent seal. Also a Grade 5 non-precoated coverstone that was free of dust was used for a short stretch and proved satisfactory. The limits of the test section are in the two southbound lanes between Engineer Stations 166+60 to 182+00.

The heavy rate of aggregate cover was designed to produce a multiple layer effect. It was theorized that the crack would be dissipated by dispersing the stress through 'rolling' of the multilayered aggregate.

Evaluation and Conclusions

It was hoped to have the cracking propagation evaluated via vertical photologging. An attempt was made on April 8, 1982, to capture the'before'cracking pattern which could then be referenced throughout the life of the project. However, traffic conditions and restricted visible cracking prevented an accurate 'before' evaluation. However, we have included this information in the addendum for reference.

We had also set aside specific control test sections to use as a datum plane for future evaluation. Again, because of the non-uniform cracking and traffic patterns, we instead elected to use the adjacent test section shoulders to provide a control datum.

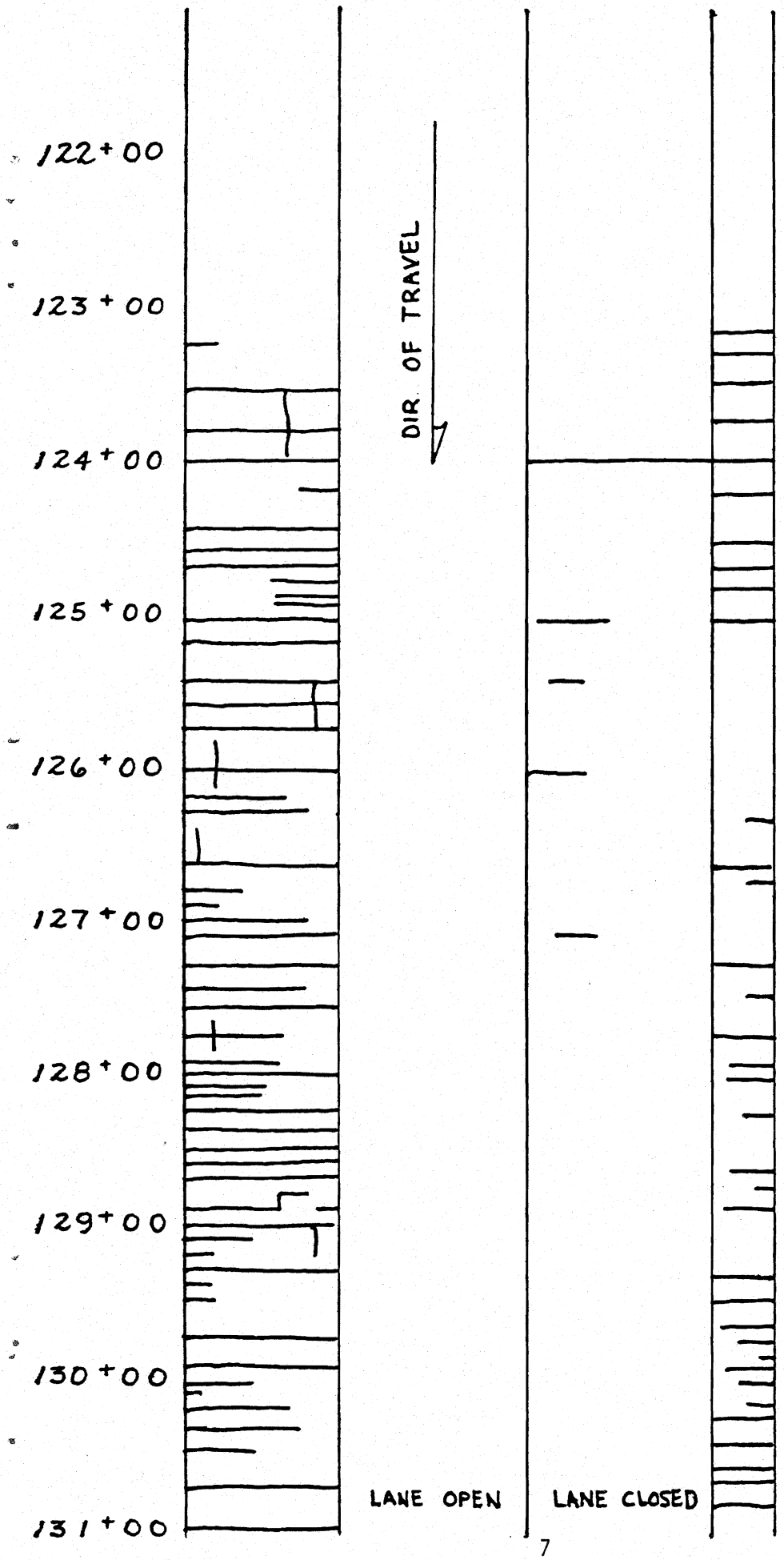
Approximately 8 months after construction of the test sections, a visual, on-the-ground mapping survey was completed. These crack sketches are included in the addendum for review. It should be noted that normal construction activity in the area necessitated the closure of the inside southbound lane throughout the project. This closed lane in every test section showed the greatest number of reflection cracks while the lane opened to traffic had significantly less cracking. It appears that the traffic kept the cracks 'knit' together in the open lane. It is also significant to note that Test Section No. 1 had considerably less reflective cracking than either Test Section No. 2 or Test Section No. 3.

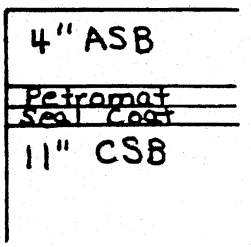
A second visual mapping survey was conducted 24 months after construction of the test sections. This was just prior to the 1½ inch ACP finish course. Again the inside southbound lane had been closed to traffic almost continuously . The same patterns as before were evident with increased reflected cracking in all sections, but significantly less reflective cracking in the lane open to traffic and again less overall reflective cracking in Test Section No. 1.

To date it appears that the most successful stress relieving interlayer design for this project is Test Section No. 1.

ADDENDA

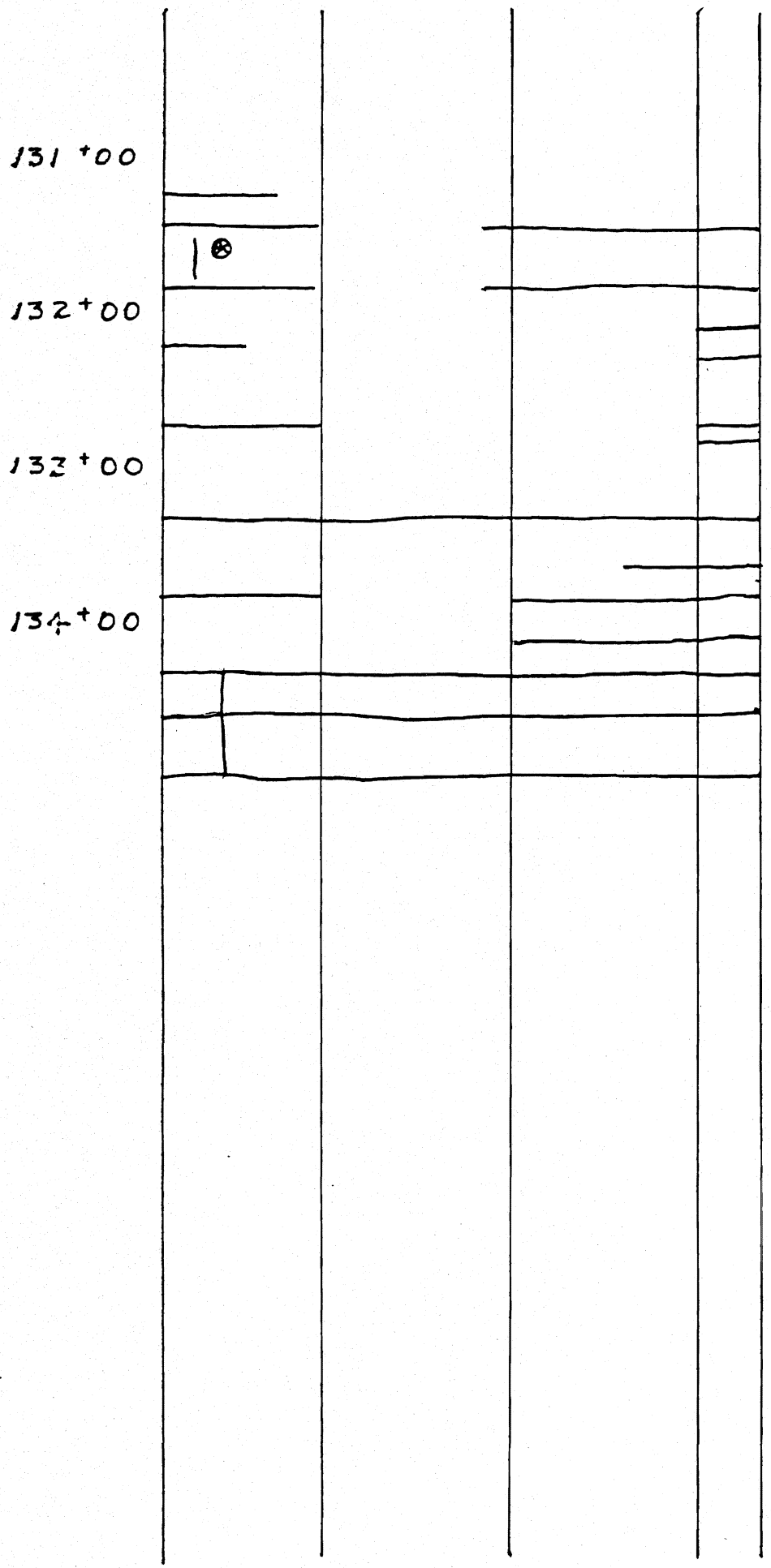
SECTION 1





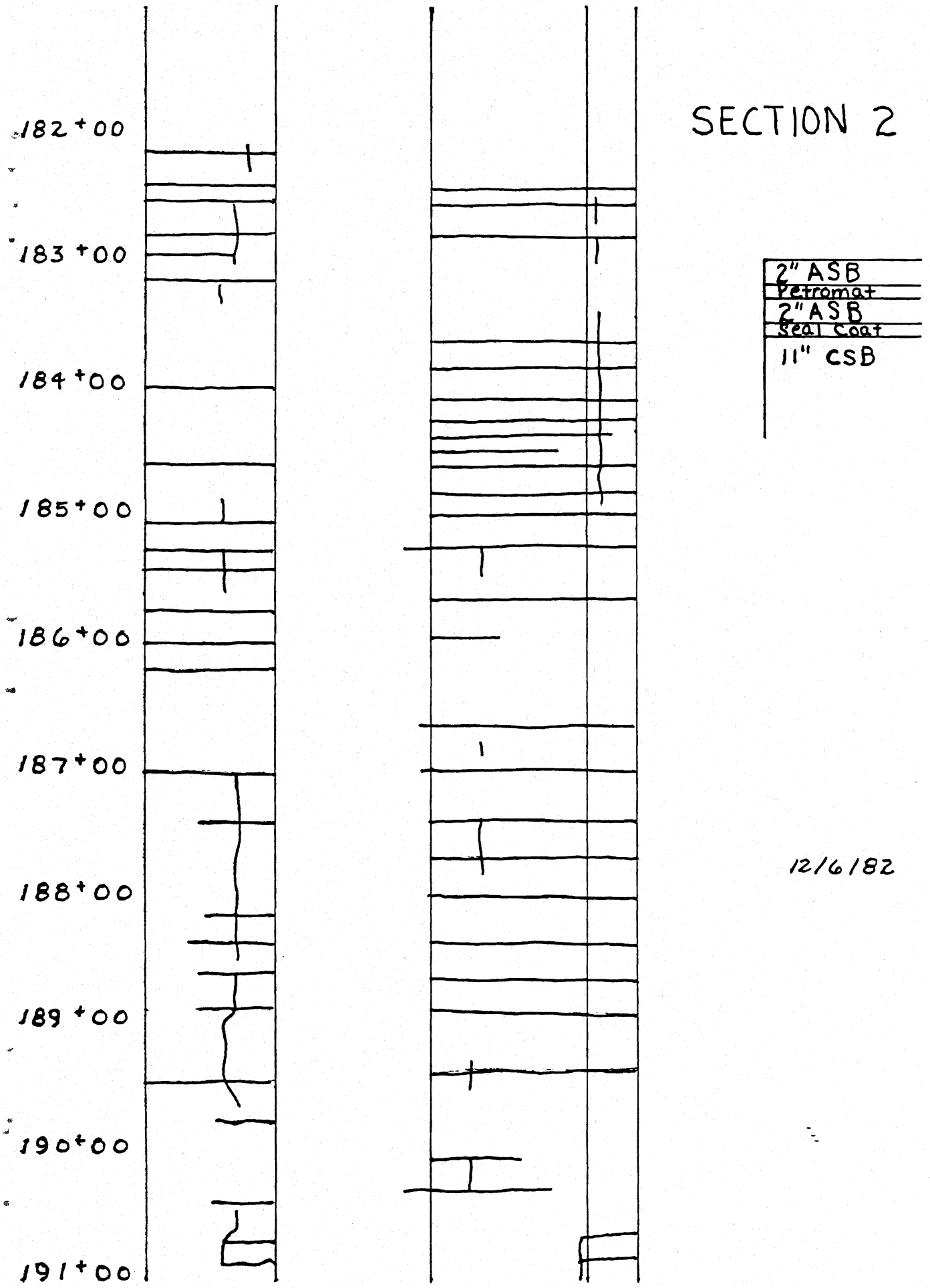
DATA TAKEN 11/18/82
BY: KWF, DFL, BKS

SCALE:
VER: 1" = 100'
HOR: 1" = 10'



