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THIRD ANNUAL REPORT
OF
MICHIGAN'S OVERALL HIGHWAY
SAFETY IMPROVEMENT PROGRAM

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AUGUST 31, 1976

MICHIGAN DEPARTMENT
OF
STATE HIGHWAYS AND TRANSPORTATION

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This Report was prepared by the Traffic and Safety, Local Government, and Maintenance Divisions, and the Railroad Contact Section, Bureau of Highways.

The opinions, findings, and conclusions expressed in this publication are those of the author and not necessarily those of the Federal Highway Administration.

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INTRODUCTION

This is the third annual report on Michigan's overall Highway Safety Improvement Construction Program. Previous reports discussed in depth the various types of improvements, described surveillance techniques for locating and prioritizing project candidates, and detailed previous annual Safety Improvement Programs. Therefore, this year's report focuses on our specific programs in the area of highway safety. Over 65 million dollars in state and federal funds was expended through out safety programs in fiscal 1975-76. In an effort to provide an informative yet concise report, we have not repeated information previously presented. Program changes have been noted and future innovations discussed, but redundancies have been omitted.

Statewide statistics and trends on fatalities, injuries, accidents, and travel are outlined in Michigan's 1976-77 annual highway safety work program prepared by the Office of Highway Safety Planning.

PROGRAM SUMMARY
FISCAL YEAR 1975-76

Total Costs

FEDERAL CATEGORICAL SAFETY FUNDS--OBLIGATED

Section 203, rail-highway crossings	\$ 3,200,006
Section 205, pavement markings	2,722,087
Section 209, high hazard locations	2,712,403
Section 210, roadside obstacles	1,217,084
Section 230, safer roads demonstration	3,095,336
Section 204, special bridge replacement	(All funds previously obligated)
Total	\$12,946,916

OTHER FEDERAL FUNDS

Interstate Safety (Is)	6,425,774
Urban Programs	6,676,810
Federal Aid Primary Program	6,455,759
Federal Aid Secondary Program (includes Off System)	<u>7,773,420</u>
Total	\$27,331,763

STATE FUNDED SAFETY PROJECTS

Ms - safety program	5,924,700
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OTHER STATE FUNDED PROJECTS (Safety Items only)

Mb - bituminous resurfacing	\$ 6,946,190
Mbr - bituminous reconstruction	4,061,406
M - miscellaneous construction	1,526,160
Mnm - nonmotorized vehicle facility	1,313,357
Msh - shoulder edge treatment	733,260
Mcp - minor construction	1,200,000
Mcs - critical structures	1,469,732
Mbd - bridge deck	<u>639,786</u>
Total	\$17,889,891

SPECIAL PROJECTS

Guardrail End Treatments	94,000
Impact Attenuators	1,260,000
Total Safety Expenditures	\$65,447,270

SECTION 1

FEDERAL-AID CATEGORICAL SAFETY PROGRAM

FISCAL YEAR 1975-76

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THE 1973 HIGHWAYS SAFETY ACT IN MICHIGAN

INTRODUCTION

Administrative responsibility for the five categorical safety subprograms detailed in the 1973 Highways Safety Act is assigned to the Michigan Department of State Highways and Transportation's Local Government and Traffic and Safety Divisions. The Office of Highway Safety Planning and the Michigan Department of State Police act in an advisory capacity.

The Department obligated a total of \$12,946,916 in Federal Aid Categorical Safety Funds during fiscal 1976.

Following is a more detailed discussion of each categorical program:

Section 203 Rail-Highway Crossings

Responsibility for the safety of rail-highway crossings is shared by the Department's Railroad Safety Unit, the railroads, and local highway authorities.

The Section 203 Program is jointly administered by the Department's Local Government Division and its railroad contact engineer. Projects involving the state trunkline system are administered entirely by the railroad contact engineer.

The Rail-Highway Crossing Improvement Program for fiscal year 1976 reflected the continuation of project programming and obligation of available Federal Aid funding. Approximately 24 new projects received program approval and 24 previously programmed projects were obligated off the state trunkline systems. Twenty-one new projects were programmed and 36 previously programmed were obligated during fiscal 1976 on state trunklines. Participation by local jurisdictions continues to be evenly divided between projects on and off the Federal Aid System.

Signing and marking of rail-highway crossings is required by federal law and is being accomplished under Categorical Safety Programs 203, 205, and 230. State trunkline grade crossing signing is in substantial conformance with the Michigan Manual on Uniform Traffic Control Devices. As a result of recent state legislation, however, the location of railroad crossing markings has been modified. As a result a statewide 205 trunkline project to reposition the markings is being developed.

Since the Department of State Highways and Transportation has no direct authority over local roads, a railroad sign program must be initiated by the local authority. Efforts by the Department to encourage these projects have met with only limited success. However, we will continue to stress the importance of complying with the Michigan Manual on Uniform Traffic Control Devices (MMUTCD). Michigan has secured a computer tape of the National Rail-Highway Inventory. Unfortunately, the inventory only identified whether signing was in place and not if that signing complied with the MMUTCD. This has made identification of crossings with deficient signing difficult. We are now verifying and supplementing the inventory and developing a program for evaluating all at-grade crossings.

Accident data retrieval will ultimately be accomplished by incorporating the rail-highway crossing inventory with the Michigan Accident Location Index (MALI) system allowing surveillance and analysis of car-train or other crossing related crashes. See pages 3-15 and 3-16 for a discussion of MALI. In the interim we will manually collect accident data and evaluate this program's impact on crossing related crashes.

By June 30, 1976, a total of \$4,558,859 in Federal Aid Safety Funds had been obligated, \$3,200,006 in fiscal 1976 representing a total cost of \$3,584,007. This is 75 percent of the initial 3-year apportionment. However, the current backlog of projects indicates the need for increased funding in the future. Congress has apparently recognized this need and has substantially increased Section 203 funding levels.

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Rail-Highway Crossings
(Section 203)

Project Location	Project										Justification					
	Warning Devices					Construction					Priority Points	Potential Accidents	Federal Funds Obligated	Total Costs		
	FLS	Gates	CA	AWS	Pvt. Mkg.	Est. Cost	Appr. Work	X-ing Work	C&G &/or	G.R.					Realign	Clear Vision
Local Highways	14	7	7	17	17	508,000	8	13			2		1,376,876	11.8	1,652,659	1,801,39
State Highways *	23	2	17			564,388	6	30	14	1			1,288,498	0.7	<u>1,547,347</u>	<u>1,856,81</u>
															\$3,200,006	\$3,658,21

* These costs are for 36 projects which have been obligated during fiscal year 1975-1976. There were an additional 21 projects programmed during 1975-76 at a total estimated cost of \$1,234,835. (Warning Devices and Construction Costs Combined).

FLS - Flashers
 CA - Cantilever Arm
 AWS - Advance Warning Signs
 C&G - Curb and Gutter
 G.R. - Guardrail

Section 205 - Pavement Marking Demonstration Program

This program is administered by the Department's Local Government Division with the Traffic and Safety Division acting in an advisory capacity. The identification and marking of no-passing zones is a high priority on roads and streets under local jurisdiction.

