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STATE HIGHWAY DEPARTMENT
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State Highway Commissioner

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COMPARATIVE FIELD STUDY OF DIFFERENT TRAFFIC PAINTS
AND STRIPING PRACTICE

A joint report of the
Research Laboratory and Maintenance Division
containing results of field observations on
experimental traffic paint installations
established by the Maintenance Division
in the summer of 1950.

Highway Research Project 47 G-36

Research Laboratory
Testing and Research Division
Report No. 160
October 10, 1951

COMPARATIVE FIELD STUDY OF DIFFERENT TRAFFIC
PAINTS AND STRIPING PRACTICES

During the 1950 painting program, five experimental traffic stripe test areas were established by the Maintenance Division for the purpose of determining the wearing qualities and bead retention properties of Department specification materials as compared with proprietary traffic paint products. Specific objectives of this study were:

1. Compare relative performance of 1950 MSHD standard paint stripes with proprietary products.
2. Compare relative performance of 1950 MSHD standard practice with 1950 MSHD paints with beads premixed and beads on.
3. Compare relative performance of 1950 MSHD paints with beads in and on with proprietary products under similar conditions.
4. Compare relative performance of Barrett tar paint with Jennite emulsion paint.
5. Compare relative performance of traffic paints on concrete and bituminous pavement surfaces.

The test installations, located as shown in Figure 1, were established and supervised by Mr. William Larkin of the Maintenance Division. The Research Laboratory of the Testing and Research Division has been responsible only for making subsequent observations on these test areas and for the reporting of the relative performance of the various paint stripes.

In November, 1950, and in February, 1951, after all paints concerned had been down at least four and eight months, respectively, evaluation surveys were made to determine the relative durabilities of the various paint stripes. Pictures showing wearing properties at approximately 9-1/2 months are presented. In order to accomplish objective No. 2, it was necessary to include the mileage of paint stripe between East Lansing and Williamston and on US-27 between Lansing and St. Johns in the evaluation surveys.

**LOCATION OF
MSHD 1950 TRAFFIC PAINT TEST AREAS**

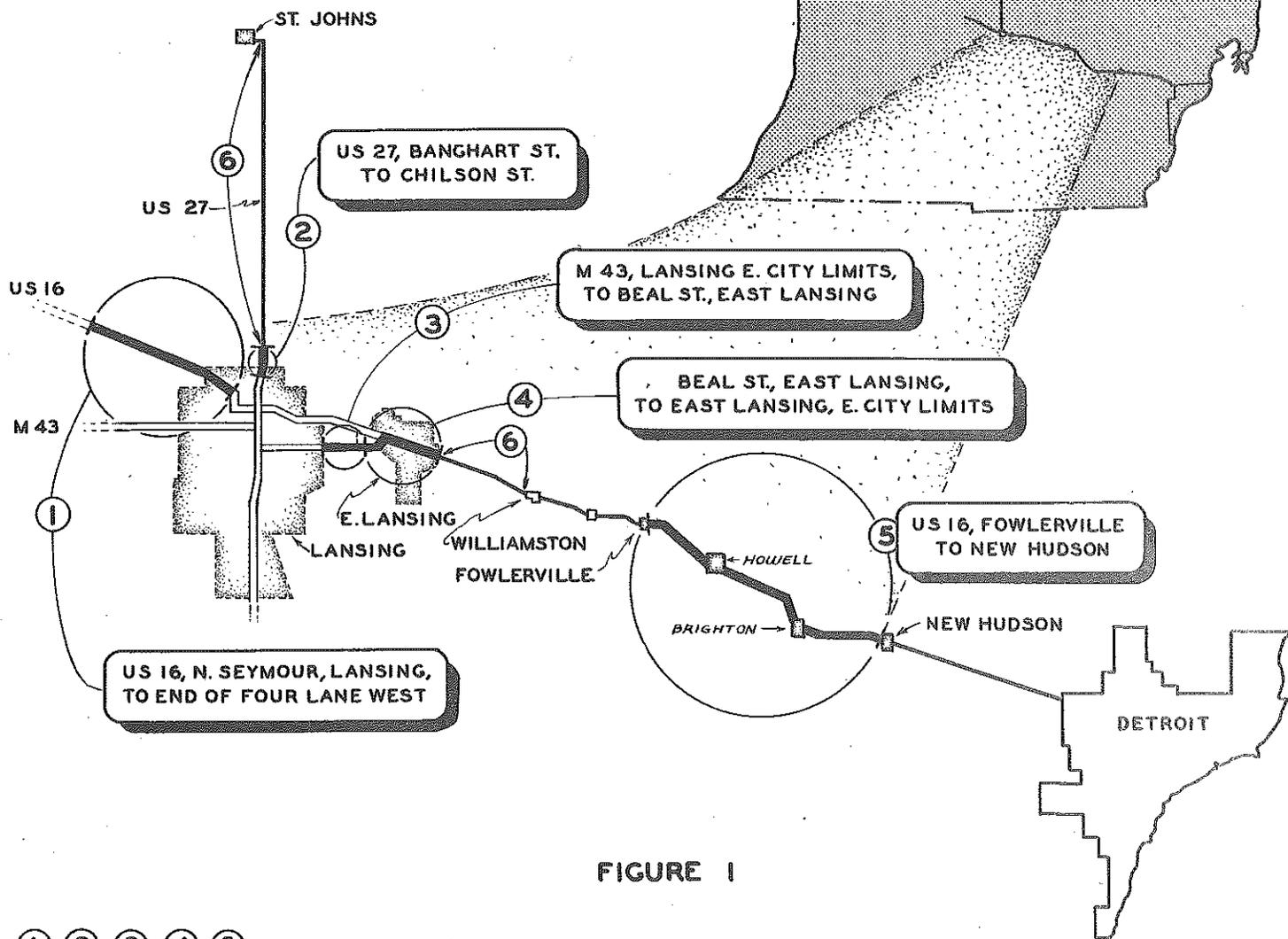


FIGURE 1

- ① ② ③ ④ ⑤ ESTABLISHED TEST AREAS.
- ⑥ STANDARD 1950 PRACTICE OUTSIDE OF ESTABLISHED TEST AREAS.

Materials

The paint materials included in the investigation were as listed below:

Michigan State Highway Department (MSHD)	1950	White and Yellow
*Prismo Binder	1950	Yellow
Prismo Lifeline (Prismo)	1950	White and Yellow
Minnesota Mining Centerlite (Centerlite)	1950	White and Yellow
Jennite (Jennite)	1950	Black
Barrett (Barrett)	1950	Black

*Prismo Binder is the same as Prismo Lifeline except intermixed beads were omitted.