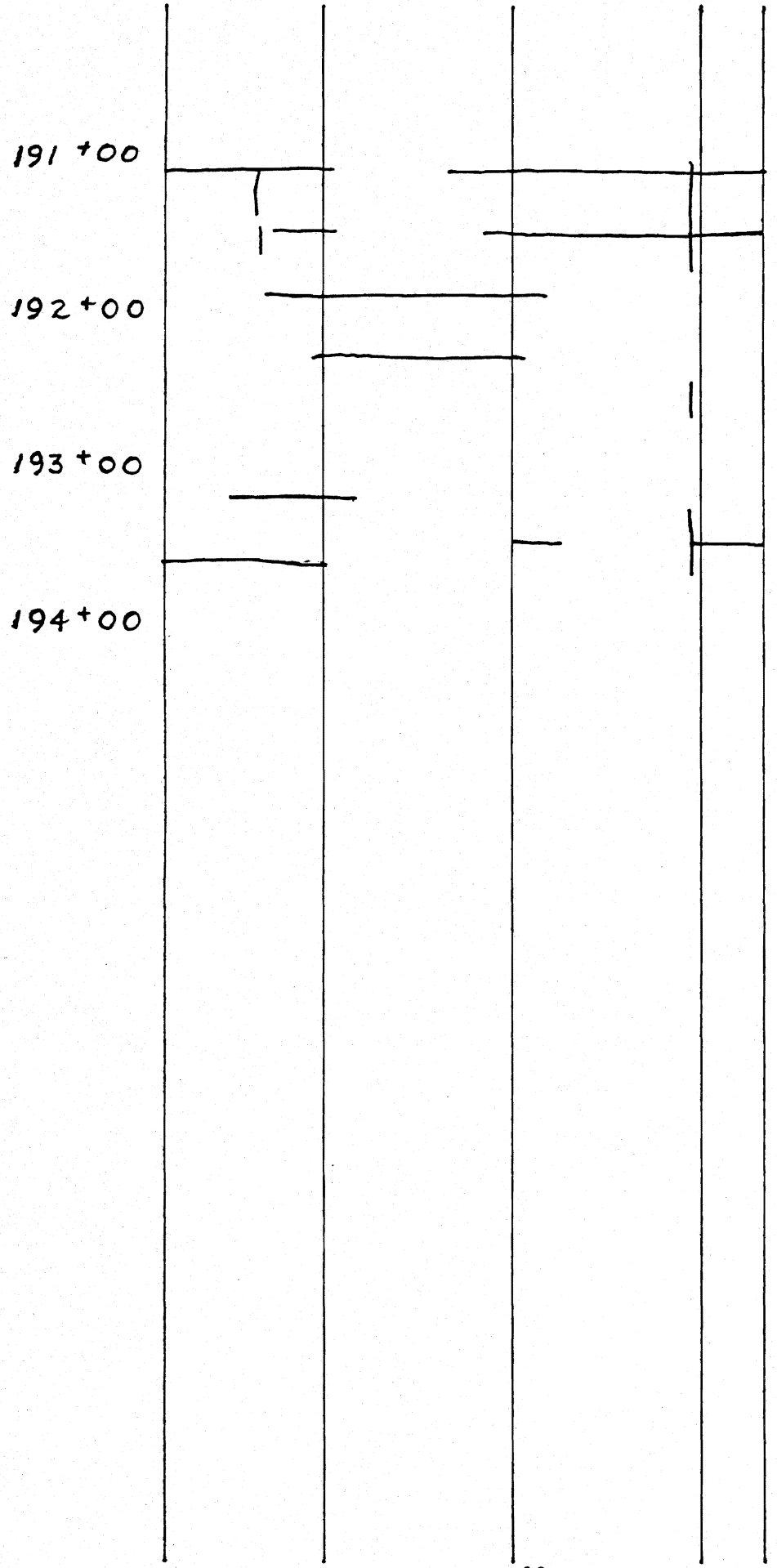
11/18/82

SECTION 2



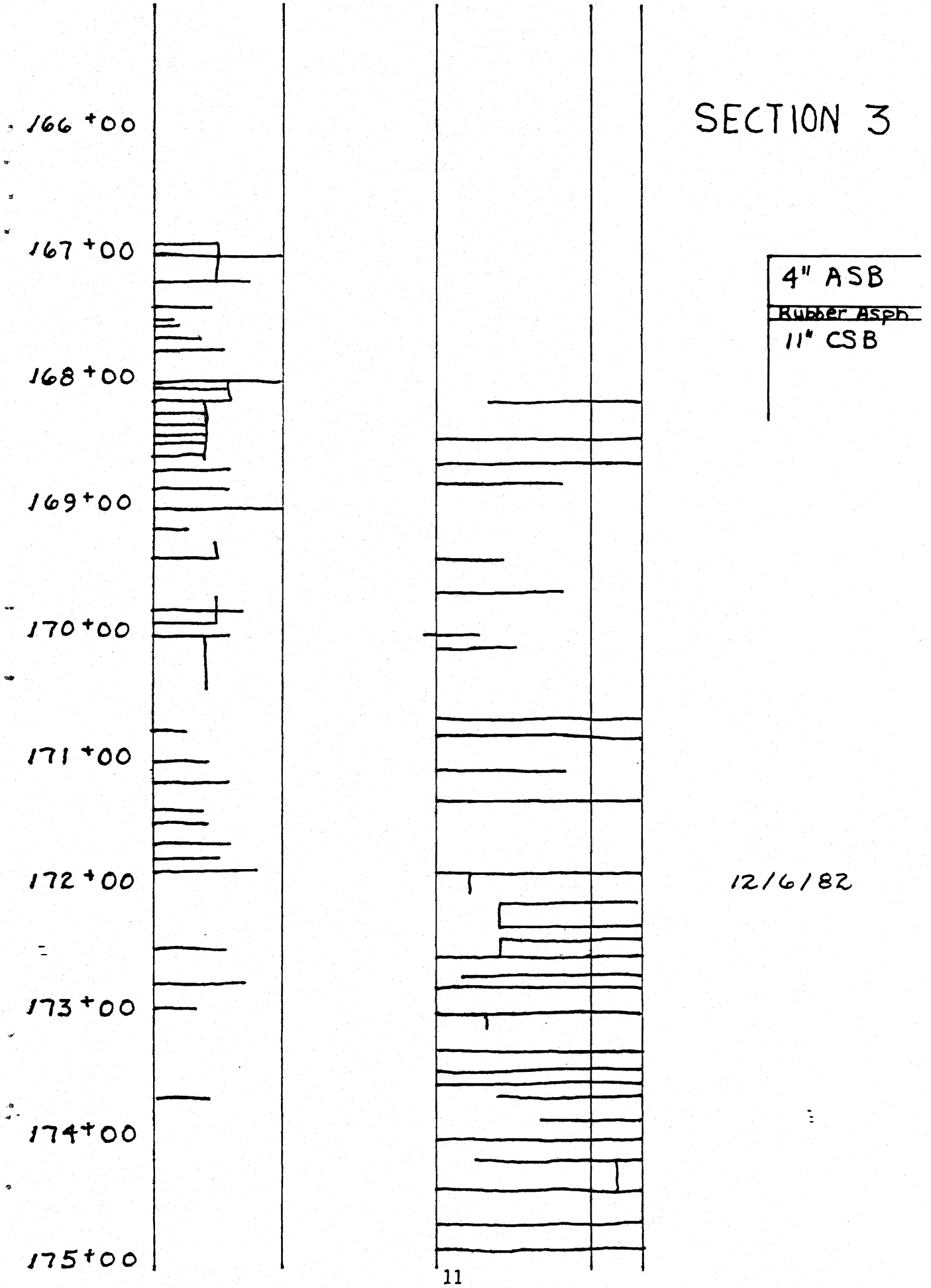
2" ASB
Petromat
2" ASB
Seal Coat
11" CSB