Acceptance of the pavement marking program has been exceptional in Michigan. This program is aimed at unmarked rural 2-lane highways, therefore most of the projects developed are along county-administered roadways.

As noted in the 1974 report, Michigan programmed two stages: the identification of no passing zones based on criteria outlined in the Michigan Manual of Traffic Control Devices and placement of pavement markings, including no-passing zones, edge lines, and centerlines.

Eighty-eight percent of Michigan's 83 counties have participated in the survey of no-passing zones. The same percentage is expected to participate in the marking program. As of July 1, 1976, 68 counties have pavement marking under contract. Pavement marking renewal projects have been let to contract in 10 of the 68 counties which participated in the initial pavement marking program.

Costs for the survey of no-passing zones were initially about \$35 per mile. However, with the increase of contractors, the average price has decreased to approximately \$23 per mile.

Projects are chosen by local authorities, both on and off the federal aid system, and they also determine priorities for pavement marking within their jurisdiction.

One of the largest participating counties (Cass) submitted a program including 1,099 miles of edgemarking, 560 miles of no-passing zones, 48 railroad crossing markings (thermoplastic), and 387 miles of centerline. There were 550 miles involved in the survey of no passing zones. The cost of the pavement painting contract was \$199,800 and the no passing zone survey contract was \$18,135. Narrow bridge pavement marking treatments were also included in this program.

By June 30, 1976, a total of \$4,558,859 in federal aid safety funds had been obligated, \$2,722,087 in fiscal year 1975-76. This represents 90.9 percent of the initial 3-year apportionment. The current backlog of 15 counties which have not submitted pavement marking projects but are under contract for survey of no-passing zones indicates that all funds apportioned will be obligated.

We believe that this program has been successful and well received. We recommend that consideration be given to continuing the program, incorporating small urban areas not covered by the existing program.

Evaluation Techniques

No projects have been completed a sufficient time to allow evaluation of this program. However the Michigan Department of State Highways and Transportation is currently gathering data. The evaluation will be used

to assign priorities based on types of pavement markings and their relationship to geographical and environmental conditions.

The study will randomly sample six to ten counties (7-10 percent) which have recently completed marking programs. Within each county selected, separate categories will be evaluated based on the type of pavement marking completed, such as centerline only, edgeline only, no-passing zones only, and combinations of the three types of markings. This will provide seven categories initially. These categories will then be grouped according to average daily traffic (ADT). Accident numbers and types will then be analyzed and the effectiveness of the program elements measured.

We assume with reasonable certainty that edgeline marking will reduce right side ran-off-roadway accidents, particularly during adverse weather conditions along curves. We also assume that the marking of centerlines and no-passing zones reduce head-on and sideswipe opposite-direction type accidents. Other types of accidents could be affected but to what extent remains to be proven. As part of this study, a control county which has not participated in the pavement marking program will be selected and studied to further measure the overall effectiveness of the program.

We are concerned, however, that the effect on accidents may not prove to be statistically significant. We believe, therefore, that the study of this program should be accomplished on a national basis utilizing criteria developed by the FHWA to insure uniformity of the analysis. This criteria should particularly relate to accident types known to be affected by pavement markings.

PAVEMENT MARKING DEMONSTRATION PROGRAM

U.S. Department of Transportation
Federal Highway Administration

NOTE: See Instructions on reverse side

TABLE A
MILES AND COST OF MARKINGS PLACED

TYPES OF MARKINGS PLACED	MILES AND COST OF MARKINGS PLACED: JULY 1, 1975 TO JUNE 30, 1976 BY SYSTEM										TOTAL MILES AND COST OF MARKINGS PLACED JULY 1, 19___ TO JUNE 30, 19___		CUMULATIVE TOTAL MILES AND COST OF MARKINGS PLACED TO DATE (Total Program)	
	FEDERAL-AID SYSTEM					OFF THE FEDERAL-AID SYSTEM								
	URBAN		PRIMARY		SECONDARY		STATE JURISDICTION		LOCAL JURISDICTION		MILES	COST	MILES	COST
	MILES	COST	MILES	COST	MILES	COST	MILES	COST	MILES	COST				
BOTH CENTER LINES AND EDGE LINES			4,024	1,070					1,096	291.4	5,120	1,361.4	6,075	1,615.3
ONLY CENTER LINES			3,519	340.1					2,827	273.2	6,346	613.3	8,694	840.2
ONLY EDGE LINES			599	101.4					3	.5	.602	101.9	1,299	219.9
TOTAL			8,142	1,511.5					3,926	565.1	12,068	2,076.6	16,068	2,675.4

All cost figures are in thousands

TABLE B
TOTAL MILES REMAINING TO BE MARKED

TYPES OF MARKINGS TO BE PLACED	MILES BY SYSTEM					TOTAL								
	FEDERAL-AID SYSTEM			OFF THE FEDERAL SYSTEM										
	URBAN	PRIMARY	SECONDARY	STATE	LOCAL									
BOTH CENTER LINES AND EDGE LINES		1,100			300	1,400								
ONLY CENTER LINES		1,200			800	2,000								
ONLY EDGE LINES		250			60	310								
TOTAL		2,550			1,160	3,710								

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PAVEMENT MARKING DEMONSTRATION PROGRAM

U.S. Department of Transportation
Federal Highway Administration

NOTE: See Instructions on reverse side

TABLE A
MILES AND COST OF MARKINGS PLACED

TYPES OF MARKINGS PLACED	MILES AND COST OF MARKINGS PLACED: JULY 1, 19 ⁷⁵ TO JUNE 30, 19 ⁷⁶ BY SYSTEM										TOTAL MILES AND COST OF MARKINGS PLACED JULY 1, 19 ⁷⁵ TO JUNE 30, 19 ⁷⁶		CUMULATIVE TOTAL MILES AND COST OF MARKINGS PLACED TO DATE (Total Program)	
	FEDERAL-AID SYSTEM					OFF THE FEDERAL-AID SYSTEM								
	URBAN		PRIMARY		SECONDARY		STATE JURISDICTION		LOCAL JURISDICTION					
	MILES	COST	MILES	COST	MILES	COST	MILES	COST	MILES	COST	MILES	COST		
BOTH CENTER LINES AND EDGE LINES			530	140.9					58	15.4	588	165.3	588	165.3
ONLY CENTER LINES			1,310	126.6					597	57.7	1,907	184.3	1,907	184.3
ONLY EDGE LINES			258	43.7					2	.3	260	44.0	260	44.0
TOTAL			2,098	311.2					657	73.4	2,755	384.6	2,755	384.6

All cost figures are in thousands

TABLE B
TOTAL MILES REMAINING TO BE MARKED

TYPES OF MARKINGS TO BE PLACED	MILES BY SYSTEM					TOTAL
	FEDERAL-AID SYSTEM			OFF THE FEDERAL SYSTEM		
	URBAN	PRIMARY	SECONDARY	STATE	LOCAL	
BOTH CENTER LINES AND EDGE LINES		5,400			1,500	6,900
ONLY CENTER LINES		5,100			3,700	8,800
ONLY EDGE LINES		1,000			300	1,300
TOTAL		11,500			5,500	17,000

Section 209 - High Hazard Locations

The administrative responsibilities for this program are divided between the Department's Local Government Division and the Traffic and Safety Division. The Traffic and Safety Division administers the state trunkline projects and acts in a review and advisory capacity to the Local Government Division which has responsibility for the administration of projects on roads under local jurisdiction.

