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EVALUATION OF VARIOUS TYPES OF RAILROAD CROSSINGS

Sixth Progress Report

TESTING AND RESEARCH DIVISION
RESEARCH LABORATORY SECTION

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J. E. Simonsen

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Michigan Transportation Commission
William C. Marshall, Chairman;
Lawrence C. Patrick, Jr., Vice-Chairman;
Hannes Meyers, Jr., Carl V. Pellonpaa,
Weston E. Vivian, Rodger D. Young
James P. Pitz, Director
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INTRODUCTION

In April 1975, the Michigan Department of Transportation, with the approval of the Federal Highway Administration, initiated a Category 2 experimental study to evaluate the performance of various types of railroad grade crossing materials. The work plan covering the experimental project is of the open-ended type so that new materials can be added by a letter of request to the FHWA rather than submitting a separate work plan for each new type of material being developed. The objectives of the study are to obtain information on construction procedures, evaluate the performance of new crossing materials with respect to durability and smoothness, and determine the relative cost of each type of crossing.

Although the experimental study concerns only the crossing material, the work involved generally includes rebuilding the entire crossing, installing new and better warning devices, and changes in roadway alignment and surface to increase the safety of the crossing. The work is 90 percent financed by Federal funds, appropriated under the Highway Safety Act of 1973, and 10 percent by Road Authority funds, either State or local depending upon the jurisdiction of the roadway.

Reports on the evaluation of various types of railroad grade crossing materials were issued in November 1976, March 1978, April 1979, May 1980, and April 1982. These earlier reports include a description of the surface materials as well as the construction procedures normally used in placing the materials. These items have been deleted from this sixth progress report which deals only with the performance of the surface materials themselves.

The materials that have been installed for evaluation are: T-Core, Fab-Ra-Cast, Steel Plank, Track-Span, Gen-Trac, Saf and Dri, Parkco, and Cobra-X. Of these materials T-Core, Fab-Ra-Cast (old design), and Track-Span are no longer manufactured and, therefore, have been deleted from the performance surveys.

Crossing Locations

Table 1 lists the locations of the experimental crossings currently included in the evaluation study and gives summary information for each one.

PERFORMANCE EVALUATION

The procedure set up for evaluating the performance of the crossings called for semiannual inspections and elevation measurements. However,

TABLE 1
SUMMARY OF DATA ON EXPERIMENTAL CROSSINGS IN SERVICE
(All crossings single tracks except as noted.)