12/6/82

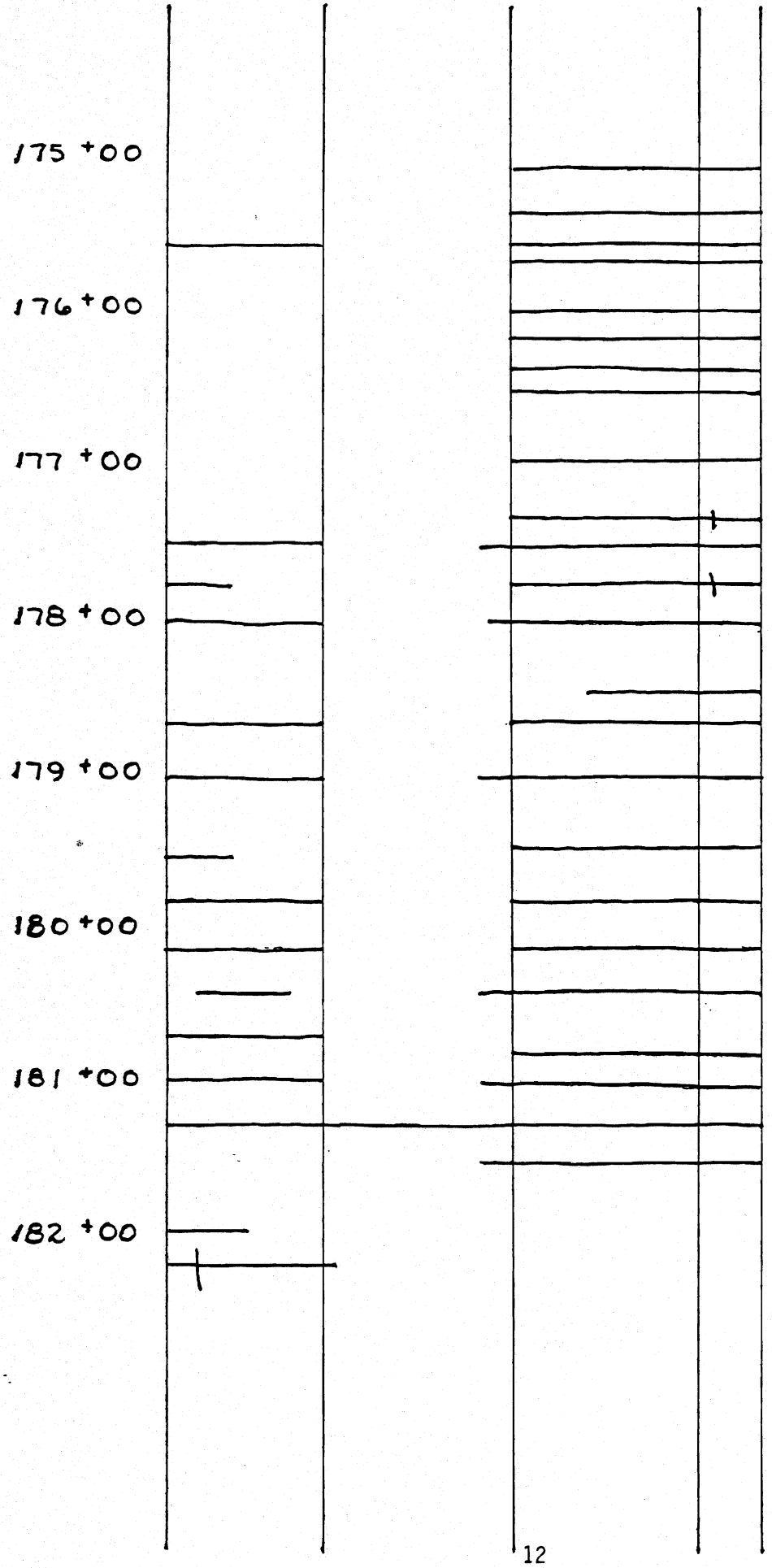


12/6/82

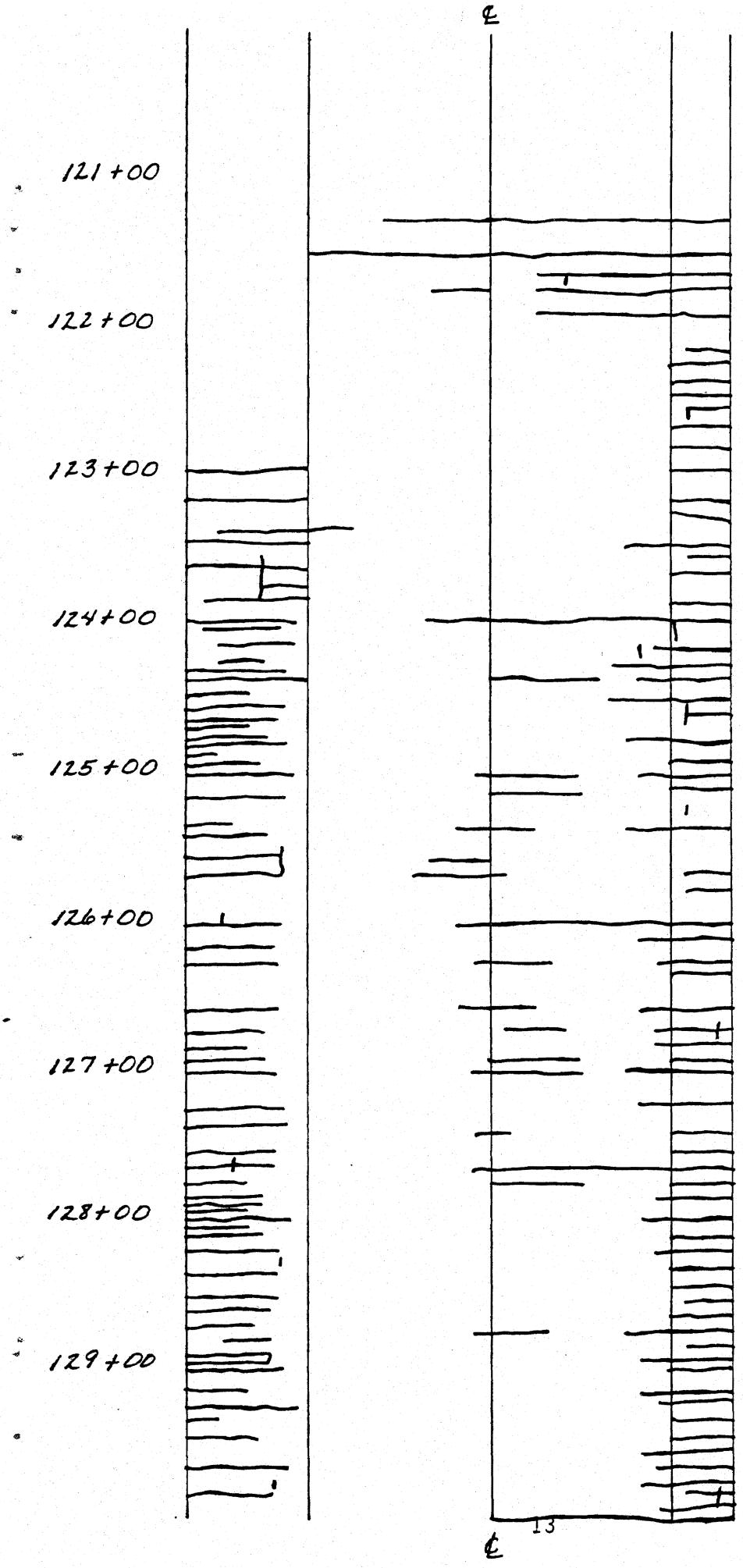
SECTION 3



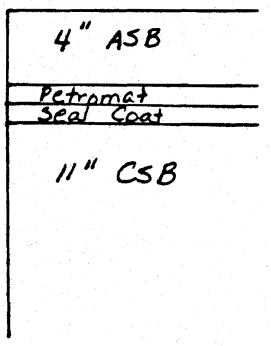
12/6/82



12/6/82

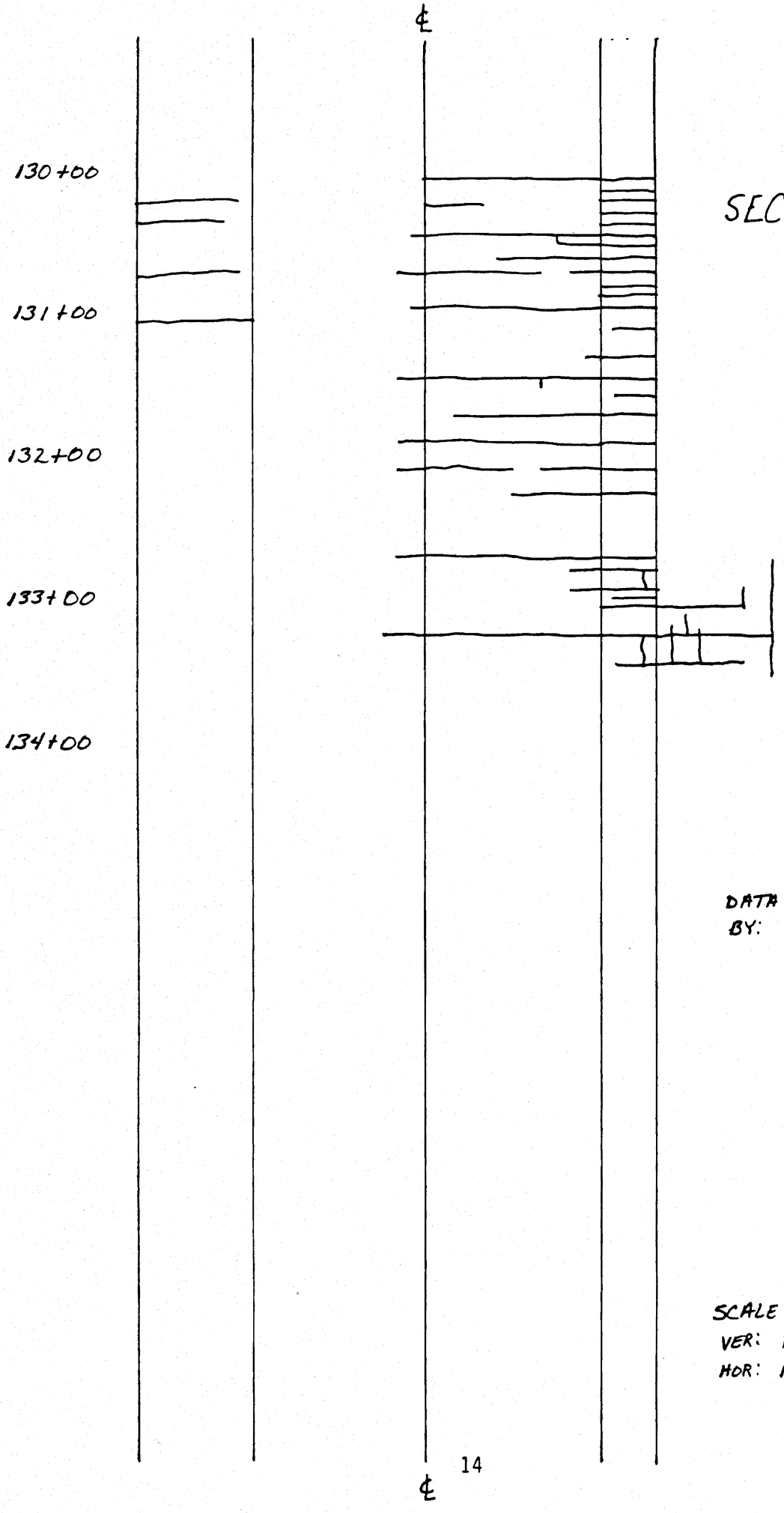


SECTION 1



DATA TAKEN 4/23/84
BY: JKD, DL, OC, JJ

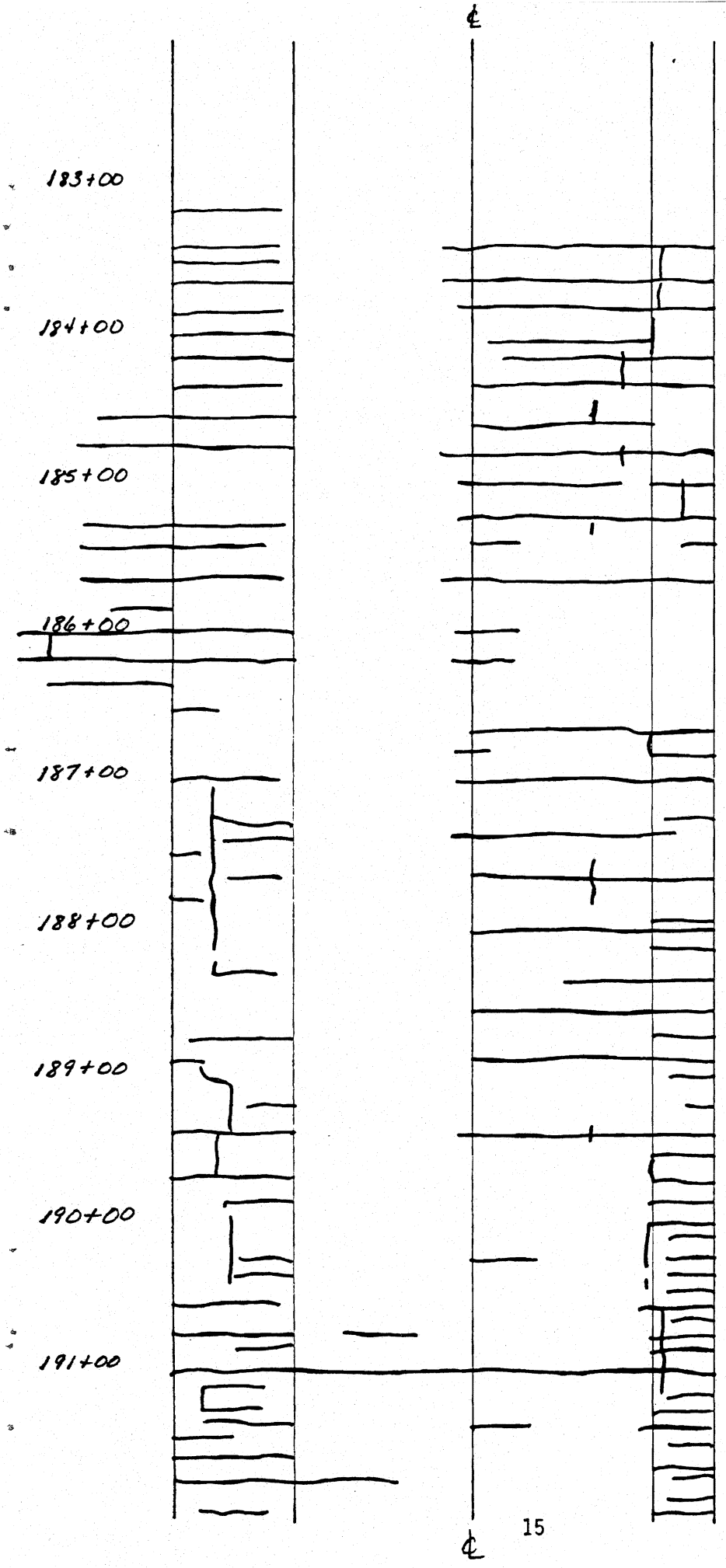
SCALE:
VER: 1" = 100'
HOR: 1" = 10'



