EXPERIMENTAL PAVING PROJECTS USING CURTISS-WRIGHT'S COAL-MODIFIED, COAL-TAR BINDER

by

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ABSTRACT

This report covers the observation and evaluation of 13 sections of experimental pavement constructed in Kentucky using coal-modified coal-tar binder. These are compared with the performance of control sections in which normal specification asphalt cements were used. The results of laboratory and field tests are also reported to support and supplement the visual surveys.

INTRODUCTION

The Curtiss-Wright Corporation -- early in April, 1959 -- announced the development of a new coal-based road-paving binder utilizing substantial quantities of bituminous coal.

The basic principles used in preparing this bituminous binder was the digestion of powdered coal in coal tar and tar oils at temperatures of 500-600°F. By adjusting the proportions of tar, tar oils, and coal, binders could be prepared having penetration ranges comparable to asphalt cements. It was the intent of the developers that the modified binders be used in the same manner as asphalt cements in hot-plant mixtures.

Because of the significance that bituminous coal plays in the economy of Kentucky, state officials were interested in any potentialities that might utilize large quantities of coal. Kentucky State Officials met with Curtiss-Wright representatives regarding the possibility of producing the coal-based binder for Kentucky highways and of utilizing Kentucky coal. At that time, the development of the coal-based binder had not progressed beyond the laboratory phase. Most of the laboratory data had been obtained with an RT-12 grade of coke-oven tar, into which 5 to 10% of pulverized bituminous coal had been digested. The mixture was heated to 500-600°F for approximately one hour under atmospheric refluxing, wherein the volatile oils were either retained in the mixture; or else recovered and replaced by a less volatile tar oil in order to achieve the desired consistency of the finished product.

It was found, again on a laboratory scale, that the properties of the digested materials differed from those of currently available coal tar or from mechanical blends of coal and tar. Primarily, the Curtiss-Wright Binder was less susceptible to consistency changes with temperature than RT-12 coal tar. It was also more resistant to hardening than the normal road tar when heated to the temperature usually used in mixing asphaltic concrete.

On June 22, 1959, the Department of Highways entered into an agreement with the Curtiss-Wright Corporation in which Curtiss-Wright would design, build, and operate a pilot plant to produce 3000 gallons per day of Curtiss-Wright Binder. The Kentucky Department of Highways was to select sites, supervise construction of test-sections of roads, and evaluate the performance of the sections.

The Curtiss-Wright Corporation completed the pilot plant on August 17, 1959. It was located at the Central Garage of the Kentucky Department of Highways in Frankfort. The batch plant had a 1500-gallon capacity. Approximately 1200 gallons of RT-12, 300 gallons of a high-boiling point coal tar oil, and 1100 to 1500 pounds of coal (pulverized so that 90% would pass a No. 200 sieve) were processed in each batch. The last batch of the experimental binder was produced on November 4, 1959.

A total of 13 sections of pavement on 12 projects was selected and constructed throughout the state to evaluate the binder. These sections were constructed as part of normal asphaltic concrete paving contracts in which the coal-based binder was substituted in a length of each pavement. Included in the experimental sections were: resurfacing of bituminous pavements and initial paving over traffic-bound granular bases. Some of the sections were in the light, rural, traffic class, while others were in a relatively heavy traffic class. The last of these sections was completed on November 7, 1959.

During the two years since construction of the test sections, the pavements have been under observation and study. Tests in the laboratory and field have been made to further evaluate the information recorded from the visual surveys. Movie films and still photographs were made before and after paving in order to record the two conditions. Additional photographs have been taken when performance conditions indicated the need.

This report covers the test site selection, construction of the test sections, and performance during the first two years of service.

SELECTION OF TEST SITES

It was decided by the Research and Construction Divisions of the Kentucky Department of Highways, that because of the time involved and other factors, it would be necessary to arrange for change orders on existing bituminous concrete paving projects in order to complete the test installations during the pilot plant production period (August to November). Since the binder was an experimental material, the time limitation did not permit the selection of projects in which there was Federal participation.

The selection of test sites was limited to the following groups of projects: state project (SP), initial treatment (IT), rural secondary (RS), and rural highway (RH). The proposals on all bituminous

hot plant-mix paving projects under construction in the above mentioned groups were studied and screened. Fifty roads that were to be paved in the construction season of 1959 were selected for visual study. The visual study included visiting each road, making notes on its condition, and taking photos of representative sections. The base and drainage conditions were especially noted; a road with a very poor base and/or totally inadequate drainage was eliminated from consideration.

As a result of numerous roads being eliminated for one or more of the reasons discussed, 20 possible test sites remained for consideration after the visual surveys were completed. It was desired to construct test sections on different types of roads under a variety of traffic conditions. Therefore, the type of construction proposed on each road was tabulated from information received from the Construction Division and the latest traffic counts on each road still under consideration were listed from the files of the Planning Division. On these bases, 12 projects, including 13 Curtiss-Wright Binder test sections were selected for use in this experimental work.

Table 1 gives the approximate location, contractor, traffic data, and type of construction proposed for each project. The 13 test sections were located in 12 counties, and 9 different contractors

TABLE 1. Projects Selected for Experimental Pavement Sections

Group No.	County	Approx. Location	Contractor	Location of Plant	Traffic ADT	Type Construction
S.P. Gr. 6	Allen	Ky. 101 in Scottsville	McLellan Stone Co.	Scottsville	1025 (57)	Class I Surface-1½"
S.P. Gr. 11 Urban	Laurel	U.S. 25 in London	Cantrill Constr. Co., Inc.	London	14150 (58)	Class I Surface-1½"
S.P. Gr. 11 Rural	Laurel	U.S. 25 north of Lily	Cantrill Constr. Co., Inc.	London	11000 (59)	Class I Surface-1½"
S.P. Gr. 16	Garrard	Ky. 39 south of Lancaster	E'Town Paving Co., Inc.	Mt. Vernon	1070 (59)	Class I Surface-1½"
S.P. Gr. 18	Magoffin	Ky. 114 in Salyersville	Ky. Road Oiling Co.	Pomp (near West Liberty)	1075 (59)	Class I Surface-1½"
S.P. Gr. 31	Nelson	U.S. 31-E north of Bardstown	MaGo Construction Co., Inc.	Bardstown	2825 (58)	Class I Surface-1½"
S.P. Gr. 32	Jackson	U.S. 460 south of McKee	MaGo Construction Co., Inc.	Near McKee	1350 (59)	Class I Surface-1½"
S.P. Gr. 37	Rowan	U.S. 60 east of Morehead	East Ky. Paving Corp.	Olive Hill	2407 (59)	Class I Surface-1½"
S.P. Gr. 38	Perry	Ky. 699 north of Leatherwood	Cantrill Constr. Co, Inc.	Leatherwood	1125 (59)	Class I Surface-1½"
S.P. Gr. 45	Franklin	U.S. 460 east of Frankfort	Robert L. Carter Co.	Frankfort	1435 (59)	Class I Surface-1½"
S.P. 54-140	Hopkins	Ky. 70 east of Madisonville	Dixie Pavers, Inc.	Henderson	2660 (57)	Class I Surface-1½"
I.T. Gr. 14	Warren	Ky. 185 south of Barren River	R.E. Gaddie Contractor	Bowling Green	50 (58)	Class I (modified) 2 3/4"
I.T. Gr. 22	Rockcastle	Ky. 618 east of Quail	E'Town Paving Co., Inc	Mt. Vernon	75 (58)	Class I (modified) 2 3/4"

