Technical Report Documentation Page

1. REPORT No.
Project No. 33211

2. GOVERNMENT ACCESSION No.

3. RECIPIENT'S CATALOG No.

4. TITLE AND SUBTITLE
Report on Skid Resistance Characteristics of Thermoplastic Stripes

5. REPORT DATE
June 1965

6. PERFORMING ORGANIZATION

7. AUTHOR(S)
G. Kemp

8. PERFORMING ORGANIZATION REPORT No.
Project No. 33211

9. PERFORMING ORGANIZATION NAME AND ADDRESS
State of California
Department of Public Works
Division of Highways
Materials and Research Department

10. WORK UNIT No.

11. CONTRACT OR GRANT No.

12. SPONSORING AGENCY NAME AND ADDRESS

13. TYPE OF REPORT & PERIOD COVERED

14. SPONSORING AGENCY CODE

15. SUPPLEMENTARY NOTES

16. ABSTRACT

The traffic department has recently been considering the use of thermoplastic stripes in connection with new standards for on-ramp and off-ramp striping. A request was made in a memorandum dated February 25, 1965, to J.L. Beaton from J.E. Wilson, that this department determine the coefficient of friction of the thermoplastic material using the California Skid Resistance tester, and also determine the effect on vehicle control when stopping on and crossing over the new stripe material during wet and dry conditions. A request was also made to perform identical tests for comparison purposes on the presently used standard paint stripe. Arrangements were made with the Highway Patrol to perform all vehicle type tests. These tests were made under the direction of T. N. Tamburri of the traffic department.

Tests performed with a standard passenger car at speeds up to 80 miles/hour did not provide any indication of control problems when weaving over dry thermoplastic or painted stripes. Also stopping tests at 30 miles/hour with two side wheels on the double 4" and 8" solid stripe did not cause any loss of vehicle control. No loss of control was noted in special crossing over tests on the 8" solid stripe at speeds up to 60 miles/hour.

When these tests were repeated under wet pavement conditions, there was no noticeable loss in vehicle control, except during braking from 30 miles/hour with two wheels on the stripe. On both thermoplastic and painted stripes, the vehicle swerved away from the stripe. All of these tests were performed by experienced drivers.

17. KEYWORDS
Project No. 33211

18. No. OF PAGES:
13

19. DRI WEBSITE LINK
http://www.dot.ca.gov/hq/research/researchreports/1964-1965/65-41.pdf

20. FILE NAME
65-41.pdf

65-41

3909
C.1

State of California
Department of Public Works
Division of Highways
Materials & Research Department

June 2, 1965

Project No. 33211

Mr. J. E. Wilson
Traffic Engineer
Division of Highways
Sacramento, California

Dear Sir:

Submitted for your consideration is:

REPORT

on

SKID RESISTANCE CHARACTERISTICS

OF

THERMOPLASTIC STRIPES

Study made by ---------------------------- Pavement Section
Under direction -------------------------- E. Zube
Project Supervisors ---------------------- J. Skog
G. Kemp
Report prepared by ----------------------- G. Kemp

Very truly yours,

JOHN L. BEATON
Materials & Research Engineer

Attachment

cc: LRGillis
ELTinney

INTRODUCTION

The traffic department has recently been considering the use of thermoplastic stripes in connection with new standards for on-ramp and off-ramp striping. A request was made in a memorandum dated February 25, 1965, to J. L. Beaton from J. E. Wilson, that this department determine the coefficient of friction of the thermoplastic material using the California Skid Resistance tester, and also determine the effect on vehicle control when stopping on and crossing over the new stripe material during wet and dry conditions. A request was also made to perform identical tests for comparison purposes on the presently used standard paint stripe. Arrangements were made with the Highway Patrol to perform all vehicle type tests. These tests were made under the direction of T. N. Tamburri of the traffic department.

SUMMARY

Tests performed with a standard passenger car at speeds up to 80 miles/hour did not provide any indication of control problems when weaving over dry thermoplastic or painted stripes. Also stopping tests at 30 miles/hour with two side wheels on the double 4" and 8" solid stripe did not cause any loss of vehicle control. No loss of control was noted in special crossing over tests on the 8" solid stripe at speeds up to 60 miles/hour.

