

PAVEMENT CONDITION STUDY
UTILIZING CATEGORY II EXPERIMENTAL PROCEDURES

An Interim Report

VERMONT DEPARTMENT OF HIGHWAYS

J. T. Gray, Commissioner

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Report prepared under the
supervision of W. F. Murphy,
Paving Engineer
April, 1975

"This report was developed for the use and benefit of the Vermont Department of Highways. Anyone, other than the Department, using this report does so with awareness that the Department does not guarantee the opinions, findings, or conclusions contained therein."

INTRODUCTION

This interim report contains the results to date of the Vermont Department of Highway's findings on pavement conditions that utilized Category II experimental procedures. As this is a "running log" reporting procedure, the charts and graphs contained herein supersede and replace the appropriate charts and graphs of previous interim reports.

A typical pavement cross-section and a location sketch for each project was included in the Master Plan, and will not be included in this or subsequent reports in the interest of brevity.

DISCUSSION

This report includes the results of the 1974 Fall cores, at which time five projects were four years old, two projects were five years old, and one project was six years old.

One area of concern that the study addresses is transverse cracking, relative to pavement age and recovered penetration. With the exception of overlays on projects that were already badly cracked there is no transverse cracking to date.

We, through this study, want to determine the feasibility of starting with a softer asphalt (which means a low viscosity asphalt at the time of initiation of the project), so that the time to reach a critical hardening point is extended over that of an initially harder asphalt. At the present time there is no question that this is what is happening. While the 150-200 penetration grade appears to have a significant advantage at this time, subsequent aging may change the slope of the curve.

It is interesting that although the 85-100 penetration asphalt continues to drop below the recovered penetration value of 40, which was the arbitrary critical penetration, there is no transverse cracking in this section. The location of this section must also be considered. This area, Rutland, has as many and possibly more freeze thaw cycles than other areas in the study. These facts would indicate that transverse cracking may be more a function of prolonged colder temperatures than warm-cold cycles. If this holds true the recovered penetration values of 40 probably will not be valid in specific areas.

The comparisons of projects with two grades of asphalt on the same project are interesting. The projects in Rutland - Proctor, Brookfield-Williamstown-Berlin and Montpelier-Middlesex, comparison of recovered penetration show definite advantages of softer asphalt in all these projects. Comparisons of air voids are decreasing with age and viscosities are increasing, although not as rapidly as we had expected.

To date it seems apparent that a asphalt with low initial viscosity will retain certain desirable characteristics over a longer time span than asphalt with a high initial viscosity. However, we point out that what we consider desirable characteristics may not be at all desirable to someone else.

RECOMMENDATIONS

In 1975 all projects in this study will be at least five years old. We therefore intend to modify our present procedure as follows:

We will maintain our semi-yearly visual inspection schedule. We will discontinue further coring until the time that transverse cracking is noted. At the time transverse cracking is noted we will again take cores in an effort to establish the critical recovery penetration values.

The need of feedback is very apparent as this study progresses. To date virtually no feedback from the interim reports has been received.

We suggest that as you insert this interim report in your master plan, a review be made. We are very interested in your thoughts, and would appreciate your reply. Please address replies to:

Mr. William F. Murphy
Paving Engineer
Vermont State Highway Dept.
Montpelier, Vermont 05602

IN DEPTH PAVEMENT STUDY UTILIZING CATEGORY II PROCEDURES

PROJECT		LANE	LOCATION	PENETRATION	CORE NO.
Rutland-Proctor	S 0163 (1)	NB	Town Line	120-150	1
"	"	NB	Comb Pole 4-3/56 (Stans Hillside Rest.)	85-100	2
Sharon-Royalton	I 89-1 (26)	SB	20/40	100-120	3
"	"	NB	16/05	100-120	4
Brook-Will-Berlin	I 89-1 (29)	NB	48/20	120-150	6
"	"	SB	48/30	150-200	5
Montpelier-Middlesex	I 89-2 (19)	NB	57/20 - 57/15	120-150	7
"	"	SB	57/20	150-200	8
Middlesex-Waterbury	I 89-2 (18)	SB	62/70	100-120	9
"	"	NB	60/20	100-120	10
Waterbury-Bolton	I 89-2 (20)	NB	68/20	120-150	11
"	"	SB	68/30	120-150	12
South Hero	RF-F028-1 (4)	NB	Directly in Front of Town Hall	120-150 (Binder) 100-120 (Top)	13 14
"	"	SB	@ Intersection of TH #8 Across from Post Office	120-150	15
Derby	I 91-3 (7)	EB	200' west of Island (Rte 5 over I-91)	120-150	16
"	"	WB	200' east of Island	120-150	17

Note: Core number shall always include date taken. Example - core marked 4-5/71 would be from Sharon-Royalton I 89-1 (26) NB taken in May of 1971.

COMPOSITE
PENETRATION
ALL CORES

PENETRATION @ 77°F

160
140
120
100
80
60
40
20

AGE IN YEARS

150-200 Pen.

100-120 Pen.

120-150 Pen.

85-100 Pen.