Projects currently being implemented were at locations identified by their accident experience, particularly those with correctable patterns. Projects on state trunklines are drawn from the Department's ongoing Michigan Safety (Ms) Program. Some locations on the local system were identified through studies completed under a grant from the Office of Highway Safety Planning, Department of State Police, which funds the traffic engineering services to local agencies provided by the MDSHT (402 funds). This Program has been very well accepted by local jurisdictions.

A wide variety of projects have been programmed, many of which are under contract. Some typical examples of projects are:

US-2, 41, M-35 (Lincoln Street) in the city of Escanaba--0.64 mile. This project widened the trunkline from four lanes to five lanes (44 feet to 64 feet face-to-face) and included pavement markings and signing. Experience with such projects in Michigan indicates that we expect to greatly reduce the significant number of left-turn related accidents occurring at three intersections and numerous commercial driveways by

providing an exclusive lane for left-turning vehicles. Federal funds for the project amounted to approximately \$450,000 while total project costs were over \$510,000.

Left-turn lanes were constructed at Forty-fourth Street at Kalamazoo Avenue in the cities of Grand Rapids and Kentwood and, because of heavy right-turn demands, the project also included right-turn lanes. The provision of exclusive lanes for both left- and right-turning vehicles greatly improves the intersection's operation by decreasing congestion and reduces accidents as the success of our Michigan Safety Program (Ms) indicates. A railroad passes diagonally through the intersection on the south and west legs which required railroad preempt part of the traffic signal operation. The preempt allows certain nonconflicting turns to continue during periods of train movements. Federal funds obligated amounted to \$470,000 and total project costs were over \$520,000.

Evaluations of Section 209 projects cannot be completed until a later date when reasonable "after" accident data is available to allow meaningful analysis of the effects of the improvements. The evaluation technique will be similar to that used in our review of the Michigan Safety (Ms) Program's 5-year program outlined in the 1975 Report.

The completion of Michigan's Accident Location Index (MALI) and development of more sophisticated computer analysis evaluation techniques (INJAAM; see page 2-2) will have a definite positive impact on selection of Section 209 and 230 projects. We envision much improved access to accident data for all intersections or sections of roadway within the state. If the current rate of project submission from local agencies

remains constant, the backlog of locations will continue to grow. We believe that needs in this area far exceed funding levels. The MALI system and INJAAM will allow us to prioritize this backlog, assuring that those locations with the greatest accident reduction potential will be programmed first.

By June 30, 1976, a total of \$7,031,181 in Federal Aid Safety Section 209 Funds had been obligated: \$2,712,403 of this was obligated during fiscal 1975-76 representing a total cost of \$2,984,000. This figure represents 91.3 percent of the initial 3-year apportionment. The Section 209 program is one of the most, if not the most, effective safety program. We strongly urge continuation and expansion of funding for this activity.

SECTION 209 - HIGH HAZARD LOCATIONS

NUMBER AND TYPES OF WORK

Fiscal Year	PS&E Federal Funds	Total Projects		Programmed								
		Program	PS&E App.	Intersect.	Signals	Bridge Construct						
1976												
State	\$1,117,530	5	6	4	2							
Local	\$1,594,873	12	9	6	3	1						
	\$2,712,403											

Section 210 - Elimination of Roadside Obstacles

The administrative responsibility for this program is also divided between the Department's Local Government Division and the Traffic and Safety Division. The Traffic and Safety Division administers the Department's state trunkline portion and acts in a review and advisory capacity to the Local Government Division who has responsibility for projects on highways under local jurisdictions.

For the state trunkline portion of this program, the Department has concentrated on "Yellow Book" type projects on the noninterstate freeway system. Candidate projects are based upon fixed object accidents per mile. Our election to utilize Section 210 funds for total roadside improvements to noninterstate freeways is partially based upon the heavy traffic volumes prevalent on these road segments and the high ratio of single vehicle ran-off-road crashes. These projects are total improvements of freeway segments and include removal, relocation, or shielding of fixed objects, modernization of guardrails and guardrail endings, minor grading to eliminate guardrails, culvert extensions, critical bridge railing replacements with concrete safety barriers, putting traffic signs on breakaway bases or relocating to bridge overpass structures, etc.

Among local jurisdiction, Section 210 funds have been primarily oriented toward projects involving narrow bridge treatments, small culvert replacements and extensions, removal of roadside obstacles, and removal and installation

of guardrail. On all new federal and state funded projects AASHTO standards relative to lateral clearances on bridges are followed.

A typical upgrading project submitted by Jackson County included removal of selected trees, protective treatments at seven narrow bridges, and sideslope regrading. The project length was 14.4 miles and cost \$174,450 with \$157,000 being federal funds.

The statewide sampling survey of roadside obstacles required by Section 210 (and mentioned in our 1975 report) has been completed for the rural and urban highways under local jurisdictions and for all state trunklines. However, the development of roadside obstacle programs in Michigan will be based more on accident data rather than on this survey.

As mentioned in last year's report a sampling was taken in one district and part of another on state trunklines and, based upon a 3-year printout (1972, 1973, 1974) and fixed object accidents of five or more within 0.2 mile, it was revealed that 50 percent of the total fixed object accidents occurred on 7 percent of our total trunkline mileage. We have not pursued this study further this year since we had already committed our remaining Section 210 funds to noninterstate freeway projects. We intend to study the concentrations of fixed object accidents further, with the intent of developing a prioritization system for spot improvement correction of roadside obstacles.

The development of MALI and INJAAM will enable us to better define where fixed object accidents are occurring, the type of fixed object impacted,

and the severity of the accident. Our analysis of this program will focus on off road crashes. In addition to evaluating the total program impact, we intend to analyze the various types of roadside improvement.

The State Highway Commission and FHWA was recently instructed by Federal District Court to reevaluate tree removal projects funded under the Roadside Obstacle Program, Section 210 and Section 230. An injunction prohibiting the execution of a number of approved contracts was secured by the West Michigan Environmental Action Committee. A response to the injunction has been filed. Also, additional program justification is being developed for review by the court.

In assessing removal of trees in accordance with Federal Regulations (FHPM 7-7-2), we initially concluded that limited tree removal projects, as proposed by the individual counties, were nonmajor actions and did not require the review procedures prescribed for major action projects. Although nonmajor action projects do not require public hearings, contacts were made with individual property owners and local and state clearinghouse review procedures, public and agency involvement was obtained.

The effect of this court order, which addresses only live trees and not other obstacles, requires the Department to conduct an evaluation to determine if the proposed tree removals significantly affect the quality of the human environment. If it does, an Environmental Impact Statement will be required. If not, a Negative Declaration will be developed. However, the Department is not to be precluded from immediate removal of trees in "clearly hazardous settings." Criteria have been developed

identifying such locations and are being presented to the court for review and approval. This legal action has had an adverse effect on the roadside obstacle program at the local level. Since the litigation was initiated, very few, if any, obstacle removal projects have been submitted.