Two types of beads designated Type 1 and Type 2 were used in the investigation. Type 1 is intended for application on the surface of traffic paint films, and Type 2 is intended to be mixed in traffic paints. Relative grading characteristics are shown below.

Sieve No.	Sieve Opening, inches	Total Percent Passing	
		Type 1	Type 2
20	0.0831	100	
30	0.0232	65-95	
40	0.0165	35-80	
50	0.0117	10-40	100
60	0.0098		95 - 100
100	0.0059	0- 5	45 - 75
200	0.0029	0	0 - 2

Type 1 and 2 beads were obtained from MSMD 1950 stock purchased from Minnesota Mining Company.

Application

All paint stripes were put down with regular paint spray equipment by regular paint crews. However, throughout the test areas, four different combinations of paint stripes were laid down. They will be

referred to in the report as Class A, Class B, Class C, and Class D.

Each class of paint stripe is defined below.

Class A - Regular application of paint with 6 lb. per gal. of Type 1 beads on top.

Class B - Paint application with 4 lb. per gal. of Type 2 beads premixed in the paint and 2 lb. of Type 1 beads on top.

Class C - Paint application with 4 lb. per gal. of Type 2 beads premixed in the paint and no beads on top.

Class D - Paint application with no beads.

In the development of Class B and Class C stripes for the different materials, it should be understood that Prismo's Lifeline and Minnesota's Centerlite are manufactured and sold containing 4 pounds of small beads premixed per gallon of materials as a packaged product. In the case of Michigan State Highway white and yellow paints, however, the Type 2 beads were premixed in the paint on the job, to produce a material comparable to the two proprietary paints used in the study.

The percent of paint remaining on the pavement at the time of survey was determined in accordance with ASTM test procedure Designation D821-47. All percent values determined less than 1 have been rated at zero in this report.

The experiment clearly demonstrates the advantage to be gained in stripe performance by the use of beads premixed in the paint film. Further, when beads are premixed in MSHD paints, wearing properties may be expected at least equal to that of proprietary paints which are sold as a package material with beads premixed. The outstanding wearing characteristics of Prismo's Lifeline and Minnesota's Centerlite is obviously due in part at least to the presence of the small beads (sold) premixed in the paint.

In addition to the main evaluation study, incidental studies associated with the work include the effect of premixed beads on drying time of paint film and observations related to bleeding under beads.

EVALUATION OF TRAFFIC PAINT DURABILITY

In this phase of the work each test area was separately appraised and the results therefrom have been presented, starting with Test Area 1. It is to be noted at this point that Test Areas 1, 2, 3, and 4 are located in urban areas and, therefore, subject to high traffic densities and considerable line crossing. This will account for the general low values for paint remaining in these four areas.

Test Area One:

A schematic diagram of Test Area 1 is presented in Figure 2. This test area is located on US-16 between North Seymour, Lansing, and the end of the four lane pavement west of Lansing. With reference to Table 1, which contains a summary of observation data, the following comparisons on relative paint performances have been made.

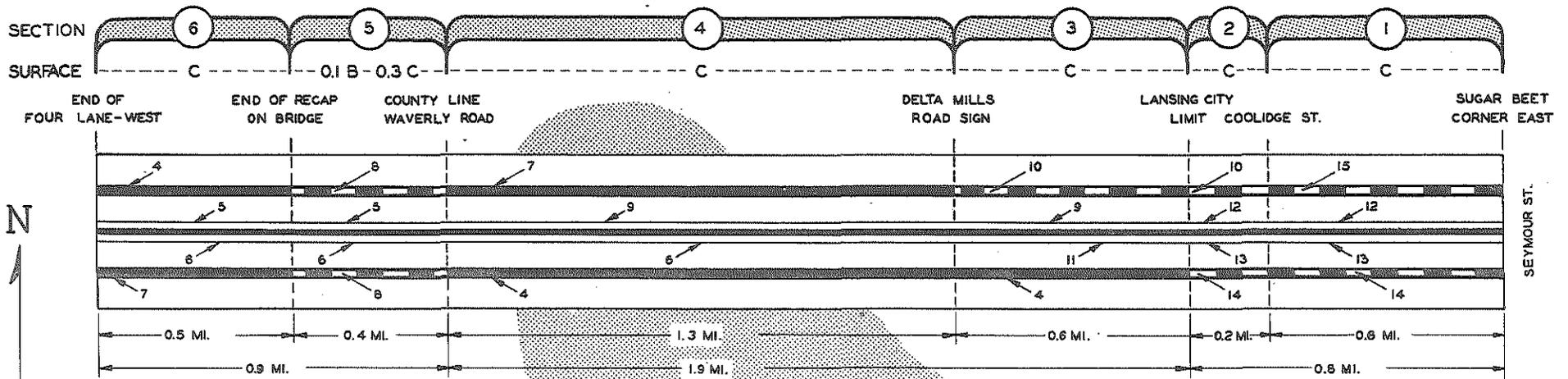
1. The lane lines in Test Area 1, including MSHD 1950 Class B white, Centerlite Class C white, were completely worn away by traffic at 7 months and, therefore, no direct comparison could be made at that time. See lane lines pictured in Figure 3A.

At 4 months, MSHD Class B white lane line had twice as much paint remaining on bituminous concrete as on portland cement concrete, and about the same amount on portland cement concrete as Centerlite Class C white lane line. Ref. Stripes (8-10-14-15).

2. MSHD 1950, Class B, yellow center line had nearly the same percent of paint remaining on concrete as in the case of Prismo Lifeline, Class B, yellow and about half as much as in the case of Minnesota Mining Centerlite Class B yellow at 7 months. See Figures 3A through C. Corresponding amounts at 4 months were much closer. Ref. Stripes 5-6-9-11.

3. On bituminous concrete, MSHD Class B yellow center line had considerably less paint remaining than in the case of Prismo Lifeline Class B yellow, at 7 months. Corresponding percentages at 4 months were very close. Ref. Stripes 5-6.
4. On bituminous concrete, Prismo Lifeline Class C yellow center line had the same amount of paint remaining as was the case with Centerlite Class C, both at 4 months and 7 months. Ref. Stripes 12-13.
5. On concrete, MSHD 1950 black lane line (Barrett) had about the same percent of paint remaining as Jennite, at 4 months and 7 months. Ref. Stripes 4-7.

Although Jennite showed durability approximately equivalent to that of MSHD 1950 black (Barrett), the Jennite in Test Area 1 had a brownish cast, and width of stripe varied from 5 to 7 inches. See Figure 3D.