"THE CHAMPION LINE" NO. 81
CROSS SECTION 10 SQUARES TO INCH

PENETRATION @ 77°F

160

140

120

100

80

60

40

20

0

1

2

3

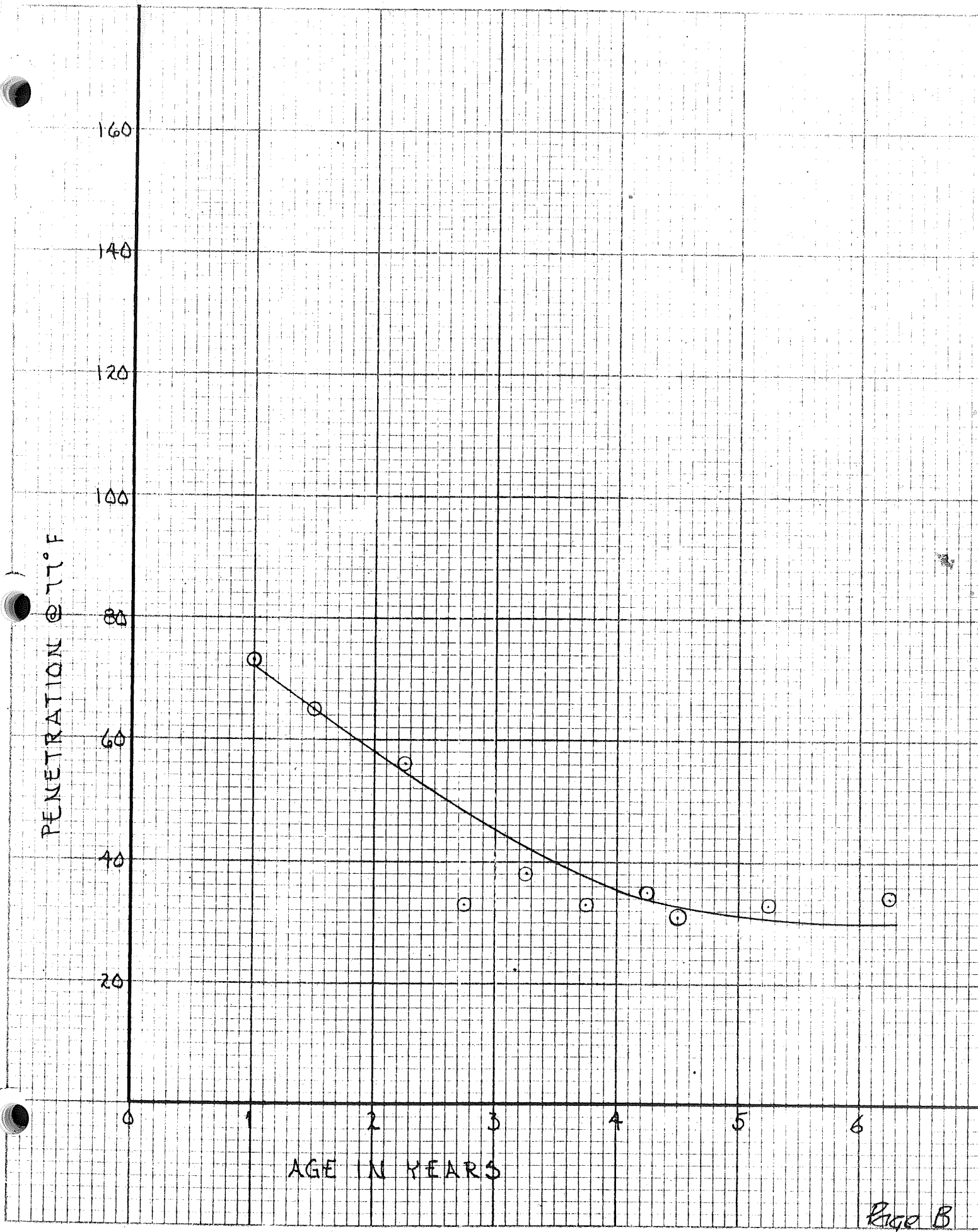
4

5

6

AGE IN YEARS

Page B

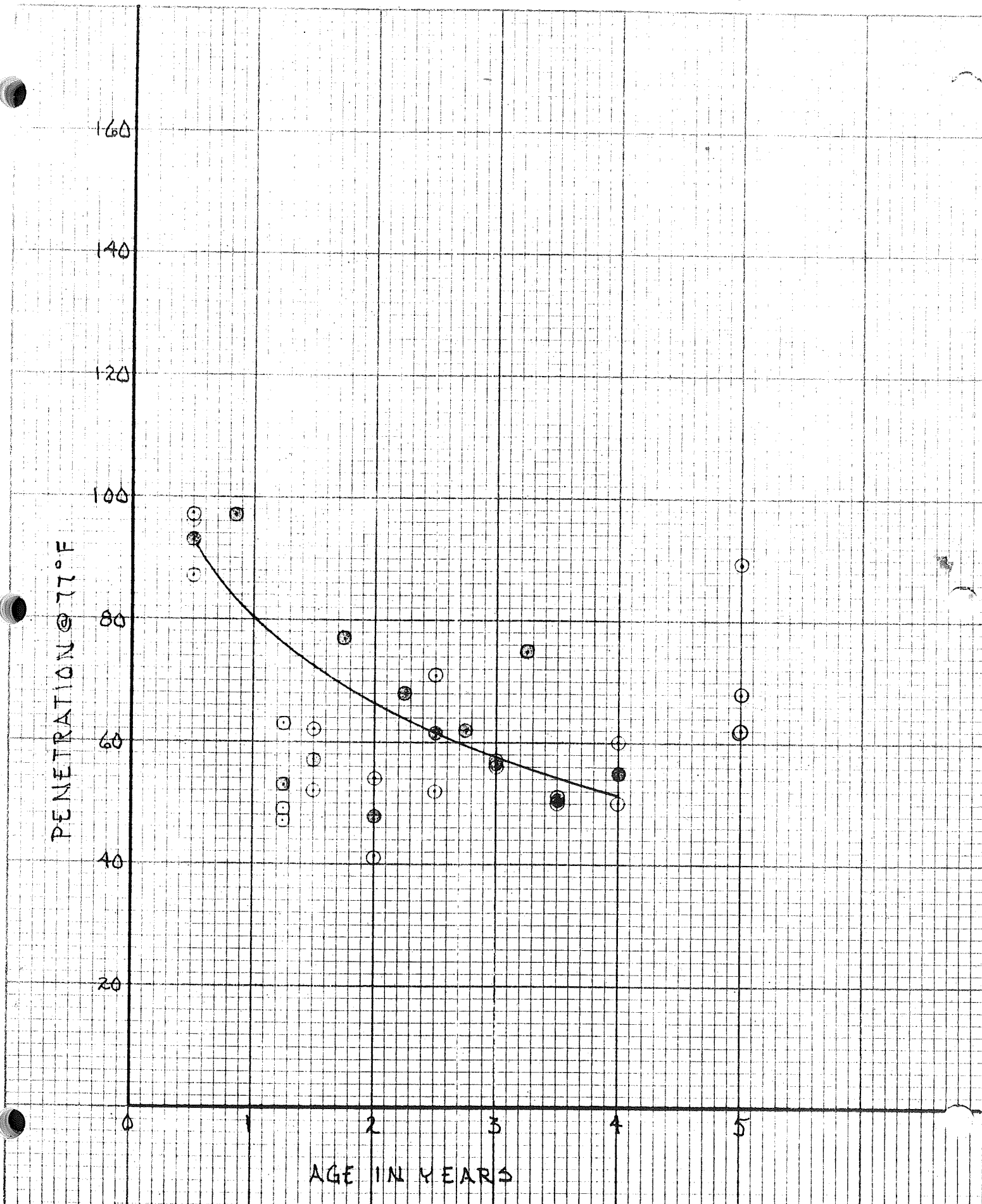


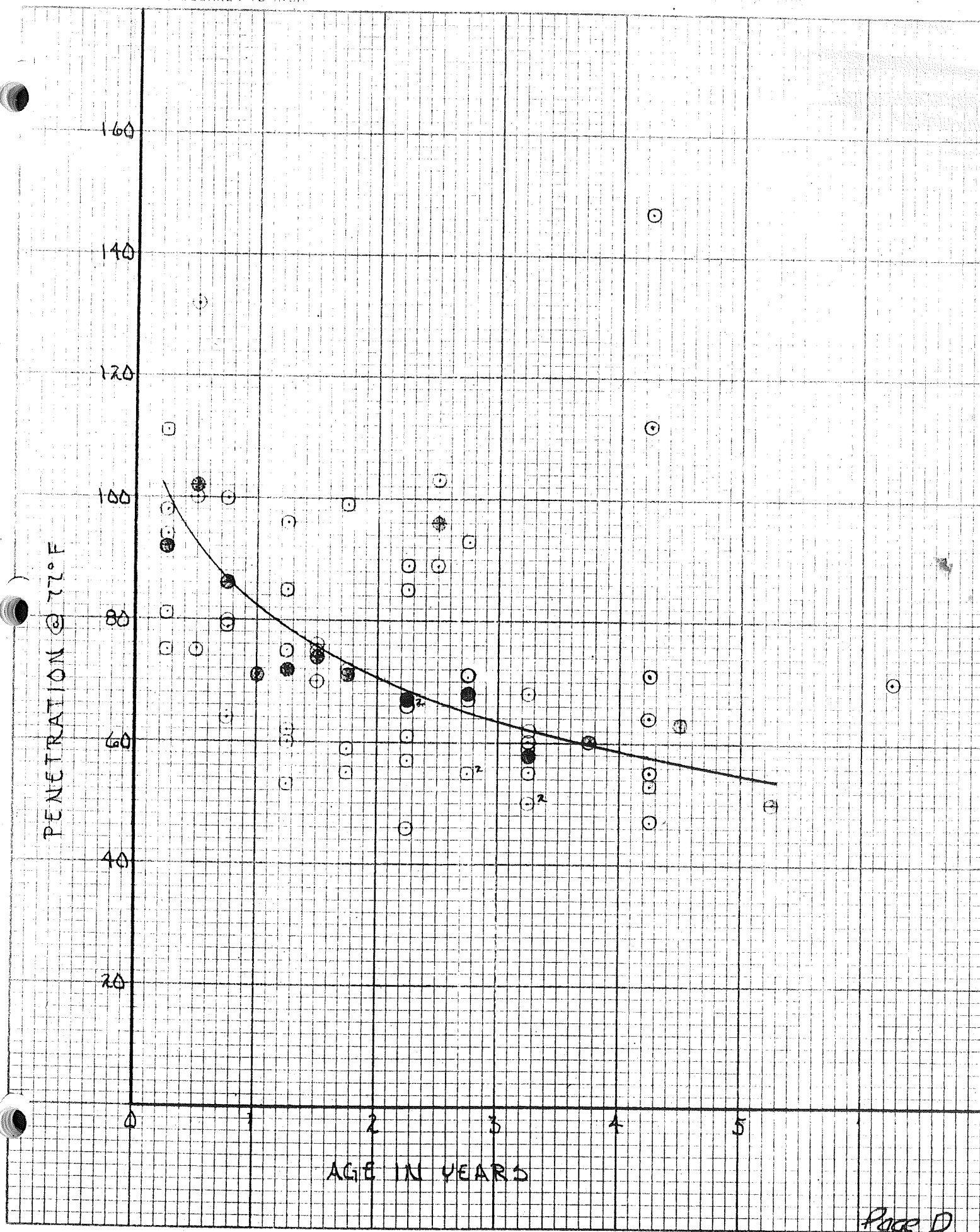
PENETRATION @ 77°F

160
140
120
100
80
60
40
20

AGE IN YEARS

0 1 2 3 4 5





THE COLUMBIAN LINE NO. 815

CROSS SECTION 10 SQUARES TO INCH

PENETRATION @ 77°F

160

140

120

100

80

60

40

20

0

1

2

3

4

5

AGE IN YEARS

Page E

125

122

108

99

103

74

FLEXIBLE PAVEMENT EVALUATION SURVEY

Route I 89 Project Sharon-Royalton No. I 89-1 (26)Date Built, Beginning Stage I 1967 Ending Stage II 1969 Paved 1969Prime Contractor Perini Corp. Stage II Resident W. F. MurphyPaving Contractor L. M. Pike & Son, Inc. Road Insp. Alan AreyPlant Location Bethel, Vermont Plant Insp. John BullardType Base Item 213 - Open Binder Type III Surface to be applied on Stage IIIThickness Base 5" Binder 1 3/4" Surface 1 1/2" Stage IIIBituminous Material: Source Atlantic Refining CorporationGrade 100-120 Average Pen. Top Binder 107

Traffic Data

		YEAR						
	Design	1970	1971	1972	1973	1974		
ADT	2660	3927	5435	5960	5960	5550		
DVH			900	1020	780	420		
D%			54	58SB	58	58		
T%			8	10	7	7		

Sample Locations:

Northbound

Delineator Post 16/05 Sta. 855+00 Core Location #4

Southbound

Delineator Post 20/40 Sta. 1086+00 Core Location #3

Remarks: Core location 3a. selected 150'± south of 20/40 as this area appears to be more representative of the pavement in the area. after 1 year of service.

Climatological Data

Year	69-70	70-71	71-72	72-73	73-74		
Freezing Index	1544	1595	1226	983	649		
Freeze Thaw Cycles	82	96	105	112	110		

DESIGN OF BITUMINOUS MIX

to Interstate Project Sharon-Royalton Number I 89-1 (26)

Sieve	Base Item 213			Binder Type III			Item 361 Top Type III		
	Specs	Job Mix	Job Average	Specs	Job Mix	Job Average	Specs	Job Mix	Job Average
2	100	100	100		----	-----			
1 1/2		----	----			-----			
1	55-75	55-75	62			-----			
3/4		----	----	100	100	100			
1/2	25-55	25-55	35	95-100	95-100	99	1/2"	95/100	98
3/8		----	----	76-94	82-94	86	3/8"	80/92	86
3/4	5-25	5-25	13	54-74	58-70	61	#4	58/70	63
10	0-10	0-10	9	34-53	40-49	46	#8	44/53	50
20		----	----	14-32	18-27	24	#16	32/41	38
40		----	----	8-20	8-17	11	#30	21/30	26
200		----	----	3-6	3-6	4	#50	11/20	15
Ac	2.5-3.5	2.5-3.5	3.1	6-8	6.2-7.0	6.5	#200	3/6	5
							AC	6.1/6.9	6.4

Tests on Compacted Mixes

Ability-Method	<u>Marshall</u>	Ave. Top (lb.)	<u>1352</u>	Type III	Ave. Binder (lb.)	<u>1112</u>
% of Theoretical Density-Top	<u>98</u>	% Binder	<u>96</u>			
Ave % Voids - Top	<u>3</u>	% Binder	<u>4</u>			
Ave % Voids Filled with Ac-Top	<u>85</u>	% Binder	<u>76.2</u>			
Ave Flow - Top	<u>9</u>	Binder	<u>6</u>			

Aggregate:

	Binder	Top Whitcomb	Binder	Top
+10 Source	<u>Rock of Ages Quarry</u>	<u>W. Leb.</u>	<u>Bethel White Granite</u>	<u>Amphibolite</u>
+10 Source		Type		
-10 Source	<u>Perini - Ford Pit</u>	<u>Pike-Norwich</u>	<u>Natural Sand</u>	<u>Natural Sand</u>
-10 Source	<u>Perini-Bethel</u>	Type	<u>Crusher Dust</u>	
Filler or Additive, Source	<u>None</u>	Type		

Remarks: Above values are valid for entire (26) contract. For actual test results for test areas. See Plant Inspector's daily reports for 8-13-69 (NB 16/05) and 8-18-69 (SB 20/40) for surface course.

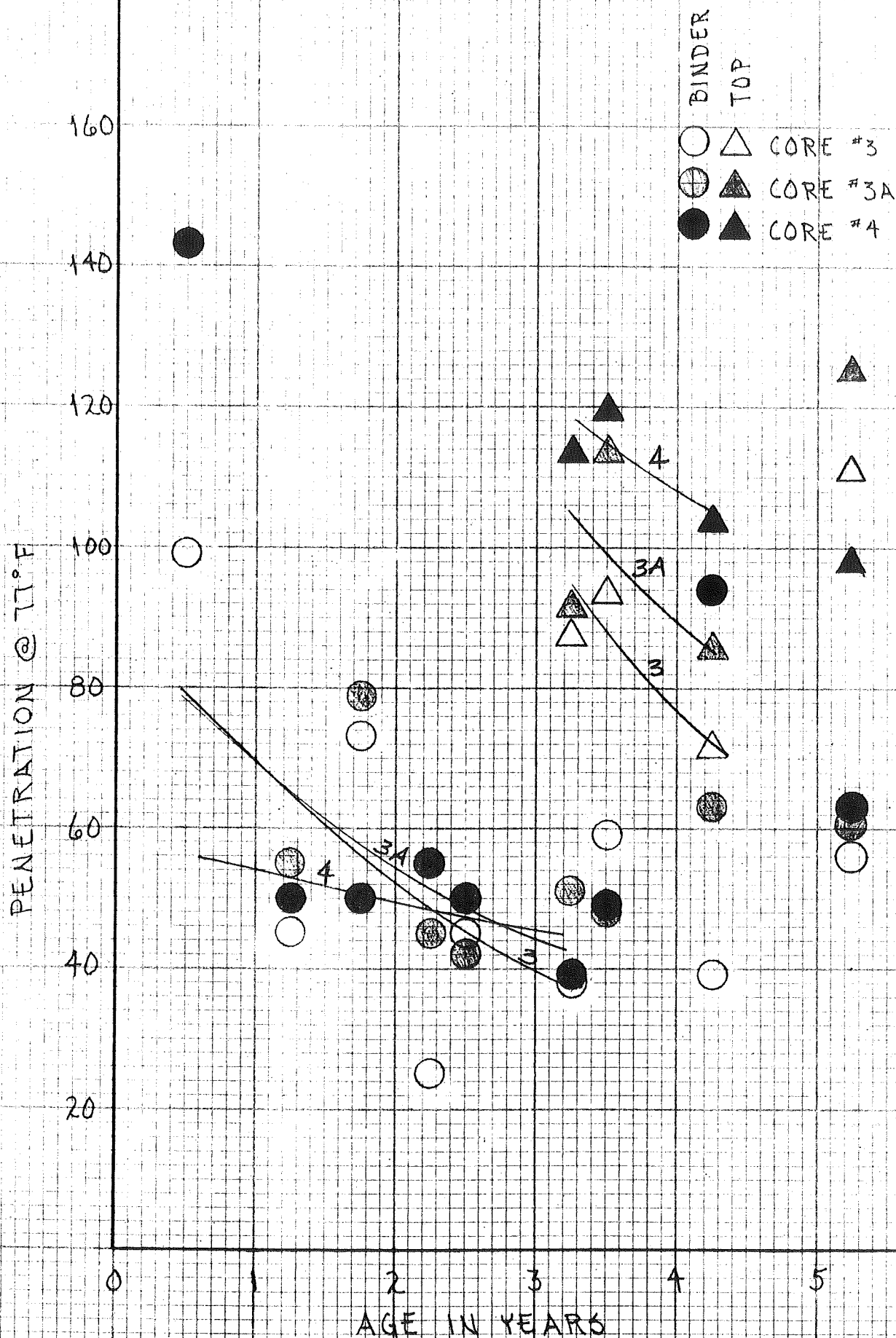
Date Abson Run	Core No.	Age	Recov. Pen.		Density		TCI (Feet)	Recov. Viscosity	
			Top	Bind. SB	Top	Bind.		Top	Bind.
4/21/70	3-4-70	1/2	-	1 99	-	93.2	NONE	-	1 1322
12/3/70	3-12-70	1 1/2	-	2 45	-	93.9	NONE	-	2 4335
5/24/71	3-5-71	1 3/4	-	3 73	-	95.2	NONE	-	3 2020
11/17/71	3-11-71	2 1/2	-	3 25	-	97.0	NONE	-	3 6211
4/14/72	3-4-72	2 1/2	-	3 45	-	96.3	NONE	-	3 5113
1/27+2/6/73	3-11-72	3 1/2	3 87	3 38	95.2	97.1	NONE	3 965	1 5944
4/23/73	3-4-73	3 1/2	3 93	1 59	97.5	97.7	NONE	3 909	3 3066
12/18&19/73	3-10-73	4 1/4	3 71	3 39	97.4	95.8	NONE	3 1050	3 6017
11/12&14/74	3-11-74	2 1/4	3 111	3 56	98.3	97.4	NONE	3 548	3 3271
				NE					
4/21/70	4-4-70	1/2	-	1 143	-	93.8	NONE	-	1 941
12/4/70	4-12-70	1 1/2	-	2 50	-	96.2	NONE	-	2 3646
5/26/71	4-5-71	1 3/4	-	2 50	-	93.5	NONE	-	2 3664
11/18/71	4-11-71	2 1/2	-	3 55	-	96.9	NONE	-	3 3063
4/13/72	4-4-72	2 1/2	-	3 50	-	95.2	NONE	-	3 4247
2/1+7/73	4-11-72	3 1/2	3 114	3 39	97.6	98.3	NONE	3 752	3 3960
4/26/73	4-4-73	3 1/2	3 120	3 49	97.0	97.5	NONE	3 736	3 3915
1/11&14/73	4-10-73	4 1/4	3 104	2 94	97.5	97.9	NONE	3 839	2 1164
11/21&26/74	4-11-74	2 1/4	3 98	3 63	96.3	98.1	NONE	3 906	3 2038