SECTION 1

DATA TAKEN 4/23/84
BY: JKD, DL, OC, JJ

SCALE :
VER: 1" = 100'
HOR: 1" = 10'



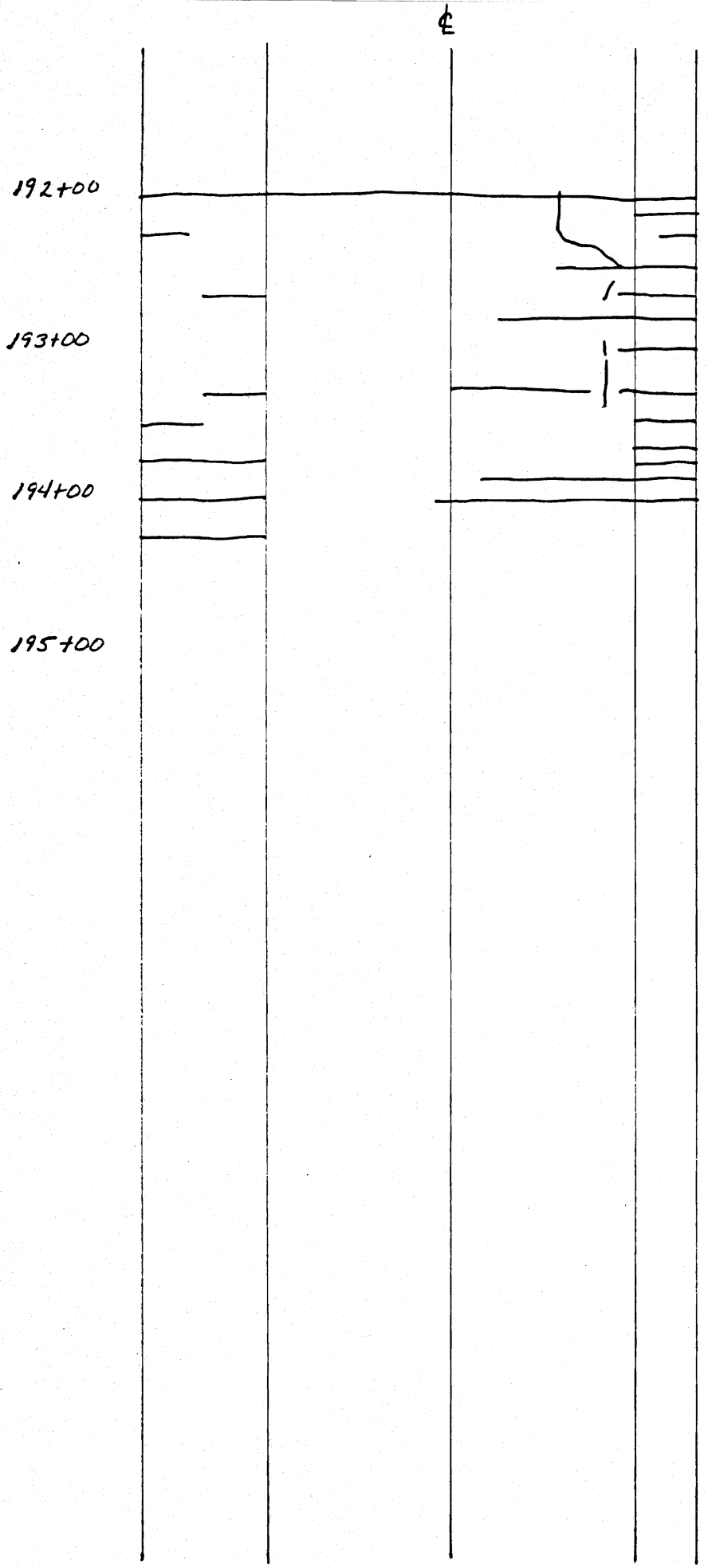
SECTION 2

2" ASB
Petromat
2" ASB
Seal Coat
11" CSB

N

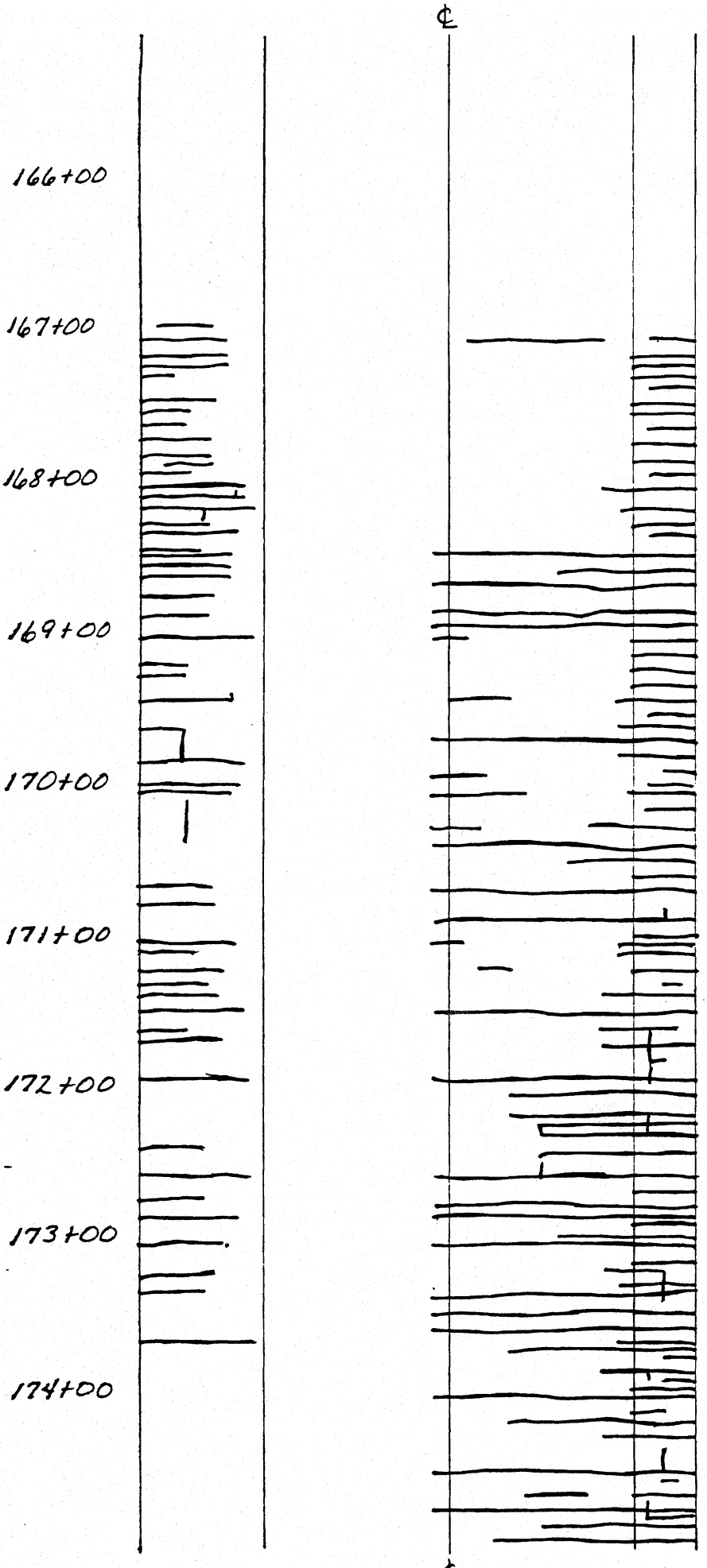
DATA TAKEN 4/23/84
BY: JKD, DL, OC, JJ

SCALE:
VER: 1" = 100'
HOR: 1" = 10'



SECTION 2

DATA TAKEN 4/23/84
BY: JKD, DL, OC, JJ



SECTION 3

4" ASB

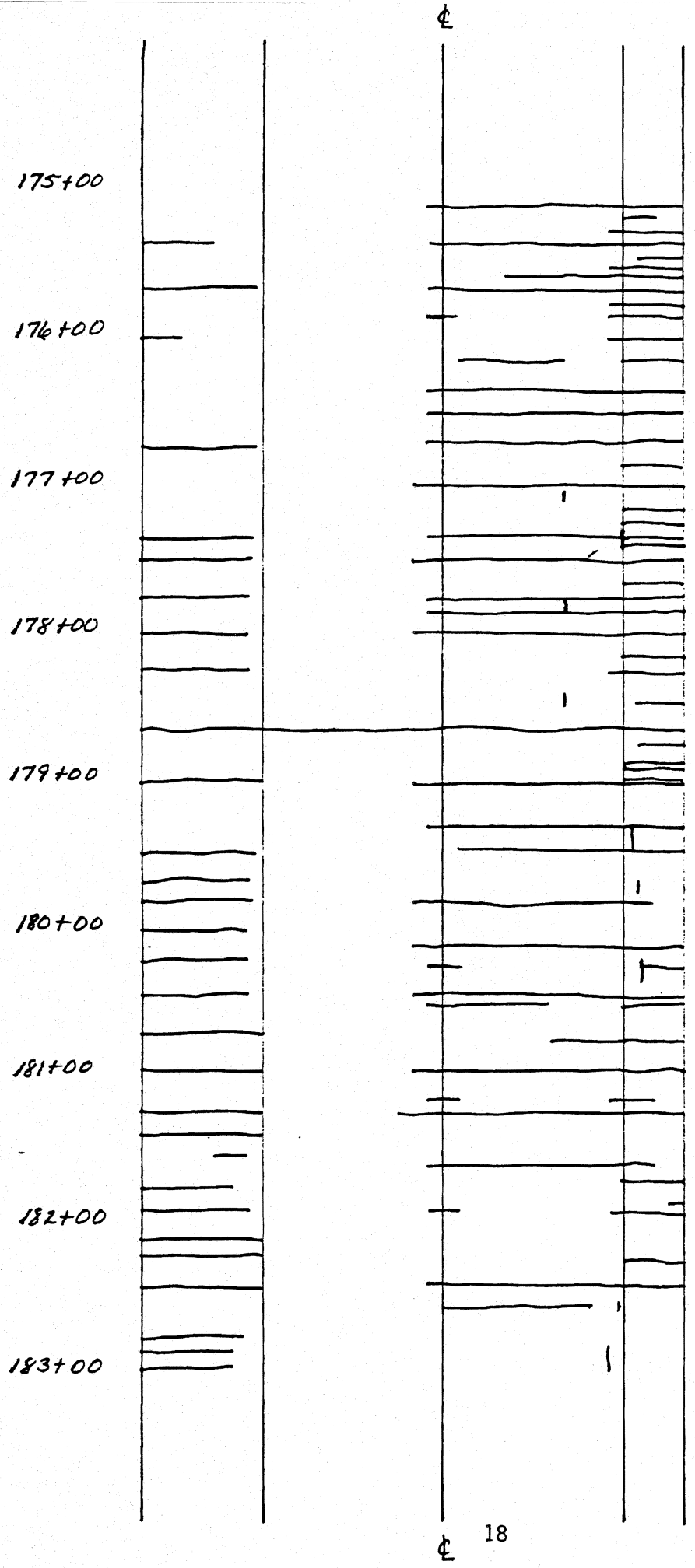
Rubber Asph.