SEYMOUR ST.

TEST AREA I

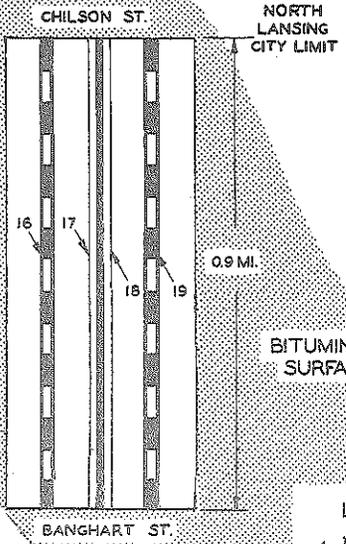
U.S. 16, NORTH SEYMOUR, LANSING, TO END OF 4 LANE, WEST

LEGEND: (TEST AREA I)

- 4. SOLID LINE. JENNITE BLACK.
- 5. SOLID LINE. PRISMO LIFELINE YELLOW PREMIX BINDER (NO BEADS IN AS RECEIVED), 4 LB./GAL. PRISMO BEADS MIXED IN, 2 LB./GAL. NO. 1 PRISMO BEADS ON.
- 6. SOLID LINE. 1950 SPECIFICATION MSHD YELLOW, 4 LB./GAL. NO. 2. MMM BEADS IN, 2 LB./GAL. NO. 1 MMM BEADS ON.
- 7. SOLID LINE. BARRETT BLACK.
- 8. SKIP LINE. 1950 SPECIFICATION MSHD WHITE, 4 LB./GAL. NO. 2. MMM BEADS IN, NO BEADS ON, BARRETT BLACK.
- 9. SOLID LINE. CENTERLITE PREMIXED YELLOW (FACTORY MIXED WITH MMM BEADS AS RECEIVED), 2 LB./GAL. NO. 1 MMM BEADS ON.
- 10. SKIP LINE. 1950 SPECIFICATION MSHD WHITE, 4 LB./GAL. NO. 2. MMM BEADS IN, 2 LB./GAL. NO. 1. MMM BEADS ON, BARRETT BLACK.
- 11. SOLID LINE. PRISMO PREMIXED YELLOW (FACTORY MIXED WITH PRISMO BEADS AS RECEIVED), 2 LB./GAL. NO. 1. MMM BEADS ON.
- 12. SOLID LINE. CENTERLITE PREMIXED YELLOW (FACTORY MIXED WITH MMM AS RECEIVED), NO BEADS ON.
- 13. SOLID LINE. PRISMO PREMIXED YELLOW (FACTORY MIXED WITH PRISMO BEADS AS RECEIVED), NO BEADS ON.
- 14. SKIP LINE. CENTERLITE PREMIXED WHITE (FACTORY MIXED WITH MMM BEADS AS RECEIVED), NO BEADS ON, BARRETT BLACK.
- 15. SKIP LINE. 1950 SPECIFICATION MSHD WHITE, 4 LB./GAL. NO. 2. MMM BEADS IN, 2 LB./GAL. NO. 1. MMM BEADS ON, JENNITE BLACK.

LEGEND: (TEST AREA 2)

- 16. SKIP LINE. 1950 SPECIFICATION MSHD WHITE, NO BEADS IN, 6 LB./GAL. NO. 1. MMM BEADS ON, BARRETT BLACK.
- 17. SOLID LINE. 1950 SPECIFICATION MSHD YELLOW, NO BEADS IN, 6 LB./GAL. NO. 1. MMM BEADS ON.
- 18. SOLID LINE. PRISMO LIFELINE YELLOW PREMIX BINDER, NO BEADS IN, 6 LB./GAL. NO. 1. MMM BEADS ON.
- 19. SKIP LINE. PRISMO LIFELINE WHITE PREMIX BINDER, NO BEADS IN, 6 LB./GAL. NO. 1. MMM BEADS ON, BARRETT BLACK.



TEST AREA 2

U.S. 27, BANGHART ST. TO CHILSON ST.

FIGURE 2

TABLE I

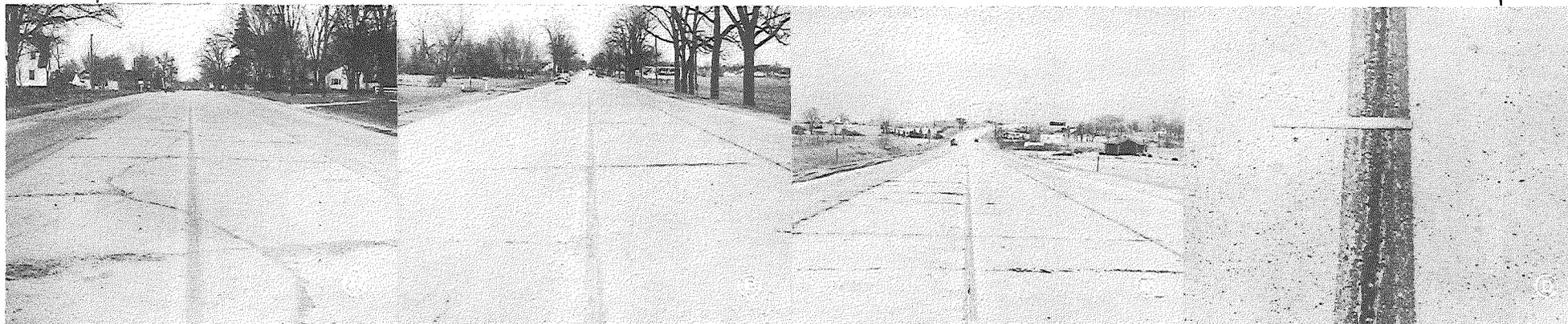
SUMMARY OF DATA FROM TEST AREA 1 AT 4 AND 7 MONTHS

US-16, North Seymour, Lansing, to End of Four Lane West

STRIPE NO.	BRAND	*BEAD APPLICATION CLASS	COLOR	TRAFFIC VEHICLES PER DAY	LENGTH OF STRIPE MILES	LINE LOCATION	PAINT REMAINING PERCENT	
							At 4 Months	At 7 Months
CONCRETE SURFACE								
8-10-15	MSHD	B	White	3500	0.80	Lane	33	0
6	MSHD	B	Yellow	3300	2.10	Center	71	22
5-11	Prismo	B	Yellow	3500	1.40	Center	78	25
9	Centerlite	B	Yellow	3600	1.90	Center	79	49
14	Centerlite	C	White	3300	0.32	Lane	36	2
13	Prismo	C	Yellow	3300	0.80	Center	85	55
12	Centerlite	C	Yellow	3600	0.80	Center	85	55
4	Jennite	D	Black	3500	1.90	Lane	61	5
7	Barrett	D	Black	3500	1.80	Lane	59	5
BITUMINOUS CONCRETE SURFACE								
8	MSHD	B	White	3500	0.12	Lane	65	0
6	MSHD	B	Yellow	3300	0.10	Center	70	5
5	Prismo	B	Yellow	3600	0.10	Center	80	35

*NOTE: Class A = Standard application with 6# beads on top.
Class B = Application with 4# beads premixed with 2# beads on.
Class C = Application with 4# beads premixed with no beads on.
Class D = Application with no beads.