Stage
III
Summer '72

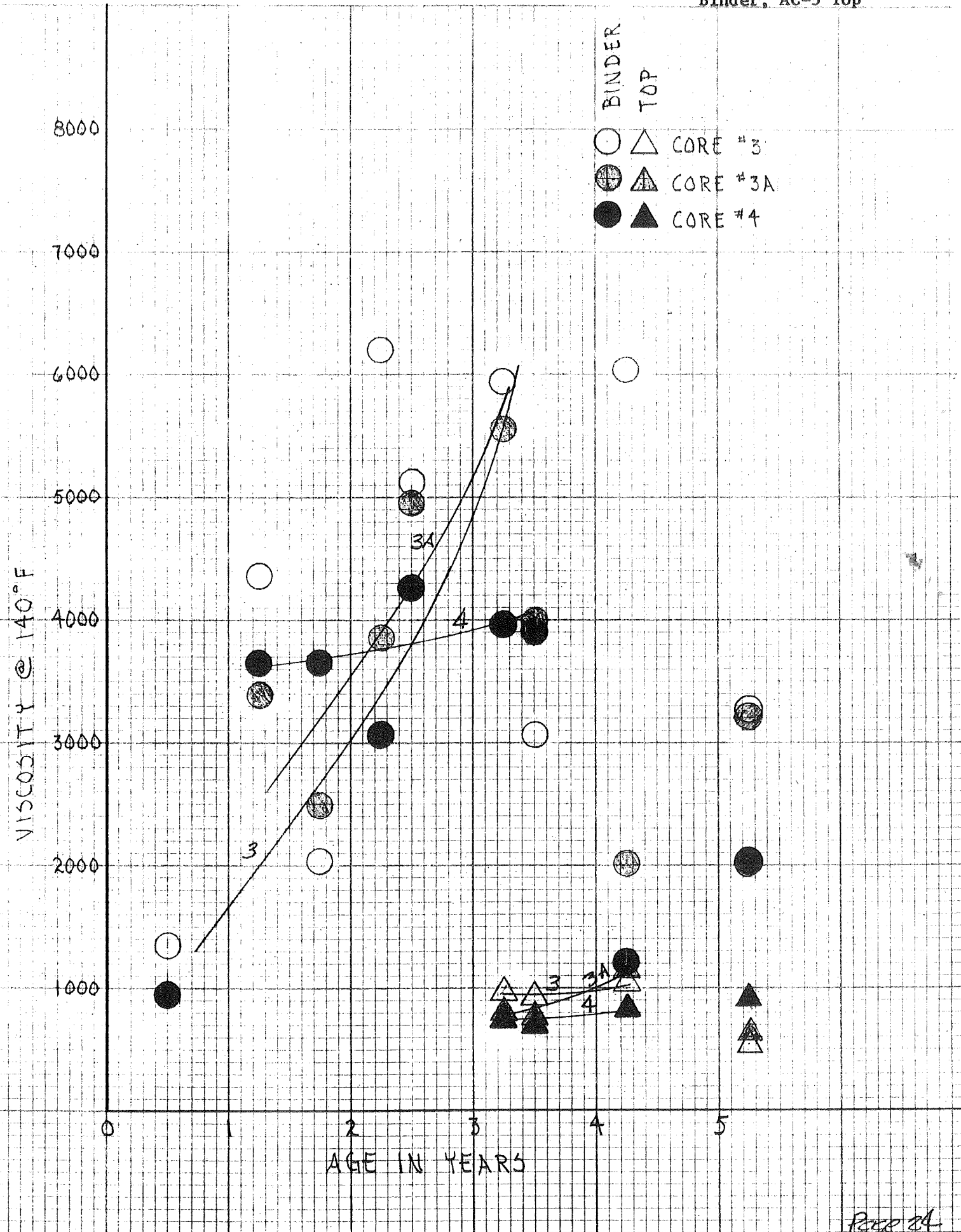
Stage
III
Summer '72

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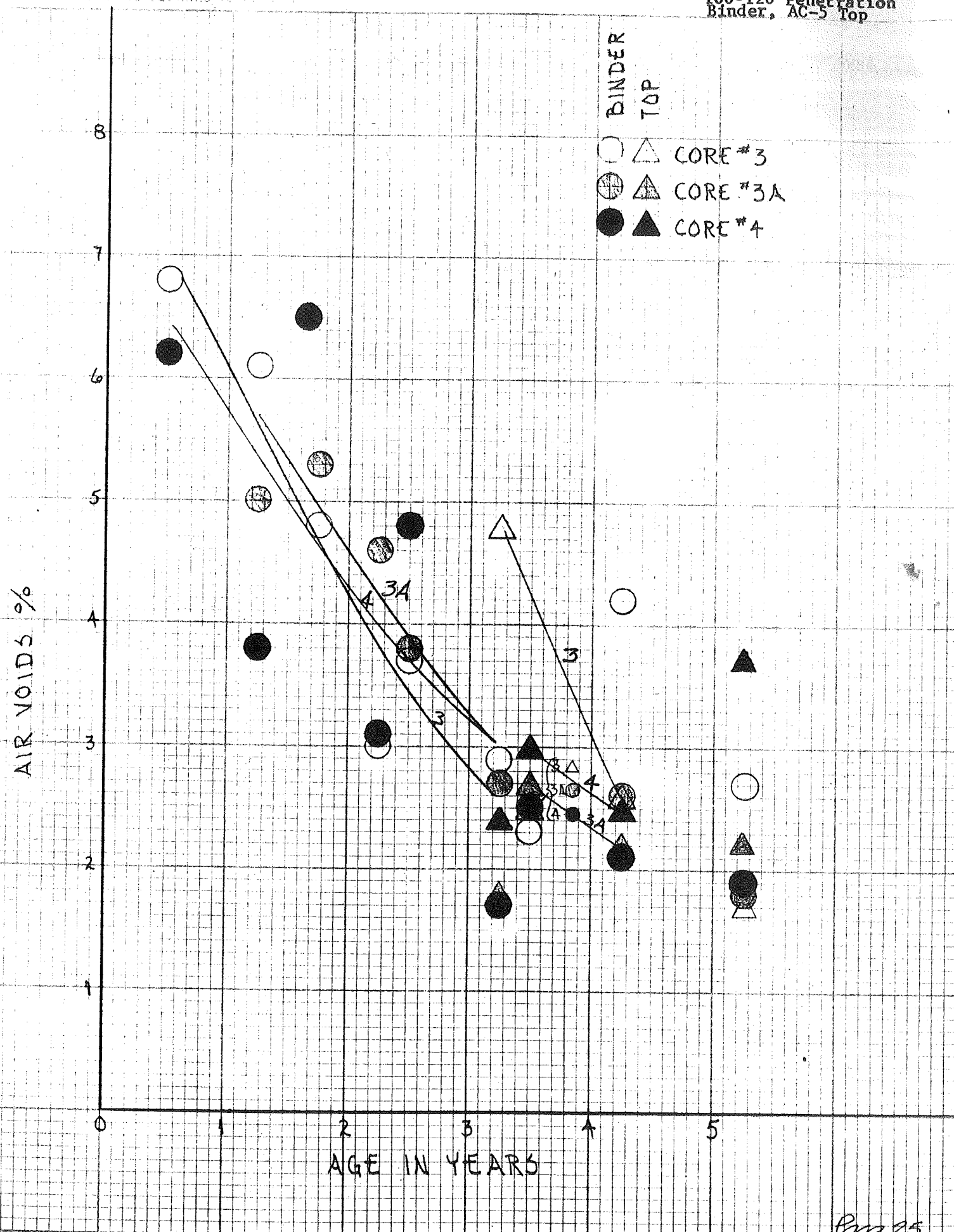
Stage
III
Summer
72



OF VISCOSITY UNIT NO. 10
 SQUARES TO



USE OF THIS REPORT IS LIMITED TO THE
 PROJECT AND AREA FOR WHICH IT WAS PREPARED



FLEXIBLE PAVEMENT EVALUATION SURVEY

oute Interstate Project Brookfield-Williamstown-Berlin No. I 89-1 (29)

ate Built, Beginning Stage I 1969 Ending Stage II 1970 Paved 1970

Prime Contractor Perini Corporation Resident A. Lavin

Paving Contractor L. M. Pike & Sons, Inc. Road Insp. R. Lance, F. Hall, Jr.

Plant Location Berlin Plant Insp. R. Rippner

Type Base Item 213 Binder Type III Surface To be applied on Stage II

Thickness Base 5" Binder 1 3/4" Surface 1 1/4"

Bituminous Material: Source Atlantic & Shell of Canada

Grade 120-150 Average Pen. Top Binder 137

Traffic Data

	YEAR							
	1965 Design	1971	1972	1973	1974			
ADT	2650	5380	6660	5960	6280			
DVH		830	970	780	845			
D%		53	59	58	55			
T%		4	10	7	7			

Sample Locations:

Paved October 5, 1970

48 NB 48 NB Delineator Posts
15 25
Core Area #6 Approx. Sta. 2603 ±0 - 2612 ±00

Remarks:

Climatological Data

Year	69-70	70-71	71-72	72-73	73-74		
Freezing Index	1900	2115	1533	983	953		
Freeze Thaw Cycles	76	76	73	112	80		

FLEXIBLE PAVEMENT EVALUATION SURVEY

Route Interstate Project Brookfield-Williamstown-Berlin No. I 89-1 (29)Date Built, Beginning Stage I 1970 Ending Stage II 1970 Paved 1970Prime Contractor Perini Corporation Resident A. LavinPaving Contractor L. M. Pike & Son, Inc. Road Insp. R. Lance, F. Hall, Jr.Plant Location Berlin Plant Insp. R. RippnerType Base Item 213 Binder Type III Surface To be applied in Stage IIIThickness Base 5" Binder 1 3/4" Surface 1 1/2"Bituminous Material: Source Shell of Canada, British PetroleumGrade 150-200 Binder AC-5 Top Average Pen. Top 179 Binder 157

Traffic Data

	YEAR					
	1965 Design	1971	1972	1973	1974	
ADT	2650	5380	6660	6660	6280	
DVH		830	970	860	845	
D%		53	59	59	59	
T%		4	10	7	7	

Sample Locations: Paved October 16, 197048 SB 48 SB Core #5 Approx. Sta. 2612±0
25 35

Remarks:

Climatological Data

Year	69-70	70-71	71-72	72-73	73-74		
Freezing Index	1900	2115	1533	1322	953		
Freeze Thaw Cycles	76	76	73	115	80		

DESIGN OF BITUMINOUS MIX

Interstate Project Brookfield-Williamstown-Berlin Number I 89-1 (29)

Sieve	Base % Passing			Binder % Passing			Quality Assurance Program - 406 Top III		
	Specs	Job Mix	Job Average NB SB	Specs	Job Mix	Job Average NB SB	Specs	Job Mix	Job Average
2	---	---	255	---	---	---	---	---	---
1 1/2	100	Same	100 100	---	---	---	---	---	---
1	55-85	Same	77 77	---	---	---	---	---	---
3/4	45-70	Same	62 62	100	Same	100 100	---	---	---
1/2	35-55	Same	43 49	95-100	Same	98 98	1/2"	98	99
3/8	---	---	---	76-94	78-90	82 81	3/8"	86	86
1/4	15-25	Same	17 17	54-74	54-66	58 57	#4	59	60
#10	3-10	Same	9 7	34-53	40-49	45 43	#8	48	48
#20	---	---	---	14-32	14-23	21 20	#16	39	39
#30	---	---	---	3-20	8-17	12 11	#30	29	29
#200	---	---	---	3-6	Same	5 5	#50	17	16
Ac	3.5-4.5	Same	4.1 4.0	6.0-8.0	6.0-6.8	6.3 6.3	#200 AC	4 6.4	3 6.5

Tests on Compacted Mixes

Stability-Method	Marshall	Ave. Top (lb.)	1074	Ave. Binder (lb.)	1738 (SB) 1656 (NB)
Ave % of Theoretical Density-Top	95	% Binder	NB 97 SB 97		%
Ave % Voids - Top	5	% Binder	3 3		%
Ave % Voids Filled with Ac-Top	79.1	% Binder	80.2 80.2		%
Ave Flow - Top	11	Binder	10 9		

Aggregate:

+10 Source	Kelly Const. Co.	Type	Granite
+10 Source		Type	
-10 Source	Perini Pit (Lemieux Pit)	Type	Sand (natural)
-10 Source		Type	

Filler or Additive, Source None Type

Remarks: Above values for NB lane in Control Strip area. Core Area paved October 5, 1969 see Plant Inspector's Daily Report for actual values for this site.

Date Abson Run	Core No.	Age	Recov. Pen.		Density		TCI (Feet)	Recov. Viscosity	
			Top	Bind.	Top	Bind.		Top	Bind.
				SB 150-200					
12/2/70	5-11-70	(-)	-	2 117	-	97.0	NONE	-	2 1060
6/4/71	5-5-71	1/2	-	3 120	-	96.7	NONE	-	3 1111
11/30/71	5-11-71	1	-	3 64	-	95.6	NONE	-	3 1796
4/14/72	5-4-72	1 1/2	-	3 117	-	97.8	NONE	-	3 1048
12/26/72	5-11-72	2	-	3 105	-	97.2	NONE	-	3 1139
5/1/73	5-4-73	2 1/2	-	3 107	-	98.1	NONE	-	3 1101
1/15&16/74	5-10-73	1/4	3 101	3 123	96.7	98.6	NONE	3 1046	3 970
12/2&4/74	5-11-74	1 1/4	3 102	3 103	97.6	98.1	NONE	3 777	3 1111
				NB 120-150					
12/7/70	6-11-70	(-)	-	3 86	-	92.3	NONE	-	3 1418
5/27/71	6-5-71	1/2	-	3 83	-	93.2	NONE	-	3 1554
12/1/71	6-11-71	1	-	3 95	-	97.3	NONE	-	3 1161
4/18/72	6-4-72	1 1/2	-	3 64	-	96.2	NONE	-	3 1536
12/27/72	6-11-72	2	-	3 56	-	97.1	NONE	-	3 2188
5/1/73	6-4-73	2 1/2	-	3 62	-	96.6	NONE	-	3 2004
1/17&18/74	6-10-73	1/4	3 100	3 103	97.8	98.3	NONE	3 1108	3 624
12/6&8/74	6-11-74	1 1/4	2 104	2 103	97.9	98.0	NONE	2 724	2 1110

Stage III
AC-5
179 Pen.
515 Vis.

Stage III
AC-5
179 Pen.
515 Vis.

3 (Switched #5 & #6)