By June 30, 1976, a total of \$6,264,837 in Federal Aid Safety Section 210 funds had been obligated, with \$1,217,084 obligated during fiscal 1975-76 representing a total cost of \$1,340,000. This figure represents 92.9 percent of the initial 3-year apportionment. Present backlog indicates no difficulty in expending future safety funds.

SECTION 210 OBSTACLES

NUMBER AND TYPES OF WORK

Fiscal Year	PS&E Federal Funds	Total Projects		Programmed						
		Program	PS&E App.	Removals	Yellow Book	Atten.	Culverts	Narrow Bridges	Guard Rail	Other
1975-76										
State	\$ 102,850	3	3			2				1
Local	\$1,114,234	5	7	2					3	
	\$1,217,084									

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Section 230 - Federal Aid Safer Roads Demonstration Program

Section 230 provides roads and streets off the Federal Aid System with monies for safety improvements. The administrative responsibility is handled by the Department's Local Government Division with traffic engineering consultation provided by the Traffic and Safety Division on an as-needed basis. The program includes sign and signal upgradings, rail-highway crossing improvements and Yellow Book type projects, (obstacle removals and narrow bridge improvements).

Section 230 sign upgrading projects accounted for 138 new requests and 62 programmed projects including 10 with PS&E approval. During fiscal 1976 the number of agencies participating in sign upgrading numbered 265. We attribute this large participation to the road network inventory services that Department personnel are able to provide cities and counties and traffic engineering seminars funded by Federal 402 funds. In addition, the American Automobile Association (AAA) is very active in the promotion of this program. See page 3-12 for further details.

A railroad consolidation project in the city of Menominee has received federal program approval. This project entails the abandonment of one mile (18 crossings) of existing urban area track and transfers operation to an adjacent existing line on the outskirts of the city. The project has an expected accident reduction of 18.7 for the 18 crossings abandoned as determined by a car-train exposure factor.

Our 1975 report reviewed eleven intersection geometric improvements submitted for Section 230 funding. During the 1976 fiscal year only three intersection improvement projects were submitted with all receiving program and PS&E approval. Since most intersection geometric improvements are aimed at reducing one or more correctable types of accident patterns, considerable benefits are realized. A problem with this type of improvement is that existing right-of-way widths often will not accommodate proposed geometric improvements. Because of the time required to purchase right-of-way, most agencies are reluctant to pursue geometric improvements and opt for such projects as signal upgrading instead.

Projects involving the upgrading of traffic signal controls have attracted considerable attention from both counties and cities. Most locations programmed have only one signal head and antiquated controllers. We have noted, however, that several of the locations fail to meet traffic volume warrants. We believe, therefore, that FHWA justification criteria should require that a signal upgrading project be preceded by a traffic volume warrant study.

By June 30, 1976, a total of \$4,643,928 in federal safety funds had been obligated with \$3,095,336 obligated in fiscal 1976, representing a total cost of \$3,621,066. The total obligated amount represents 48.6 percent of the initial 3-year apportionment. The current backlog of projects, with approximate federal costs exceeding 6 million, indicates that all funds will be expended.

SECTION 230 Safer Roads Demonstration

		NUMBER AND TYPES OF WORK								
		Total Projects		Programmed						
Fiscal Year	PS&E Federal Funds	Program	PS&E App.	Removals	Yellow Book	Atten.	Culverts	Narrow Bridges	Guard Rail	Obstacles & Signs
1976	\$1,695,336	80	29	1	1	0	2	1	1	74

*Does not include railroad projects

Rail-Highway Crossings
(Section 230)

Project Location	Project						Justification						Total Costs		
	Warning Devices					Est. Cost	Construction					Priority Points		Potential Accidents	Federal Funds Obligated
FLS	Gates	CA	AWS	Pvt. Mkg.	Appr. Work		X-ing Work	C&G &/or G.R.	Realign	Clear Vision	Est. Cost				
Fiscal 1976 Summary	8	4	2	10	10	576,000	6	7			994,000		14.8	1,400,000	\$1,570,0

FLS - Flashers
 CA - Cantilever Arm
 AWS - Advance Warning Signs
 C&G - Curb and gutter
 G.R. - Guardrail

Section 204 Special Bridge Replacement Program

Section 144 of Title 23 of the United States Code provides financial assistance to replace bridges over waterways or other topographical barriers that are considered significantly important and are unsafe because of structural deficiencies, physical deterioration or functional obsolescence. The program in Michigan is administered by the Department's Local Government Division.

Bridges under local jurisdiction have been surveyed for structural adequacy and are ranked for priority of replacement in accordance with critical need based on the local agency's financial resources, importance of the bridge to the area, and the structural condition of the existing bridge.

To date 14 bridges representing \$12,500,000 in Federal Aid Funds have been obligated, all during fiscal 1975. As a result no new projects of this type were initiated during fiscal 1976.

We currently have a backlog of approximately 240 structures to be improved. A typical improvement costs between \$200,000 and \$300,000 and occasionally exceeds \$1,000,000. Additional funds required to improve all currently listed deficient structures, if available, would be approximately \$60,000,000.

SECTION 2

PART I

THE 1975-1976

MICHIGAN SAFETY (Ms) PROGRAM

INTRODUCTION

Last year's Second Annual Report outlined types of improvements performed through the 100 percent Michigan funded Safety (Ms) Program. Project locating and screening procedures developed during the first ten years of the program were also discussed. This year's report briefly outlines new techniques developed for locating correctable accident patterns as well as a look at a much more refined system now being developed. A discussion of fiscal 1976 expenditures and a 2-year "before and after" study of projects let during fiscal 1971-72 are also included.

The objective of the Safety (Ms) Program is to identify locations experiencing significant correctable patterns of accidents, isolate, and program cost-effective solutions.

The present procedure isolates similar roadway segments for purpose of analysis. In order to maintain a manageable system, the state was divided into three geographical areas. Urban and rural roadways were also categorized yielding six different roadway types for study. Computer printouts of locations experiencing significantly greater than average accidents, by type, were then generated. Ten basic accident types are analyzed: angle, left turn, fixed object, rearend, head on, sideswipe, parking, night, wet surface, and pedestrian.

This system yields 60 different printouts of abnormal accident sites which are associated with proven engineering solutions. For example, locations experiencing angle accidents (further broken down to include only signalized locations) are reviewed for possible implementation of all-red phases, oversize lenses, or signal progression alterations. Another printout of left-turn accidents at signalized intersections may yield candidates for left-turn signal phasing, construction of center lanes for left turns, or left-turn prohibitions.

Though the present identification system is an improvement over that used in previous years, it is still quite cumbersome, requiring extensive manual analysis. We presently are developing Project INJAAM (Injury Accident Analysis Model). The objective of this project is the development of a computer model that will read basic data, locate abnormal accident sites, test corrective measures, predict expected change in injury accidents, and cost evaluate each alternative. Finally,

it will establish the optimum aggregation of proposed action that will maximize the reduction in injury within a predetermined budget constraint. The ability to test the sensitivity of the model is expected. The principle component of the model is a three-dimensional array of environmental, geometric, and accident characteristics. By using several arrays of different time frames, we anticipate the ability to test for trends and the results of various policies within our Safety Program. Some of the elements of this system have been developed and are now being tested. The remaining steps are being developed.