T E S T A R E A I



▲ TEST AREA 1, SECTION 3,
1950 CENTERLITE CLASS B YELLOW CENTER STRIPE
ON LEFT. 1950 PRISMO CLASS B YELLOW CENTER
STRIPE ON RIGHT.

▲ TEST AREA 1, SECTION 4,
1950 CENTERLITE CLASS B YELLOW CENTER STRIPE
ON LEFT. 1950 MSHD CLASS B YELLOW CENTER
STRIPE ON RIGHT.

▲ TEST AREA 1, SECTION 6,
1950 PRISMO CLASS B YELLOW CENTER STRIPE
ON LEFT. 1950 MSHD CLASS B YELLOW CENTER
STRIPE ON RIGHT.

▲ TEST AREA 1, APPEARANCE OF JENNITE
SHOWING TYPICAL WIDTH OF STRIPE.
IN THIS CASE 6 7/8 INCHES.

T E S T A R E A 2



▲ TEST AREA 2,
1950 MSHD CLASS A YELLOW CENTER STRIPE
ON LEFT. 1950 PRISMO CLASS A YELLOW CENTER
STRIPE ON RIGHT.

RELATIVE APPEARANCE
OF TRAFFIC STRIPES
IN AREAS 1, 2 AND 3
AT 9 1/2 MONTHS

T E S T A R E A 3



▲ TEST AREA 3,
1950 PRISMO CLASS B WHITE LANE LINE ON LEFT.
1950 MSHD CLASS B WHITE LANE LINE ON RIGHT.

FIGURE 3

Test Area Two:

Test Area 2 is located on US-27 between Banghart Street and North City Limits of Lansing. All test stripes are on bituminous concrete and extend a distance of 0.9 mile each. A schematic diagram of this test area is shown in Figure 2 and summary of test data will be found below in Table II.

TABLE II

SUMMARY OF TEST DATA FROM TEST AREA 2 AT 4 AND 7 MONTHS

US-27 between Banghart St. and North Limits, Lansing

STRIPE NO.	BRAND	BEAD APPLICATION CLASS	COLOR	TRAFFIC VEH. PER DAY	LENGTH OF STRIPE MILES	LINE LOCATION	PAINT REMAINING PERCENT	
							4 months	7 months
16	MSHD	A	White	3700 S.B.*	0.54	Lane	45	4
19	Prismo Binder	A	White	3000 N.B.	0.54	Lane	65	0
17	MSHD	A	Yellow	3700 S.B.	0.90	Center	75	30
18	Prismo Binder	A	Yellow	3000 N.B.	0.90	Center	75	30

*S.B. = South Bound, N.B. = North Bound

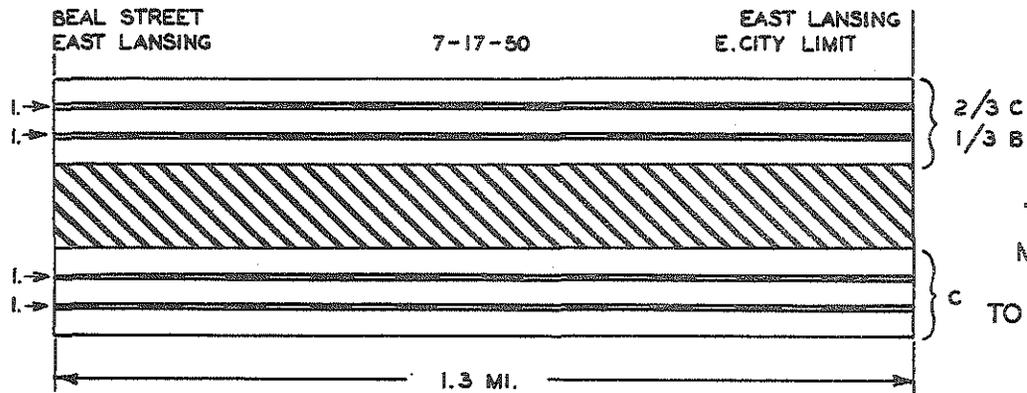
The following comparisons are based on data in Table II. Traffic in southbound lanes was found to be slightly higher than that going north which would favor the Prismo lane, stripe 19.

1. At 7 months, MSHD 1950 Class A white lane line had 4 percent of paint remaining as compared to zero for Prismo Binder Class A white, even though traffic favored the Prismo product. It is interesting to note that the corresponding percentages at 4 months were reversed. Ref. Stripes 16-19.
2. MSHD 1950 Class A yellow center line and Prismo Binder Class A yellow performed equally well, having the same percent of paint remaining at both surveys. Ref. Stripes 17-18.

Pictures of center yellow paint stripes taken at 9-1/2 months are shown in Figure 3E.

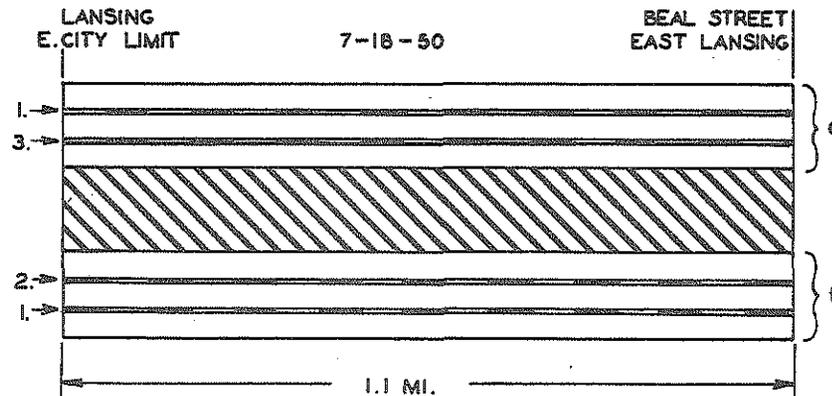
Test Area Three:

Test Area 3 is located on M-43 between Lansing and East Lansing. This particular section has a very high daily traffic volume with considerable lane crossing. A schematic diagram of the test area is shown in Figure 4. Test data are summarized in Table III.