were involved. Eleven 1-1/2-in., Class I resurfacings and two 2-3/4-in., modified Class I base, initial-treatment pavements were included. The average traffic count ranged from 50 to 14,150 per day.

After individual discussions explaining the over-all project with the contractors involved, a change order was prepared by the Construction Division for each project. In effect, these change orders provided that the Department furnish the contractor the experimental binder at no charge as compensation for the extra expense and time required for construction of the test section. The contractors agreed to this arrangement.

CONSTRUCTION

A control section of pavement containing asphaltic binder was constructed near or adjacent to each test section in order that comparisons could be made between the conventional binder and the experimental Curtiss-Wright Binder. The roadways on which the control and test sections were paved were selected so as to have approximately the same base and drainage conditions. Thus, the only difference between a test section and its companion control section was in the binder. A sketch of the pavement structure for each test and control section is given in Fig. 1. Separate sketches are shown for the Allen County Project since there was some variation in the

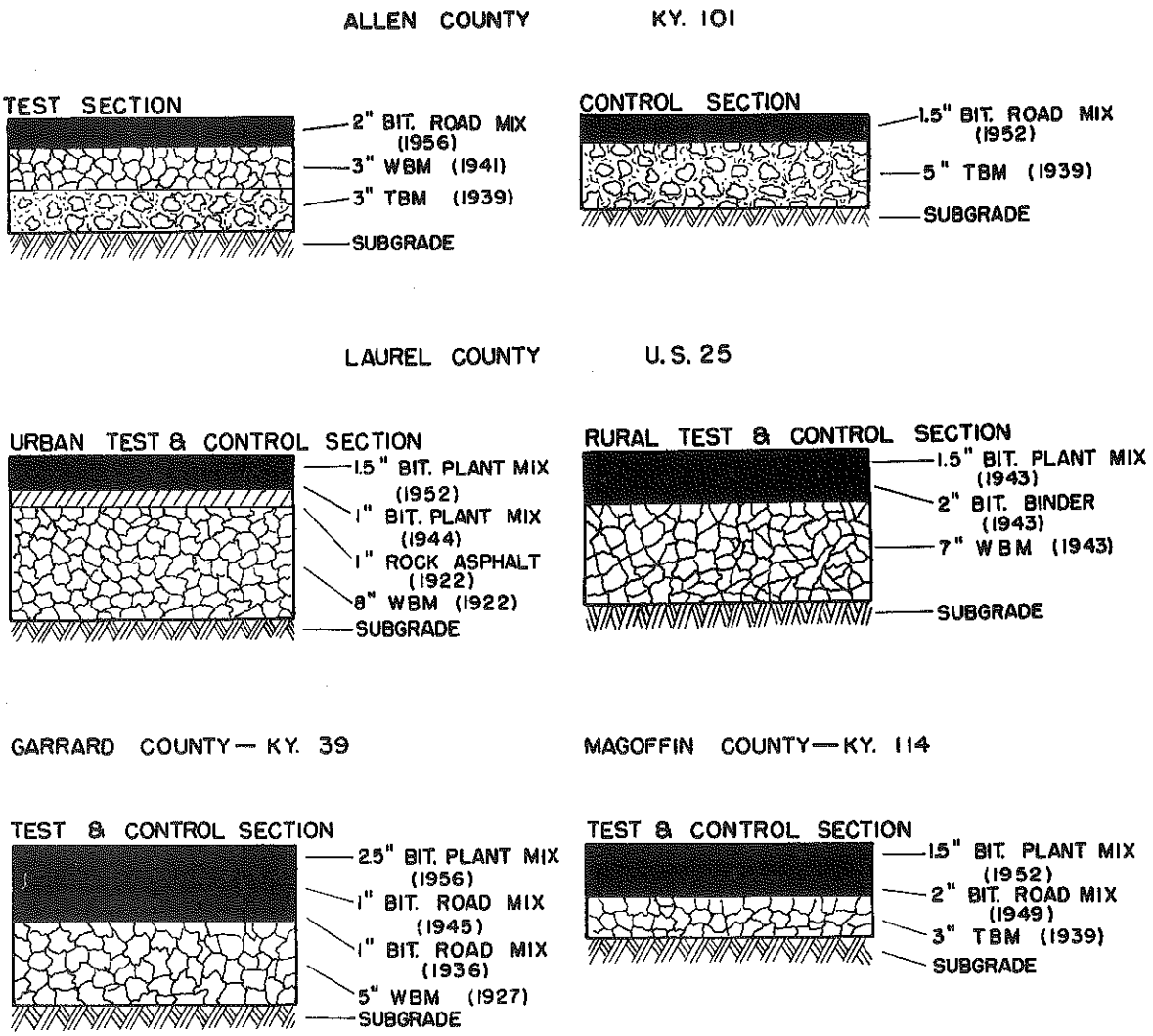

Fig. 1. Sketches Showing Elements of Experimental Sections

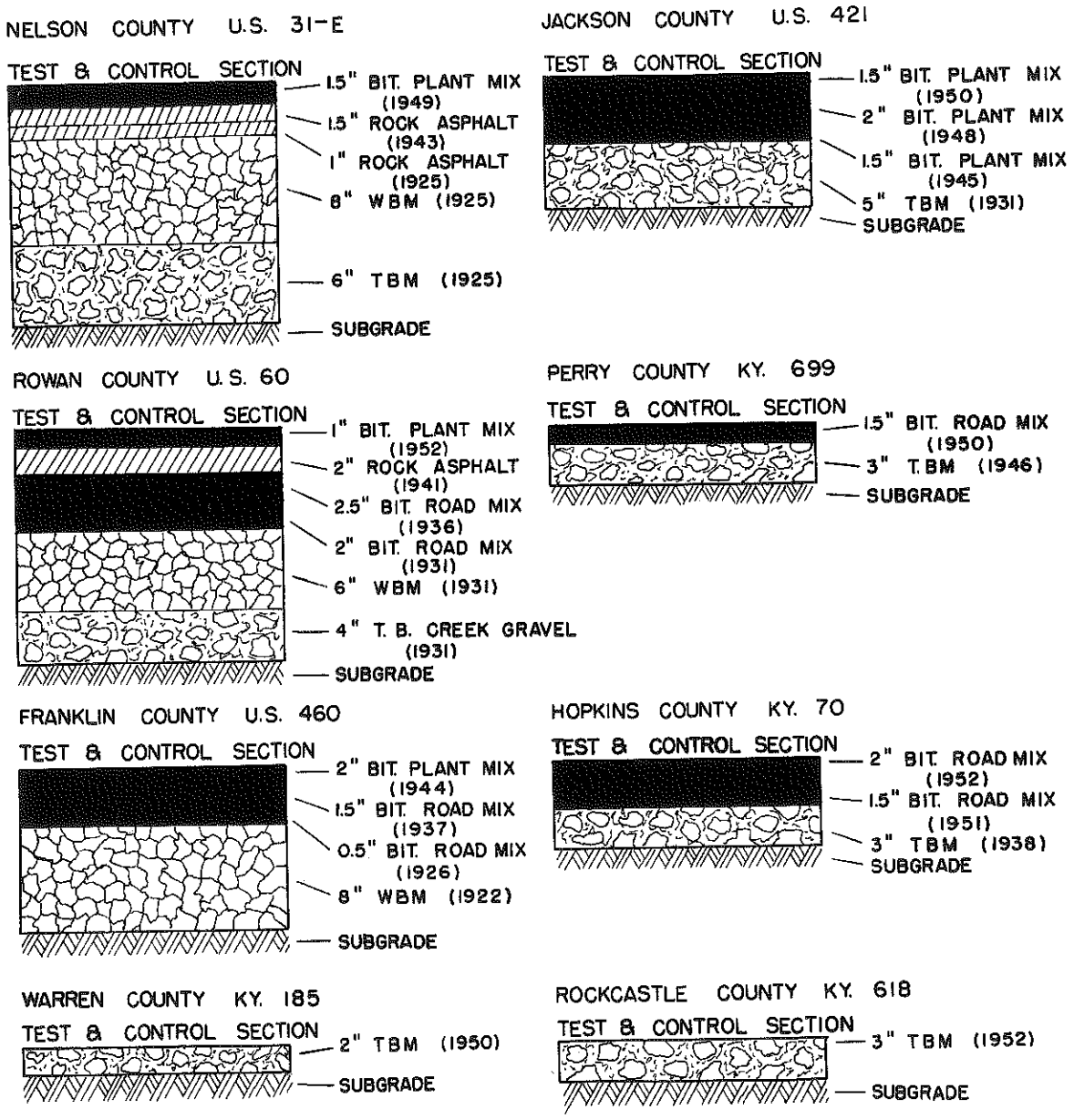

Fig. 1. (Continued) Sketches Showing Elements of Experimental Sections

construction history there. The elements listed in Fig. 1 refer to prior applications of paving courses and their respective dates. Soundings were not made for this study. The test sections, of course, used the Curtiss-Wright Binder while the control sections were constructed with the asphaltic binders specified in the original project contracts. Both the experimental and the standard mixes were made and laid under the Kentucky Standard Specifications for Road and Bridge Construction (1956) which designates: (1) the temperatures of the aggregates, binder, and mix at the plant and the mix at the paver; (2) the gradations of the aggregates and combined mixes; (3) mixing