1975-76 Expenditures

In the first 12 months of Michigan's extended fiscal year¹ nearly \$6,000,000 has been spent through the Michigan Safety (Ms) Program. Expenditures by project type are given below:

<u>Description</u>	<u>Number of Projects</u>	<u>Amount</u>
Spot locations	61	\$4,600,000 ²
Skidproofing	3	132,000
Sign upgrading to MUTCD Standards (force account)	Statewide	660,000
Sign upgrading Additions to Section 210 projects	2	86,500
Thermoplastic pavement markings	Statewide	90,200
Upgrading damaged guardrail ³	Statewide	39,000
District work orders	70	294,000
Preliminary engineering for safety studies	Statewide	23,000
		<u>\$5,924,700</u>

-
1. Fiscal 1976 runs from July 1, 1975, to September 30, 1976
 2. Includes approximate right-of-way changes
 3. This is a relatively new item in the Program to replace end sections of damaged guardrail with buffered ends.
-

Spot location project cost varied from \$1,960 for curbed radii to \$675,300 for widening from 4 to 5 lanes through a strip commercial area. Average project cost was \$80,000.

SECTION 2

PART II

EVALUATION OF THE
MICHIGAN SAFETY (Ms) PROGRAM

1971 and 1972

An excerpt from TSD-287-76

by Arthur H. Yang, Research Statistician

INTRODUCTION

The following data summarized a more comprehensive study and evaluation of the Michigan Safety (Ms) Program for fiscal 1971 and 1972. A total of 108 spot location improvement projects of the type outlined in last years report were completed at a cost of approximately \$6.4 million⁴.

4. Total Ms Program expenditures exceeded \$8.0 million. Items such as edge marking, impact attenuators, force account work, and the state's share of Topics projects accounted for more than \$1.6 million.

There were 39 projects excluded from this study. Projects at locations where considerably higher accident potential would have been expected during the time period after improvement were not included. This may have been due to a new shopping center or other large traffic generator in an area where no accident problem existed before. These are termed "development" type projects and are aimed at accident prevention rather than reduction. Also, among the 39 excluded projects were seven minor improvement projects accomplished in conjunction with major operational changes (such as radius improvements coupled with a new 1-way street operation). Though a significant accident reduction was realized, it could not be attributed to the minor safety improvement.

TABLE 1
NUMBER OF PROJECTS AND COST
IN 1971 AND 1972

Improvement Type	Number of Projects	Total Construction Cost	Average Cost Per Project
Construction of directional crossovers	6	\$ 486,029	\$ 81,005
Widening from 4 to 5 lanes (intersections)	11	775,388	70,490
Widening from 4 to 5 lanes (extended sections)	7	1,128,706	161,244
Correction of horizontal and vertical alignment	5	470,691	94,138
Construction of median left-turn lanes	3	153,854	51,285
Intersection flaring	7	345,000	49,286
Skidproofing	17	442,000	26,000
Widening from 2 to 3 lanes	8	516,647	64,581
Miscellaneous (all projects not otherwise classified)	5	429,264	85,853
Total	69	\$4,747,579	\$ 68,805

TABLE 2

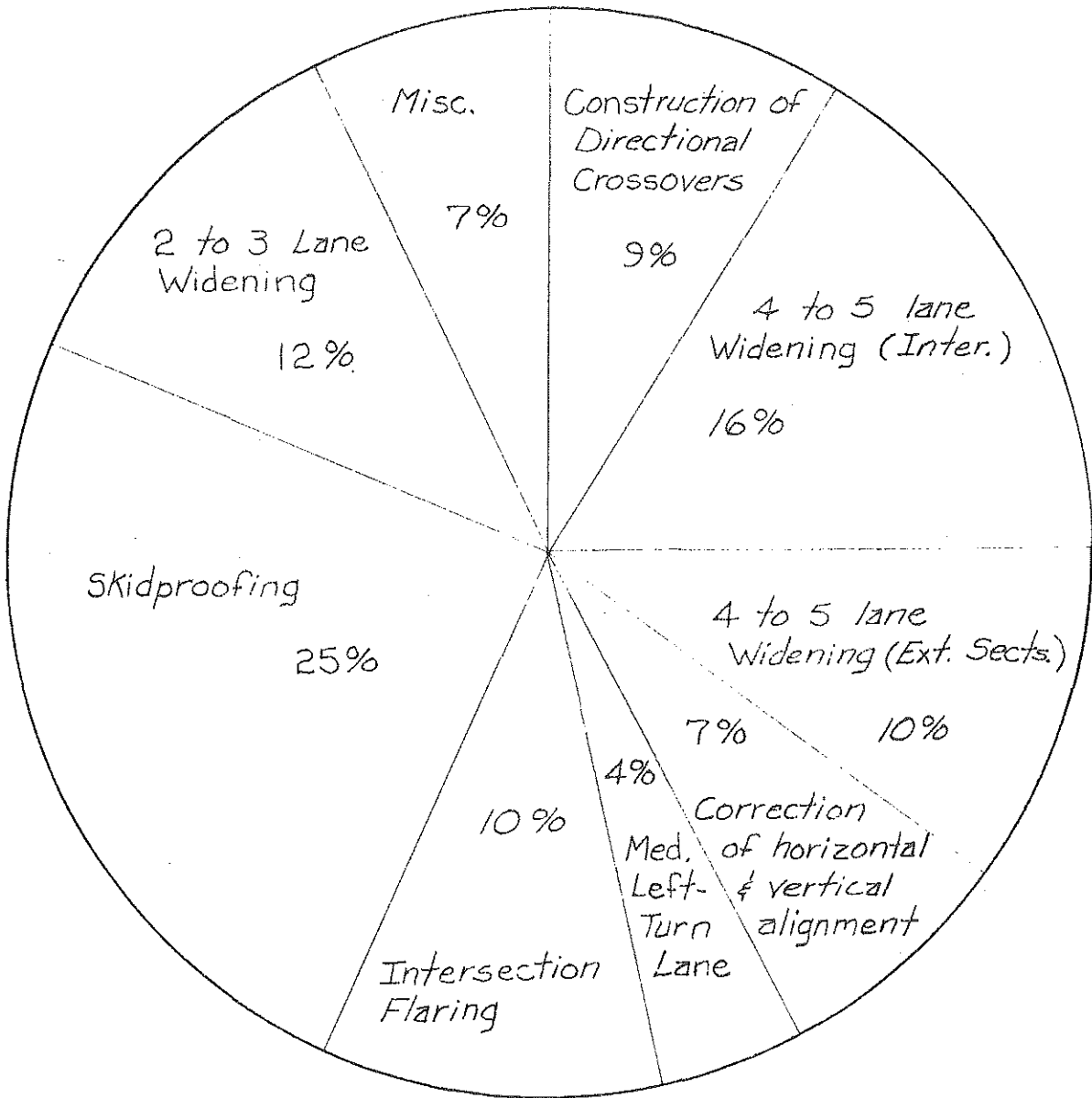
COMPARISON OF "BEFORE" AND "AFTER"