TEST AREA 4
 M 43 AND US 16
 FROM BEAL ST.
 TO EAST CITY LIMIT,
 EAST LANSING

TEST AREA 3
 M 43 FROM LANSING
 EAST LIMIT TO BEAL ST,
 EAST LANSING



C = CONCRETE
 B = BLACKTOP

LEGEND:

1. SKIP LINE. 1950 SPECIFICATION MSHD WHITE, 4 LB./GAL. NO. 2 MMM BEADS IN, 2 LB./GAL. NO. 1 PRISMO BEADS ON; BARRETT BLACK.
2. SKIP LINE. PRISMO PREMIXED WHITE (FACTORY MIXED WITH PRISMO BEADS AS RECEIVED), 2 LB./GAL. NO. 1 PRISMO BEADS ON; BARRETT BLACK.
3. SKIP LINE. CENTERLITE PREMIXED WHITE (FACTORY MIXED WITH MMM BEADS AS RECEIVED) 2 LB./GAL. NO. 1 PRISMO BEADS ON; BARRETT BLACK.

FIGURE 4

EXPERIMENTAL TRAFFIC STRIPE INSTALLATIONS, 1950

TABLE III

SUMMARY OF TEST DATA FROM TEST AREA 3 AT 4 AND 7 MONTHS

M-43 between Lansing and East Lansing

STRIPE NO.	BRAND	BEAD APPLICATION CLASS	COLOR	TRAFFIC VEHICLES PER DAY	LENGTH OF STRIPE MILES	LINE LOCATION	PAINT REMAINING, PERCENT	
							4 mo.	7 mo.
<u>Concrete Surface</u>								
1	MSHD	B	White	9700	0.66	Lane	65	0
3	Centerlite	B	White	9700	0.66	Lane	30	0
<u>Bituminous Concrete Surface</u>								
1	MSHD	B	White	8900	0.66	Lane	80	7
2	Prismo	B	White	8900	0.66	Lane	55	1

With reference to Table III, it may be seen that:

1. On concrete both the MSHD 1950 Class B white lane line and MMM Centerlite Class B white lane line had completely worn away under traffic at 7 months. At 4 months, MSHD had over twice as much remaining as was true of Centerlite. Ref. Stripes 1, 3.

2. On the bituminous concrete surface the MSHD 1950 Class B white lane line stood up better than the Prismo Lifeline Class B white lane line at both surveys. Ref. Stripes 1, 2. Condition of paints at 9-1/2 months is illustrated in Figure 3F.

Test Area Four

This test area is a continuation of Test Area 3 on route M-43, extending to East Limits of East Lansing on US-16. A schematic diagram of Test Area 4 is shown in Figure 4. The results of evaluation survey are given in Table IV. Traffic in this area was very heavy, amounting to approximately 12,800 vehicles per day.

No comparison can be drawn from this test area because all paint stripes were completely worn away by traffic at 7 months, and very nearly so at 4 months. See Table IV.

TABLE IV

SUMMARY OF TEST DATA FROM TEST AREA IV AT 4 AND 7 MONTHS

STRIPE NO.	BRAND	BEAD APPLICATION CLASS	M-43 and US-16 inside East Lansing COLOR	TRAFFIC VEHICLES PER DAY	LENGTH OF STRIPE, MILES	STRIPE LOCATION	PAINT REMAINING, PERCENT AT:	
							4 mo.	7 mo.
<u>South Boulevard; Concrete Surface</u>								
1	MSHD	B	White	11800	0.52	South Lane	5	0
1	MSHD	B	White	11800	0.52	North Lane	3	0
<u>North Boulevard: 2/3 Concrete, 1/3 Bituminous Concrete Surface</u>								
1	MSHD	B	White	13400	0.52	South Lane	5	0
1	MSHD	B	White	13400	0.52	North Lane	1	0

Test Area Five

Test Area 5 is located on US-16 extending between Fowlerville and New Hudson. See Figure 1. In this area only MSHD 1950 Class B white and yellow stripes were used. The purpose was to observe the wearing qualities of this type of stripe as compared with the standard procedure of applying 6 pounds of beads per gallon on top. The test data have been summarized in Table V.

Comparison of MSHD Class A and B Stripes

One of the major objectives of this investigation was to determine the relative performance of MSHD paint stripes with beads premixed and on top versus MSHD standard practice of putting beads only on top of the paint film. To do this it was necessary to compare the results of Test Area 5 with those in the area between Williamston and East Lansing and between Lansing and St. Johns, where Class A application was used exclusively. The results for this latter area are summarized below in Table V.

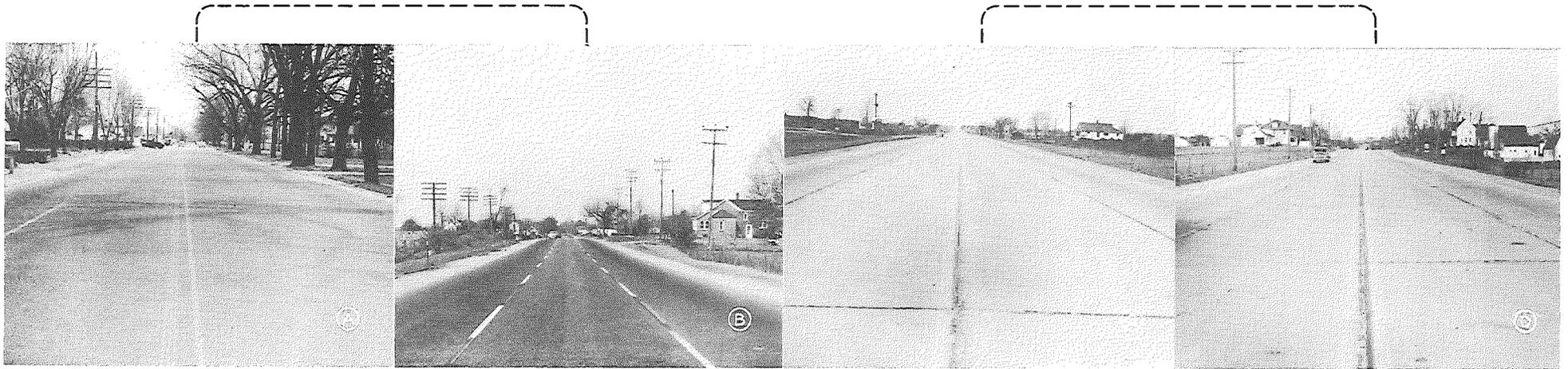
TABLE V

SUMMARY OF TEST DATA FROM TEST AREAS 5 AND 6 AT 4 AND 8 MONTHS

Area 5: US-16-Fowlerville to New Hudson
 Area 6: US-16-East Lansing to Williamston
 Area 6: US-27-Lansing to St. Johns