time; and (4) the type of asphaltic binder (for control sections only) and aggregate used. It was considered necessary to clean the plants and pavers before and after using the Curtiss-Wright Binder. The plants were cleaned by pumping fuel oil through the lines while they were hot and by wasting the initial batch of material. A paver was cleaned by spraying it with fuel oil while it was still warm. Of course, precautions were taken to remove all the free fuel oil from the plant (weighing bucket, etc.) before any of the materials produced were used for paving.

The experimental binder was pumped from its storage tank (railroad tank car) at the Frankfort pilot plant into truck transports and hauled to each job. The trailers were 5500-gallon, insulated tankers equipped with propane heaters and temperature gages. One

tanker was spotted at the hot-mix plant for storage. This trailer was hooked directly into each plant by running a line from the rear of the tank to the pump on the plant.

Samples were taken of the different types of aggregate, the asphaltic and experimental binder, and the final mixes used on each project. These samples were delivered to the laboratory for testing. The results from laboratory tests performed on the tar binders are listed in Table 2. The RT-12 was the raw material used in the production of the Curtiss-Wright binder. It was supplied from materials obtained by Curtiss-Wright for the project. The asphaltic cement used in the control section for each project was tested for acceptance by the Department. The results of these tests are shown in Table 3. One-half of the projects was designed for PAC-5 (85 to 100 pen.) and the other half for PAC-7 (120 to 150 pen.).

Average combined aggregate gradations for the test and control sections are shown in Tables 4 and 5. Marshall test cylinders were prepared in the laboratory by reheating samples of the mixtures taken from selected projects. The test data on these specimens were recorded in Table 6. The average stability for the three component Curtiss-Wright binder surface mix was 1696 pounds and ranged between 846 and 3059 pounds. The flow for these samples averaged 7.9/100