YEARLY AVERAGE DISTRIBUTION OF ACCIDENTS BY TYPE

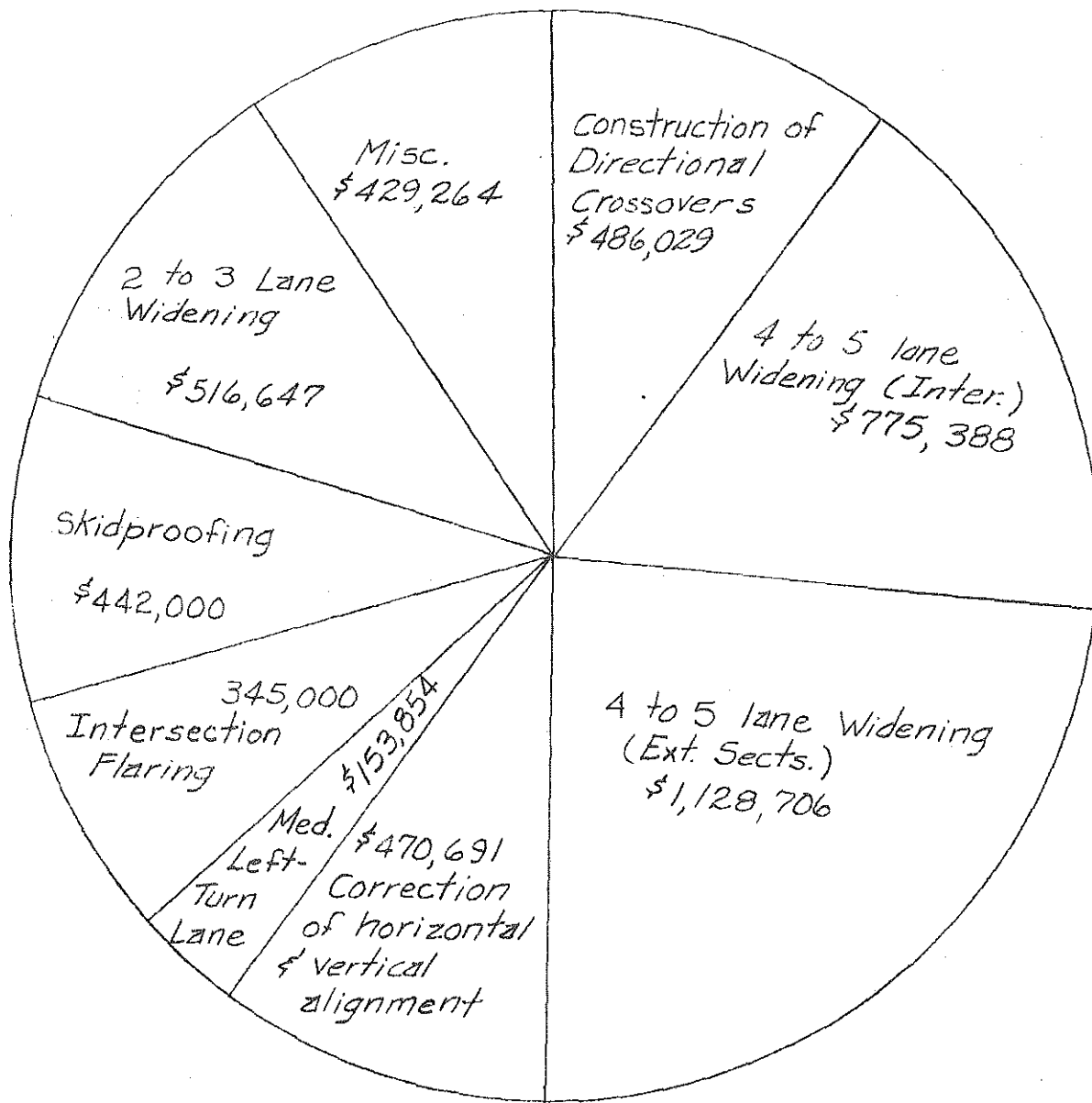
IMPROVEMENT TYPE	NUMBER OF PROJECTS	ACCIDENT TYPE	BEFORE	AFTER	PERCENT REDUCTION	STATISTICAL TEST *
Construction of directional crossovers	6	Total	376	313	17%	S
		Fatal	0	0.5		
		Injury	103	87	16%	N
Widening from 4 to 5 lanes (intersections)	11	Total	327	298	9%	N
		Fatal	0.5	0.5		
		Injury	95	90	5%	N
Widening from 4 to 5 lanes (extended sections)	7	Total	382	320	16%	S
		Fatal	2	0.5		
		Injury	133	103	23%	S
Corrections of horizontal and vertical alignment	5	Total	24	23	4%	N
		Fatal	0	1		
		Injury	11	7	36%	N
Construction of median left-turn lanes	3	Total	197	211	-7%	N
		Fatal	0	0.5		
		Injury	74	63	15%	N
Intersection flaring	7	Total	95	71	25%	S
		Fatal	0	0		
		Injury	26	24	8%	N
Skidproofing	17	Total	936	836	11%	S
		Fatal	2	1		
		Injury	274	241	12%	S
Widening from 2 to 3 lanes	8	Total	95	82	14%	N
		Fatal	0	1.5		
		Injury	27	25	7%	N
Miscellaneous (all projects not otherwise classified)	5	Total	65	79	-22%	N
		Fatal	2	0		
		Injury	22	28	-27%	N
TOTAL	69	Total	2,497	2,233	11%	S
		Fatal	6.5	5.5	15%	N
		Injury	765	668	12%	S

* S - statistically significant increase or decrease at 90% confidence level.

* N - no significant change



DISTRIBUTION OF SAFETY PROJECTS
 by Type of Improvement
 (based on 69 locations)



DISTRIBUTION OF PROJECT COSTS
 by Type of Improvement
 (based on 69 locations)

Discussion of "Before and After" Study

A detailed description of the basic project types was presented last year and will not be repeated. However, further discussion of a few of the project types is required to avoid misinterpretation of the preceding table.

Widening from 4 to 5 lanes (intersections)

Traditionally this project type has been among the most effective in reducing certain types of accidents at signalized intersections, mainly left-turn related and rear end. However, the study shows reductions which may not be statistically significant. Our analysis reveals, however, that these projects were extremely beneficial when the following factors are considered.

At three of the locations traffic signals were installed upon completion of construction. This generally reflects growing areas where traffic volumes had increased to a point where signalization was necessary, thus prompting the widening. Experience indicates that signalization without providing headed-up left-turn lanes would have resulted in a dramatic increase of left-turn and rearend collisions.

At two of the remaining locations, left turns were prohibited from the trunkline prior to construction. Related accidents at adjacent intersections, not studied, may have been reduced.

Another important factor that we were unable to evaluate is volume changes at individual locations. Spot samples indicate that crossroad volumes more than doubled at some locations in the "after" period.

Miscellaneous Projects

Two of these projects were directed at reducing fatal accidents. There were a total of four fatalities in the 2-year "before" period and zero after. Total accidents remained about the same. At the remaining three locations safety projects were initiated to prevent accidents in the face of rapidly increasing traffic volumes. Two of the locations were signalized upon completion of the construction.