	Type of Crossing	Railroad	Type of Line	Crossing Length, ft	Route Location	Roadway Surface	No. of Lanes	Average Daily Traffic*
1976	Steel Plank	D & T S.L.	Main	32	Hurd Rd	Bituminous	2	1,200
	Steel Plank+	D & T S.L.	Main	39	Nadeau Rd	Bituminous	2	2,000
1977	Saf and Dri	Con Rail	Industrial	67	Oakland Ave	Concrete	5	25,000
	Steel Plank	D & T S.L.	Industrial	110	M 50, Monroe	Bituminous	4	10,100
1978	Saf and Dri	G.T.W. R.R.	Main	63	US 131, Schoolcraft	Concrete	4	11,100
	Steel Plank	D & M R.R.	Main	111	M 65, Twining	Concrete	2	3,500
	Steel Plank	D & M R.R.	Main	45	US 23, Rogers City	Concrete	2	1,750
	Steel Plank	D & M R.R.	Main	52	M 33, Aloha	Bituminous	2	1,400
	Steel Plank+	M.I.R.C.	Main	65	M 115, Cadillac	Bituminous	2	3,800
	Parkco	D & M R.R.	Main	48	US 23, Omer	Bituminous	4	7,800
	Parkco	D & M R.R.	Industrial	78	US 23, Alabaster	Bituminous	2	5,300
	Gen-Trac	D & M R.R.	Main	52	US 23, Alpena	Bituminous	2	9,700
	Gen-Trac	D & M R.R.	Industrial	60	US 23, Cheboygan	Concrete	4	7,900
	Gen-Trac	D & M R.R.	Main	52	F 41, Oscoda	Bituminous	4	11,500
	Gen-Trac	G.T.W. R.R.	Main	30	Niagara St, Saginaw	Concrete	2	11,000
1979	Saf and Dri	C&O R.R.	Industrial	80	US 10, Ludington	Bituminous	5	14,000
	Saf and Dri	G.T.W. R.R.	Main	66	M 21, Owosso	Bituminous	4	17,900
	Steel Plank[2]	C&O R.R.		45	M 100, Grand Ledge	Bituminous	4	5,100
	Steel Plank[5]	D & T S.L.	Main	52	Northline Rd, Wyandotte	Bituminous	4	9,000
	Steel Plank	D & T S.L.	Main	42	Goddard Rd, Wyandotte	Bituminous	2	
	Parkco	C&O R.R.	Main	45	M 100, Grand Ledge	Bituminous	4	5,100
	Parkco	G.T.W. R.R.	Industrial	60	US 131 BR, Grand Rapids	Bituminous	4	28,000
	Parkco	D.T.&I. R.R.	Industrial	60	King Rd, Trenton	Concrete	4	
	Parkco[4]	D.T.&I. R.R., Con Rail, D & T S.L.		54	Oak St, Wyandotte	Bituminous	3	
	Parkco	C&O R.R.	Industrial	60	I 196 BR, Wyoming	Bituminous	2	11,400
	Parkco[3]	D.T.&I. R.R., Con Rail		48	Goddard Rd, Wyandotte	Bituminous	2	
	Gen-Trac	G.T.W. R.R.	Main	51	M 36, Ionia	Bituminous	4	12,000
	Gen-Trac	C&O R.R.	Industrial	48	M 36, Ionia	Bituminous	4	12,000
	Gen-Trac	C&O R.R.	Main	63	US 131, Reed City	Bituminous	4	9,300
	Gen-Trac	C&O R.R.	Main	45	M 37, White Cloud	Bituminous	2	3,800
	Gen-Trac	G.T.W. R.R.		63	M 13, Bay City	Bituminous	2	14,400
	Gen-Trac	G.T.W. R.R.		30	Kelton St, Bay City	Bituminous	2	
	Gen-Trac	G.T.W. R.R.		73	State St, Bay City	Bituminous	2	
	Gen-Trac	G.T.W. R.R.		45	Backus St, Bay City	Concrete	2	
	Gen-Trac	G.T.W. R.R.		94	Wenona Ave, Bay City	Bituminous	2	
	Gen-Trac	G.T.W. R.R.		121	Marquette St, Bay City	Bituminous	2	
	Gen-Trac	G.T.W. R.R.		78	Henery St, Bay City	Bituminous	2	
	Gen-Trac	G.T.W. R.R.		36	North Union St, Bay City	Bituminous	2	
	Gen-Trac[3]	Con Rail		54	Northline Rd, Wyandotte	Bituminous	4	9,000
1980	Steel Plank[5]	D & T S.L.	Main	45	Pennsylvania Rd, Wyandotte	Bituminous	2	9,600
	Steel Plank[2,5]	D & T S.L.	Main	52	East Elm St, Monroe	Bituminous	2	2,000
	Track-Span	D & T S.L.	Main	25	East First St, Monroe	Concrete	2	2,000
	Track-Span	Con Rail	Industrial	60	East First St, Monroe	Concrete	2	2,000
	Saf and Dri	C&O R.R.	Main	72	M 57, Clio	Bituminous	2	10,000
	Saf and Dri	C&O R.R.	Main	40	M 83, Gera	Bituminous	2	5,000
	Parkco	Con Rail	Main	66	I 96 BL, Lansing	Concrete	4	14,300
	Parkco	Con Rail	Industrial	42	East Elm St, Monroe	Bituminous	2	2,000
	Parkco	D.T.&I. R.R., Con Rail	Main	42	Pennsylvania Rd, Wyandotte	Bituminous	2	9,600
	Parkco	D & M R.R.	Main	42	M 72, Grayling	Bituminous	2	9,000
	Parkco[5]	C&O R.R.	Industrial	72	M 13, Saginaw	Bituminous	4	11,000
	Gen-Trac	G.T.W. R.R.	Industrial	40	Auburn Rd, Auburn Heights	Bituminous	2	9,300
	Cobra - X[2]	G.T.W. R.R.	Main	54	M 40, Marcellus	Bituminous	2	2,500
	Cobra - X[3]	G.T.W. R.R.	Main	93	M 216, Marcellus	Bituminous	4	2,300
1981	Saf and Dri	C&O R.R.	Main	48	M 15, Arthur	Bituminous	2	3,400
	Saf and Dri[2,5]	C&O R.R.	Main	108	M 54 BR, Flint	Bituminous	4	
	Gen-Trac	C&O R.R.	Main	84	US 31, Grand Haven	Bituminous	6	14,400
	Cobra - X	C&O R.R.	Main	42	M 15, Vassar	Bituminous	2	4,600
	Cobra - X	Con Rail	Industrial	72	M 89, Plainwell	Bituminous	2	2,500
	Parkco[5]	Con Rail	Main	42	M 89, Plainwell	Bituminous	2	2,500
	Parkco	C&O R.R.	Main	60	Seven Mile Rd, Northville	Concrete	4	8,300
	Parkco[5]	L. C. R.R.	Main	90	M 52, Adrian	Concrete	4	6,900
	Parkco[5]	L. C. R.R.	Main	72	US 223, Palmyra	Bituminous	2	6,800
	Parkco	G.T.W. R.R.	Main	54	M 24, Oxford	Bituminous	4	28,800
	Parkco[5]	C&O R.R.	Main	162	M 46, Merrill	Bituminous	4	5,100
	Parkco[5]	M. I. R.	Main	66	M 71, Owosso	Bituminous	4	16,000
	Parkco[5]	M. I. R.	Main	60	M 71, Owosso	Bituminous	4	12,500
	Gen-Trac	Con Rail	Main	51	M 52, Chelsea	Bituminous	4	10,800
1982	Steel Plank[2,5]	D & M R.R.	Main	70	M 13, Pinconning	Bituminous	4	10,000
	Parkco[2,5]	D.T.&I. R.R.	Main	54	M 85, Trenton	Concrete	2	27,500
	Gen-Trac[3]	C&O R.R.	Main	60	M 54 BR, Mt. Morris	Bituminous	5	11,200
	Saf and Dri[5]	L. C. R.R.	Main	222	M 34, Adrian	Bituminous	3	8,700