TABLE 2. Test Results for Tar Binders

Project Number	County and Road	Sampling Date	Penetration at 25°C.	Softening Point in °C.	Specific Gravity at 25°C./25°C.	Solubility in CS_2 (%)	Thin Film Oven Test % Wt. Loss	Thin Film Oven Test Penetration Residue at 25°C.	Thin Film Oven Test Softening Pt. Residue in °C.
				Three Component Binder					
S.P. Gr. 6	Allen, Ky. 101	10-12-59	46.0	52.2	1.278	69.5	13.2	0	75.5
S.P. Gr. 11	Laurel, U.S. 25 (Urban)	11-4-59	54.5	52.2	1.272	71.8	13.1	0	74.1
S.P. Gr. 16	Garrard, Ky. 39	9-24-59	52.0	50.0	1.294	71.2	15.2	0	82.2
S.P. Gr. 18	Magoffin, Ky. 114	9-18-59	67.3	47.8	1.253	74.1	15.2	0	77.7
S.P. Gr. 31	Nelson, U.S. 31E	10-22-59	61.3	44.0	1.274	72.3	13.9	0	74.7
S.P. Gr. 32	Jackson, U.S. 421	9-29-59	46.3	50.0	1.269	72.2	12.3	0	76.2
S.P. Gr. 37	Rowan, U.S. 60	9-1-59	60.0	49.5	1.257	75.0	14.8	0	81.6
S.P. Gr. 38	Perry, Ky. 699	10-6-59	39.0	51.0	1.278	70.1	11.0	0	73.0
S.P. Gr. 45	Franklin, U.S. 460	9-8-59	48.3	56.1	1.257	70.1	13.6	0	78.2
S.P. 54-140	Hopkins, Ky. 70	10-15-59	68.0	45.0	1.225	73.2	13.7	0	70.0
I.T. Gr. 14	Warren, Ky. 185	10-1-59	41.0	51.5	1.283	68.3	9.6	0	71.1
I.T. Gr. 22	Rockcastle, Ky. 618	9-21-59	88.5	35.0	1.263	75.9	16.6	0	75.0
				Two Component Binder					
S.P. Gr. 11	Laurel, U.S. 25 (Rural)	11-7-59	54.7	46.5	1.274	71.8	12.6	0	73.9
				RT-12					
S.P. Gr. 11	Laurel, U.S. 25 (Rural)	11-7-59	205.0	___	1.284	77.9	16.5	0	73.0
I.T. Gr. 14	Warren, Ky. 185	10-2-59	259.0	___	1.274	79.6	16.8	0	74.5

TABLE 3. Acceptance Test Results for Asphalt Cements

Project Number	County and Road	PAC Grade	Water Content	Specific Gravity at $\frac{60°F.}{60°F.}$	Solubility in CCl_4 (%)	Flash Point (°F.)	Ductility	Penetration at 77°F.	Loss on Heating Wt. Loss (%)	Loss on Heating Penetration Residue (% of Original)
S.P. Gr. 6	Allen, Ky. 101	7	0.0	1.035	99.9	600+	100+	130	0.14	91.1
S.P. Gr. 11	Laurel, U.S. 25 (Urban & Rural)	5	0.0	1.020	99.9	600+	100+	89	0.11	87.6
S.P. Gr. 16	Garrard, Ky. 39	5	0.0	1.035	99.9	600+	100+	92	0.13	89.0
S.P. Gr. 18	Magoffin, Ky. 114	7	0.0	1.016	99.9	600+	100+	126	0.12	90.9
S.P. Gr. 31	Nelson, U.S. 31E	7	0.0	1.032	99.9	600+	100+	138	0.12	90.9
S.P. Gr. 32	Jackson, U.S. 421	5	0.0	1.035	99.9	600+	100+	92	0.13	89.0
S.P. Gr. 37	Rowan, U.S. 60	5	0.0	1.018	100.0	600+	100+	95	0.12	87.0
S.P. Gr. 38	Perry, Ky. 699	7	0.0	1.017	99.9	600+	100+	132	0.10	86.1
S.P. Gr. 45	Franklin, U.S. 460	5	0.0	1.023	99.9	600+	100+	88	0.14	91.1
S.P. 54-140	Hopkins, Ky. 70	5	0.0	1.026	99.9	600+	100+	86	0.12	91.4
I.T. Gr. 14	Warren, Ky. 185	7	0.0	1.018	99.9	600+	100+	138	0.15	91.0
I.T. Gr. 22	Rockcastle, Ky. 618	7	0.0	1.034	99.9	600+	100+	130	0.14	88.2

TABLE 4. Average Combined Gradations (Test Sections)

Surface

Project Number	County and Road	Percentage Passing Sieve Size							
		1/2	3/8	No. 4	No. 8	No. 16	No. 50	No. 100	No. 200
S.P. Gr. 6	Allen, Ky. 101	100.0	91.1	58.6	43.0	35.7	5.4	1.3	0.6
S.P. Gr. 11	Laurel, U.S. 25 (Urban)	100.0	92.9	60.6	37.9	24.6	3.4	0.9	0.4
S.P. Gr. 11	Laurel, U.S. 25 (Rural)	100.0	94.0	60.3	42.1	24.5	3.7	1.7	0.9
S.P. Gr. 16	Garrard, Ky. 39	100.0	93.4	57.5	41.9	34.7	5.7	1.7	0.9
S.P. Gr. 18	Magoffin, Ky. 114	100.0	94.2	60.1	39.3	33.4	7.6	1.8	0.7
S.P. Gr. 31	Nelson, U.S. 31E	100.0	91.8	58.2	42.0	34.0	5.8	3.1	1.9
S.P. Gr. 32	Jackson, U.S. 421	100.0	93.1	58.5	43.5	37.7	9.6	5.4	1.6
S.P. Gr. 37	Rowan, U.S. 60	100.0	90.0	59.9	42.5	35.6	5.0	1.5	0.6
S.P. Gr. 38	Perry, Ky. 699	100.0	92.3	57.1	41.6	33.3	5.5	1.4	0.4
S.P. Gr. 45	Franklin, U.S. 460	100.0	96.4	61.7	41.0	35.8	11.1	1.7	0.6
S.P. 54-140	Hopkins, Ky. 70	100.0	92.0	65.4	48.8	36.9	7.4	1.5	0.8

Modified Base

Project Number	County and Road	Percentage Passing Sieve Size							
		1-1/2	1	1/2	No. 4	No. 8	No. 16	No. 50	No. 100
I.T. Gr. 14	Warren, Ky. 185	100.0	95.4	60.1	39.2	27.7	20.0	9.6	5.3
I.T. Gr. 22	Rockcastle, Ky. 618	100.0	88.1	59.9	37.7	27.8	18.2	4.6	1.7

TABLE 5. Average Combined Gradations (Control Sections)