SECTION 3

OTHER SAFETY-RELATED PROJECTS

FISCAL YEAR 1975-76

TRANSPORTATION LIBRARY
MICHIGAN DEPT. STATE HIGHWAYS &
TRANSPORTATION LANSING, MICH.

INTRODUCTION

Michigan programs several other types of projects that are not entirely safety oriented but do include several safety-related work items.

Projects falling within this category include federal aid urban, federal aid primary, federal aid secondary (includes off-system projects), and 100 percent state and local funded projects.

Typical safety-related work items accomplished through these projects are: intersectional geometric improvements, signal modernizations, rail-highway crossing and signal improvements, roadside control, guard-rail modernization, obstacle removal, resurfacing for skidproofing, median barrier construction, side slope improvement, and shoulder improvements.

Federal Aid Urban Program

A total of 59 projects were let to contract during fiscal 1976. Safety-related improvements were included in 48 of the projects. Several long projects included intersections which would have qualified for safety funding based on accident experience. Other projects involved the modification of crossovers, the improvement of sight distance through extensive grading, and the installation of guardrail when obstacle relocation or removal was not feasible.

During fiscal 1976, a total of \$39,082,614 was expended of which \$6,676,810 was safety related.

Federal Aid Primary Program

Projects within this program are on state trunkline routes. [REDACTED]
[REDACTED] Project types vary and include bridge railing and bridge deck replacement, traffic signing, and interchange ramp upgrading. During fiscal 1976, 13 projects were let to contract at a total cost of \$9,222,513. A review of the projects indicated that approximately \$6,455,759 is safety related.

Federal Aid Secondary Program

Projects within this program are usually less than \$100,000 although occasionally a project will exceed \$1,000,000 as one did during the 1976 fiscal year. That project involved constructing dual 24-foot bituminous aggregate roadways and shoulders plus construction of a bridge over the C.M.W. railroad on Federal Aid Secondary Route 323 in Marquette County. A total of \$13,141,949 was expended by this program under 96 separate contracts. It was determined that \$7,773,420 of the total amount could involve highway safety.

Michigan Funded Projects

In addition to the Safety (Ms) Program, there are several other state funded programs within which safety-related work is performed.

The determination of which project types are safety related is relatively simple, but time consuming. For instance, resurfacing projects are checked against skidtest data within the project limits. Those areas where the skid number was low are considered as safety expenditures. The same criteria was used in determining which bridge deck would be credited as safety items.

Projects which replaced bridge railings, improved traffic signals, eliminated guardrail through grading, extended culverts, upgraded guardrail type, installed flared guardrail endings, etc., were evaluated similar to projects submitted for federal aid funding. If the project would have qualified for federal funds, 100 percent of the cost was considered safety. The percentage of safety items on other projects varied considerably.

Pedestrian and bicycle construction projects were considered 100 percent safety related if total segregation from the automobile conflict was established. Shoulder improvements were also considered 100 percent safety related because of the large percentage of right side, ran-off-roadway accidents and published research confirming the value of stabilized shoulders.

Mb Bituminous Resurfacing - This program is primarily aimed at the driving surface of highways. During fiscal 1976, there were 50 such projects let to contract. Resurfacing of highways that exhibit low coefficients of wet sliding friction, a high percentage of wet surface accidents, or have uneven surfaces are of primary concern. Correction of superelevation has also been accomplished through this program. The cost of these projects totaled \$9,674,486, of which 36 projects or \$6,946,190 could be attributed to an annual skidproofing program.

MBR Bituminous Reconstruction - This program focuses on the surface and base of highways. Projects may include minor widening and roadside control with curb and gutter and enclosed drainage. During fiscal 1976, 22 projects were let to contract at a cost of \$6,769,010. \$4,061,406 was identified as safety related.

M Miscellaneous Construction - During fiscal 1976, there were 13 safety-related projects costing \$1,526,160. Three were for highway traffic signals or improvements at a cost of 173,470. Two projects were for bridge deck and railing replacement at \$187,300 and two projects were for widening and resurfacing at a cost of \$539,600. Three others corrected base course failures at a cost of \$238,840. The remaining projects were a guardrail project for \$59,525; one for bridge railing replacement and lighting for \$54,025, and one for loop ramp construction and minor widening costing \$273,400.

Mbd - Bridge Deck - Projects in this program correct bridge decks that have exhibited spalling to the point where rebars are exposed, the bridge deck leaks or the bridge deck is slippery when wet. In most

cases the deck is waterproofed after completing any required minor deck repair and a latex modified mortar, concrete, or bituminous surface is applied. During fiscal 1976, ten projects were let to contract at a cost of \$1,005,000 of which \$639,786 is safety related.

Mnm Nonmotorized Vehicle Facility - This program funds facilities for exclusive pedestrian and bicycle usage. The conflict between vehicles, bicycles, and pedestrians has been the subject of concern for several years. The 12 projects programmed cost a total of \$1,313,357 with \$1,089,037 being expended off the interstate system. The projects provided paved shoulders or separate pathways for nonmotorized vehicles. Ten of the projects were let to contract adjacent to "US" or "M" routes and two others adjacent to "I" routes.

Msh Shoulder Edge Treatment - This program provides a minimum 3-foot bituminous edge strip along the right-hand side of state highways. It is aimed at preventing the formation of an edge drop between the pavement and adjacent shoulder material. An edge line is provided to delineate the driving lanes and prevent regular usage of the added width. During fiscal 1976, there were 11 projects involving 76.2 miles at a cost of \$733,260.

Mcp Minor Construction - This program involves the implementation of projects by maintenance forces and is primarily Yellow Book work performed on state highways, mostly nonfreeways. The type of safety-related work includes: grading for elimination of guardrail; providing clear vision or eliminating snowdrift problem, upgrading obsolete type guardrail, extending guardrail to current safety standards, and placing end cushions; culvert modification or protection; and miscellaneous obstacle removals.

During fiscal 1976 there was a total of \$1,200,000 expended in this program.

Skidtesting

During fiscal 1976, 11,322 skidtests were conducted statewide with 9,372 being on the state trunkline system. On an "as requested" basis, skidtests were conducted by the Department at 19 nontrunkline locations. Seventeen projects were programmed to correct pavements with low coefficients of friction or concentrations of wet accidents.

Yellow Book Program

The Michigan Department of State Highways and Transportation is currently engaged in a program of implementing safety improvements to reduce hazards in the roadside environment. Some work is being done and has been done by maintenance forces; but an increasing number of Yellow Book projects are being contracted through the state's regular construction bid letting process. During fiscal year 1975-76, six interstate safety (Is) projects were specifically for roadside obstacle corrections. This type of work was also included as a part of six other projects. On the noninterstate freeway system, there was one project let to contract (countywide in Wayne County) utilizing Michigan Funds.

Due to the hazard that exposed guardrail endings pose to impacting vehicles and the possibility of penetration into passenger compartments, the Department began a program to eliminate guardrail end shoes by replacing them with buffered endings along all state highways not on the interstate system. This program required a field survey of unprotected guardrail endings and was started in the winter of 1974-75 and is still continuing. Of the State's 83 counties, 30 were surveyed in 1975-76, bringing to date a total of 60 completed counties.