* Total traffic in both directions.
[2] Two tracks.
[3] Three tracks.
[4] Four tracks.
[5] Modified design.

+ Nadeau crossing replaced and the M 115 crossing requested to be replaced.

budget reductions have necessitated that only yearly inspections be made and the time consuming task of measuring elevation changes at the crossing has been eliminated. The inspections consist of visual observation of the following performance factors:

1) Surface Wear - the wearing away of the material's surface as a result of tire contact.

2) Surface Damage - cracking, fracturing, or tearing of the surface resulting from either train or vehicular traffic or from snow clearing equipment.

3) Alignment of Units - the ability of the individual units to maintain both vertical and horizontal position while in service.

4) Fastening of Units - the ability of units to remain securely fastened in position during the life of the crossing material.

5) Fastening of Rails - the securing of the rails to the ties. Loose rails may indicate that settlement of the crossing has occurred.

6) Pavement/Crossing Joint - the distance between the end of the pavement and the crossing edge. The width of the joint may vary considerably from one crossing to another and in bituminous pavement the joint is eliminated entirely. In concrete pavements, the joint is generally filled with bituminous material.

7) Crossing Smoothness - a measure of the discomfort felt by vehicle occupants while passing over the crossing. Generally, most drivers will adjust their speed to hold the discomfort to a tolerable level and on this basis, the smoothness of the crossing is rated as 'Good, Fair, and Poor,' (Good - basically no slowdown in traffic; Fair - some slowdown in traffic; and, Poor - considerable slowdown in traffic).

The results of the 1982 performance inspections have been summarized and are given in Table 2. A brief description of the results shown for each performance factor follows:

Surface Wear - the wear noticed on one Parkco crossing had occurred on the field side pads along the rail as a result of wheel flanges coming in contact with the surface. The wear on one Gen-Trac crossing was confined to the field side unit and could have been caused by the scraping action of snowplows during snow removal. On Steel Plank crossings the wear was confined to the wheelpath areas and consisted of wearing off of the epoxy coating.

TABLE 2
1982 SUMMARY OF CROSSING PERFORMANCE

Crossing Type and Total No. of Crossings	Number of Crossings With and Without Problems in Each Performance Factor Category														
	Surface Wear		Surface Damage		Poor Alignment		Loose Panels		Loose Rails		Joint Problem		Crossing Smoothness		
	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Good	Fair	Poor
Cobra-X (7)	0	7	1	6	1	6	2	5	3	4	3	4	7	0	0
Saf and Dri (10)	0	10	8	2	0	10	2	8	2	8	2	8	10	0	0
Steel Plank (15)	13*	2	2	13	1	14	7	8	2	13	4	11	12	3	-
Gen-Trac (24)	1	23	17	7	9	15	16	8	6	18	6	18	20	4	-
Parkco (29)	1	28	6	23	5	24	--	-	2	27	8	21	28	1	-

* Epoxy coating only.