Surface

Project Number	County and Road	Percentage Passing Sieve Size							
		1/2	3/8	No. 4	No. 8	No. 16	No. 50	No. 100	No. 200
S.P. Gr. 6	Allen, Ky. 101	100.0	90.6	58.9	42.3	34.7	4.2	1.2	0.7
S.P. Gr. 11	Laurel, U.S. 25 (Urban) (Northern Portion)	100.0	87.9	56.1	40.7	35.6	4.1	0.8	0.4
	(Southern Portion)	100.0	92.5	60.9	42.3	31.6	4.6	1.4	0.7
S.P. Gr. 11	Laurel, U.S. 25 (Rural)	100.0	90.0	54.0	40.0	34.7	4.1	1.2	0.7
S.P. Gr. 16	Garrard, Ky. 39	100.0	93.3	59.0	42.4	33.7	5.9	2.6	1.5
S.P. Gr. 18	Magoffin, Ky. 114	100.0	92.5	62.7	41.2	30.9	4.5	1.0	0.3
S.P. Gr. 31	Nelson, U.S. 31E	100.0	91.7	61.4	41.7	33.9	7.9	3.4	1.9
S.P. Gr. 32	Jackson, U.S. 421	100.0	92.4	58.6	42.1	36.2	6.7	2.8	1.1
S.P. Gr. 37	Rowan, U.S. 60	100.0	92.9	54.5	42.6	31.8	4.9	1.9	1.1
S.P. Gr. 38	Perry, Ky. 699	100.0	93.7	58.6	39.7	30.7	4.8	2.1	1.2
S.P. Gr. 45	Franklin, U.S. 460	100.0	96.9	60.7	40.4	34.2	9.7	1.8	0.7
S.P. 54-140	Hopkins, Ky. 70	100.0	___	67.2	47.2	___	21.6	4.2	___

Modified Base

Project Number	County and Road	Percentage Passing Sieve Size							
		1-1/2	1	1/2	No. 4	No. 8	No. 16	No. 50	No. 100
I.T. Gr. 14	Warren, Ky. 185	100.0	93.3	59.4	39.2	31.3	23.1	10.5	5.2
I.T. Gr. 22	Rockcastle, Ky. 618	100.0	88.9	61.1	37.8	28.2	20.7	7.4	2.8

TABLE 6. Marshall Test Results for Sampled Mixtures (Re-heated)

Project Number	County and Road	Sampling Date and Time	Bitumen Content	Marshall Data Re-heated Mixtures Stability (Lb.)	Flow (0.01 In.)	Unit Wt. (Lb./Cu. Ft.)	% Air Voids
		Surface--Three Component CW Binder					
S.P. Gr. 6	Allen, Ky. 101	10-12-59, 12:30 PM	6.9	1765	8.2	133.2	14.3
		10-14-59, 1:30 PM	6.9	1061	6.3	133.7	14.3
S.P. Gr. 11	Laurel, U.S. 25 (Urban)	11-4-59, 10:15 AM	6.9	1052	7.6	137.3	12.0
		11-6-59, 11:30 AM	6.9	910	6.7	137.1	12.1
	(Rural)	11-6-59, 2:15 PM	6.9	846	5.6	136.0	12.8
		11-7-59, 10:15 AM	6.9	1062	7.5	135.3	13.3
S.P. Gr. 16	Garrard, Ky. 39	9-24-59, 11:30 AM	6.9	1076	7.7	136.6	12.5
		9-25-59, 1:00 PM	6.9	1649	6.6	135.5	12.9
S.P. Gr. 18	Magoffin, Ky. 114	9-18-59, 9:30 AM	6.9	2747	4.5	137.8	11.4
		9-18-59, 5:30 PM	6.9	3059	9.3	141.3	9.6
S.P. Gr. 31	Nelson, U.S. 31E	10-22-59, 11:15 AM	6.9	1636	10.2	138.6	11.1
		10-22-59, 4:15 PM	6.9	1548	6.0	134.0	14.0
S.P. Gr. 32	Jackson, U.S. 421	9-29-59, 9:15 AM	6.9	4645	12.3	137.5	11.8
		9-29-59, 1:00 PM	6.9	3501	4.5	———	20.0
S.P. Gr. 37	Rowan, U.S. 60	9-1-59, 4:45 PM	7.0	1463	6.9	137.2	12.1
		9-2-59, 10:30 AM	7.0	1615	10.3	140.9	9.8
S.P. Gr. 38	Perry, Ky. 699	10-6-59, 10:45 AM	6.9	1046	10.6	129.0	18.1
S.P. Gr. 45	Franklin, U.S. 460	9-9-59, 9:00 AM	6.9	1426	7.0	138.0	11.9
S.P. 54-140	Hopkins, Ky. 70	10-15-59, 11:00 AM	6.9	1030	6.2	137.6	11.8
		10-16-59, 12:30 PM	6.9	1153	9.0	133.3	14.6
AVERAGE				1696	7.9	136.5	12.9
		Surface--Two Component CW Binder					
S.P. Gr. 11	Laurel, U.S. 25 (Rural)	11-7-59, 3:15 PM	6.9	740	4.3	138.6	11.1
		Surface Control--Asphalt Cement					
S.P. Gr. 18	Magoffin, Ky. 114	9-18-59, 5:30 PM	5.5	964	7.7	137.3	10.5
S.P. Gr. 32	Jackson, U.S. 421	9-28-59, 6:30 PM	5.5	739	11.3	137.8	11.6
S.P. Gr. 38	Perry, Ky. 699	10-7-59, 1:00 PM	5.5	619	5.9	135.2	12.2
S.P. Gr. 45	Franklin, U.S. 460	9-8-59, 11:30 AM	5.5	591	7.5	139.9	10.2
AVERAGE				728	8.1	137.5	11.1
		Modified Base--Three Component CW Binder					
I.T. Gr. 14	Warren, Ky. 185	10-1-59, 2:30 PM	6.9	1898	10.8	139.7	10.5
		10-2-59, 9:30 AM	6.9	1579	12.0	134.1	14.1
I.T. Gr. 22	Rockcastle, Ky. 618	9-21-59, 12:45 PM	6.9	1040	7.8	137.4	12.0
		9-21-59, 4:30 PM	6.9	1463	16.0	131.5	15.7
AVERAGE				1468	11.6	135.6	13.1
		Modified Base Control--Asphalt Cement					
I.T. Gr. 22	Rockcastle, Ky. 618	9-21-59, 6:00 PM	5.5	993	10.0	134.5	13.1
		Surface--RT-12					
S.P. Gr. 11	Laurel, U.S. 25 (Rural)	11-7-59, 1:10 PM	6.9	348	5.5	141.7	8.9
		Modified Base--RT-12					
I.T. Gr. 14	Warren, Ky. 185	10-2-59, 10:45 AM	6.9	1501	7.5	141.5	9.3

inches. Samples from four of the control sections of surface mix gave an average stability of 728 pounds and flow of 8.1/100 inches.