When these tests were repeated under wet pavement conditions, there was no noticeable loss in vehicle control, except during braking from 30 miles/hour with two wheels on the stripe. On both thermoplastic and painted stripes, the vehicle swerved away from the stripe. All of these tests were performed by experienced drivers.

Skid resistance tests on the thermoplastic stripe are very low, and in the range of a "bleeding" asphalt pavement. The painted stripe was somewhat higher, but quite variable in different test areas. It appears that the friction value for painted stripes is influenced by the original pavement texture, and the film thickness of the traffic paint.

CONCLUSIONS

There does not appear to be any greater hazard in vehicle operation over thermoplastic traffic stripes than that encountered over presently used paint stripes. In both instances some loss of control occurred when braking with two wheels directly on both types of 8" wide stripes. Under such conditions driver control might become critical with an inexperienced operator. The degree of this hazard will depend on the difference in coefficient of friction between the stripe and pavement surface. On the basis of the measurements made during the present test series, the thermoplastic stripe would present the greater degree of hazard when braking with two wheels on the stripe.

The results of the tests indicate that some hazard may exist in the case of a motorcycle crossing over the thermoplastic stripe at high speeds during wet weather. The slight rise of the stripe coupled with the low friction value might cause loss of control.

Stripe Application

Arrangements were made with the Highway Patrol Academy to place the test stripes on portions of the road system within the Academy training area. These arrangements were first made through Captain Overhouse and later in more detail with Sergeant Phillips. The thermoplastic material was placed on 4-27-65, using the thermoplastic striping equipment from District IV through the cooperation of Maintenance Engineer, H. L. Miller.

The striping crew under the direction of Mr. Shed applied the thermoplastic stripe at a pot temperature of between 450°F and 500°F and a pavement temperature of 100 - 110°F which gave a stripe thickness of about 3/16". The thermoplastic material was white in color and contained about 20% of glass beads. Immediately after applying the stripe, glass beads were also sprinkled on the surface which had a tendency to sink into the hot thermoplastic material. This final sprinkling of glass beads gave a slight sandpaper texture to the surface. In comparison to a regular painted and beaded surface the texture was not as rough. This thermoplastic stripe was ready for use by traffic within about two to three minutes.

A comparison painted stripe was applied by equipment from this department in three applications, with the final application sprinkled with 62F34 specification glass beads. Three applications of paint were applied in order to build up the paint film, and simulate an older painted stripe.

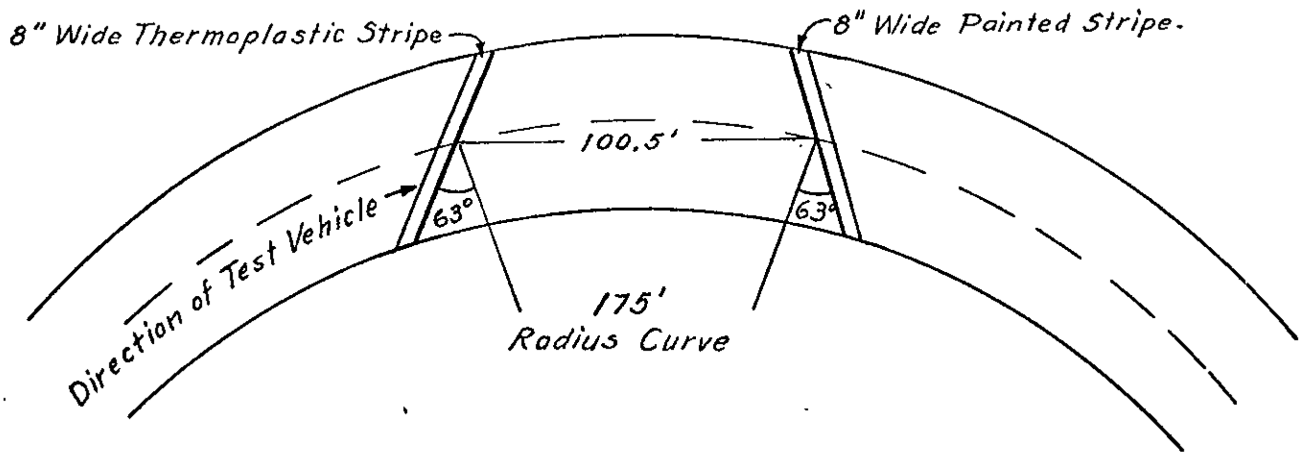
Test striping with the academy training area consisted of the following:

Tangent Section

1.	200'	Thermoplastic	4"	wide	normal	spaced	stripe	
2.	200'	Painted	"	"	"	"	"	
3.	200'	Thermoplastic	4"	wide	double	continuous	stripes	
4.	200'	Painted	"	"	"	"	"	
5.	200'	Thermoplastic	8"	wide	single	continuous	stripe	
6.	200'	Painted	"	"	"	"	"	

Curve Section

Illustration



Vehicle Testing

Vehicle tests were performed on 5-18-65 using a 1964 Dodge highway patrol car. Sergeant Phillips, training officer, at the academy performed all the vehicle tests.

Vehicle testing was performed in order to determine the effect of thermoplastic stripes on vehicle control while performing various maneuvers over the stripes. These same maneuvers were also performed over the regular painted stripe for comparative purposes. Movies were taken of the vehicle performing these tests by this department and are available for future reference.

Observations and driver reactions to the various tests performed are as follows:

Dry Pavement Tests

Tests were performed by weaving the vehicle over all tangent section stripes at speeds of 60, 70 & 80 M. P. H. and also stopping tests on the double and 8" wide stripes at 30 M. P. H.

Driver reaction and visual observations of the weaving tests indicated no apparent difference in driver control between the thermoplastic and painted stripes. There was definitely more tire noise when the vehicle passed over the thermoplastic stripe. In the stopping tests with two side wheels on the stripe the vehicle stopped relatively straight regardless of stripe type, however, there appeared to be a greater deposit of black rubber on the thermoplastic stripe.

Vehicle tests were performed on the curve section by driving the vehicle around the curve at speeds of 45, 55 and 60 M. P. H. These curve tests were performed to determine vehicle control in relation to crossing over the stripes at a wider angle and in more of a centrifugal fashion.

Again driver reaction and visual observations indicated no apparent difference in vehicle control between the different stripes nor was there any loss of control of the vehicle when crossing over the stripes. At speeds of 55 and 60 M. P. H. smoke was seen emanating from the rear tires of the test vehicle.

Wet Pavement Tests

Tangent Section (8" wide stripe)

Wet pavement condition tests were performed first over the 8" wide stripes because it was felt that this wide stripe would provide the worse possible condition. Weaving vehicle tests at 60, 70 and 80 M. P. H. indicated little difference between the thermoplastic and painted stripe. The driver intimated that he thought the rear of the vehicle had a slight tendency to break away on the thermoplastic stripe although visual observations did not confirm his reaction. Braking tests at 30 M. P. H. on both stripe types, with two wheels on the stripe, had a definite bad effect on vehicle control, and the vehicle actually swerved away from the stripe. Under these braking conditions driver control could present some problems to an inexperienced driver. For informational purposes on the stopping stability of the test vehicle a few wet pavement stopping tests were performed at 30 M. P. H., and the vehicle stopped in a straight line which indicated the stripes were the cause of the vehicle losing control and not sliding in a straight line. Cause of vehicle swerve while stopping on the stripe is naturally due to differences in coefficient of friction of the stripe and roadway surfaces.

Curve Section

Vehicle testing of the curve section in a wet pavement condition at speeds of 35, 45 and 50 M. P. H. indicated no apparent problem because of the stripes and no difference was indicated by the different stripe materials.

Skid Resistance Test Results

Coefficient of Friction by California Test Method

The coefficient of friction determinations were performed by California Test Method #342B and are shown in Table A. The values determined simulate a coefficient of friction obtained when a vehicle with smooth tires locks its brakes at 50 M. P. H. on a wet pavement surface. Under these conditions of test the tentative minimum coefficient of friction desired for a pavement surface is 0.25f.

As shown in Table A the skid resistance test results of the thermoplastic stripe are all well below this tentative minimum requirement. Skid resistance test results of the normal painted stripes are quite variable and at two locations the average values are above the minimum requirement. The average values obtained on the 8" wide normal painted stripe are below the minimum requirement both in the tangent and curve test areas. It is apparent from these tests that the frictional resistance of a normal painted stripe is dependent on initial pavement surface texture. Therefore, the skid resistance characteristics of painted stripe are dependent on the amount of pavement surface texture remaining after painting which in turn is controlled by initial surface texture and quantity of paint applied.