TEST AREA NO.	STRIPE NO.	BRAND	BEAD APPLICATION CLASS	COLOR	TRAFFIC VEHICLES PER DAY	LENGTH OF STRIPE, MILES	LINE LOCATION	PAINT REMAINING PERCENT	
								4 mo.	8 mo.
<u>Concrete Surface</u>									
5	1	MSHD	B	White	4500	4.00	Lane	78	51
5	6	MSHD	B	Yellow	4500	1.00	Center	90	78
6	16	MSHD	A	White	6900	2.34	Center*		17
6	17	MSHD	A	Yellow	3500	6.9	Center		15
*Black and white skip center on 2-lane concrete; traffic is total both ways.									
<u>Bituminous Concrete Surface</u>									
5	1	MSHD	B	White	4500	19.00	Lane	85	78
5	6	MSHD	B	Yellow	4500	8.00	Center	92	85
6	16	MSHD	A	White	4900	12.00	Lane	80	60
6	17	MSHD	A	Yellow	4900	6.0	Center	80	30
6	17	MSHD	A	Yellow	4900	1.5	No Passing	83	49

A comparison of data in Table V shows that MSHD 1950 Class B stripes have given better service than the Class A stripes. Also it is indicated in the photographs in Figure 5 A through G that the Class B lines are much better defined than the class A lines. This condition has been recognized before wherever paints with premixed beads have been applied.



▲ US-16, EAST LANSING—WILLIAMSTON—
1950 MSHD CLASS A, WHITE LANE AND CENTER
YELLOW. TEST AREA 6.

▲ TEST AREA 5, US-16, 1/2 MILE EAST
OF FOWLerville—1950 MSHD CLASS B,
WHITE LANE STRIPES.

▲ US-27, 2 MILES NORTH OF LANSING—
1950 MSHD CLASS A, YELLOW CENTER STRIPES.
TEST AREA 6.

▲ TEST AREA 5, US-16, 7 MILES EAST
OF FOWLerville—1950 MSHD CLASS B,
YELLOW CENTER STRIPES.



▲ US-16, EAST LANSING—WILLIAMSTON—
1950 MSHD CLASS A, WHITE LANE AND YELLOW
CENTER STRIPES. TEST AREA 6.

▲ TEST AREA 5, US-16, LAKE CHEMUNG—
1950 MSHD CLASS B, WHITE LANE AND YELLOW
CENTER STRIPES.

▲ TEST AREA 5 IN HOWELL, 1950 MSHD CLASS B,
WHITE CENTER STRIPE.

FIGURE 5

RELATIVE APPEARANCE OF TRAFFIC STRIPES, AREAS 5 AND 6, AT 9 1/2 MONTHS

INCIDENTAL OBSERVATIONS

During the course of the investigation, two additional observations were made which are believed worthy of including in the report. They concern (1) the effect of premixed beads on drying time of paint film and (2) bleeding characteristics of paint films with beads.

EFFECT OF PREMIXED BEADS ON DRYING TIME

The effect of relative humidity on the drying time of white and yellow paint is considerably lessened by the introduction of beads into the paint at the rate of 4 lb. per gallon. The amount of this reduction in drying time is of the order of 50 percent of the original drying time under average field conditions, with even greater reduction under more adverse conditions. The effect of beads in paint on drying time is clearly illustrated by the curves in Figure 6.

BLEEDING CHARACTERISTICS OF PAINT FILMS WITH BEADS

It was observed that the reflectorized white and yellow traffic stripes had acquired a slight yellowish cast where they had been applied over tar or asphalt, such as tarred joints, old black skip lines, joint sealing compounds and bituminous concrete resurfacing material.

Microscopic examination disclosed that the volatile constituents of the bituminous material migrate upward through the paint film and accumulate under the beads. This material, which is apparently of a sticky or gummy nature and initially yellow in color, gradually becomes darker, then brown, and finally almost black. This resinous film is soluble in trichloro-ethylene, although where associated with tar it is insoluble in carbon tetrachloride. This phenomenon is shown in Figure 7.