Hourly temperature records were made for: (1) aggregate entering the hot mixing chamber, (2) Curtiss-Wright binder in storage at the plant, (3) mixture at the plant, and (4) mixture at the paver. The mix temperatures at the plant and at the paver have been listed in Table 7 along with the type and capacity of the plant used on each project. In order to reduce objectionable fumes at the plants and pavers, operating temperatures were lowered somewhat below normal asphaltic mix temperatures on some projects. Specification ranges for asphaltic cements are 250° to 300°F for mix at plant and 225° to 275°F at paver. This change in operational temperature was made with the concurrence of the Curtiss-Wright project staff. While lowering the mix temperatures at the plant lessened the amount of fuming, it did not eliminate the problem entirely.

A summary of the construction data on the experimental sections is listed in Table 8. Some 10.2 miles of pavement containing 150,900 gallons of Curtiss-Wright Binder and 4,700 gallons of RT-12 were placed in 13 test sections.

One hundred feet of movie film was taken on both the control and test section before and after paving. This was done by mounting a photographer on top of a car and traveling over the sections at 30

TABLE 7 - Curtiss-Wright Binder Mixture Temperature Range

Project	County	Plant		Plant	Paver
		Type	Capacity	Min.-Max.	Min.-Max.
SP Gr 6	Allen	Cont.	83 T/hr.	255-285	235-280
SP Gr 11 (Urban)	Laurel	Batch	5000 lbs.	240-270	230-265
SP Gr 11 (Rural)	Laurel	Batch	5000 lbs.	220-290	220-280
SP Gr 16	Garrard	Cont.	120 T/hr.	240-280	230-270
SP Gr 18	Magoffin	Cont.	120 T/hr.	240-265	220-245
SP Gr 31	Nelson	Batch	4000 lbs.	255-275	240-260
SP Gr 32	Jackson	Cont.	150 T/hr.	230-250	230-245
SP Gr 37	Rowan	Batch	6000 lbs.	230-280	205-265
SP Gr 38	Perry	Cont.	150 T/hr.	240-280	235-270
SP Gr 45	Franklin	Batch	4000 lbs.	235-265	235-265
SP 54-140	Hopkins	Batch	3800 lbs.	270-300	210-270
IT Gr 14	Warren	Batch	3750 lbs.	250-265	220-260
IT Gr 22	Rockcastle	Cont.	120T/hr.	250-270	235-265

TABLE 8 -- Construction Data - Curtiss-Wright Binder Test Section

Project	Length (mi.)	Mix (tons)	CW Binder (gal.)	Aggregate Type & Size	Prime or Tack		Date(s) Constructed 1959
					Type	Appl. (gal/sq.yd.)	
SP Gr 6	0.5	920.39	13,500	No. 9 Ls. Nat. Sand	RS-1	.05	Oct. 12, 13 & 14
SP Gr 11 (Urban)	0.5	831.80	13,000	No. 9 Ls. Nat. Sand	RS-1	.05	Nov. 4 & 6
SP Gr 11 (Rural)	0.9	947.23	10,600 (3,000-2 comp)	No. 9 Ls. Nat. Sand	RS-1	.05	Nov. 6 & 7
SP Gr 16	0.9	944.35	12,000	" "	RS-1	.05	Sept. 24 & 25
SP Gr 18	0.9	665.01	9,500	" "	RS-1	.05	Sept. 18
SP Gr 31	1.0	1017.38	14,300	" "	RS-1	.05	Oct. 21 & 22
SP Gr 32	1.0	1026.78	13,500	" "	RS-1	.05	Sept. 29
SP Gr 37	0.9	802.00	11,500	" "	RS-1	.05	Sept. 1
SP Gr 38	1.1	995.87	13,500	" "	RS-1	.05	Oct. 6 & 7
SP Gr 45	0.6	626.15	9,000	" "	RS-1	.05	Sept. 9
SP 54-140	1.0	916.31	13,500	40% No. 9 Ls. 10% No. 11 Ls. 25% Nat. Sand 25% Ls. Sand	RS-1	.05	Oct. 15 & 16
IT Gr 14	0.5	658.59	8,000	No. 6 Ls. Ls. Sand	RT-2 Prime	0.4	Oct. 1 & 2
IT Gr 22	0.5	677.45	9,000	No. 6 Ls. Ls. Sand	RT-2 Prime	0.4	Sept. 21
TOTAL	10.2	11029.31	150,900				

miles per hour. Specially marked traffic cones were set along the edge of the roadway at 500-ft. intervals so that different features of the surface could be located and referenced. The purpose of the initial film was to record the condition of the road before paving and to aid in the evaluation of the future surveys. The second set if films was taken to record the surface condition just after paving. Still photographs were made of irregular places in both the test and control sections before and after paving. These photos were used for close study of specific conditions. The boundaries of the test and control sections are marked by 18- x 24-inch metal signs. Each sign identifies an experimental or standard section and its length in miles.

The following items were observed during construction:

a. The Curtiss-Wright Binder coated the aggregate exceptionally well.

b. Traffic could be permitted on a pavement that has been paved with Curtiss-Wright Binder very early without apparent damage.

c. Fumes given off by the Curtiss-Wright Binder hot-mix created a difficult working condition for the construction personnel.

d. The Curtiss-Wright Binder mix "set" very quickly and was difficult to finish after initial compaction.

e. A tar-type tack coat would probably have been more compatible with the experimental binder than the emulsified asphalt tack used.

PERFORMANCE

Visual Surveys

During the two years since construction of the test sections, the Research Division of the Kentucky Department of Highways has been continuously evaluating this binder. Tests in the laboratory and field have been run to support the information gained from visual surveys. Still photos were made at approximately six-month intervals and more often if the performance indicated the need. The most reliable and usable information, that was collected on the project, was the visual performance surveys. These surveys were made monthly for the first year and semi-annually for the second, and as mentioned, included photographs of items noted in the surveys. Strip-type performance maps were prepared for each test section and its companion control section. Performance features were recorded on the maps in a color code signifying the time observed. The legend for the performance surveys is noted in Fig. 2, and typical performance maps are shown in Figs. 3 and 4.