11" CSB

N

DATA TAKEN 4/23/84

BY: JKD, DL, OC, JJ



SECTION 3

DATA TAKEN 4/23/84
BY: JKD, DL, OC, JJ

TECHNICAL MEMORANDUM

STATE DEPARTMENT OF HIGHWAYS AND PUBLIC TRANSPORTATION

Cooperative Research Program

TO: Mr. Ken Fults, District 11

FROM: Ken Hankins

SUBJECT: Vertical Photologging Data

STUDY NO. _____

AREA NO. _____

DATE: April 29, 1982

D-10R
750.261

Please find attached the results of the subject data collected April 8, 1982. As you recall, these "Rubber Asphalt-Fabric" sections will be constructed and tested in association with Research Project 2-9-79-261 "Evaluation of Fabric Underseals". Basically, the attached will constitute "before treatment" data even though most of the information was collected on the control or non-treated section.

KH/dj
Attachment
cc: Dr. Jon Epps w/attachment
Mr. Bill Elmore w/attachment

Ken Hankins

cc: Research Engineer, File D-10

Form-1292 Rev. 8-76

SUMMARY OF
VERTICAL PHOTOLOG INFORMATION
OBTAINED APRIL 8, 1982
LOOP 224

	Location	Limits	% Cracked
1.	Outside shoulder opposite rubber asphalt section	Sta. 171+00 to 67+50	1.94
2.	Outside shoulder opposite the control section	Sta. 67+50 to 62+16	1.57
3.	Outside lane of the control section	Sta. 67+50 to 62+16	0.52
4.	Inside lane of the control section	Sta. 67+50 to 62+16	0.57

PHOTOLOG DATA

LOCATION LOOP 224
DIRECTION OF TRAVEL SOUTH BOUND
DATE OBTAINED APRIL 8, 1982
Sta 171 + 00 Neg. Direction

Lane Rubber Asph-fabric on Soil Cement Subbase Shoulder
CONTROL OR TEST SECTION
Outside Shoulder opposite Rubber Asphalt Section-No Rub-Asph. Seal

FRAME No.	% AREA Cracked	FRAME No.	% AREA Cracked	FRAME No.	% AREA Cracked	FRAME No.	% AREA Cracked
1	10	31	0	61		91	
2	0	32	0	62		92	
3	0	33	0	63		93	
4	10	34	0	64		94	
5	0	35	0	65		95	
6	5	36	6	66		96	
7	0	37	0	67		97	
8	3	38	0	68		98	
9	0	39	0	69		99	
10	0	40	0	70		100	
11	0	41	0	71			
12	0	42	8	72			
13	0	43	0	73			
14	0	44	0	74			
15	0	45	3	75			
16	8	46	0	76			
17	0	47	0	77			
18	0	48	0	78			
19	0	49	0	79			
20	0	50	5	80			
21	0	51	8	81			
22	0	52	0	82			
23	0	53	0	83			
24	3	54	0	84			
25	0	55	4	85			
26	7	56	0	86			
27	0	57		87			
28	0	58		88			
29	8	59		89			
30	0	60		90			

$$\% \text{ Cracked} = \frac{88}{5600} = 1.57\%$$

PSB-41

DISTRICT 11

LOCATION LOOP 224
DIRECTION OF TRAVEL SOUTH BOUND
DATE OBTAINED APRIL 8, 1982
Sta 67 + 50 Neg. Direction

Lane Rubber Asph-fabric on Soil Cement Subbase Shoulder
CONTROL OR TEST SECTION
Outside Shoulder Opposite Control Section

FRAME No.	% AREA Cracked	FRAME No.	% AREA Cracked	FRAME No.	% AREA Cracked	FRAME No.	% AREA Cracked
1	0	31	0	64-S 61		91	
2	0	32	0	62		92	
3	0	33	3	63		93	
4	0	34	4	64		94	
5	0	35	7	65		95	
6	0	36	0	66		96	
7	0	37	0	67		97	
8	0	38	0	68		98	
9	0	39	6	69		99	
10	0	40	10	70		100	
11	0	41	10	71			
12	0	42	4	72			
13	0	43	0	73			
14	0	44	0	63-S 74			
15	0	45	8	75			
16	0	46	0	76			
17	0	47	3	77			
18	0	48	0	78			
19	0	65-S 49	0	79			
20	0	50	9	80			
21	0	51	0	81			
22	10	52	10	-- 82			
23	4	53	0	83			
24	0	54	0	End 84			
25	0	55		85			
26	4	56		86			
27	0	57		87			
28	0	58		88			
29	9	59		89			
30	4	60		90			

$$\% \text{ Cracked} = \frac{105}{5400} = 1.94\%$$

PSB-41.B

DISTRICT 11

LOCATION LOOP 224
DIRECTION OF TRAVEL SOUTH BOUND
DATE OBTAINED APRIL 8, 1982
Sta 67 + 50 Neg. Direction

Rubber Asph-Fabric on Soil Cement Subbase LANE Outside
CONTROL OR TEST SECTION
Outside Lane - Control Section

FRAME No.	% AREA Cracked	FRAME No.	% AREA Cracked	FRAME No.	% AREA Cracked	FRAME No.	% AREA Cracked
1	0	31	0	61		91	
2	0	32	0	64-0 62		92	
3	0	33	0	63		93	
4	0	34	0	64		94	
5	0	35	0	65		95	
6	0	36	0	66		96	
7	0	37	0	67		97	
8	0	38	0	68		98	
9	0	39	0	69		99	
10	0	40	0	70		100	
11	0	41	8	71			
12	0	42	0	72			
13	0	43	0	73			
14	0	44	0	63-0 74			
15	0 --	45	5	75			
16	0	46	0	76			
17	0	47	0	77			
18	0	48	0	78			
19	0 65-0	49	0	79			
20	0	50	0	80			
21	0	51	0	81			
22	2	52	0 --	82			
23	12	53	0	83			
24	0	54	0	84			
25	0	55	0	85			
26	0	56	0 End	86			
27	0	57		87			
28	0	58		88			
29	2	59		89			
30		60		90			

$$\% \text{ Cracked} = \frac{29}{5600} = 0.52\%$$

PSB-41.D

DISTRICT 11

LOCATION LOOP 224
DIRECTION OF TRAVEL SOUTH BOUND
DATE OBTAINED APRIL 8, 1982
Sta 67 + 50 Neg. Direction

Before Treatment Rubber Asph-Fabric on Soil Cement Subbase
LANE Inside
CONTROL OR TEST SECTION
Inside Lane - Control Section

FRAME No.	% AREA Cracked	FRAME No.	% AREA Cracked	FRAME No.	% AREA Cracked	FRAME No.	% AREA Cracked
1	5	31	0	64-I 61		91	
2	0	32	0	62		92	
3	4	33	0	63		93	
4	0	34	0	64		94	
5	0	35	0	65		95	
6	0	36	0	66		96	
7	0	37	0	67		97	
8	0	38	0	68		98	
9	0	39	0	69		99	
10	0	40	0	70		100	
11	0	41	8	71			
12	0	42	0	72			
13	0	43	0	73			
14	0	44	8	-63-I 74			
15	0	-- 45	0	75			
16	0	46	0	76			
17	0	47	0	77			
18	0	48	0	78			
19	0	65-I 49	0	79			
20	0	50	0	80			
21	0	51	0	81			
22	0	-- 52	0	82			
23	0	53	0	83			
24	0	54	7	84			
25	0	55	0	85			
26	0	56	0	End 86			
27	0	57		87			
28	0	58		88			
29	0	59		89			
30	0	60		90			

$$\% \text{ Cracked} = \frac{32}{5600} = 0.57\%$$

PSB-41.G

Fabric, Item 3099

Item 3099 Statewide 12 Month Average Bid Price = $ 0.54 per SY

Petromat Cost Furn & Place $ 0.50 per SY X 6632 SY = $3,316

Com Labor Contr (4 Men)(10 Hrs)(= 40 MH @ $5.00 =	$200.
Light Pneu Roller Oper(1 Man)(10 Hrs)=10 MH @ $5.00=	50.
$200 X 15% Profit =	30.
$200 X 20% Ins.,etc.Additives =	40.
Subtotal Labor =	$320.
Pickup Truck(10 Hrs)($5.00 per Hr) =	$ 50.
Light Pneu Roller(15 Hrs)($20 per Hr) =	300.
Subtotal Equipment =	$350.
Subtotal Labor and Equipment =	$3,986.
25% Loss of productivity for small amount of work units compared to move in and out costs =	$1,000.
Justified Total Cost	$4,986.
6,632 SY @ $0.75 per SY =	*$4,974.

* Actual Cost to State
Field Change No. 4

Rubber Asphalt, Item 3225

Statewide Average Bid Price 14 Tons @ $456 per Ton =	$6,384
* Mobilization =	4,500
Contractor Additive $770 per Ton X 5% X 14 Tons=	600.
Justified Total Cost =	$11,484 Total

** 14 Tons @ $810.00 per Ton = $11,340.00

* Transport laborers, distributor, heater, blender, storage tanks, broom, hand tools, etc., from San Antonio to Nacogdoches. Pay penalty forpartial transport load of asphalt, plus asphalt cost delivered to jobsite. Pay cost of kerosene delivered to jobsite. Heat asphalt in storage tank to 425°F, pump into blender, add ground rubber, blend, and pump onto distributor. Loss of productivity due to above costs, plus move out costs for only placing 14 Tons of Item 3225, Hot Asphalt-Rubber.

** Actual Cost to State Field Change No. 4

File T. 57

320 8c

DAILY ROAD REPORT - ASPHALT AND AGGREGATE

Item No. 3225-502 Asphalt: Type Hot Asphalt - Rubber
Course 1 Source Exxon, Baytown Tex.
Date 4-8-82 Aggregate: Type CI B Type B Grade H
Source

Project: C 2560-1-28
Control: 2560-1-28
Highway: US 59/Lp 224
County: Nacogdoches

APPLICATION

GENERAL Ref. No.	Length Sta. to Sta.		Length Feet	Wid. Ft	AGGREGATE Area S.Y.	S.Y./C.Y.	Load Tally	C.Y. Aggr.	Tons ~~Gals.~~ Start	Tons ~~Gals.~~ End	ASPHALT Net ~~Gals.~~ Tons	Temp. °F	Gals S.Y.
							3-5 CY						
	172+00	182+00	1000	13	1444		1-6 CY	21	25.33	21.98	3.35	350	0.62
							1-5 CY						
	166+50	172+00	550	11	672		1-6 CY	11	28.50			345	
							4-5 CY						
	166+50	182+00	1550	11	1894		1-6 CY	26					
							2-5 CY						
	166+50	182+00	1550	6	1033		1-6 CY	16					
	166+50	173+00	650	6	433		1-6 CY	6					
	173+00	177+00	400	6	266		1-5 CY	5					
	177+00	182+00	500	6	333		1-5 CY	5					
	172+00	182+00	1000	8	889		1-5 CY 1-6 CY	11		15.46	13.04		

AGGREGATE STOCKPILED Load Tally	Total C.Y.		Total Today	Previous Total	Total To Date	Avg. Rate To Date		Tons
			6964	—	6964		101 CY	16.39
							—	—
							101	16.39
							69 S.Y. / C.Y.	0.63 Gal. / S.Y.

ASPHALT RECEIVED

Load. Cert. No.	Lab. No.	Gals.	Load. Cert. No.	Lab. No.	Gals.	Load. Cert. No.	Lab. No.	Gals.