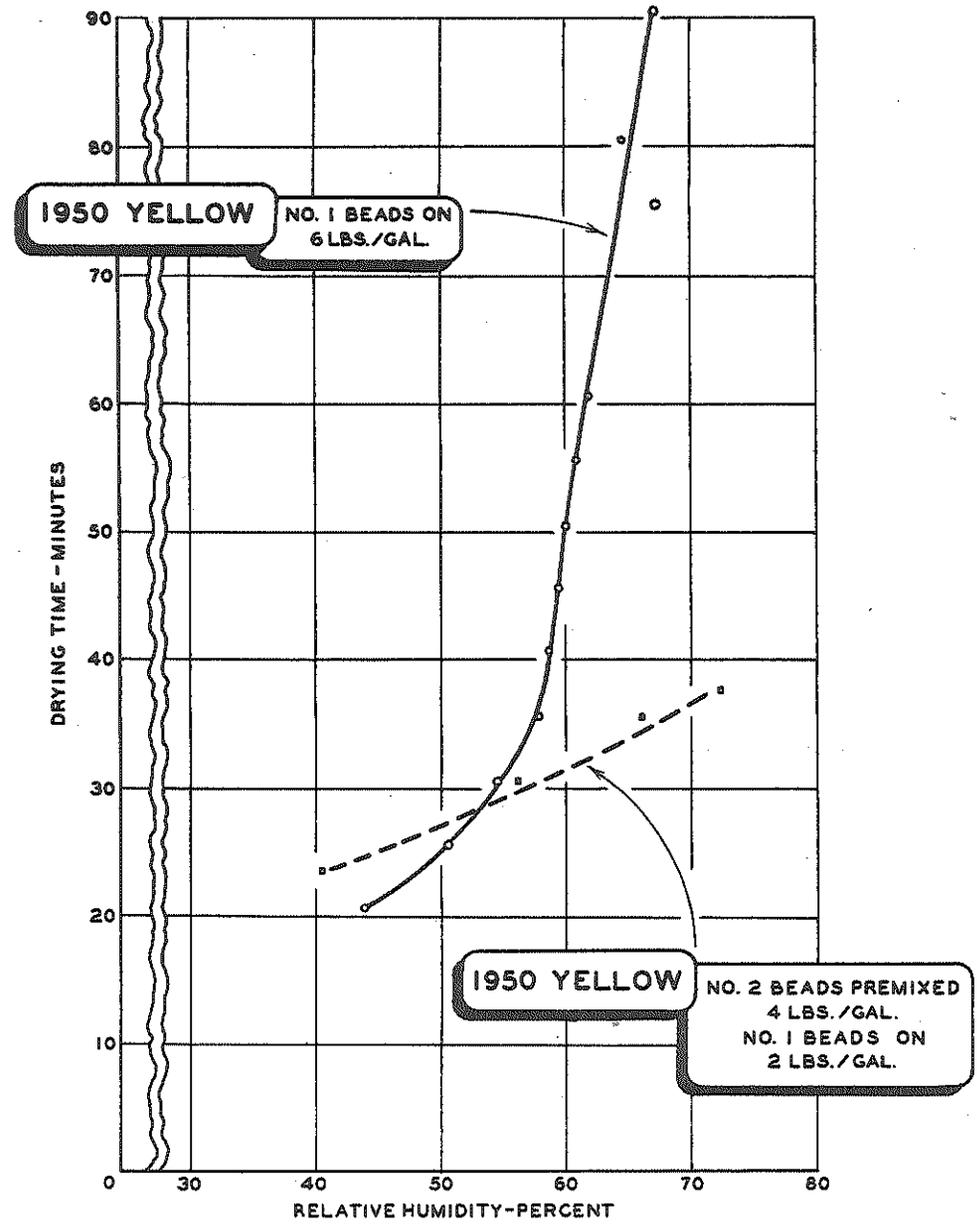
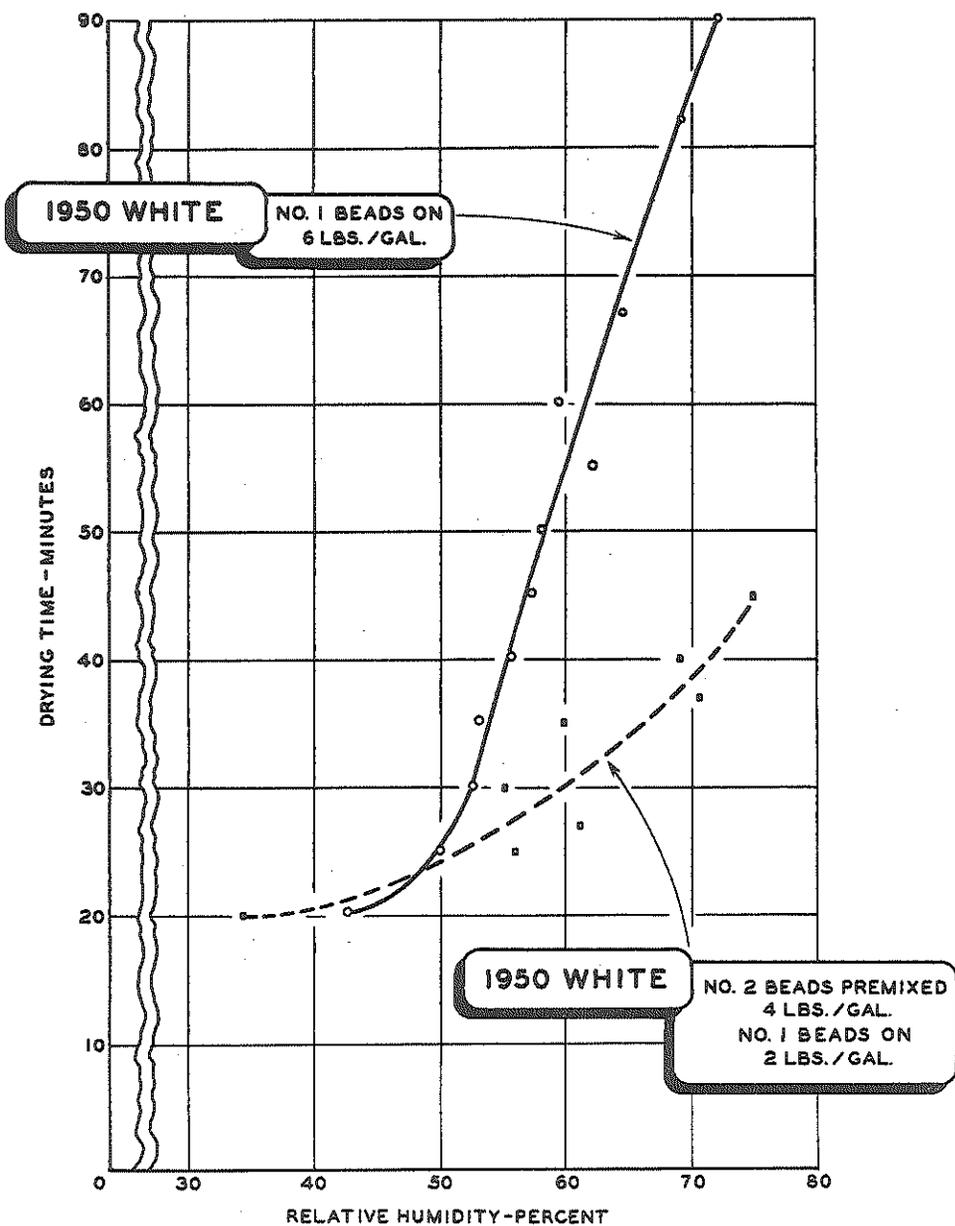


FIGURE 6

EFFECT OF PREMIXING GLASS BEADS IN 1950 MSHD PAVEMENT MARKING PAINT ON RELATIONSHIP BETWEEN DRYING TIME AND RELATIVE HUMIDITY
1950 PAINTING SEASON

The result of this resinous film is to turn the beads dark brown in color, although they can be shown under the microscope still to be clear, colorless and transparent, once they have been pried loose from their coated sockets. The film adheres more strongly to the concave inner surfaces of the bead sockets than it does to the beads, and probably helps to loosen the latter.