The application of the normal glass beads to the painted or thermoplastic surface does not appear to greatly increase the coefficient of friction of these surfaces. The probable reason is the roundness, fineness and bedding characteristics of the glass beads into the painted or thermoplastic films.

TABLE A

Skid Resistance Test Results

California Test Method 342-B

4" Wide Normal spaced stripe (Tangent Section)

Thermoplastic Stripe	Pavement adjacent to stripe
.15	.35
.12	.32
.13	.31
Ave. = .13	Ave. = .33

Yellow Painted Stripe

Yellow Painted Stripe	Pavement adjacent to stripe
.25	.35
.26	.31
.32	.35
.35	
Ave. = .30	Ave. = .34

Double Continuous Stripes (Tangent Section)

Thermoplastic Stripe		Pavement adjacent to stripe
.13	.14	.33
.11	.13	.34
.12	.13	.32
Ave. = .12	.13	Ave. = .33

Yellow Painted Stripe

Yellow Painted Stripe		Pavement adjacent to stripe
.29	.24	.37
.29	.30	.33
.26	.29	.37
Ave. = .28	.28	Ave. = .36

8" Wide continuous stripe (Tangent Section)

Thermoplastic Stripe	Pavement adjacent to stripe
.13	.35
.15	.38
.14	.38
Ave. = .14	Ave. = .37

TABLE A (Cont'd)

Yellow Painted Stripe

	.26
	.13
	.23
	.14
	.15
Ave. =	.18

	.37
	.36
	.37
Ave. =	.37

8" Wide continuous stripe (Curve test Section)