MARKS

Truck # D-110, D-101 & D-102

4,360 Gal ÷ 6,964 SY = 0.63 Gal/S

266 Gal per Ton

7.5 Lb per Gal

(16.34 T) x (266 Gal/Ton) = 4,360 Gal

27

Inspector Peter K. Still

Report No.
Sheet ___ of ___

STATE DEPARTMENT OF
HIGHWAYS AND PUBLIC TRANSPORTATION
DIVISION OF MATERIALS AND TESTS
AUSTIN, TEXAS 78703

MCS.TST.02 GENERAL TEST REPORT D-9 CHARGES 75.00

CONTRACT NO. 05810033 REQ NO. CONTROL 2560-01-028 RD 0805
ENGINEER J. M. WINGATE PROJECT C 2560-1-28
CONTRACTOR HARVIS CONSTRUCTION, INC. DIST 11 CO NACOGDOCHES HWY US 59

****

LABORATORY NO. JA28AC028 DATE RECD 04/28/82 DATE REPTD 04/30/82
DATE SAMPLED 04/26/82
MATERIAL FABRIC UNDERSEAL CODE [illegible]
PRODUCER PHILLIPS PETROLEUM CORP, BARTLESVILLE, OK CODE 768
IDENTIFICATION MARKS SPEC. ITEM 3039
SAMPLED FROM ROLL 4-25615 QUANTITY 6666.700 UNIT SY

****

REMARKS: FABRIC WT. 4.4 OZ/SQ.YD. MACHINE DIRECTION ELONGATION 76% WITH 128# BREAK. CROSS-MACHINE ELONGATION 85% WITH 138# BREAK. ASPHALT RETENTION 4.3 OZ/SQ.FT., WITH NO CHANGE IN AREA.

DIVISION OF MATERIALS AND TESTS
[illegible]
[illegible]

APPROVAL OF CHANGE IN PLANS

F. C. Request No. 4 Accompanied by Typical Sections Hwy. No. US59/Lp 22

Nacogdoches County, Federal Proj. No. C 2560-1-28, Control 2560-1-28

TO THE STATE HIGHWAY ENGINEER:

Approval of the following changes in plans and/or specifications is requested.

Limits: Sta. 125 to Sta. 245 (Sections)

Description: Add two 1,200' test strips of Item 3099-501, Fabric Underseal and one 1,540' test strip of Item 3225-502, Hot Asphalt-Rubber within the limits shown above and as depicted on the attached Typical Sections.

This field change is requested for the following reasons:

The composite base structure includes Cement Treated Foundation Course. Reflective cracking from the cement treated base course results in undesirable cracks in the Asphalt Stabilized Base and ACP Surface Course. The test sections will provide valuable knowledge of the effectiveness of each system to prevent or reduce reflective cracking.

ontractor:

Item No.	DESCRIPTION	Unit	FIELD CHANGE QUANTITIES			ORIGINAL PLAN QUANTITIES		
			Quantity	Contract Price	Amount	Quantity	Contract Price	Amount
099-501	Fabric Underseal	SY	6,632	0.75	4,974.00	0	0	0
225-502	Hot Asphalt-Rubber	Ton	14	810.00	11,340.00	0	0	0
0-508	Aggr(Cl B Ty B Gr 4)	CY	1,909	35.00	66,815.00	1,883	35.00	65,905.0
0-571	Asph(AC-5,AC-10 or EA-CRS 2)	Gal	67,647	1.20	81,176.40	68,357	1.20	82,028.4

Total $ 164,305.40 Total $ 147,933.40

Net Underrun $ Net Overrun $ 16,372.00

Respectfully requested by:

Resident Engineer — Date

Recommended for Approval by:

R. L. Lewis — Chief Engineer of Highway Design — Date 4-5-82

Engineer, Secondary Roads — Date

J. L. Braird — District Engineer — Date 4-2-82

Bridge Engineer — Date

Engineer Manager — Date

Approved J. E. Zeller — Construction Engineer — Date 4-6-82

Verified by — Initials — Date

Approved Marcus L. Yancy Jr. — Assistant Engineer Director — Date 4-6-82

NOTE: Eight copies of this form must be submitted to the S. H. D. Main office through the office of the District Engineer for each field change requested on Federal Aid Primary and Interstate Projects, and five copies for field changes on State and Federal Secondary Projects.

SUPPLEMENTAL AGREEMENT

Project: C 2560-1-28
Control: 2560-1-28
US Highway 59/Loop 224
Nacogdoches County
PD No. 0805

WHEREAS, a contract was entered into on the 1st day of June, 1981, by and between the State of Texas, represented by the Engineer-Director, State Department of Highways and Public Transportation, and Marvis Construction, Inc. and J-W Payne Construction Company, Inc., for the construction of Widen, Grading, Structures, Base, Grade Seperation, ACP, etc. on the above captioned project, and

WHEREAS, the composite base structure on this project includes a Cement Treated Foundation Course and an Asphaltic Concrete Base and Surface Course, and

WHEREAS, reflective cracking extending from the Cement Treated Base through the Asphaltic Concrete Base and Surface Course is an undesirable inherent problem with this type of base structure, and

WHEREAS, it is desirable to develop a system which will eliminate or reduce this reflective cracking problem by placing test strips using various types of stress relieving materials, and

WHEREAS, three test strips will be placed as provided for by Field Change Request Number 4 for this project, and

WHEREAS, it is necessary to supplement the contract by the addition of the following items and arrive at a unit price for performing the work;

Item 3099-501 Fabric Underseal
Item 3225-502 Hot Asphalt-Rubber

THEREFORE, it is mutually agreed by the parties hereto that the above items of work shall be added to this contract, and that Seventy Five Cents ($0.75) per Square Yard for Item 3099-501 Fabric Underseal and Eight Hundred and Ten Dollars ($810.00) per Ton for Item 3225-502 Hot Asphalt-Rubber are fair and equitable prices for performing these items of work, and that the Contractor agrees to perform these items of work for these unit prices in accordance with the applicable Special Specifications, copies of which are attached hereto and shall become a part of this agreement.

Project: C 2560-1-28
Control: 2560-1-28
Highway: US 59/Lp 224
County: Nacogdoches

RECOMMENDED FOR APPROVAL BY:

STATE DEPARTMENT OF HIGHWAYS
AND PUBLIC TRANSPORTATION

4-6-82
Resident Engineer Date

4-13-82
District Engineer Date
or Engineer Manager

Bridge Engineer Date
Chief Engineer of Highway Design

Construction Engineer Date

Certified as being executed for the purpose and effect of activating and/or carrying out the orders, established policies, or work programs heretofore approved and authorized by the State Highway and Public Transportation Commission.

Engineer-Director Date

Executed and approved for State Highway and Public Transportation Commission under authority of Commission Minute 78501.

Marvis Construction, Inc. and
J-W Payne Construction Co., Inc.
(Firm)

By:
President (Marvis Construction, Inc.) Date

By:
President (J-W Payne Construction Co., Inc.) Date

SURETY APPROVAL

United States Fidelity and Guaranty Company
(Firm)

By:
Joe Max Green (Attorney-In-Fact)

United States Fidelity and Guaranty Company
(Firm)

By:
~~Jack Brubier~~
Joe Max Green (Attorney-In-Fact)

CERTIFIED COPY

GENERAL POWER OF ATTORNEY

No. 81795

Know all Men by these Presents:

That UNITED STATES FIDELITY AND GUARANTY COMPANY, a corporation organized and existing under the laws of the State of Maryland, and having its principal office at the City of Baltimore, in the State of Maryland, does hereby constitute and appoint

Joe Max Green

of the City of **Nacogdoches**, State of **Texas**,
its true and lawful attorney in and for the State of **Texas**

for the following purposes, to wit:

To sign its name as surety to, and to execute, seal and acknowledge any and all bonds, and to respectively do and perform any and all acts and things set forth in the resolution of the Board of Directors of the said UNITED STATES FIDELITY AND GUARANTY COMPANY, a certified copy of which is hereto annexed and made a part of this Power of Attorney; and the said UNITED STATES FIDELITY AND GUARANTY COMPANY, through us, its Board of Directors, hereby ratifies and confirms all and whatsoever the said

Joe Max Green

may lawfully do in the premises by virtue of these presents.

In Witness Whereof, the said UNITED STATES FIDELITY AND GUARANTY COMPANY has caused this instrument to be sealed with its corporate seal, duly attested by the signatures of its Vice-President and Assistant Secretary, this 26th day of February, A. D. 1971

UNITED STATES FIDELITY AND GUARANTY COMPANY.

(Signed) By Karl H. Doerre
Vice-President.

(SEAL)

(Signed) H. Ronald Kirkland
Assistant Secretary.

STATE OF MARYLAND, BALTIMORE CITY, } ss:

On this 26th day of February, A. D. 1971, before me personally came Karl H. Doerre, Vice-President of the UNITED STATES FIDELITY AND GUARANTY COMPANY and H. Ronald Kirkland, Assistant Secretary of said Company, with both of whom I am personally acquainted, who being by me severally duly sworn, said that they resided in the City of Baltimore, Maryland; that they, the said Karl H. Doerre and H. Ronald Kirkland were respectively the Vice-President and the Assistant Secretary of the said UNITED STATES FIDELITY AND GUARANTY COMPANY, the corporation described in and which executed the foregoing Power of Attorney; that they each knew the seal of said corporation; that the seal affixed to said Power of Attorney was such corporate seal, that it was so fixed by order of the Board of Directors of said corporation, and that they signed their names thereto by like order as Vice-President and Assistant Secretary, respectively, of the Company.

My commission expires the first day in July, A. D. 19..74....

(SEAL) (Signed) Herbert J. Aull
Notary Public.

STATE OF MARYLAND BALTIMORE CITY, } Sct.

I, Robert H. Bouse, Clerk of the Superior Court of Baltimore City, which Court is a Court of Record, and has a seal, do hereby certify that Herbert J. Aull, Esquire, before whom the annexed affidavits were made, and who has thereto subscribed his name, was at the time of so doing a Notary Public of the State of Maryland, in and for the City of Baltimore, duly commissioned and sworn and authorized by law to administer oaths and take acknowledgments, or proof of deeds to be recorded therein. I further certify that I am acquainted with the handwriting of the said Notary, and verily believe the signature to be his genuine signature.

In Testimony Whereof, I hereto set my hand and affix the seal of the Superior Court of Baltimore City, the same being a Court of Record, this 26th day of February, A. D. 1971

(SEAL) (Signed) Robert H. Bouse
Clerk of the Superior Court of Baltimore City.

FS 3 (9-67)

SPECIAL SPECIFICATION

ITEM 3099

FABRIC UNDERSEAL

1. DESCRIPTION. This item shall consist of furnishing and placing a fabric underseal in accordance with the details shown on the plans and the requirements of these specifications. This underseal shall consist of a single application of asphalt covered with one layer of the fabric with or without sand or screenings.

2. MATERIALS. The woven or non-woven fabric furnished shall be constructed exclusively of man-made thermoplastic fibers. These fibers may be oriented in the fabric in either a random or an aligned orientation and the fibers may be either continuous or discontinuous throughout the fabric. The fabric itself shall be mildew resistant, rot-proof and shall be satisfactory for use with asphalt cements.

   a. Physical Requirements. The fabric supplied shall meet the following additional requirements when sampled and tested in accordance with the methods specified.