PENETRATION @ 77°F

160
140
120
100
80
60
40
20

AGE IN YEARS

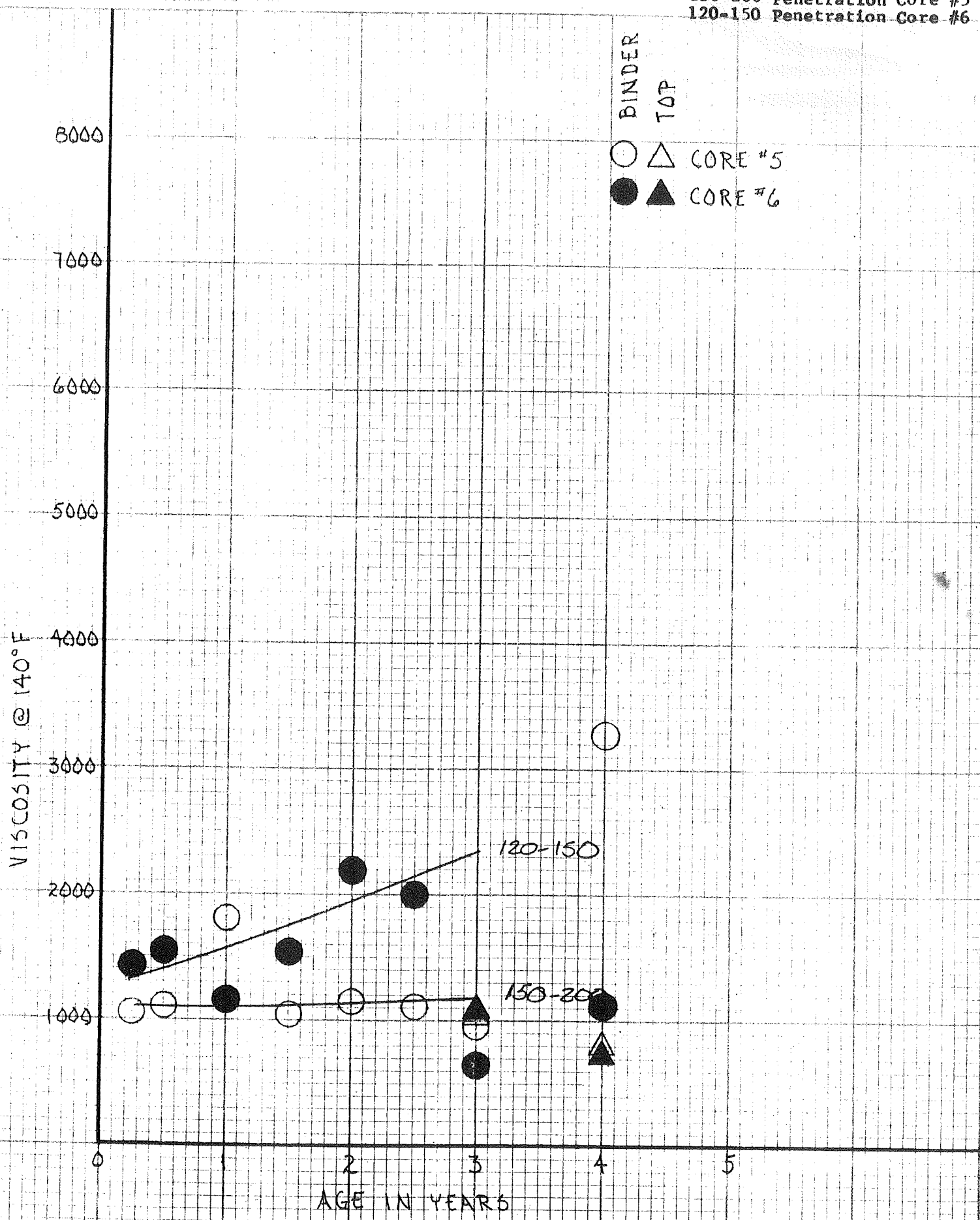
BINDER

TAP

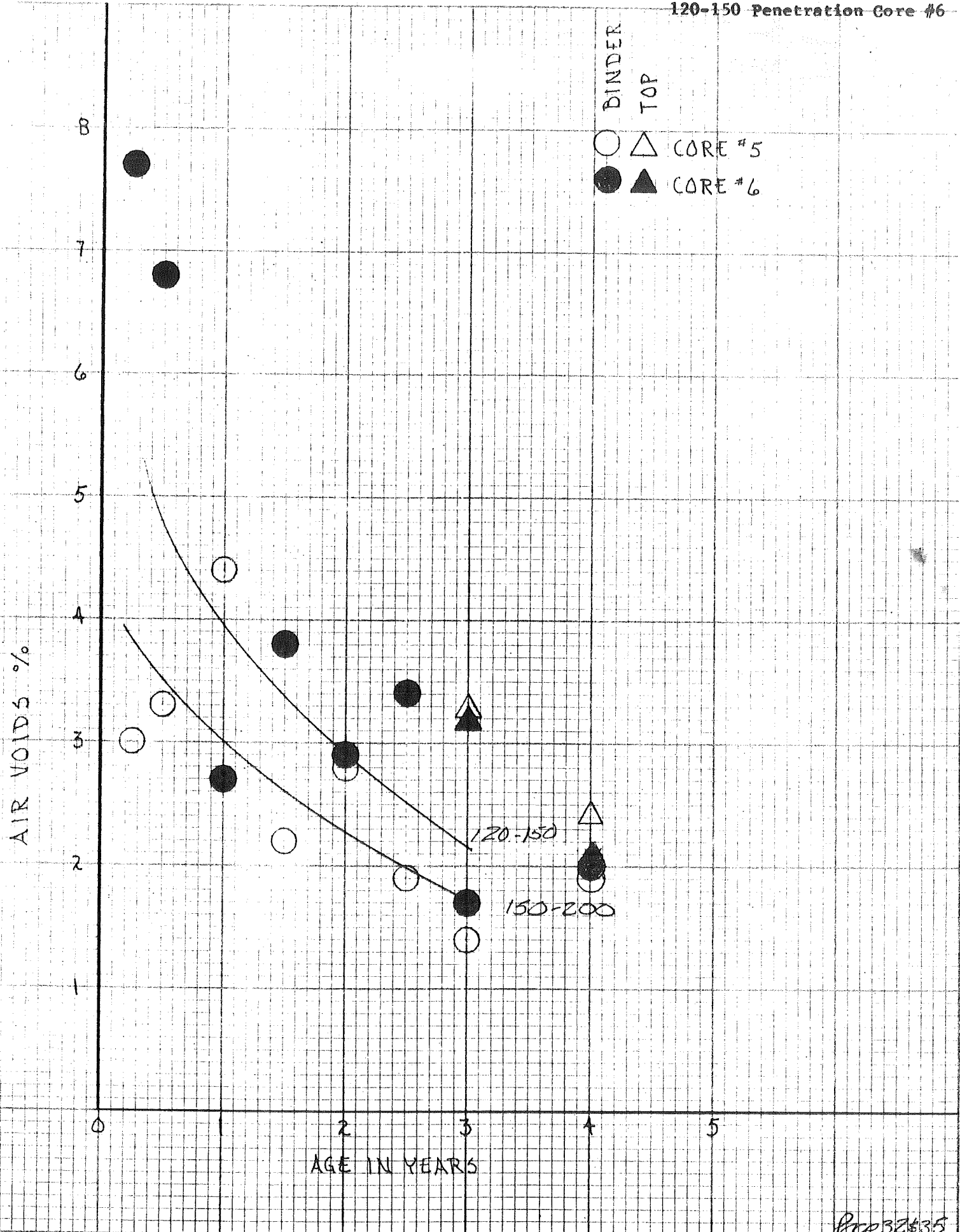
○ △ CORE #5
● ▲ CORE #6

150-200

120-150



THE CHART FOR LINE NO. 810
 ROLL 30 INCHES SQUARES TO 1/4 IN



FLEXIBLE PAVEMENT EVALUATION SURVEY

Route Interstate Project Montpelier-Middlesex No. I 89-2 (19)

Date Built, Beginning Overlay Ending Paved 1970

Prime Contractor L. M. Pike & Son, Inc. Resident R. H. Snow

Paving Contractor L. M. Pike & Son, Inc. Road Insp. T. J. Connellie

Plant Location & L. M. Pike @ Williston Plant Insp. Walsh, Grout, Colby, Stancliff
Kelly Const. @ Barre

Type Base Binder Surface Type IV

Thickness Base Binder Surface 2"

Bituminous Material: Source Atlantic - Albany, New York

120-150 130

Grade 150-200 Average Pen. Top 162 Binder

Traffic Data

	Design	YEAR						
		1971	1972	1973	1974			
ADT	4380	8845	9660	9660	9210			
DVH		1210	1420	1120	1245			
D%		55	55	55	55			
T%		4	10	7	7			

Sample Locations:

Delineator Post 57/0 NB Core Location #7

NB Lane - 120-150 Pen. A.C.

Delineator Post 57/1 SB Core Location #8

SB Lane 150-200 Pen. A.C.

Remarks: Original pavement constructed 1960. Overlay consisted of 2 one-inch courses of Type IV mix. Mix furnished by 3 plants.

Climatological Data

Year	69-70	70-71	71-72	72-73	73-74		
Freezing Index	1900	2115	1533	1322	953		
Freeze Thaw Cycles	76	76	73	115	80		

DESIGN OF BITUMINOUS MIX

ate Interstate Project Montpelier-Middlesex Number I 89-2 (19)

Sieve	Base			Binder			Top Type IV		
	Specs	Job Mix	Job Average	Specs	Job Mix	Job Average	Specs	Job Mix	Job Average
2									
1 1/2									
1									
3/4									
1/2									
3/8									
#4							95-100	95-100	100
#10							50-85	63-75	72
#20							35-70	45-54	50
#40							16-40	21-30	27
#80							8-26	8-17	13
#200							3-6	3-6	4
%Ac							6-8	6.6-7.4	6.8

Tests on Compacted Mixes

Stability-Method Marshall Ave. Top (lb.) 912 Ave. Binder (lb.) _____

Ave % of Theoretical Density-Top 96.5 %Binder _____ %

Ave % Voids - Top 3.5 % Binder _____ %

Ave % Voids Filled with Ac-Top 81.3 % Binder _____ %

Ave Flow - Top 10 Binder _____

Aggregate:

+10	Source	<u>Pike-Demers Quarry (Winooski)</u>	Type	<u>Trap Rock</u>	<u>Dolomitic Limestone</u>
+10	Source	<u>VT Paving Same</u>	Type		
-10	Source	<u>L.M. Pike Richmond Pit</u>	Type	<u>Sand</u>	
-10	Source	<u>VT Paving Williston Pit</u>	Type	<u>Sand</u>	
Filler or Additive, Source		<u>Demers-Shelburne</u>	Type	<u>Dust</u>	

Remarks: + 10 Source Kelley Const. Crushed granite

- 10 Source Kelley Const. Sand

- 10 Source Kelley Const. Crushed granite (dust)

Same job mix used all 3 plants.

Montpelier-Middlesex I 89-2 (19)

[illegible]

PENETRATION @ 77°F

160

140

120

100

80

60

40

20

BINDER
TOP

○ △ CORE #7
 ● ▲ CORE #8

150-200 Binder
 150-200 Top

120-150 BINDER

120-150 TOP

AGE IN YEARS

VISCOSITY @ 140°F

8000

7000

6000

5000

4000

3000

2000

1000

0

2

3

4

5

AGE IN YEARS

BINDER

TOP



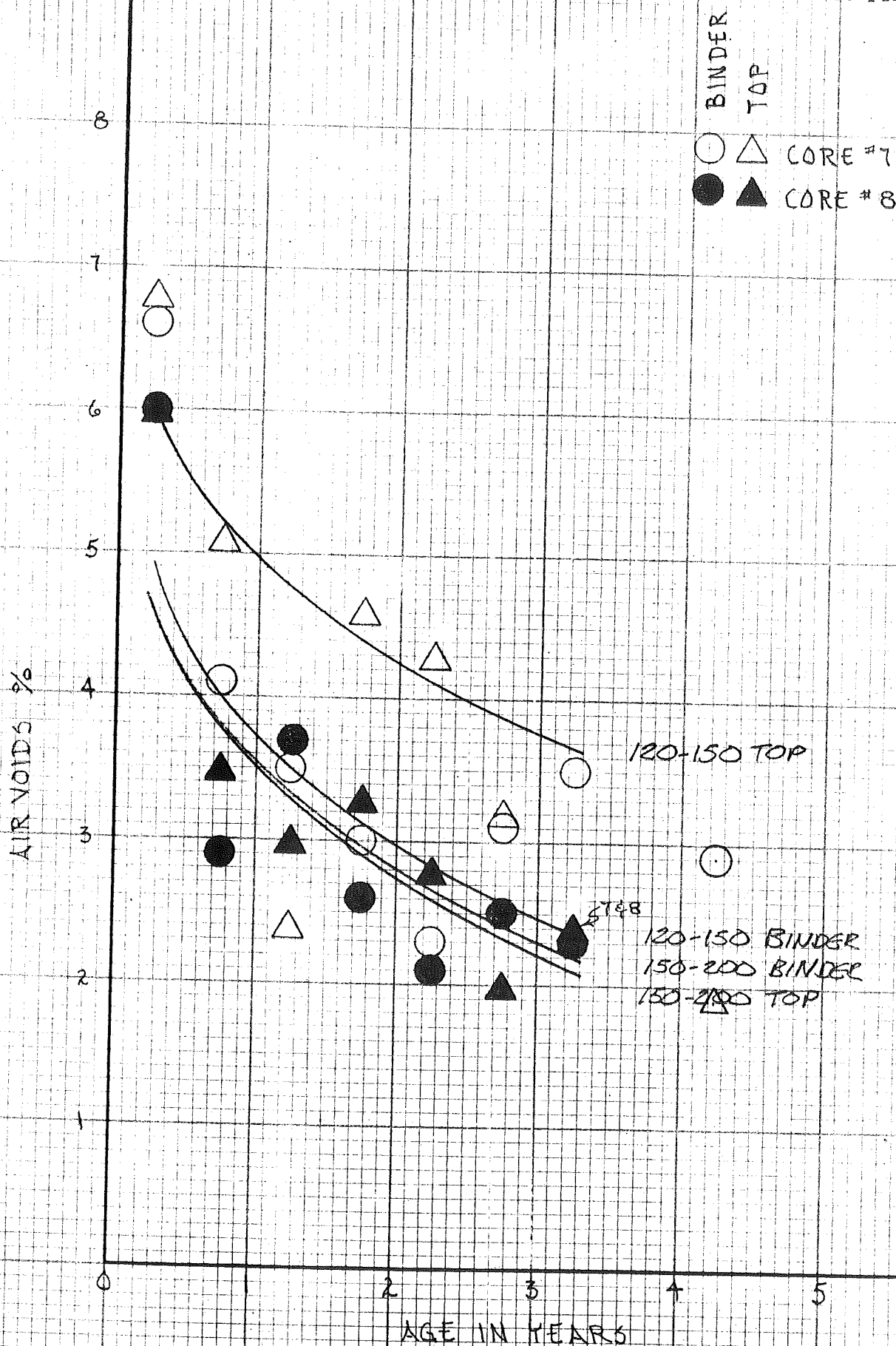
CORE #7



CORE #8

120-150

150-200



FLEXIBLE PAVEMENT EVALUATION SURVEY

Route Interstate Project Middlesex-Waterbury No. I 89-2 (18)

Date Built, Beginning Overlay Ending _____ Paved 1969

Prime Contractor L. M. Pike & Son, Inc. Resident R. Woodard

Paving Contractor L. M. Pike & Son, Inc. Road Insp. R. Snow
VT Paving - Williston

Plant Location L. M. Pike - Williston Plant Insp. Callan, Potter, Grout
Kelley Const. - Barre

Type Base _____ Binder _____ Surface Type IV

Thickness Base _____ Binder _____ Surface 2"

Bituminous Material: Source Atlantic - Albany, New York

Grade 100-120 Average Pen. Top 106 Binder _____

Traffic Data

	Design	YEAR			
		1971	1972	1973	1974
ADT	4380	8150	9160	9160	8460
DVH		1120	1210	1080	1140
D%		55	55	55	55
T%		4	10	7	7

Sample Locations:

Delineator Post 60/18 SB Core location #10 (changed to 62/00 NB 1971 safety reasons)

Delineator Post 62/14 SB Core location #9

Remarks: Original pavement constructed 1960. Overlay consisted of 2 one-inch courses of Type IV mix. 3 plants supplied mix for the overlay project.