Thermoplastic Stripe

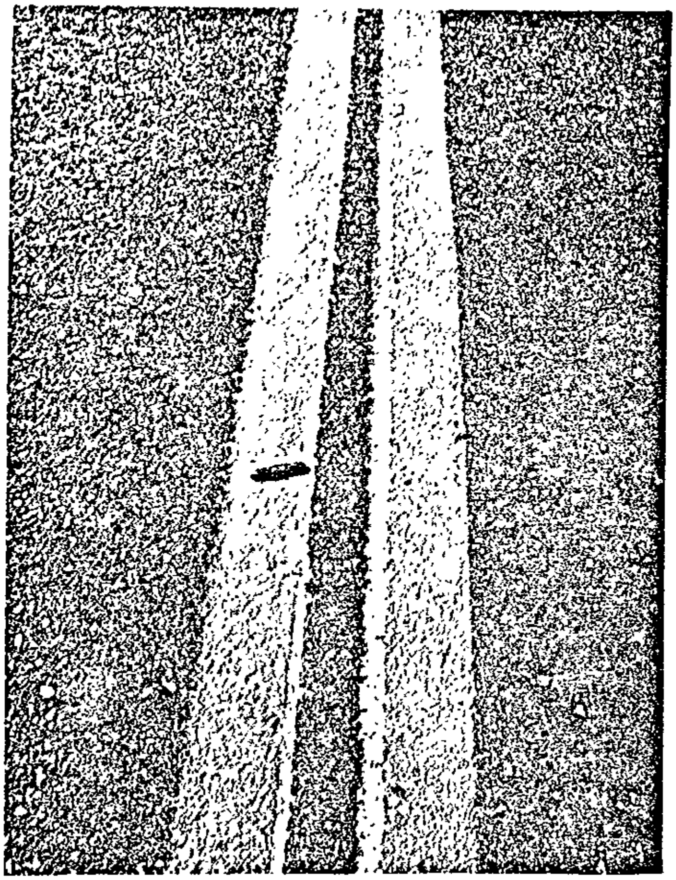
	.15
	.13
	.11
	.12
Ave. =	.13

Yellow Painted Stripe

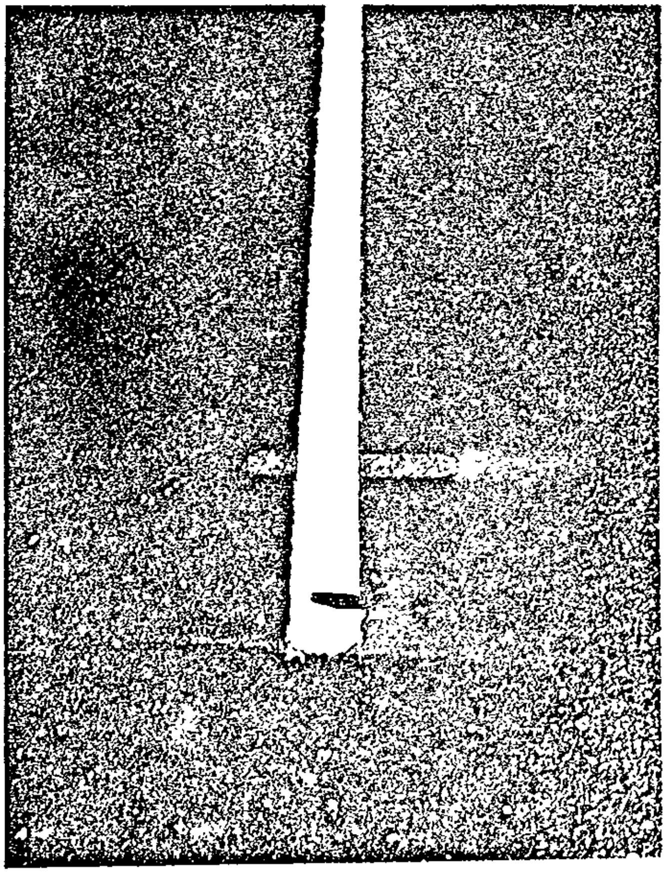
	.19
	.21
	.14
	.14
Ave. =	.17

Pavement in Curve

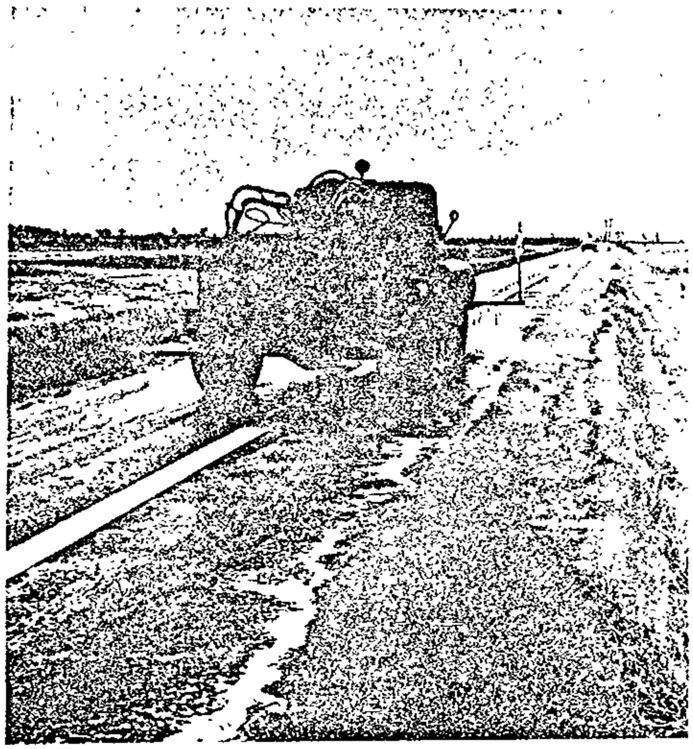
	.30
	.37
	.35
	.30
	.35
	.34
	.37
	.34
	.31
Ave. =	.34