TEST	METHOD	REQUIREMENT	
Original Physical Properties:		Minimum	Maximum
(1.) Fabric weight, oz./sq.yd.:	ASTM D 1910 paragraph 37 or 38	4.0	9.0
(2.) "Apparent elongation" at "breaking load" on warpwise specimens, percent:	ASTM D 1682, Grab Method G as modified by paragraph F. Testing Requirements of this specification.	50	150
(3.) "Apparent elongation at "breaking load" on fillingwise specimens, percent:	" " "	50	150
(4.) "Breaking load," on warpwise specimens, pounds:	ASTM D 1682, Grab Method G as modified by paragraph F. Testing Requirements of this specification.	45	---
(5.) Breaking load," on fillingwise specimens, pounds:	" " "	80	---

(6.) Asphalt retention, oz./sq.ft.	paragraph F. Testing Requirements of this specification.	0.5	8.5
(7.) Change in area caused by asphalt retention test & subsequent asphalt removal. Reported as change in area of specimen measured after test as compared to area of specimen prior to test, percent:	paragraph F. Testing Requirements of this specification.	---	± 15

(8.) Physical Properties After 275°F. Asphalt Retention Test & Subsequent Asphalt Removal: Fabric samples so treated shall when tested in accordance with the methods prescribed for tensile and elongation tests comply with the minimum and maximum strength requirements as set forth for "as-received" samples under "Original Physical Properties" with a 10% tolerance allowed.

b. Packaging Requirements. The fabric shall be packaged in standard-width rolls of specified length. The fabric itself shall be uniformly wound onto suitable cylindrical forms or cores to aid in handling and unrolling. Each roll of fabric and the form or core upon which it is rolled shall be packaged individually in a suitable sheath, wrapper or container to help protect the fabric from damage due to ultra-violet light and moisture during normal storage and handling.

c. Identification Requirements. Each roll shall be labeled or tagged in such a manner that the information for sample identification and other quality control purposes can be read from the label without opening the roll packaging. Each roll shall be identified by the manufacturer as to lot number or control numbers, date of manufacture, tare weight of core plus wrapper, width and length of fabric on the roll plus the gross weight of the entire package which is to include fabric, core, wrapping sheath or container tags, etc.

d. Sampling Requirements. Each roll may be subject to a fabric-weight determination on a per-roll basis. In addition, individual test samples shall be cut from at least one roll selected at random from each 100 rolls or fraction thereof representing each shipment. Individual samples shall be no less than one foot in length by full-roll width.

e. Basis for Rejection. Should any individual roll fail to meet the fabric-weight requirement when the entire roll is weighed then that roll is subject to rejection. Should any individual sample selected at random from 100 rolls (or fraction thereof) fail to meet any specification requirement, then that roll shall be rejected and two additional samples shall be taken, one from each of two other additional rolls selected at random from the same 100-roll lot (or fraction thereof). If either of these two additional samples fail to comply with any portion of the specification, then the entite quantity of rolls represented by that sample shall be rejected.

f. Testing Requirements. Fabric-weight determinations may be made upon complete rolls of fabric. In addition the individual test samples selected in accordance with the sampling procedure outlined may be used for fabric-weight determination. If individual test samples are used for fabric-weight determination, then all 19 of the 4 X 8 inch specimens required for testing of a roll shall be selected from the one-foot by roll-width test sample and the 19 individual test specimens shall be weighed and the average weight expressed in ounces per square yard and calculated and reported on that basis.

The determination of the "breaking load" and the "apparent elongation" at "breaking load" shall be made in accordance with ASTM D 1682 entitled "Standard Methods of Test for Breaking and Elongation of Textile Fabrics" using Grab Method G with a constant rate of traverse so that the breaking load is reached in 20 seconds plus or minus three seconds. Modified jaws are to be used in which the 1 inch x 2 inch jaw faces are serrated with approximately 0.5 millimeter deep serrations in a horizontal direction when the jaws are pulled vertically. The continuous teeth or serrations are to be pointed slightly upward on the jaw faces as the jaws are positioned in the testing machine. Original Physical Property test specimens as placed in the testing machine shall be rectangular and measure four by eight inches. When placed in the 1 inch x 2 inch modified jaws the fabric shall extend one-half inches on either side of the one-inch wide by two-inch high jaws.

Five individual specimens shall be chosen for determination of original physical properties, tensile and elongation testing in the warp-wise direction and eight individual specimens shall be chosen for testing in the filling-wise direction. It is important that these specimens be chosen at random from each individual test sample of at least one foot in length by full-roll width selected at random in accordance with the prescribed sampling procedure. The average test value obtained on the five specimens and the average test value for the eight specimens tested shall be reported as the final test values for those tests in the warp and fill directions respectively. Additional individual specimens shall be selected for those tests involving hot asphalt.

Asphalt retention and potential change of area of the fabric shall be determined as follows:

Three warp-wise specimens of four by eight inch dimension and three filling-wise specimens of like dimension shall be selected at random from the individual one foot wide by roll width test sample. These test specimens shall be individually weighed to the nearest 0.1 gram and then submerged for 30 minutes in the specified asphalt cement maintained at a temperature of 275 $\pm$ 4 F. in a mechanical convection oven. After the required submersion the test specimens shall be removed and hung to drain in the oven for an additional 30 minutes at 275 $\pm$ 4 F. The samples shall then be removed from the oven and allowed to drain for one hour at a temperature of 76 $\pm$ 4 F.

The asphalt cement used for this test shall meet the detailed requirements for viscosity grade AC-10 of the Texas State Department of Highways and Public Transportation Specification Item, "Asphalts, Oils and Emulsions" with the additional requirement that the viscosity at 275 F. shall be within the range of 2.3 to 2.8 stokes. After the one hour at 76 $\pm$ 4 F. the asphalt coated specimens shall be weighed to the nearest 0.1 g and then placed in naphtha heated to 110 $\pm$ 5 F. for 30 minutes. Fresh naphtha contained in trays at the specified temperature may be alternated as necessary during the 30 minute period to effect removal of the asphalt cement from the specimens. Specimens will be blotted with paper towels and allowed to air dry to effect naphtha removal. The area of the specimens will then be measured for the determination of percent change in area. Asphalt retention and change in area will be calculated as follows:

$$\text{asphalt retention, oz./sq.ft.} = \frac{\text{wt. in grams asphalt} \times 0.0352739}{\text{area of specimen after test in in}^2 \div 144}$$

$$\text{change in area, \%} = 100 - \left[\frac{\text{area of specimen after test in in}^2}{\text{original area of specimen in in}^2} \times 100\right]$$

Load test specimens which have been previously subjected to the 275 F. Asphalt Retention Test and Asphalt Removal procedures shall be centered in the jaws of the tensile testing machine. The three inch jaw separation will be maintained. If the original 4 X 8 inch specimen has expanded or chrunk in size the required fabric spacing around the jaws will of necessity not be maintained. Specimens will be centered and 3 inch jaw separation maintained.

3. CONSTRUCTION METHODS. The area on which the underseal is to be placed shall be clean of dirt, dust or other deleterious material by sweeping or other approved methods. Asphaltic materials of the type and grade shown on the plans shall be applied on the clean surface by an approved type of self-propelled pressure distributor so operated as to distribute the material in the quantity specified, evenly and smoothly under a pressure necessary for proper distribution. The Contractor shall provide all necessary facilities for determining the temperature of the asphaltic material and all of the heating equipment and in the distributor for determining the rate at which it is applied and for securing uniformity at the junction of two distributor loads. The distributor shall have been recently calibrated and the Engineer shall be furnished an accurate and satisfactory record of such calibration.

This underseal shall not be applied when the air temperature is below 60 F and is falling, but it may be applied when the air temperature is above 50 F and is rising, the air temperature being taken in the shade away from artificial heat. Neither the asphalt nor the fabric shall be placed when general weather conditions, in the opinion of the Engineer, are not suitable.

After beginning the work, should the yield on the asphaltic material appear to be in error, the distributor shall be calibrated in a manner satisfactory to the Engineer before proceeding with the work.

Asphaltic material shall be applied ahead of the placement of the fabric in widths 10 inches wider than the fabric. The asphaltic material shall be applied at the approximate rate shown on the plans or as directed by the Engineer.

String lines will be set for alignment as required by the Engineer.

Immediately upon application of the asphalt, the fabric shall be aligned and carefully broomed and/or rolled into the asphalt with equipment approved by the Engineer. In the event the initial alignment is not satisfactory and causes the fabric to wrinkle during placement, the fabric shall be cut and realigned overlapping the previous material and proceeding as before. All transverse joints shall be overlapped a minimum of 6 inches. In lapping joints, the top fabric shall be folded back to allow application of a light coat of asphalt. The top fabric is then folded back onto the asphalt and broomed and squeegeed out smoothly. Rolling and/or brooming the fabric into the asphalt at the joints shall be accomplished in such a way that the air bubbles which form under the fabric will be removed. This may be accomplished by brooming from the center of the fabric toward the outer edges. The fabric shall be neatly cut and contoured at all joints as directed by the Engineer.

If the edges of the fabric tend to be displaced because of air currents, the Engineer may require that the edges be secured to the pavement at 15-foot intervals. In the event this procedure does not prove satisfactory, then work will be suspended until conditions are more favorable.

Adjacent panels of the fabric shall overlap a minimum of 4 inches. Additional asphalt shall be applied to make these longitudinal joints.

Turning of equipment shall be gradual and kept to a minimum to avoid damage to the fabric. On typical sections not receiving a seal coat, the surface of the underseal fabric shall be covered with a thin layer of clean sand or clean crusher screenings at a rate sufficient to absorb the excess asphalt. The sand and/or crusher screenings shall be approved by the Engineer. On typical sections to be seal coated only sufficient sand shall be spread ahead of the tires to prevent sticking.

All storage tanks, piping, retorts, booster tanks and distributors used in storing or handling asphalt material shall be kept clean and in good operating condition at all times, and they shall be operated in such a manner that there will be no contamination of the asphaltic material with foreign material. It shall be the responsibility of the Contractor to provide and maintain, in good working order, a recording thermometer in the storage heating unit at all times.

The Engineer will select a temperature of application based on the temperature viscosity relationship that will permit application of the asphalt within the limits recommended in the item, "Asphalts, Oils and Emulsions". The recommended range for the viscosity of the asphalt is 50 seconds to 60 seconds Saybolt Furol. The Contractor shall apply the asphalt at a temperature within 15 F of the temperature selected.

4. MEASUREMENT. Asphaltic material will be measured at the point of application on the road in gallons at the applied temperature. The quantity to be paid for shall be the number of gallons used as directed in the accepted underseal.

   The fabric underseal shall be paid for by the square yard based on the calculated quantity shown on the contract plans with no allowance made for overlapping at joints.

5. PAYMENT. The work performed and materials furnished, as prescribed by this item, and measured as provided under "Measurement", will be paid for at the unit prices bid for "Asphalt" and "Fabric Underseal", which price shall each be full compensation for cleaning and preparing the existing pavement; for furnishing, preparing, hauling and placing all materials, including sand or crusher screenings; for all freight involved; for all manipulation, including rolling and brooming and for all labor, tools, equipment and incidentals necessary to complete the work.

   Where a seal coat is proposed, "Aggregate" and "Asphalt" for the seal coat will be measured and paid for under the Item, "Seal Coat".

   Where an asphaltic concrete pavement is proposed, "Aggregate" and "Asphalt" for the asphaltic concrete pavement will be measured and paid for under the appropriate asphaltic concrete pavement item.

SPECIAL SPECIFICATION

ITEM 3225

HOT ASPHALT-RUBBER SEAL COAT

1. DESCRIPTION. This item shall consist of a surface treatment composed of a single application of a hot asphalt-rubber material covered with aggregate for sealing of new bases or existing pavements in accordance with these specifications.

Seal coats shall not be applied when the air temperature is below 70 F and is falling, but may be applied when the air temperature is above 65 F and is rising, the air temperature being taken in the shade and away from artificial heat.

Hot asphalt-rubber material shall not be placed when general weather conditions, in the opinion of the Engineer, are not suitable.

2. MATERIALS.

(1) Asphaltic Materials. The asphaltic materials used shall be one or more of the materials prescribed in the Item, "Asphalts, Oils and Emulsions", whichever are called for on plans.

(2) Rubber. (Rubber Manufacturer to Certify)

(a) Vulcanized Rubber. To be used in a mixture of asphalt, rubber and diluent. The rubber shall be ground tire rubber meeting, when tested by Test Method Tex-200-F, Part I, gradation as follows:

	Percent by Weight
Retained on No. 8 Sieve.....	0
Retained on No. 10 Sieve.....	0 - 2
Retained on No. 30 Sieve.....	90 - 100
Retained on No. 40 Sieve.....	96 - 100

The material shall be free from fabric, wire, cord or other contaminating materials except that up to 4% of a dusting material such as calcium carbonate may be included to prevent the particles from sticking together. The rubber, irrespective of diameter, shall not be greater than 1/4 inch in length and shall not have a moisture content in excess of 2 percent by weight.