Climatological Data

Year	69-70	70-71	71-72	72-73	73-74
Freezing Index	1669	1593	1380	1120	1076
Freeze Thaw Cycles	83	85	97	107	101

DESIGN OF BITUMINOUS MIX

Route Interstate Project Middlesex-Waterbury Number I 89-2 (18)

	Base			Binder			Top		
Sieve	Specs	Job Mix	Job Average	Specs	Job Mix	Job Average	Specs	Job Mix	Job Average
2							----	----	-----
1 1/2							----	----	-----
1							----	----	-----
3/4							----	----	-----
1/2							----	----	-----
3/8							100	100	100
#4							95-100	95-100	99
#10							63-75	62-74	69
#20							45-57	45-54	49
#40							21-30	24-33	27
#80							8-17	8-17	11
#200							3-6	3-6	3.7
%Ac							6.6-7.4	6.3-7.1	6.9

Tests on Compacted Mixes

Stability-Method Marshall Ave. Top (lb.) 894 Ave. Binder (lb.) _____

Ave % of Theoretical Density-Top 96.3 %Binder _____ %

Ave % Voids - Top 3.7 % Binder _____ %

Ave % Voids Filled with Ac-Top 81.3 % Binder _____ %

Ave Flow - Top 10 Binder _____

Aggregate:

+10 Source VT Paving - Demers Quarry Type Trap Rock (Dolomite Limestons)

+10 Source L.M. Pike - Demers Quarry Type " " " "

-10 Source VT Paving (Williston) Type Sand

-10 Source L.M. Pike (Richmond) Type Sand

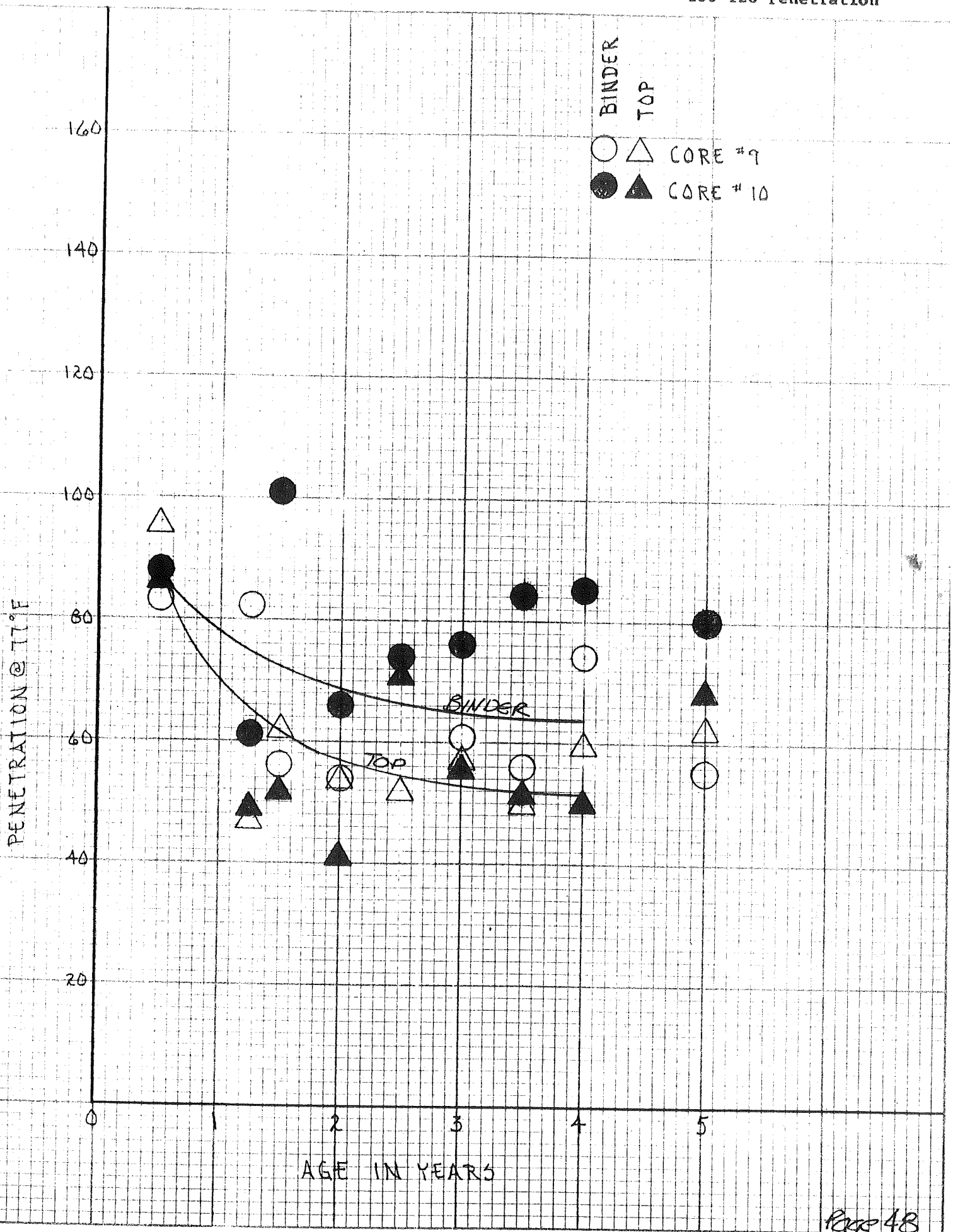
Filler or Additive, Source Demers Type Crusher Dust

Remarks: + 10 Source Kelley Const. (crushed Granite) Barre
 - 10 Source Kelley Const.
 Filler or Additive Source Kelley Const.

Same job mix used all 3 plants.

Date Abson Run	Core No.	Age	Recov. Pen.		Density		TCI (Feet)	Recov. Viscosity	
			Top	Bind.	Top	Bind.		Top	Bind.
						SB			
4/14/70	9-4-70	1/2	1 96	1 83	92.6	91.8	NONE	1 1426	1 1876
12/28/70	9-12-70	1 1/2	2 47	2 82	95.0	95.5	NONE	2 3906	2 1858
5/20/71	9-5-71	1 1/2	2 62	3 56	94.4	95.7	100	2 3011	3 2927
11/23/70	9-11-71	2	2 54	3 54	98.1	96.2	67	2 3311	3 3186
5/2/72	9-4-72	2 1/2	2 52	-	97.8	-	200	2 3459	-
1/12/73	9-11-72	3	2 57	3 61	98.8	95.7	200 travel 100 pass	2 2485	3 2572
5/7&8/73	9-4-73	3 1/2	3 50	3 56	97.4	95.8	33	3 3295	3 2627
1/24&25/74	9-10-73	4	3 60	3 74	96.8	94.9	33	3 2233	3 2151
12/23&27/74	9-11-74	5	3 62	3 55	95.8	96.5	21 TRAVEL 125 PASS	3 2049	3 2577
						SB			
4/15/70	10-4-70	1/2	1 87	1 88	89.8	93.7	NONE	-	1 1592
12/11/70	10-12-70	1 1/2	2 49	2 61	94.4	93.2	NONE	2 4261	2 2777
						NB			
5/19/71	10-5-71	1 1/2	3 52	3 101	98.5	96.7	200	3 3262	3 1517
11/24/71	10-11-71	2	3 41	3 66	96.8	96.4	20	3 3806	3 2416
4/27/72	10-4-72	2 1/2	3 71	3 74	99.2	96.7	29	3 2094	3 1804
12/15+16/73	10-11-72	3	3 56	3 76	99.5	96.6	40 travel 33 pass	3 2245	3 1760
5/8&9/73	10-4-73	3 1/2	3 51	3 84	99.7	97.8	200	3 2900	3 2059
1/25&28/74	10-10-73	4	2 50	3 85	99.0	96.6	200 TRAVEL 67 PASS	2 2895	3 1443
12/30&31/74	10-11-74	5	3 68	3 80	99.4	97.1	18 TRAVEL 18 PASS	3 981	3 1485

* Because of traffic hazard, have switched to 62/09 NB from 60/18 SB.



VISCOSITY @ 140°F

BINDER
TOP
CORE #9
CORE #10

8000
7000
6000
5000
4000
3000
2000
1000

AGE IN YEARS

0

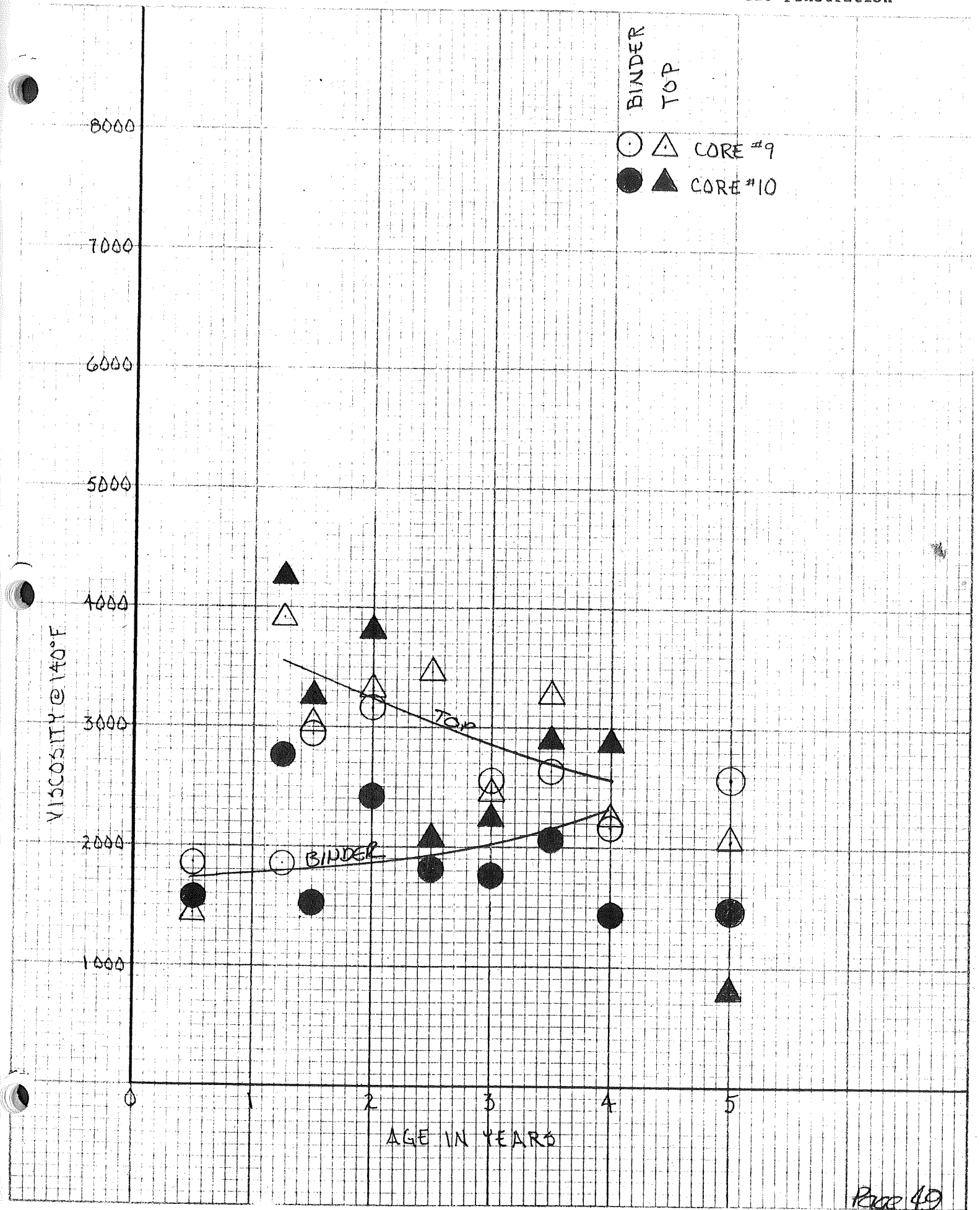
1

2

3

4

5



10.2

Middlesex-Waterbury
I 89-2(18)
100-120 Penetration

AIR VOIDS %

AGE IN YEARS

BINDER
TOP
CORE #9
CORE #10

8
7
6
5
4
3
2
1
0

2

3

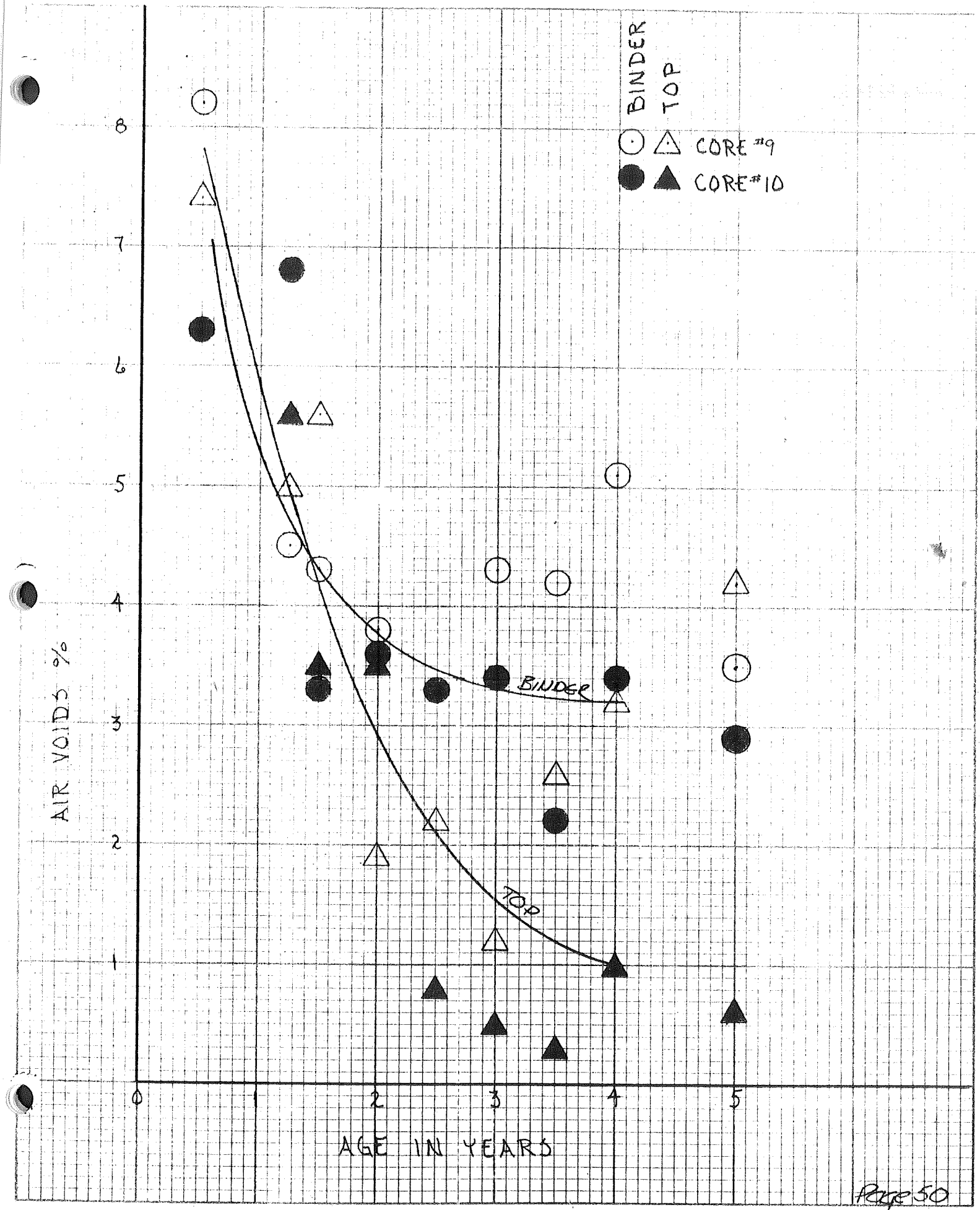
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5

BINDER

TOP

Page 50



FLEXIBLE PAVEMENT EVALUATION SURVEY

Route Interstate Project Waterbury-Bolton No. I 89-2 (20)Date Built, Beginning Overlay Ending _____ Paved 1970Prime Contractor L. M. Pike & Son, Inc. Resident R. W. TurnerPaving Contractor L. M. Pike & Son, Inc. Road Insp. R. LancePlant Location VT Paving & L. M. Pike @ Williston Plant Insp. Grout, Walsh, Colby, StancliffType Base _____ Binder _____ Surface Type IVThickness Base _____ Binder _____ Surface 2"Bituminous Material: Source Atlantic - AlbanyGrade 120-150 Average Pen. Top 130 Binder _____

Traffic Data

		YEAR						
	Design	1971	1972	1973	1974			
ADT	3980	8255	8750	8750	7960			
DVH		1110	1150	1040	1075			
D%		56	54	54	54			
T%		5	10	7	7			

Sample Locations:

Delineator Post 68/2 NB Core location #11Delineator Post 68/3 SB Core Location #12

Remarks: Original pavement constructed 1961. Overlay consisted of 2 one-inch courses of Type IV mix. Mix furnished by two plants.