Surface Damage - the surface damage observed at the rubber crossings is primarily caused by snowplows and is generally minor in extent. On a few crossings, the rubber covering has been scraped off so as to expose small areas of the steel reinforcement plates. The surface damage at the two Steel Plank crossings was caused by a car derailment. The damage consists of an indentation in the steel surface parallel to the rail. The Cobra-X crossing surface damage had occurred in the field units next to the rail. Small chunks of the surface were broken off, apparently by the flanges of the railcar wheels exerting pressure on the edges of the surface panels.

Panel Alignment - the alignment problem is primarily the result of settlement or tilting of the individual panels. The range in off-set was estimated to vary from 1/8 to 1 in. The crossings most affected by alignment off-sets were Gen-Trac and Parkco.

Loose Panels - the loose panels are primarily located in the wheelpaths of the highway traffic. Normally the looseness of the panels is caused by the bolts working loose in the ties. In the case of the Gen-Trac panels, tie wear has been observed under the bearing area of the panels (as much as 1/2 to 3/4 in. wear has been noted). Loose panels are generally confined to the field sides of the crossings. The cable fastening method used to hold the Parkco panels in position does not fasten the panels to the shims or ties and, therefore, this crossing type cannot be rated with respect to looseness of the panels.

Loose Rails - loose rails were found at 15 crossings. Although this problem has not as yet resulted in any increase in the crossing roughness, it does indicate that some settlement of the crossing foundation has occurred.

Joint Problems - cracking and fracturing of the pavement along the crossings were noticed at 23 crossings. This type of joint failure results primarily from the crossing movements when trains pass over the crossing. It is still minor in nature and has not yet interfered with the performance of the crossings. Pieces of header boards were missing at seven of the Parkco crossings.

Crossing Smoothness - 77 of the crossings were rated in the 'good' category—no slowdown in traffic. Eight were rated 'fair'—some slowdown in traffic. There were no crossings rated 'poor.' The 'fair' ratings were the result of crossing settlements rather than poor performance of the material itself.

MATERIAL COST

Typical bid prices for each of the five types of experimental crossing materials, including fastening hardware, are as follows:

Crossing Type	Cost per Track-Foot						
	1976	1977	1978	1979	1980	1981	1982
Steel Plank	$105	$120	$130	$135	$115	--	$244
Saf and Dri	--	$210	$230	$230	$225	$265	$260
Parkco	--	--	$220	$234	$220	$253	$250
Gen-Trac	--	--	$240	$249	--	$252	$291
Cobra-X	--	--	--	--	$160	$200	--

By way of comparison, the Goodyear crossing material, approved for use in 1974 after a 10-year evaluation period, has ranged in price per track-foot from $260 to $280 during 1981-82.

It is of interest to note that the Goodyear design in use today is the same as the ones installed over 20 years ago. In contrast, of the materials included in this evaluation program, two failed after two years service (T-Core and Fab-Ra-Cast); one (Track-Span) has been taken off the market; and four (Steel Plank, Saf and Dri, Parkco, and Gen-Trac) developed problems within one to three years after installation and all have now been redesigned to improve their performance; and the last type (Cobra X) has only been in service for one to three years at low volume crossings. As a result, the latest designs have seen only limited service and the available data are insufficient to predict if the redesigned crossings will perform satisfactorily and be as cost-effective as the Goodyear crossings.

CONCLUSIONS

Cobra-X - All crossings are performing satisfactorily after two and three years of service.

Saf and Dri - The six-year old crossing on Oakland St in Lansing as well as the newer ones are performing satisfactorily. A potential problem with a loose side panel on one crossing is scheduled for investigation.

Steel Plank - One crossing was replaced with bituminous material and another had one panel replaced with bituminous material. Replacement of

the latter crossing has been requested. These two crossings were of the 'old' design which has not given satisfactory service.

Six of the 15 crossings currently included in this study are of the new design. These installations range in age from one to three years and are all performing satisfactorily at this time.

Gen-Trac - Severe wear of the ties under the support area of the field units had developed at five crossings. Maintenance work will be required to correct this problem. One crossing is currently scheduled for repair. Less severe rocking of the side panels was noted at 11 more crossings. Eight crossings were found to perform satisfactorily.

Parkco - These crossings continue to serve satisfactorily. Nine of the crossings are of the new, heavier reinforced, design to prevent fracture of the steel reinforcement in case support is weakened under a panel.

RECOMMENDATIONS

Because of the potential maintenance problems at Gen-Trac crossings, it is recommended that the use of this crossing type—short panels—be discouraged in favor of the Gen-Trac II crossing—long panels.