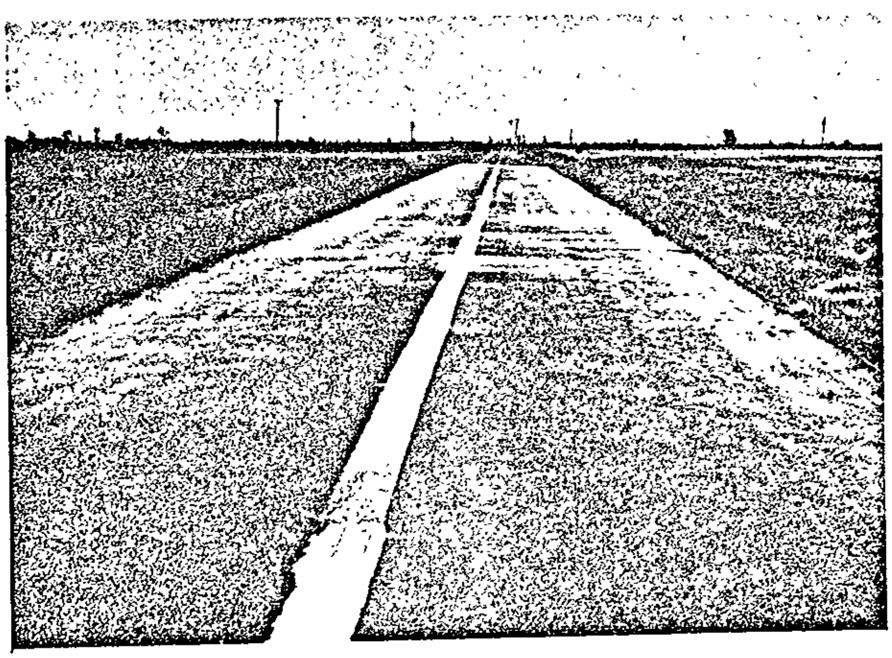
Close up of double paint stripes in tangent test area. Note the rough pavement texture and the fact that road surface texture is showing through the paint film.



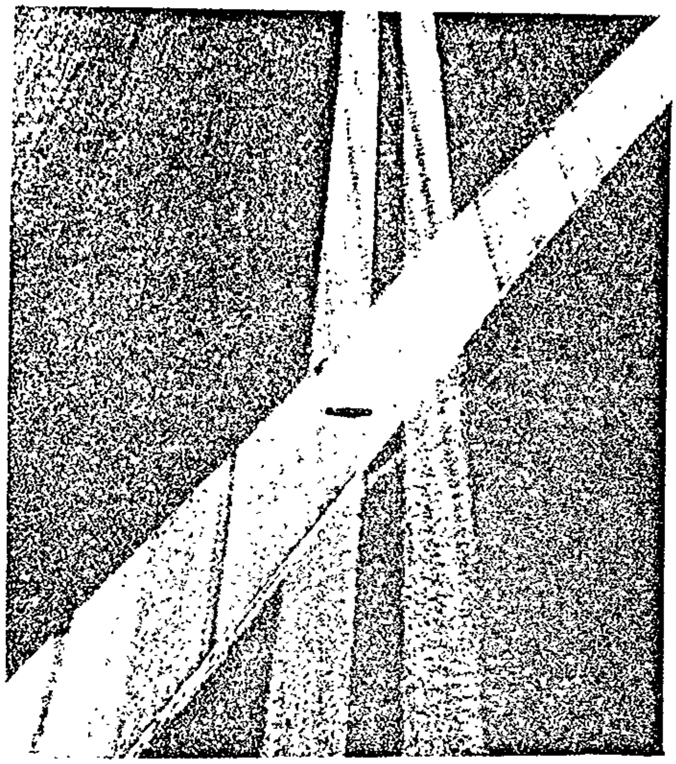
Close up of single 4" wide thermosplastic stripe. Note the rough pavement surface texture does not show through this thick coating.



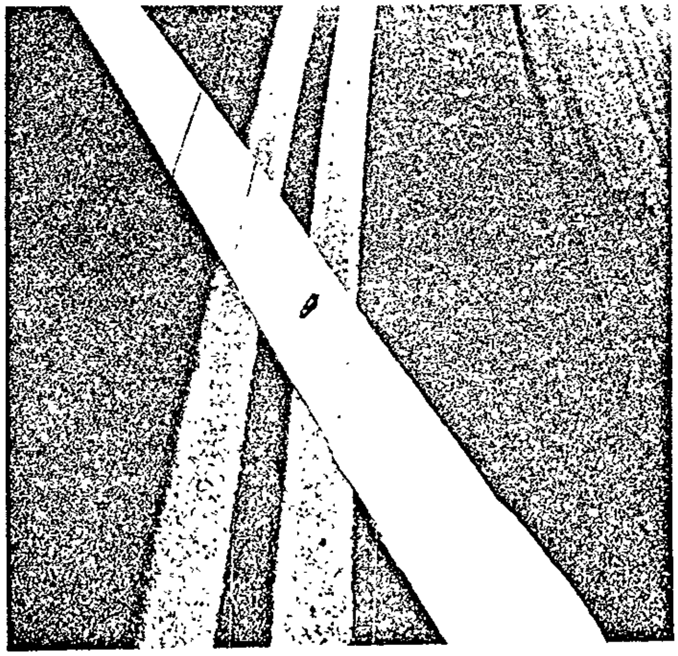
Showing method of water application on tangent test area.