This work is currently being performed by state and local contract forces as funds are made available. Because of the lack of funds, during the fiscal year 1976, work authorizations totaling only \$94,000

were issued. However, it is planned that this program will be completed by the end of the 1978 fiscal year. The provision of safer guardrail terminations is a vital step in our Department's roadside safety improvement program.

Interstate Freeways - Yellow Book Status

The removal, relocation, or protection of roadside obstacles on the 1,053 miles of interstate routes open to traffic continues with 883 miles of upgrading approved by the FHWA. The remaining 170 miles are in accordance with present day standards with the exception of a limited number of buried end section guardrails which should ultimately be replaced with cable type anchorages.

Of the 883 miles:

1. Thirty-one percent (271 miles) has been completed or are presently under contract.
2. Forty percent (351 miles) are programmed and in design.
3. Twenty-nine percent (261 miles) are either unprogrammed or inactive to date. Part of the 261 miles are currently programmed to be performed by state maintenance forces, but it is doubtful that the work can be completed in a timely manner.

We are currently reviewing the capabilities of contract maintenance agencies to determine if they can perform the work by the fall of 1977. If not, the projects will be reprogrammed for contract bid lettings.

Interstate Safety (Is)

The Federal-Aid Interstate Safety Program provides funding for both major and minor corrective safety work on the interstate system and is contracted through the competitive bid process. Major corrective work

includes bridge widenings, bridge railing replacements with concrete safety barriers, extensive regrading, additional through and/or auxiliary lanes, redesign of basic geometry or the complete reconstruction of an interchange, replacement of existing median guardrails with concrete safety barriers and providing or upgrading freeway lighting. Most safety projects are authorized after approval of a justification based upon the reduction of accidents and recommended corrective measures.

Minor corrective work, of a Yellow Book nature utilizes federal aid interstate funding to provide a safer roadside for errant motorists on the state's highway system. It includes modernization or replacement of guardrails, minor grading, culvert extensions and safer endings, and putting sign posts on frangible bases or relocating signs to bridge overpass structures. Further details regarding the Yellow Book program are on page 3-7.

In fiscal year 1975-76, Michigan awarded Interstate Safety (Is) projects totaling \$6,425,774.

IMPACT ATTENUATORS

During fiscal 1976 the Michigan Department of State Highways and Transportation's Traffic and Safety Division authorized the construction of 42 impact attenuators. Hi-Dro Cell attenuators were installed at 41 locations with the remaining location being a "GREAT" guardrail energy absorption terminal attenuator.

The average cost per installation during fiscal 1976 was \$30,000. A total of \$1,260,000 was authorized during fiscal 1976 for impact attenuators.

Installation priorities are assigned based on accident histories and accident potential. We intend to develop a ranking system for such installations based on available encroachment rate data, severity ratios, and cost information. We are also developing maintenance guidelines which appear to be a serious problem as increasing numbers of impact attenuators are authorized.

Traffic Engineering Services

The Michigan Department of State Highways and Transportation annually seeks out, identifies, and recommends improvements at locations experiencing severe accident problems on the local road system. In addition, the Department carries out a program that inventories the road network of cities and counties to determine if traffic control devices on the local road system meet the standards as set forth in the Manual of Uniform Traffic Control Devices. The traffic engineering services for cities and counties program has been ongoing since July 1, 1972, and is funded by Section 402 funds through a grant from the Office of Highway Safety Planning, Department of State Police.

Work activities have resulted in the completion of traffic control devices inventories for 44 counties and 36 cities or villages. In terms of mileage, this means that 15,135 miles of the 25,552 miles of county primary roads throughout the state have been inventoried. We have also provided traffic engineering analysis of high accident locations for 34 local jurisdictions with formal engineering analysis reports being prepared for each. The reports outlined geometrics and operational improvements for the locations examined which, when implemented, should reduce the accident potential. Recommended improvements involved construction of exclusive left-turn lanes where left-turn accidents were the predominate pattern at an intersection, upgrading of signing and pavement markings, improvement of driveway openings, and the installation of traffic signals where warranted. A recent evaluation report reviewed six locations to determine the effects of implemented recommendations. The results of

the before-and-after accident study indicated a 37 percent reduction in accidents during the study period.

To achieve uniformity and accelerate the upgrading of traffic control devices, Department personnel are conducting a program to train personnel in local jurisdictions to conduct field inventories on their respective highway system. Since the request for assistance has steadily increased, the Department has utilized instructional seminars as the primary method of training local personnel in the technicalities of conducting inventories of traffic control devices. In these instructional seminars photolog film projectors are used as a teaching aid. In addition, Department personnel act as consultants in providing technical assistance to the local governmental agencies and review completed inventories by spot checks. Additionally, this program has assisted local agencies in obtaining federal funding, where warranted, to modernize existing traffic signal installations to meet the requirements of the Manual of Uniform Traffic Control Devices.

Skid testing of pavements for skid resistance is also a service being provided at the request of local agencies to aid in determining slippery pavement conditions. When a low stopping coefficient is encountered and supportive accident data is present, a recommendation for an application of skid resistant surface treatment is made to the local agencies.

At present, the accident data retrieval and analysis process utilized by the traffic engineering services program is strictly a manual one. With the implementation of the Michigan Accident Location Index (MALI) for

locating traffic accidents by the Department of State Police, computer programming may be utilized to efficiently detect and analyze high accident locations in those counties (6) where the index is operational. With this automated process, we obtain the capability to maintain a surveillance mechanism for identifying high accident locations on the local road system similar to that used on the trunkline system. As additional local road systems are added to MALI, the automated surveillance process will be extended to those local jurisdictions.

Michigan Accident Location Index (MALI)

The Departments of State Police and State Highways and Transportation in cooperation with the Office of Highway Safety Planning have developed a computerized accident location reference and analysis system commonly referred to as MALI (Michigan Accident Location Index). The basic intent of the MALI System has been to eliminate the current manual requirements for locating and coding accident reports and to develop a direct key-to-disk accident data transcription process which will facilitate expansion of the state's accident surveillance and locating capabilities to nontrunkline roadways. The MALI System will eventually locate accidents on all major roads and streets within the state.

On May 17, 1976, the MALI System became operational and began processing 1976 traffic crashes on the state trunkline system in 74 of the 83 counties and on the local system in four counties. The traffic crashes that occur on the trunkline system and on the local system where the computer files are not complete will be located to pseudo locations by road type and political subdivisions so that all 1976 traffic data will be retained. As the computer files for the remainder of the trunkline and local systems are completed, they will be included on the master index at which time 1976 crash data will be retrieved and placed at specific locations.

Now that the trunkline system is near completion, the MALI project direction will shift to the local road systems. The Department of State Highways and Transportation is presently exploring the use of a consultant to assist in the development of the computer files for the local system.

A new plan is being developed which will complete this portion of the MALI project within three years, which is considerably less than the 6-year plan that was originally adopted. The project has been assisted by some local governmental agencies who, through Section 402 funded grants provided by the Office of Highway Safety Planning, have completed or are presently working on their own computer file. The completion of the local system across the state is important to the overall project goal of extending accident analysis capabilities to all roads and streets across the state. This will also greatly improve our ability to evaluate improvement projects.