Climatological Data

Year	69-70	70-71	71-72	72-73	73-74		
Freezing Index	1689	1593	1380	1120	1076		
Freeze Thaw Cycles	83	85	97	107	101		

DESIGN OF BITUMINOUS MIX

Route Interstate Project Waterbury-Bolton Number I 89-2 (20)

Sieve	Base			Binder			Top Type IV		
	Specs	Job Mix	Job Average	Specs	Job Mix	Job Average	Specs	Job Mix	Job Average
2									
1 1/2									
1									
3/4									
1/2							100	Same	100
3/8							95-100	Same	100
#4							50-85	68-80	71
#10							35-70	45-54	48
#40							16-40	21-30	27
#80							8-26	8-17	12
#200							3-6	Same	4
%Ac							6-8	6.2-7.0	6.8

Tests on Compacted Mixes

Stability-Method Marshall Ave. Top (lb.) 870 Ave. Binder (lb.) _____
 Ave % of Theoretical Density-Top 97 %Binder _____
 Ave % Voids - Top 3 % Binder _____
 Ave % Voids Filled with Ac-Top 83.5 % Binder _____
 Ave Flow - Top 9 Binder _____

Aggregate:

+10	Source	<u>Demers Quarry (Winooski)</u>	Type	<u>Dolomitic Limestone</u>
+10	Source	<u>Demers Quarry (Shelburne)</u>	Type	<u>Same</u>
-10	Source	<u>Pike - Richmond Pit</u>	Type	<u>Sand</u>
-10	Source	<u>VT Paving - Williston Pit</u>	Type	<u>Sand</u>
Filler or Additive, Source		<u>Demers Quarry (Shelburne)</u>	Type	<u>Crusher Dust</u>

Remarks: Same job mix used both plants.

Waterbury-Bolton I 89-2 (20)

[illegible]

THE CHAMPION LINE NO. 813
CROSS SECTION 10 SQUARES TO INCH

PENETRATION @ 77°F.

160

140

120

100

80

60

40

20

0

AGE IN YEARS

BINDER

TOP



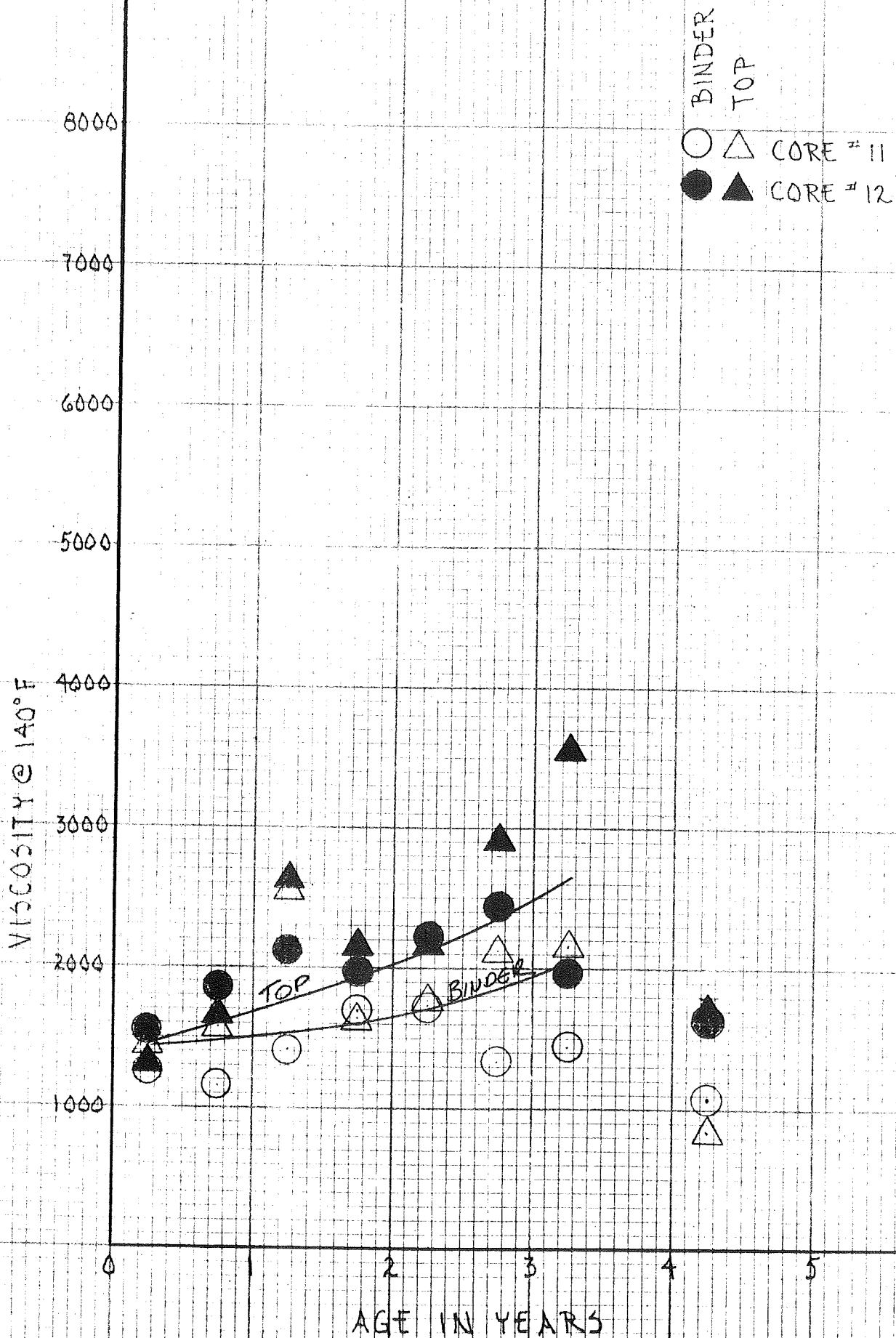
CORE #11

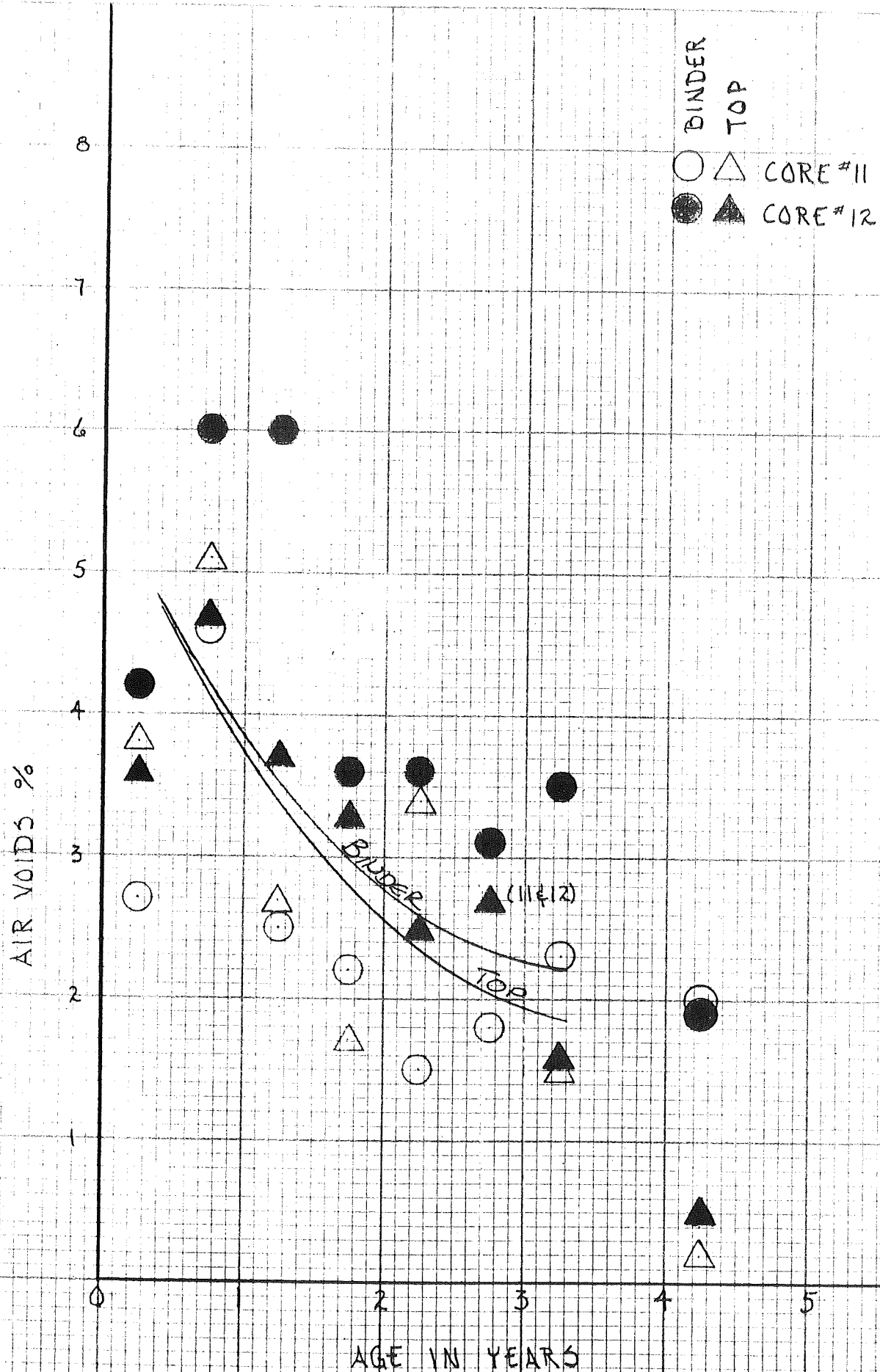


CORE #12

TOP

BINDER





FLEXIBLE PAVEMENT EVALUATION SURVEY

Route Interstate Project DerbyF 341-5 (3)
No. I 91-3 (7)Date Built, Beginning Binder 1969 Ending Top 1970 Paved 1969+1970Prime Contractor S. V. Rossi Const. Co. Resident Nelson Duba, Dave SargentPaving Contractor L. M. Pike & Son, Inc. Road Insp. Dave SargentPlant Location Coyentry, VT Plant Insp. PotterType Base Item 213 Binder Type II Surface Type IIIThickness Base 3" Binder 1 3/4" Surface 1 1/4"Bituminous Material: Source Esso Everett, Mass.Grade 120-150 Average Pen. Top 125 Binder 125

Traffic Data

	1967 Design	YEAR							
		1971	1972	1973	1974				
ADT	1130	1365	1250	5200	5550				
DVH		225	230	700	525				
D%		56	59	52	52				
T%		6	11	7	7				

Sample Locations:

US #5 portion of Contract at Derby interchange Core location #16 200'± west of west end of islands.Core location #17 200'± east of east end of islands.Remarks: US #5 relocation portion of I 91-3 (7)

Climatological Data

Year	69-70	70-71	71-72	72-73	73-74		
Freezing Index	2069	1975	1792	1342	1404		
Freeze Thaw Cycles	86	91	95	113	99		

DESIGN OF BITUMINOUS MIX

Route US #5 Project Derby Number I 91-3 (7)

Sieve	Base Item 213			Binder Type II			Top Type III		
	Specs	Job Mix	Job Average	Specs	Job Mix	Job Average	Specs	Job Mix	Job Average
2		100	100						
1 1/2									
1		55-75	66		100	100			
3/4					95-100	99			
1/2		25-55	40		80-92	86		95-100	100
3/8					68-80	74		82-94	90
3/4		5/25	14		44-56	49		54-66	65
#10		0-10	7		33-42	37		41-54	48
#20					16-27	22		20-29	23
#30					8-17	10		8-17	9
#200					2-5	3		3-6	3
Ac		2.5-3.5	3.1		5.3-6.1	6.0		6.0-6.8	6.5

Tests on Connected Mixes

Stability-Method Marshall Ave. Top (lb.) 962 Ave. Binder (lb.) 1150

Ave % of Theoretical Density-Top 93.1 %Binder 95.1

Ave % Voids - Top 6.9 % Binder 4.9

Ave % Voids Filled with Ac-Top Not obtainable % Binder 75.6

Ave Flow - Top 5 Binder 8

Aggregate:

+10 Source Calkins - Coventry Type Crushed Gravel

+10 Source Type

-10 Source Pike - Coventry Type Natural Sand

-10 Source Type

Filler or Additive, Source Type

Remarks:

Derby I 91-3 (7)

Date Alson Run	Core No.	Age	Recov. Pen.		Density		TCI (Feet)	Recov. Viscosity	
			Top	Bind.	Top	Bind.		Top	Bind.
2/18/71	16-12-70	$\frac{1}{4}$	¹ 98	³ 131	93.8	94.5	NONE	¹ 1441	³ 946
5/10/71	16-5-71	$\frac{1}{2}$	² 75	³ 111	94.9	94.9	NONE	² 1974	³ 1224
12/7/71	16-11-71	$1\frac{1}{4}$	² 75	³ 100	95.1	95.0	NONE	² 2012	³ 1455
6/23/72	16-5-72	$1\frac{1}{2}$	² 70	³ 103	95.2	96.3	NONE	² 2339	³ 1318
12/29/72- 1/2/73	16-11-72	$2\frac{1}{4}$	46	³ 86	97.5	96.4	NONE	2849	1451
5/18&22/73	16-4-73	2 $1\frac{1}{2}$	² 89	³ 99	96.5	96.8	NONE	² 1591	³ 1203
12/4&6/73	16-11-73	3 $1\frac{1}{4}$	³ 55	³ 126	97.1	96.2	NONE	³ 3015	³ 868
1/20&22/75	16-10-74	4 $1\frac{1}{4}$	² 55	³ 121	98.0	96.9	16	² 2340	³ 807
2/16/71	17-12-70	$\frac{1}{4}$	³ 111	³ 156	96.1	94.8	NONE	³ 1247	³ 775
5/12/71	17-5-71	$\frac{1}{2}$	³ 100	³ 117	-	-	NONE	³ -	² 1078
12/9/71	17-11-71	$1\frac{1}{4}$	³ 85	² 88	95.6	94.1	NONE	³ 1580	² 1533
6/5/72	17-5-72	$1\frac{1}{2}$	³ 76	³ 85	96.1	96.3	NONE	³ 1528	³ 1738
1/3&4/72	17-11-72	$2\frac{1}{4}$	85	64	95.9	97.5	NONE	1497	1778
5/23/73	17-4-73	2 $1\frac{1}{2}$	³ 103	³ 113	95.5	96.6	NONE	³ 1111	³ 1222
12/6&11/73	17-11-73	3 $1\frac{1}{4}$	³ 60	³ 89	97.4	96.8	NONE	³ 2590	³ 1205
1/22&24/74	17-10-74	4 $1\frac{1}{4}$	³ 147	³ 121	96.4	97.6	250	³ 501	³ 641