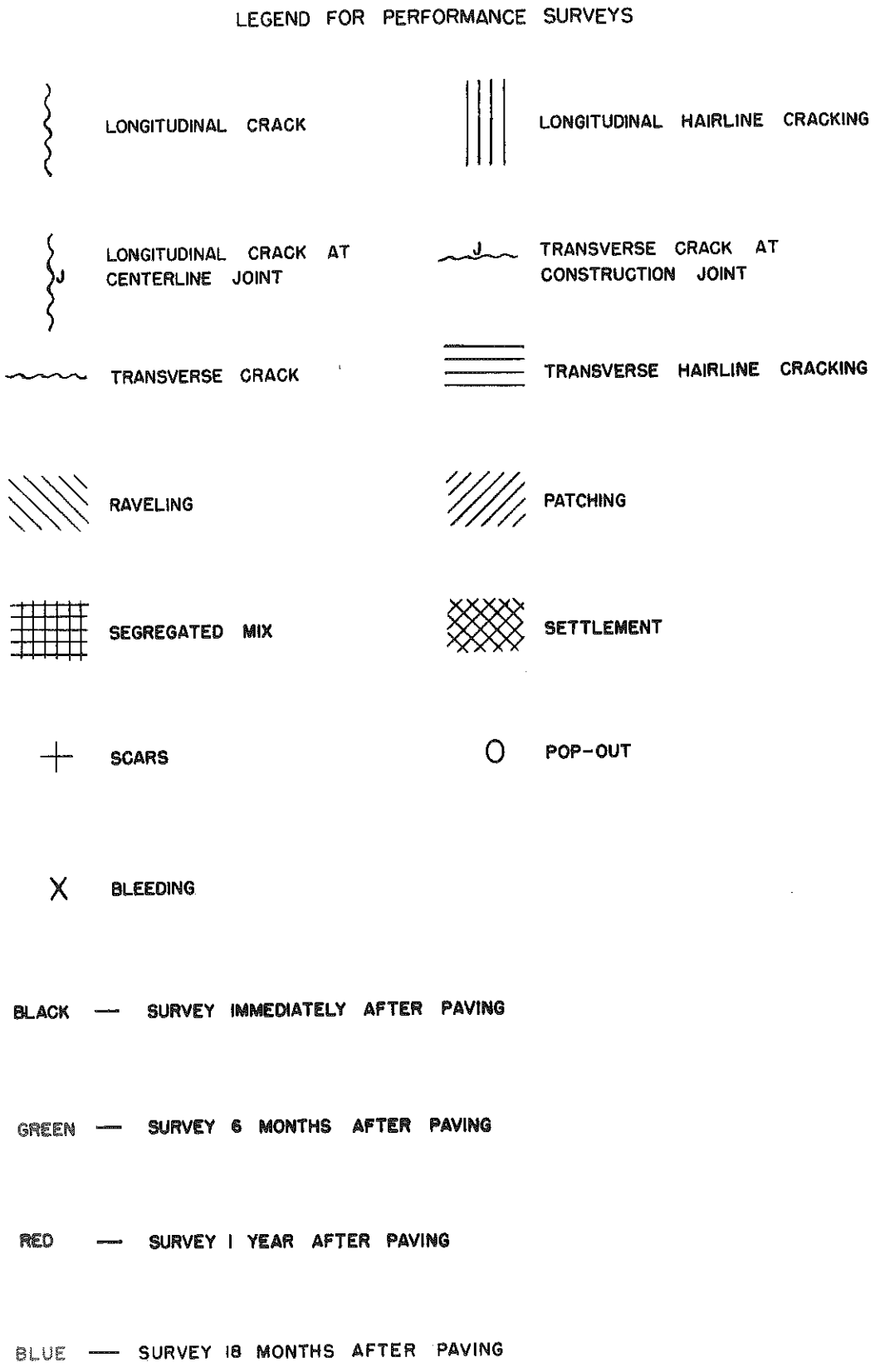

Fig. 2. Legend for Performance Surveys

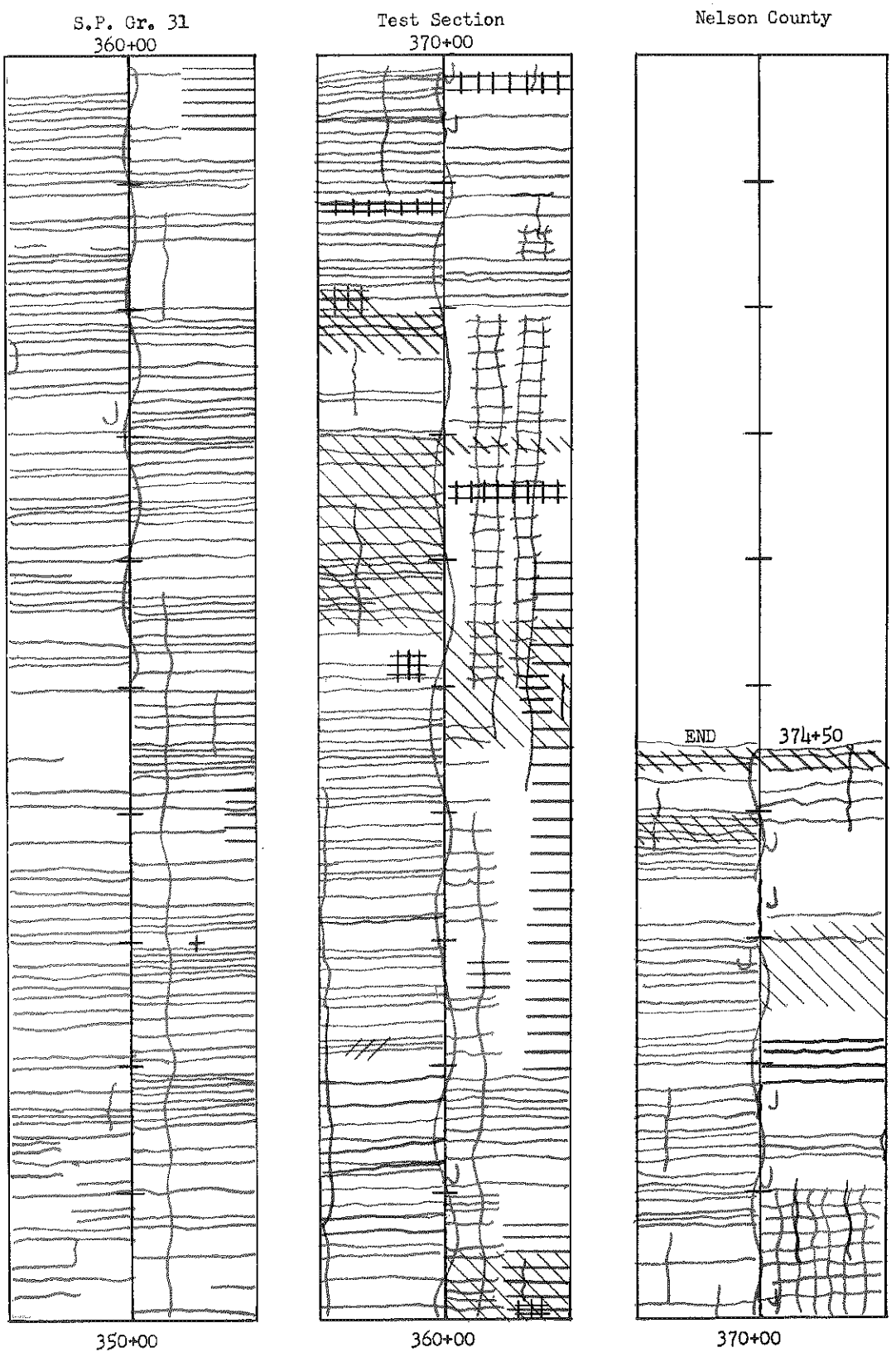

Fig. 3. Performance-Type Strip Map for Approximately One Half of Nelson County SP Group 31 Test Section (2 Years after Surfacing)