(b) Combined Vulcanized and Devulcanized Rubber. To be used in a mixture of asphalt, extender oil and rubber.

The combined rubber shall be a mixture of ground tire rubber which is approximately 60% vulcanized rubber and 40% devulcanized rubber. Devulcanization to be detected by adding 40-50 grams of the rubber to a tight 6" rubber mill. The devulcanized rubber will bond on the mill roll in one pass and usually will be retained on the mill roll.

The natural rubber content by ASTM C 297 of the combined rubber shall be a minimum of 30%.

The gradation of the combined rubber when tested by Test Method Tex-200-F, Part I, shall be as follows:

	Percent by Weight
Retained on No. 8 Sieve	0
Retained on No. 30 Sieve	20 - 40
Retained on No. 50 Sieve	60 - 85
Retained on No. 100 Sieve	85 - 100

The combined rubber shall be free from fabric, wire, cord or other contaminating materials, except that up to 4% dusting agent such as calcium carbonate may be included to prevent the particles from sticking together.

(3) Diluent. The diluent shall have an initial boiling point of not less than 350 F when tested in accordance with ASTM Test Method D 86.

(4) Extender Oil. The extender oil shall be a high-flash, resinous aromatic type which when mixed with the asphaltic material will result in a mixture with an absolute viscosity of the blended materials of 600-2000 poises at 140 F.

(5) Aggregate. The aggregate used shall be of the type and grade or types and grades as noted on the plans and selected from those prescribed in the Items, "Aggregate for Surface Treatments (Class B)", "Aggregate for Surface Treatments (Precoated)(Class B)" or in the Item, "Aggregate for Surface Treatments (Lightweight)".

3. EQUIPMENT.

(1) Distributor. The distributor shall be self-propelled pressure type equipped with a separate power unit, distributing pump capable of pumping the specified material at the specified rate through the distributor tips, and equipment for heating the bituminous material. The distribution bar on the distributor shall be fully circulating with nipples and valves so constructed that they are bathed in the circulating asphalt to the extent that the nipples will not become partially plugged with congealing asphalt upon standing, thereby causing preliminary streaked or irregular distribution of asphalt. Distributor equipment shall include a tachometer, pressure gauges, volume measuring devices, and a thermometer for reading temperature of tank contents. The spray bars on the distributor shall be controlled by a bootman riding at the rear of the distributor in such a position that operation of all sprays is in full view and accessible to him for controlling spray widths. The distributor shall be capable of adequately mixing the asphalt, oil, diluent and rubber and keeping the rubber in uniform suspension. The distributor may be equipped with an on board scale system capable of weighing its load within an accuracy of 0.4% of the load being weighed.

The method and equipment for combining the rubber and asphalt shall be so designed and accessible that the Engineer can readily determine the percentages, by weight, of each of the two materials being incorporated into the mixture.

(2) Aggregate Spreader. A self-propelled continuous-feed aggregate spreader will be used which will uniformly spread aggregate at the rate specified by the Engineer.

(3) Rollers. Rolling equipment shall meet the governing specifications for the Item, "Rolling".

(4) Broom. Broom shall be a rotary, self-propelled power broom for cleaning existing pavement surfaces.

(5) Aggregate Heating System. The system for heating the cover aggregate shall be of the type that continually agitates the aggregate during heating and in which the temperature can be so controlled that the aggregate will not be injured in the necessary heating operations required to obtain the specified temperature. The burner, or combination of burners, and type of fuel used shall be such that in the process of heating the aggregate to the desired specified temperature, no residue from the fuel shall adhere to the heated aggregate. A continuous recording thermometer shall be provided which will indicate the temperature of the aggregate when it leaves the heating system.

(6) Truck Scales. A set of standard platform truck scales, conforming to the Item, "Weighing and Measuring Equipment" shall be placed at a location approved by the Engineer. The Engineer may waive this requirement if the distributor has adequate on board, calibrated scale system.

4. CONSTRUCTION METHODS. The Contractor may use a mixture of asphalt, diluent and rubber or of asphalt, extender oil and combined rubber.

(1) Mixture of Asphalt, Diluent (Optional) and Vulcanized Rubber.

(a) Mixing.

The temperature of the asphalt shall be between 350 F and 425 F during the addition of the rubber. The asphalt and rubber shall be carefully combined and mixed and reacted together for a period of time as required by the Engineer which shall be based on laboratory testing by the asphalt-rubber supplier or State Department of Highways and Public Transportation. The temperature of the resulting asphalt-rubber mixture shall not be less than 325 F during the reaction period.

If a job delay results after the full reaction has occurred, the asphalt-rubber mixture may be allowed to cool but shall be slowly reheated to an acceptable spraying temperature just prior to application. However, because of possible polymer reversion when rubber is held for prolonged periods of high temperatures, the asphalt-rubber mixture shall not be reheated to a temperature in excess of 350 F.

The Contractor shall show proof that his equipment is capable of mixing the asphalt and rubber to achieve the required consistency, or demonstrate the ability to achieve this consistency by placing a test section at a location acceptable to the Engineer.

The proportions of the two materials, by weight, shall be 75%, plus or minus 2%, asphalt and 25%, plus or minus 2%, ground vulcanized rubber. After the mix reaches the proper consistency described in (a) "Mixing" above, the mix may be diluted.

The amount of diluent used may be up to 7½%, by volume, of the hot asphalt-rubber composition as required for adjusting viscosity for spraying or better "wetting" of the cover aggregate.

(b) Prime Coat. Prior to applying the hot asphalt-rubber treatment on a base course, the surface to be sealed shall receive a prime coat, unless otherwise directed by the Engineer, applied and paid for as a separate item conforming to the requirements of the Item, "Prime Coat".

(c) Tack Coat. Unless otherwise directed by the Engineer, prior to applying the hot asphalt-rubber treatment on an existing wearing surface, a tack coat shall be applied. The tack coat, if used, shall not be paid for separately but shall be considered subsidiary to the various bid items.

(d) Spreading. Hot asphalt-rubber mixture shall be applied on the approved prepared surface with specified self-propelled pressure distributor so operated as to distribute the material in the quantity specified, evenly and smoothly, under a pressure necessary for proper distribution.

Hot asphalt-rubber material may be applied in a width not to exceed 13 feet, or as shown on the plans, but may be reduced if uniformity of distribution is not achieved. No traffic or hauling will be permitted over the freshly applied hot asphalt-rubber material. Hot asphalt-rubber material shall not be applied until immediate covering with aggregate at the proper temperature is assured. Paper or other suitable material shall be used to prevent overlapping of transverse joints.

Where specified on the plans, the cover aggregate shall be preheated to a temperature between 250 and 350 F. Canvas or similar covers that completely cover each load shall be used to minimize temperature drop of the exposed cover aggregate, if directed by the Engineer.

Aggregate shall be immediately and uniformly applied and spread by the specified self-propelled continuous feed aggregate spreader, unless otherwise shown on the plans or authorized by the Engineer in writing. The aggregate shall be applied at the approximate rates indicated on the plans and as directed by the Engineer.

The Contractor shall be responsible for the maintenance of the surface until the work is accepted by the Engineer.

The entire surface shall be broomed, bladed or raked as required by the Engineer and shall be thoroughly rolled with the type or types of rollers specified on the plans.

All storage tanks, piping, retorts, booster tanks and distributors used in storing or handling asphaltic material shall be kept clean and in good operating condition at all times, and they shall be operated in such manner that there will be no contamination of the asphaltic materials with foreign materials. It shall be the responsibility of the Contractor to provide and maintain in good working order a recording thermometer at the storage heating unit at all times. The Engineer will select the temperature of application based on the temperature-viscosity relationship that will permit application of the asphalt within the limits recommended in

the Item, "Asphalts, Oils and Emulsions".

(2) Mixture of Asphalt, Extender Oil and Combined Rubber.

(a) Mixing.

The proportions of the asphalt and rubber by weight, shall be 78%, plus or minus 2%, asphalt (including extender oil) and 22%, plus or minus 2%,rubber. The asphalt and extender oil shall be combined and heated to a temperature of not less than 400 F. The proportions of the asphalt and extender oil shall be that which will result in a blend of materials with an absolute viscosity of 600-2000 poises at 140 F, when sampled and tested in accordance with Test Method Tex-528-C.

After the asphalt and extender oil have reached the proper consistency, the combined rubber shall be added and thoroughly mixed.

The Contractor shall show proof that his equipment is capable of mixing the asphalt and rubber to achieve the required consistency, or demonstrate the ability to achieve this consistency by placing a test section at a location acceptable to the Engineer.

(b) Prime Coat. Prior to applying the hot asphalt-rubber treatment on a base course, the surface to be sealed shall receive a prime coat, unless otherwise directed by the Engineer, applied and paid for as a separate item conforming to the Item, "Prime Coat".

(c) Tack Coat. Unless otherwise directed by the Engineer, prior to applying the hot asphalt-rubber treatment on an existing wearing surface, a tack coat shall be applied. The tack coat, if used, shall not be paid for directly but shall be considered subsidiary to the various bid items.

(d) Spreading. Hot asphalt-rubber mixture shall be applied at a temperature between 375 F and 425 F on the approved prepared surface with specified self-propelled pressure distributor so operated as to distribute the material in the quantity specified, evenly and smoothly, under a pressure necessary for proper distribution.

Hot asphalt-rubber material may be applied in a width not to exceed 13 feet, or as shown on the plans, but may be reduced if uniformity of distribution is not achieved. No traffic or hauling will be permitted over the freshly applied hot asphalt-rubber material. Hot asphalt-rubber material shall not be applied until immediate covering with aggregate at the proper temperature is assured.

Paper or other suitable material shall be used to prevent overlapping of transverse joints.

Where specified on the plans, the cover aggregate shall be preheated to a temperature between 250 and 350 F. Canvas or similar covers that completely cover each load shall be used to minimize temperature drop of the exposed cover aggregate, if directed by the Engineer.

Aggregate shall be immediately and uniformly applied and spread by the specified self-propelled continuous feed aggregate spreader, unless otherwise shown on the plans or authorized by the Engineer in writing. The aggregate shall be applied at the approximate rates indicated on the plans and as directed by the Engineer.

The Contractor shall be responsible for the maintenance of the surface until the work is accepted by the Engineer.

The entire surface shall be broomed, bladed or raked as required by the Engineer and shall be thoroughly and slowly rolled with type or types of rollers specified on the plans.

All storage tanks, piping, retorts, booster tanks and distributors used in storing or handling asphaltic materials shall be kept clean and in good operating condition at all times, and they shall be operated in such manner that there will be no contamination of the asphaltic materials with foreign materials. It shall be the responsibility of the Contractor to provide and maintain in good working order a recording thermometer at the storage heating unit at all times.

5. MEASUREMENT. Hot asphalt-rubber mixture will be measured by the ton of 2,000 pounds, including asphalt, rubber and diluent (or extender oil); weighed upon completion of the mixing and just prior to delivery to the point of application, and tared immediately after application. If the distributor is equipped with on board scales the weighing will be immediately before and after each application.

Aggregate will be measured by the cubic yard in vehicles as applied on the road.

Rolling of the type specified on the plans, performed as required by the Engineer, will be measured by the actual hours such rolling equipment works.

6. PAYMENT. The work performed and materials furnished as prescribed by this item and measured as provided under "Measurement" will be paid for at the unit prices bid for "Hot Asphalt-Rubber" and "Aggregate" of the class, type and grade specified, which prices shall be full compensation for cleaning the existing surface; for furnishing all materials and freight involved; for all heating, mixing, hauling and placing all materials including tack coat and for all manipulations, labor, tools, equipment and incidentals, including test sections, necessary to complete the work except rolling and prime coat.

All rolling performed as required will be measured and paid for in accordance with the provisions governing the Item, "Rolling".

The prime coat will be measured and paid for in accordance with the provisions governing the Item, "Prime Coat".