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RESEARCH UPDATE

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SKID RESISTANCE OF THERMOPLASTIC PAVEMENT MARKINGS

Purpose: To evaluate the skid resistance of thermoplastic pavement markings and to determine how different skid resistant material combinations affect both skid resistance and retroreflectivity of the markings.

Location: Caledonia County Airport, Lyndon, Vermont

Equipment: Pavemark hand-operable application cart.
Ripack 2000, hand held, propane-fired heat shrinker.
Push broom and roller measuring device.
British Pendulum Tester (BPT).
FHWA portable trailer-mounted skid tester.

Materials & Cost:

Thermoplastic:	$444 ($1.11 per lf)
Liquid Propane:	$12.50
Glass Beads:	included in cost of thermoplastic
Crushed glass:	included in cost of thermoplastic

Weather: Weather at the time of application was rainy and 50^0 F.

Application:

White traffic paint was applied on the asphaltic concrete aircraft parking apron in two, 100 foot sections. One section had an application of glass beads while the other did not. Yellow thermoplastic was applied on the taxiway in four, 100 foot sections. Glass bead applications were as follows: one section with 100% beads, one with no beads, one section with equal parts of glass beads and crushed glass, and one with 70% glass beads and 30% crushed glass. In order to obtain an adequate pavement-thermoplastic bond, when it stopped raining, the pavement was dried with the Ripack heat shrinker for 50 feet of the 100 foot length for each of the thermoplastic sections except for the one with no beads.

Testing:

On September 29, 1993, tests were performed with the British Pendulum Tester. The results were as follows:

TEST STRIPE SECTION	TEST 1	TEST 2	TEST 3	TEST 4	TEST 5
1. Paint with beads	48	47	49	50	49
2. Paint without beads	53	50	49	47	45
3. Thermoplastic with beads	46	44	45	43	42
4. Thermoplastic without beads	23	22	25	25	24
5. Thermoplastic with 50/50 mix crushed glass and beads	67	66	66	64	65
6. Thermoplastic with 70/30 mix crushed glass and beads	57	56	56	55	54

On September 30, 1993, FHWA skid testing took place on the same lines. The results were as follows:

TEST STRIPE SECTION	TEST 1	TEST 2	TEST 3	TEST 4	TEST 5
1	28	29	29	30	30
2	23	27	30	20	30
3	21	31	27	29	29
4	6	9	6	7	7
5	39	47	45	54	53
6	41	43	42	46	48

Data Analysis:

Hypothesis testing about the population means was used to test the hypothesis that there is no difference between the mean value of the skid resistance of a stripe painted with drop-on beads and the skid resistance of a thermoplastic stripe with drop-on beads. The null hypothesis is thus:

$H_0 : \mu_1 = \mu_3$, where

μ_1 = mean skid resistance, paint with beads, and
μ_3 = mean skid resistance, thermoplastic with beads

Sample size was five for both treatments

At the 95% confidence level, the null hypothesis would be rejected if the calculated z statistic were greater than 1.645. In this analysis, the z value is 1.023. Thus, the null hypothesis cannot be rejected and it can be concluded that there is no significant difference between the two means.

Conclusion:

Statistical analysis of the data obtained from skid resistance measurements with the British Pendulum Tester and the FHWA trailer mounted skid tester, indicated that there is no significant difference in the skid resistance of a painted traffic stripe with drop-on beads, as compared with a thermoplastic traffic stripe with drop-on beads.

Additional Testing:

On July 22, 1994 the material was tested for retroreflectivity and skid resistance with the BPT. The painted lines had been repainted in the spring, so only the thermoplastic lines were tested. The results are as follows:

Skid Resistance

	TEST 1	TEST 2	TEST 3	TEST 4	TEST 5
Test Site 3 Thermoplastic with beads	50	40	40	47	40
Test Site 4 Thermoplastic with no beads	85	71	85	70	67
Test Site 5 Thermoplastic with 50/50 beads/glass	50	50	60	58	66
Test Site 6 Thermoplastic with 70/30 beads/glass	46	44	44	50	52

Retroreflectivity (millicandellas)

TS 3	TS 4	TS 5	TS 6
327	100	168	277

The skid resistance values for thermoplastic without beads had a much higher skid value than the others, but it is felt the high skid values were due to the crack pattern of the thermoplastic, rather than due to glass beads, or the lack thereof. All thermoplastic develops fine, hairline cracks within the first year following application. With proper application of drop-on beads, the crack pattern is "alligator/polygon" in shape, with the polygons averaging 5 to 10 square inches. With no drop-on beads, not only were the cracks wider, but the polygon areas were much smaller, averaging 1 to 3 square inches. Furthermore, the edges of the polygons were "curled", creating raised edges on the polygon perimeters. It is the resistance of these raised edges, when testing with the BPT, that resulted in the high readings on Test Site 4.

Retroreflectivity of Test Site 4 (no drop-on beads) is much lower than the other test sites. There is very little traffic on the lines at the airfield, so that retroreflectivity of the test sections would be due to retained drop-on beads. In the future, after several years of snowplow abrasion and wear due to aircraft traffic, it would be expected that the retroreflectivity of Test Site 4 would approach that of the other sites, as drop-on beads are worn off and embedded beads are exposed.

On August 2, 1994, K.J. Law, with a Model M1290 Friction Tester tested the lines. The tests were done using the same type of equipment that was used on September 30, 1993. The results (uncorrected) are as follows:

	TEST 1	TEST 2	TEST 3
TS 3	23.5	22.7	22.7
TS 4	36	37	32.4
TS 5	41.7	42.7	41.5
TS 6	31.5	37.9	32.4

Conclusion:

In summary, the skid resistance of the thermoplastic with drop-on beads is not significantly different than that of the paint with drop-on beads. Thermoplastic with a 50/50 mix of glass beads and crushed glass applied has a higher skid resistance value than the standard thermoplastic/glass bead mixture. The 50/50 mixture has considerably lower retroreflectivity, however.

Follow-up:

Performance monitoring will continue with an emphasis on skid resistance, retroreflectivity, and durability of the material.