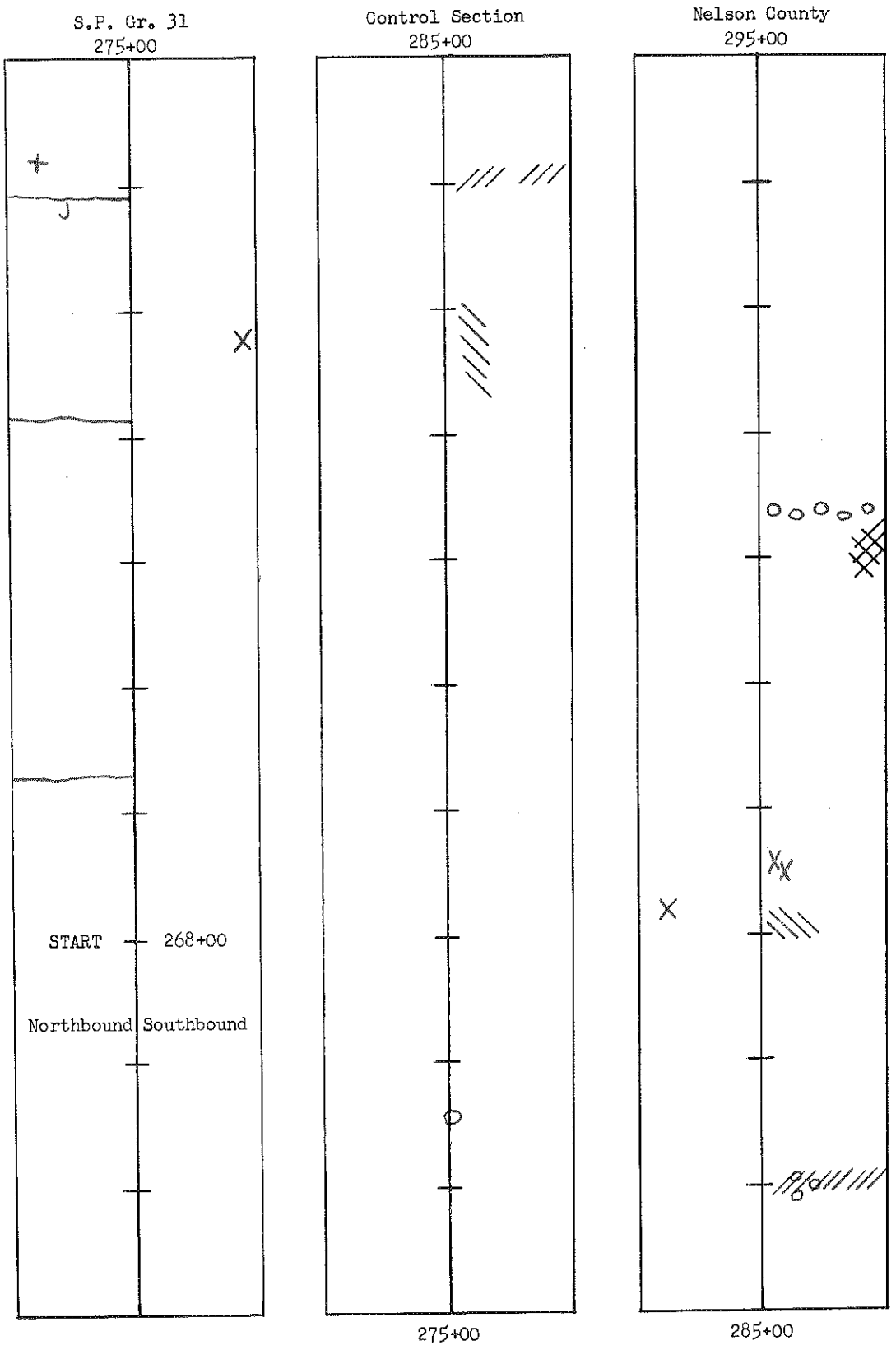

Fig. 4. Performance-Type Strip Map for Approximately One Half of Nelson County SP Group 31 Control Section (2 Years after Surfacing)

Six of the test sections will be discussed to summarize the comparative performance of the test and control sections. One of the test sections, SP Group 31 in Nelson County, was resurfaced with an asphaltic emulsion seal coat late in 1961. Several of the test and control sections have required maintenance patching of one form or another.

SP Group 31 on US 31E in Nelson County is a primary highway and is second to SP Group 11, Laurel County, in average daily traffic volume. The structural pavement design is comparable to existing primary pavements and thicker than the secondary projects in this study[1]. There was some cracking and raveling of the pavement prior to placing the test pavement and the control. Figure 5 was taken prior to paving the test section near station 370. The test pavement in this area showed considerable reflection cracking following the first winter season. Figure 6 shows the same general areas as in Fig. 5 one year after paving. Figure 3 is the strip-type performance chart for part of the Nelson County project. This test section had deteriorated to such an extent that the Maintenance Division advised that the entire Curtiss-Wright binder surfaced test section be covered with a seal-type application. An asphaltic emulsion seal was placed in the late fall of 1961 on this test section as shown in Fig. 7.

[1] Superscript numbers refer to listing of references following the report.

Fig. 5. Area of Transverse Cracking Near Station 370 of Nelson County SP Group 31 Test Section (Before Surfacing with Curtiss-Wright Binder)

Fig. 6. Transverse Cracks Reflecting Through Curtiss-Wright Binder Mix Near Station 370 of Nelson County SP Group 31 (One Year after Surfacing)

Fig. 7. Nelson County SP Group 31 Test Section after an Asphaltic Emulsion Seal Coat had been Placed (October 1961)