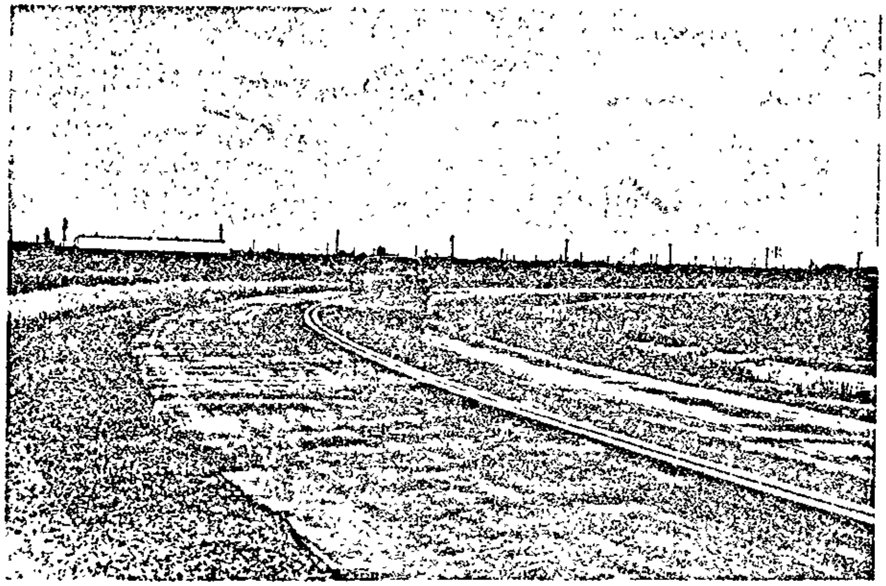
Typical of pavement in tangent test area in a wet condition



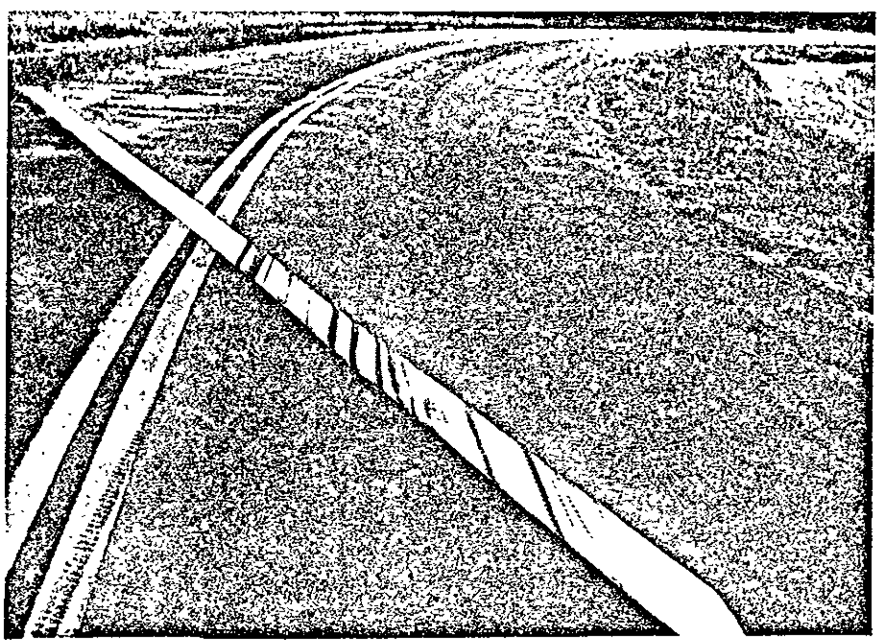
Close up of yellow paint stripe in curve section. The surface texture of this pavement was much smoother than the tangent sections and the paint film had a tendency to fill the surface texture of the pavement.



Close up of thermoplastic stripe in curve section.



Showing curve test section in wet pavement condition.



Showing tire deposits over thermoplastic stripe caused during dry tests. Note that in general the tire deposits on the black pavement and over the stripe follow in the same line which indicates that no skid porblem involving the stripes would exist during dry weather.