PENETRATION @ 77°F

160
140
120
100
80
60
40
20

AGE IN YEARS

BINDER
TOP

○ △ CORE #16

● ▲ CORE #17

BINDER

TOP

VISCOSITY @ 140°F

8000

7000

6000

5000

4000

3000

2000

1000

BINDER
TOP

○ △ CORE #16
● ▲ CORE #17

AGE IN YEARS

8000

7000

6000

5000

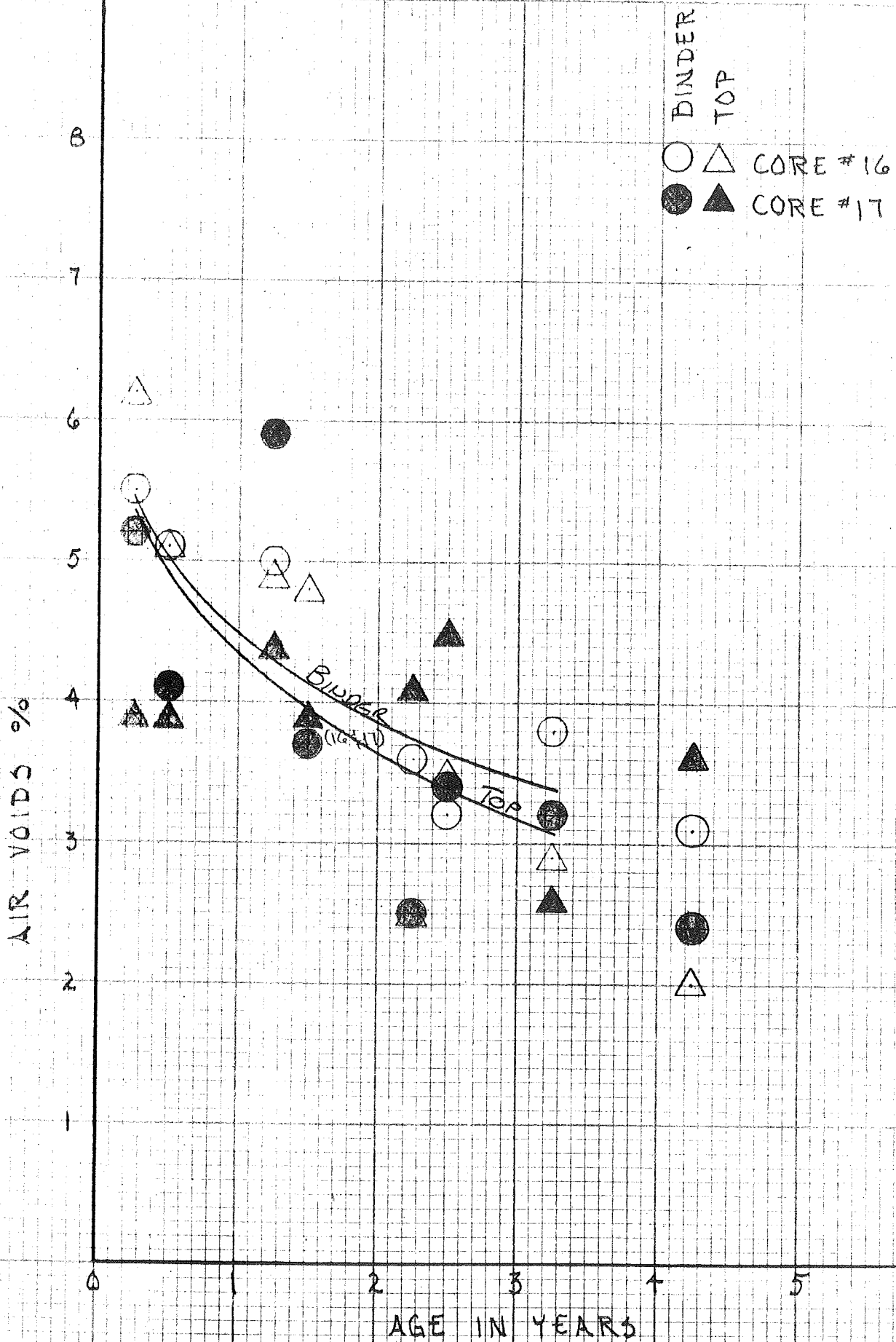
4000

3000

2000

1000

AGE IN YEARS



FLEXIBLE PAVEMENT EVALUATION SURVEY

Route US #2 Project South Hero No. RF F 028-1 (4)
 Date Built, Beginning 1969 Ending 1970 Paved 1969-Binder
1970-Top
 Prime Contractor Burnett Construction Resident S. R. Piro
 Paving Contractor L. M. Pike & Son, Inc. Road Insp. S. R. Piro
 Plant Location Pike - Williston Plant Insp. Grout, Klinefelter
 Type Base Item 213 Binder Type II Surface Type III
 Thickness Base 3" Binder 1 3/4" Surface 1 1/4"
 Bituminous Material: Source Atlantic Richfield-Albany
100-120 Top
 Grade 120-150 Binder Average Pen. Top 106 Binder 123

Traffic Data

		YEAR						
	Design	1971	1972	1973	1974			
ADT	2520	3170	2850	2900	3240			
DVH		500	530	415	455			
D%		58	52	52	52			
T%		6	9	7	7			

Sample Locations:

Core 13 and 14 NB Lane in front of Town Hall (Top Surface 100-120 penetration asphalt-Core 14)
 (Binder 120-150 penetration asphalt-Core 13)
 Core 15 SB Lane @ Intersection of TH #8 across from post office

Remarks: Surface course only - 100-120 penetration grade used Sta. 581+00 - 602+50 both lanes and 602+60 - 609+00 Lt. side only - Balance of project used 120-150.

Climatological Data

Year	69-70	70-71	71-72	72-73	73-74		
Freezing Index	1967	1871	1291	1178	1144		
Freeze Thaw Cycles	75	83	88	98	87		

DESIGN OF BITUMINOUS MIX

oute US #2 Project South Hero Number RF F 028-1 (4)

Sieve	Base			Binder Type II			Top Type III		
	Specs	Job Mix	Job Average	Specs	Job Mix	Job Average	Specs	Job Mix	Job Average
2									
1 1/2		100'	100						
1		55-85	77						
3/4		45-70	62	3/4	95-100	100			
1/2		35-55	51	1/2	78-90	83	95-100		99
3/8				3/8	64-76	62	76-88		83
#4		15-25	18	4	46-58	49	54-66		59
#10		3-10	8	10	32-41	35	39-48		44
#40				40	14-23	18	20-29		24
#80				80	6-15	9	8-17		11
#200				#200	2-5	4	3-6		3
%Ac		3.5-4.5	3.9		5.1-5.9	5.9	6.0-6.8		6.4

Tests on Compacted Mixes

Stability-Method Marshall Ave. Top (lb.) 1216 Ave. Binder (lb.) 1382

Ave % of Theoretical Density-Top 99 %Binder 97 %

Ave % Voids - Top 1 % Binder 3 %

Ave % Voids Filled with Ac-Top 91.6 % Binder 84.7 %

Ave Flow - Top 9 Binder 8

Aggregate:

+10	Source	<u>Demers - Winooski</u>	Type	<u>Dolomitic Limestone</u>
+10	Source	<u>Demers - Shelburne</u>	Type	<u>Dolomitic Limestone</u>
-10	Source	<u>Pike - Richmond</u>	Type	<u>Natural Sand</u>
-10	Source		Type	

Filler or Additive, Source Shelburne Type Dust

Remarks:

[illegible]

[illegible]

THE CHARTERED UNIT NO. 100
CROSS SECTION IN SQUARES TO INCH

PENETRATION @ 77°F

160

140

120

100

80

60

40

20

0

1

2

3

4

5

AGE IN YEARS

BINDER

TOP

○ △ CORE #15

△

△

△

△

△

△

△

VISCOSITY @ 140°F

8000

7000

6000

5000

4000

3000

2000

1000

0

2

3

4

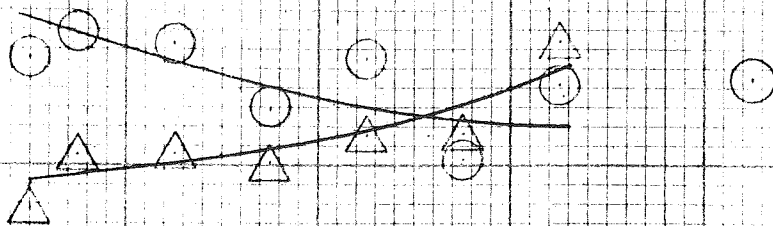
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AGE IN YEARS

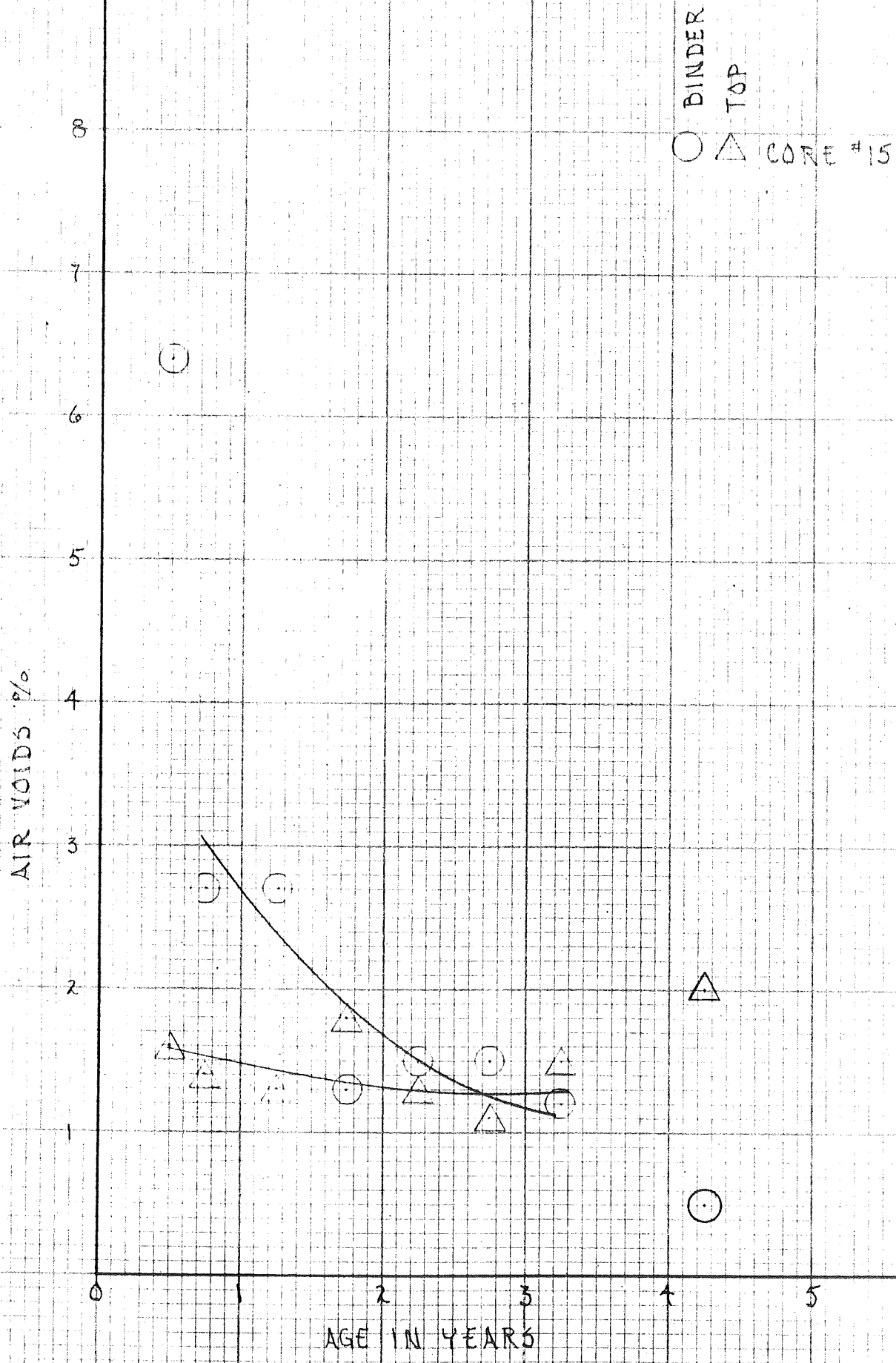
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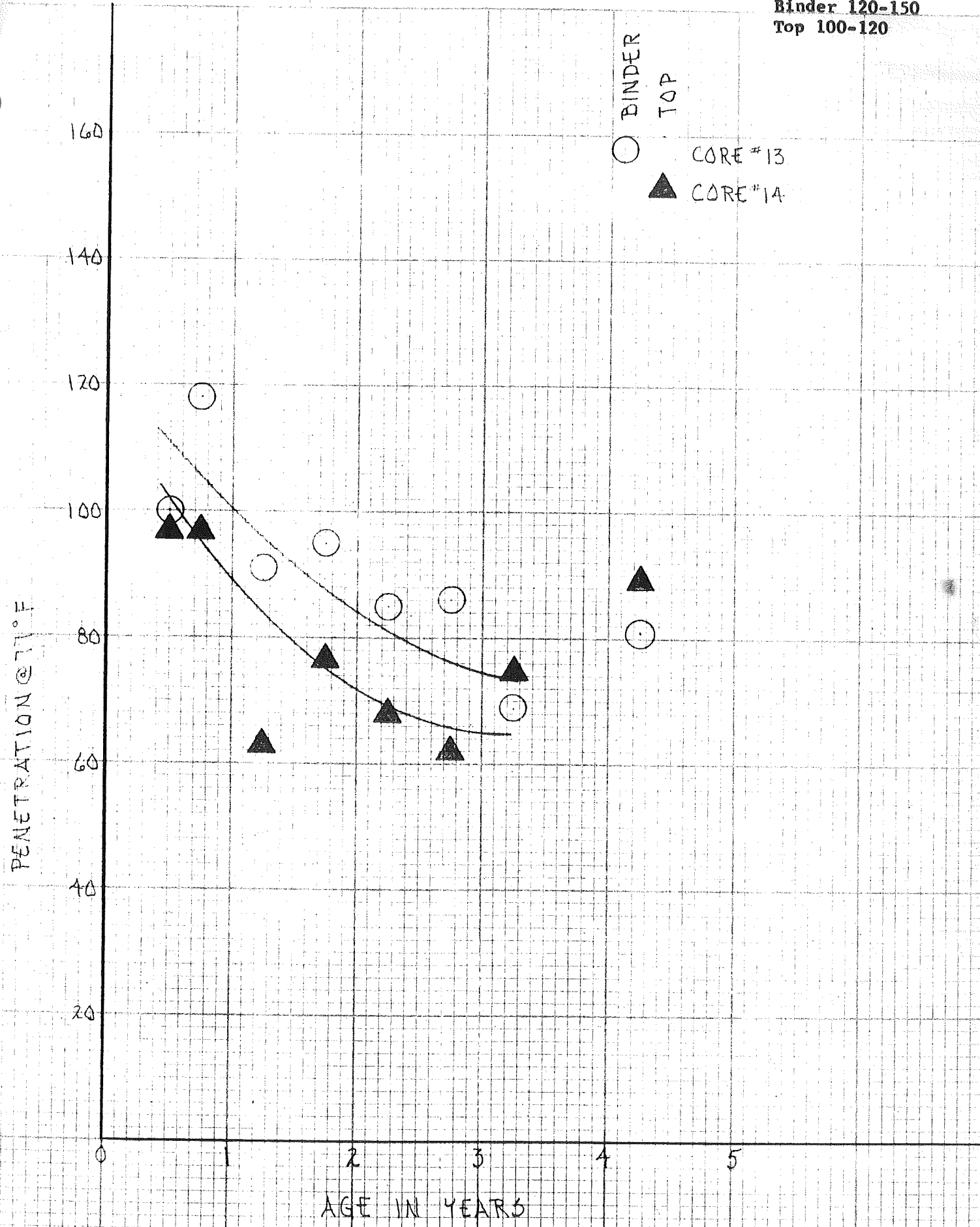
TOP