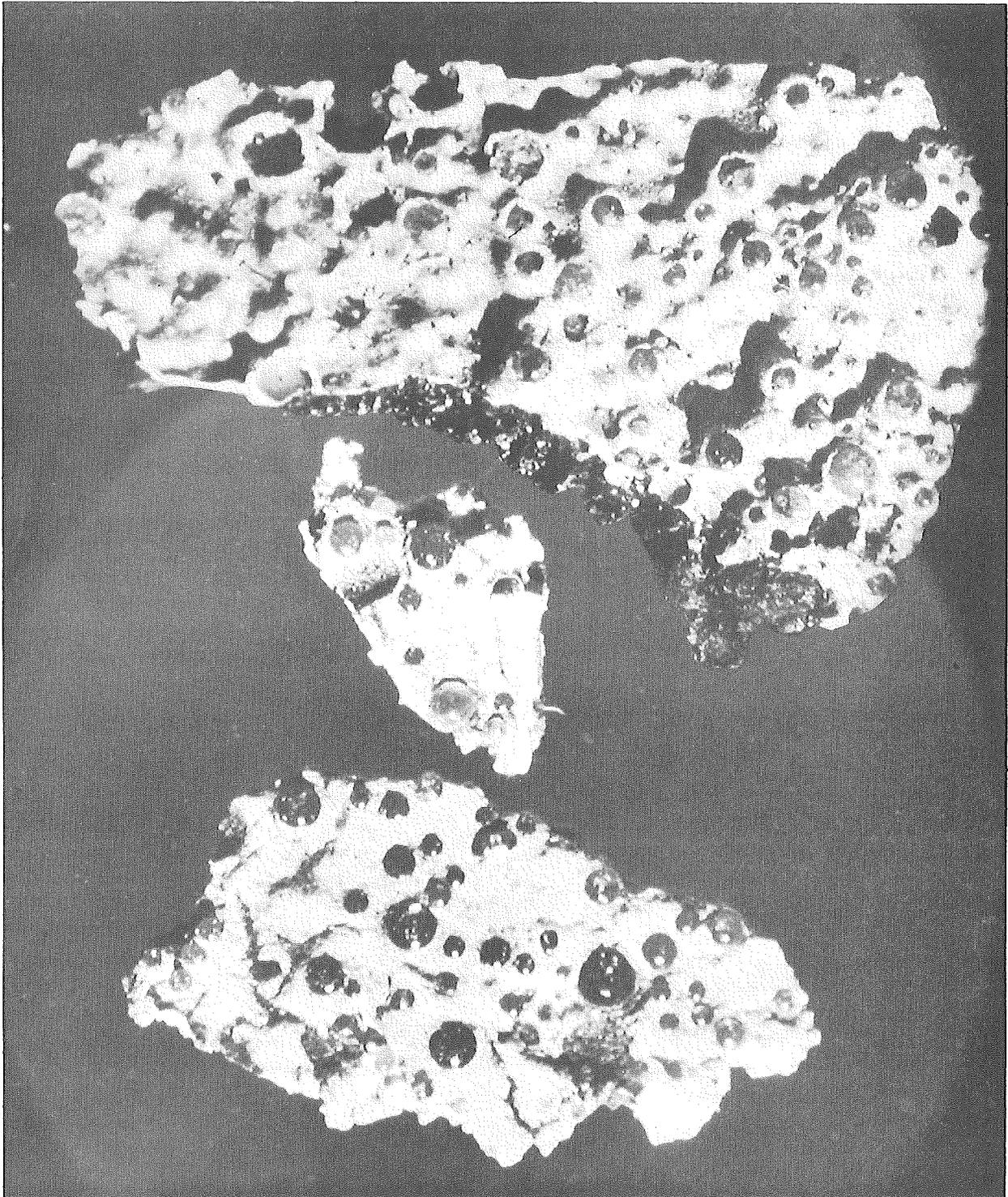
It is believed that the glass beads function as miniature burning glasses, producing concentrated heat which encourages upward migration of the more volatile products in the bituminous materials underneath the paint film and subsequently through cooking action causes a hard resinous film to form immediately under each bead. This action was found to take place more rapidly under the white than the yellow paints and also the phenomenon was more apparent under beads with the higher index of refraction.

It is not only the largest beads which become discolored in this manner, but apparently beads of all sizes, at least down to very small ones. The discoloration occurs over Jennite black paint material as well as over MSHD Barrett black.

This apparent bead discoloration may be the first evidence of bleeding in traffic paint films. After it progresses to the point where the beads are dark brown, a noticeable brownish cast is imparted to the daytime appearance of white stripes, even though no bleeding may be visible between the beads. At an advanced stage of bleeding the paint film itself becomes badly discolored.

Subsequent laboratory studies on prepared panels subjected to 7 days under infrared and ultraviolet light at a temperature of 130° F. displayed the same bleeding characteristics with consequent reduction of reflectivity of 50 percent.

It would appear at this date that bead discoloration is just one more aspect of the bleeding of bituminous materials through our white and yellow traffic marking paints, and that the development of any effective method of mitigating this phenomenon which can be devised should be expected to contribute to the overall performance of traffic paint stripes.



▲ SHOWING BOTH CLEAR AND APPARENT BLACK DISCOLORED BEADS.
IN CENTER SPECIMEN, NOTE DARK COLORED FILM IN BOTTOM OF SOCKET
FORMED BY DISPLACED BEAD.

FIGURE 7

SUMMARY

The following observations appear warranted as a result of the investigation:

1. MSHD 1950 standard paint stripes (Class A, white and yellow) were approximately equal in performance to Prismo binder Class A, white and yellow. No direct comparison could be made with MMM Centerlite Class A paint stripe because the latter material without premixed beads could not be obtained from the manufacturer.
2. MSHD 1950 white and yellow paints with beads in and on (Class B) were superior in performance to the same paints with beads on only (Class A)
3. MSHD 1950 Class B stripes were with the exception of one case (Test Area 1) superior in performance to Prismo Class B and to MMM Centerlite Class B.
4. Barrett and Jennite were approximately equal in durability, but the Jennite observed showed a brownish discoloration and spread in width from 5 to 7 inches.
5. All paints in the study showed greater durability on bituminous concrete surfaces than on portland cement concrete.
6. For 1950 MSHD white and yellow paints, drying time, as well as the effect of relative humidity on drying time, were both reduced by incorporating Type 2 beads premixed in the paint.
7. The brownish resinous film forming at the under surfaces of the beads is frequently the first indication of bleeding of bituminous materials through the paint stripes.

CONCLUSION

The experiment has conclusively demonstrated that if Type 2 beads are premixed in MSHD traffic paint materials in conjunction with beads on top, a traffic stripe will result having durability, daytime appearance, and nighttime reflection much superior to that now obtained by applying beads to top of paint film only, and at least equal in durability and performance to that of well-known proprietary paint products which are sold with beads premixed in the paint at the factory. The incorporation of beads in MSHD paints has a further advantage of lowering drying time and also reducing the effect of relative humidity upon drying time.