○ △ CORE #15



THIS CURVE IS LIFT NO. 111
THIS SECTION IS SQUARE TO OTHER





VISCOSITY @ 140°F

8000

7000

6000

5000

4000

3000

2000

1000

BINDER
TOP

○ CORE #13

▲ CORE #14

0

1

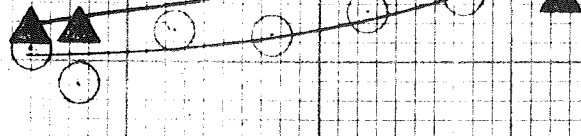
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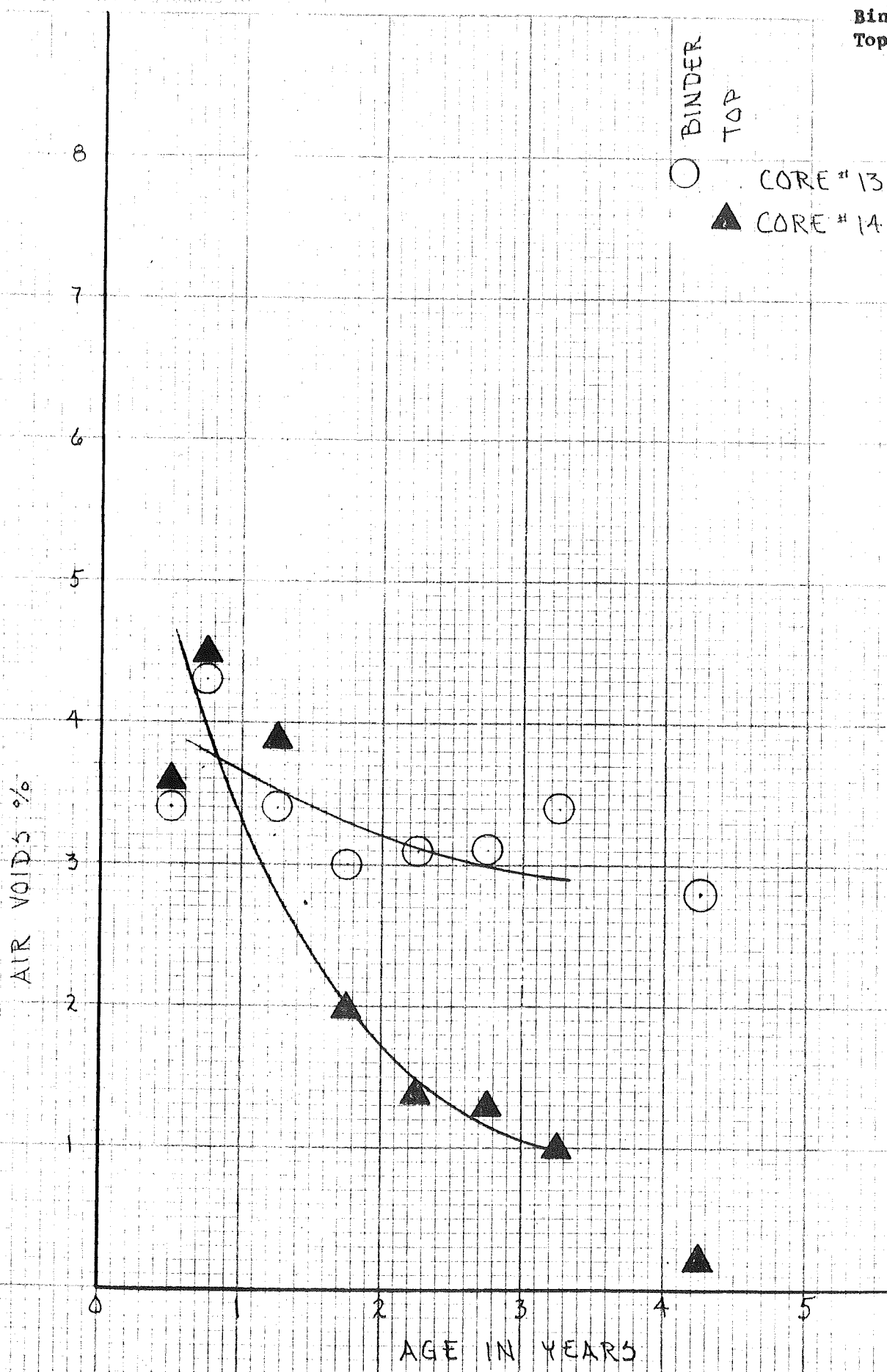
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4

5

AGE IN YEARS





FLEXIBLE PAVEMENT EVALUATION SURVEY

Route Vt 3 Project Rutland-Proctor No. S 0163 (1)

Date Built, Beginning 10-6-67 Ending 10-22-68 Paved 1968

Prime Contractor Rogers Brothers Resident Leon Dunn

Paving Contractor L. M. Pike & Son, Inc. Road Insp. R. C. Lance

Plant Location Florence Plant Insp. Gilman, Grout, Potter, Manning

Type Base 213 Binder Type III Surface Type II

Thickness Base 3" Binder 1 1/2" Surface 1"

Bituminous Material: Source Atlantic Refining-Albany, NY Humble Oil-Everett, Mass.

Grade 85-1--, 120-150 Average Pen. Top Atlantic-90 Binder Humble-92

Traffic Data Atlantic-128
Atlantic-122
YEAR

	Design	1969	1970	1971	1972	1973	1974
ADT	2250	2500	2827	2450	2890	2980	2940
DVH				285	410	425	420
D%				60	50	52	52
T%				6	8	7	7

Sample Locations:

Core #1 NB Lane @ Town Line (120-150 penetration asphalt)

Core #2 NB Lane @ Combination Pole 4-3/56 (85-100 penetration asphalt)

Remarks:

Climateological Data						
Year	68-69	69-70	70-71	71-72	72-73	73-74
Freezing Index	979	1280	1199	805	719	684
Freeze Thaw Cycles	98	93	98	105	113	101

DESIGN OF BITUMINOUS MIX

 ute 3 Project Rutland-Proctor Number S 0163 (1)

	213 Base			361 Mod. Binder Type II			361 Mod. Top Type III		
Sieve	Specs	Job Mix	Job Average	Specs	Job Mix	Job Average	Specs	Job Mix	Job Average
2		100	100						
1 1/2									
1		55/75	64						
3/4					95/100	100			
1/2		25/55	34		80/92	88		95/100	100
3/8					68/80	73		82/94	86
3/4		5/25	10		45/57	51		54/66	63
1/4		0/10	8		32/41	37		41/50	47
1/10					16/25	19		21/30	25
1/40					6/15	8		8/17	10
1/80					2/5	3		3/6	4
1/200					5,3/6,1	5,8		6,3/7,1	6,7
%Ac		2.5/3.5	3.2						

Tests on Compacted Mixes

Stability-Method Marshall Ave. Top (lb.) 1078 Ave. Binder (lb.) 1267
 Ave % of Theoretical Density-Top 95.0 %Binder 95.5 %
 Ave % Voids - Top 5.0 % Binder 4.5 %
 Ave % Voids Filled with Ac-Top 76.6 % Binder 76.1 %
 Ave Flow - Top 7 Binder 7

Aggregate:

+10 Source Vermarco Florence Type Limastone
 +10 Source Type
 -10 Source Carter Pit Brandon Type Natural Sand
 -10 Source Vermarco Florence Type Linastone screenings
 Filler or Additive, Source None Type -

Remarks:

Rutland-Proctor S 0163 (1)

Date Abson Run	Core No.	Age	Recov. Pen.		Density		TCI (Feet)	Recov. Viscosity	
			Top	Bind.	Top	Bind.		Top	Bind.
					120-150				
8/7/69	1-8-69	1	71	108	94.6	94.8	NONE	2859	1421
			1	1				1	1
4/17/70	1-4-70	1½	75	103	92.1	95.5	NONE	2470	1518
12/15/70			2	3				2	2
5/5/71	1-12-70	2¼	66	109	94.8	97.1	NONE	2897	1550
			2	3				2	3
5/7/71	1-5-71	2 3/4	71	112	94.3	96.1	NONE	2551	1297
			2	3				2	3
11/4+5/71	1-11-71	3¼	62	85	95.7	96.2	NONE	3495	1915
			2	3				2	3
6/13+15/72	1/5/72	3 3/4	60	94	94.6	96.4	NONE	2425	1640
			2	3				2	3
1/8/73	1-11-72	4¼	53	92	97.3	96.9	NONE	3790	1427
			2	3				2	3
4/19&23/73	1-4-73	4 1/2	63	76	96.2	97.6	NONE	3294	2412
			2	3				2	3
12/12/73	1-11-73	5 1/4	50	94	95.8	97.7	NONE	3701	1380
			2	3				2	3
11/5&7/74	1-10-74	6 1/4	70	110	96.1	97.5	NONE	3241	1489
					85-100				
8/7/69	2-8-69	1	73	88	96.2	97.2	NONE	1243	-
			1	1				1	1
2/22/70	2-4-70	1½	68	67	94.2	97.8	NONE	2472	2265
			2	3				2	3
2/10/71	2-12-70	2¼	56	100	93.9	97.1	NONE	3199	1257
			2	3				1	3
5/6/71	2-5-71	2 3/4	33	73	93.6	96.7	NONE	6500	1813
			2	3				2	3
12/8+9/71	2-11-71	3¼	38	49	92.4	95.8	NONE	7248	3500
			3	3				3	2
6/13+15/72	2-5-72	3 3/4	33	64	96.6	97.6	NONE	7884	2281
			2	3				2	3
1/8/73	2-11-72	4¼	35	59	96.9	98.6	NONE	5797	2360
			3	3				3	3
4/16&18/73	2-4-73	4 1/2	31	57	95.4	97.7	NONE	2742	2637
			3	3				3	3
12/14&17/73	2-11-73	5 1/4	33	57	96.7	98.0	NONE	3354	2237
			2	3				2	3
11/6&8/74	1-10-74	6 1/4	34	64	96.6	98.0	NONE	5308	2376

Rutland-Proctor
S 0163(1)

Penetrations:

Core #1 120-150

Core #2 85-100

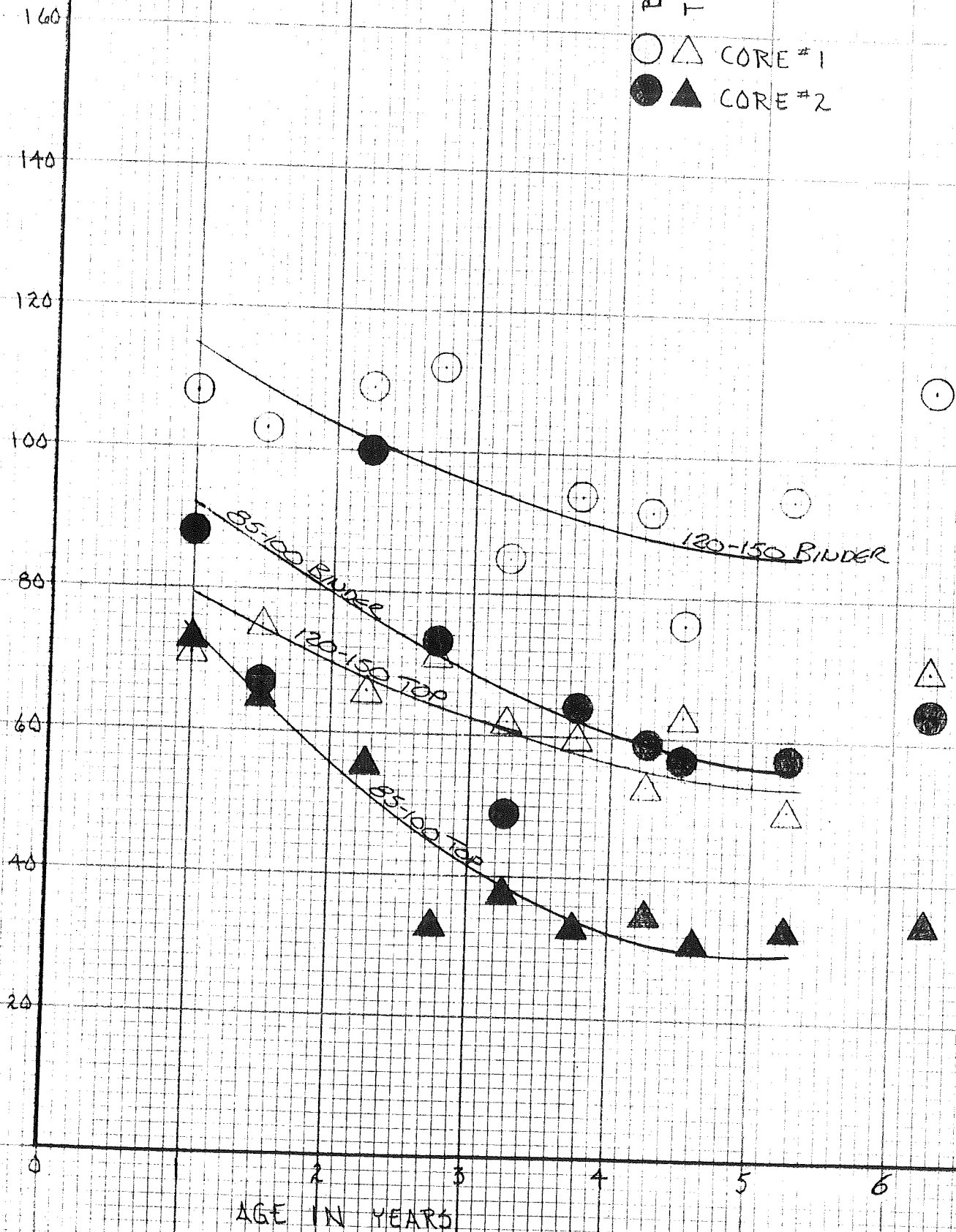
PENETRATION @ 77°F

BINDER
TOP

○ △ CORE #1
● ▲ CORE #2

AGE IN YEARS

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VISCOSITY @ 140°F.

8000

7000

6000

5000

4000

3000

2000

1000

AGE IN YEARS

BINDER
TOP

○ △ CORE #1
● ▲ CORE #2

85-100 TOP

120-150 TOP

85-100 BINDER

120-150 BINDER

