MICHIGAN HIGHWAY SAFETY PROGRAM

MAINTENANCE STANDARDS AND CONSTRUCTION AREA PRACTICES

Wilbur Smith and Associates

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Maintenance Standards and Construction Area Practices

Prepared for
Michigan State Highway Commission
Lansing, Michigan

By
Wilbur Smith and Associates
March, 1971

This study was conducted in accordance with Project #HD-69-1-001 with the Michigan State Highway Commission dated May 19, 1970.

Under the Auspices of

DEPARTMENT OF STATE POLICE
OFFICE OF HIGHWAY SAFETY PLANNING

and

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION

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March 31, 1971

Mr. Peter H. DeCamp
Traffic Geometrics Engineer
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Michigan Department of State Highways
Lansing, Michigan 48904

Dear Mr. DeCamp:

We are pleased to submit our study report, in final form, on "Maintenance Standards and Construction Area Practices" of Standard 12, Highway Design, Construction and Maintenance, of the National Highway Safety Standards. This study was conducted in accordance with our agreement with the Michigan State Highway Commission dated May 19, 1970.

The purpose of this study was to obtain from counties and cities throughout Michigan certain information on their current practices and procedures relative to roadway and roadside maintenance, handling of traffic approaching and moving through roadway construction and repair sites, training of maintenance personnel, and identification and treatment of hazards within highway rights-of-way.

This information then was evaluated in relation to standards and practices adopted by the Michigan Department of State Highways and the applicable National Highway Safety Standard, in order to develop findings and recommendations designed to minimize the opportunity for traffic accidents at road construction sites or at locations where improved maintenance practices can contribute to that objective.

A total of 17 activity areas were reviewed relative to performance by county road commissions and city public works departments with regard to selected aspects of their safety programs. In seven areas, performance by all reporting agencies was rated excellent or adequate. In the remaining ten activity areas, the study concluded that many of the reporting agencies are in need of improved practices and procedures. The report makes 12 recommendations relative to legislative or administrative action.

We appreciate the opportunity to assist the Commission in this study, and believe that implementation of the recommendations contained in this report will make a significant contribution to continued progress in reducing both the frequency and severity of accidents on Michigan streets and highways.

Very truly yours,

Wilbur Smith and Associates

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Chapter 1

INTRODUCTION

This is the second of two reports dealing with programs of Michigan highway agencies within the scope of Standard 12, Highway Design, Construction and Maintenance, of the National Highway Traffic Safety Administration, U. S. Department of Transportation.

Purpose of Standard 12

The primary purpose of highway safety programs encompassed by Standard 12 is to assure that principles of safe design and operation are considered in the planning, construction, and maintenance of all streets and highways, in order to bring about the safest practicable physical environment for the highway user.

The Standard specifies performance goals for highway safety programs in three specific activity areas:

1. Maintenance of existing streets and highways in a condition that promotes traffic safety;

2. Major improvements, either for modernization of existing roads or to provide new facilities, to be designed with proper application of approved highway safety design standards; and

3. Appropriate precautions to protect passing motorists, as well as highway workers, from accident involvement at highway construction and maintenance sites.

Point 2, above, was the subject of the first report [1] of this two-part study. This second report is concerned with Points 1 and 3: application of Standard 12 recommendations in normal roadway maintenance, and at highway construction and repair sites where special precautions are needed to guide traffic safely through the construction or maintenance site, or where traffic must be detoured around the site while construction or repair work is in progress.

Authority for Standard 12

The basic national authority for programs under Standard 12, Highway Design, Construction and Maintenance, is contained

(1) Michigan Highway Safety Program Design Standard Study, Prepared for Michigan State Highway Commission by Wilbur Smith and Associates, December, 1969.

in Chapter 4 of Title 23, U.S.C., adopted by Congress as the Highway Safety Act of 1966 (Public Law 89-564). Section 402(a) of Title 23 authorizes the issuance of a Highway Safety Standard related to highway design, construction and maintenance. The section requires that:

> Each State shall have a highway safety program approved by the Secretary [of Transportation], designed to reduce traffic accidents and deaths, injuries, and property damage resulting therefrom. Such programs shall be in accordance with uniform standards promulgated by the Secretary. Such uniform standards shall...include... highway design and maintenance (including lighting, markings, and surface treatment)...

In addition, Section 402 (b)(1)(B) states that:

> The Secretary shall not approve any State highway safety program under this section which does not...authorize political subdivisions of such State to carry out local highway safety programs within their jurisdictions as a part of the State highway safety program...

In accordance with this Congressional directive, the U.S. Department of Transportation issued Highway Safety Program Standard 12(2), which is presented in Appendix A.

Policy Objectives of Standard 12

The general objective of Standard 12 is to encourage and

(2) Highway Safety Program Manual, Vol. 12, Chapter III. Federal Highway Administration, U.S. Department of Transportation.

support in each state the application of safety principles to the design, construction, and maintenance of all rural roads and urban streets.

Within this broad policy, the Highway Safety Program Manual for Standard 12 lists the following specific objectives:

a. That state and local jurisdictions establish programs to correct safety deficiencies in all urban and rural roads, with new construction, reconstruction, and improved maintenance.

b. That the design criteria for safety features...should apply to construction, reconstruction, and improvement of all expressways, major streets, and major highways within the state, both on and off the Federal-aid system.

c. Since Federal-aid support is available for upgrading safety features on the Federal-aid system, the major attention of this program under the provisions of the Highway Safety Act should be directed toward improvements on streets, highways, and roads that are not on any Federal-aid system.

d. That safety improvements in urban street systems should be planned and implemented under provisions of the Highway

Safety Act in close coordination with all relevant TOPICS program activity in the region as administered by the Bureau of Public Roads.

e. That a program for establishing priorities for the improvement of safety features on existing streets and highways should be undertaken, taking into consideration past accident involvement, current and future hazard potential, traffic volumes, cost, and reduction in deaths and injuries expected to result from the proposed improvement.

f. That design policies, standards, guides and practices developed by the Federal Highway Administration and those of the American Association of State Highway Officials (AASHO) and the Institute of Traffic Engineers...should be used as criteria for safety features on applicable facilities.

g. That all personnel responsible for either supervising or performing work as it relates to highway design, construction, and maintenance, should be thoroughly trained in the various aspects of highway safety.

h. That all levels of government having responsibility for streets and highways should exercise construction and

maintenance procedures which assure the safe flow of traffic through construction projects and areas of maintenance activity.

Scope of Study

This study, by directive of the Michigan State Highway Commission, places primary emphasis on four sections of Standard 12:

1. Guidance, warning and regulation of traffic approaching and travelling over construction or repair sites and detours;

2. Roadway and roadside maintenance consistent with the design standards which were followed in construction, to provide safe and efficient movement of traffic;

3. Identification and correction of hazards within the highway right-of-way; and

4. Training of maintenance personnel in procedures for summoning aid, protecting others from hazards at accident sites, and removing debris.

Because the Michigan Department of State Highways follows the highway maintenance and construction site protection standards contained in Part II, Construction and Maintenance, of the Michigan Manual of Uniform Traffic Control Devices[3], this

(3) Michigan Manual of Uniform Traffic Control Devices, 1963 Edition, Revision 2, August, 1967. Prepared by Michigan State Highway Commission and Michigan Department of State Police.

study was limited to maintenance standards and construction area practices followed by counties and cities in Michigan.

Study Procedures

In order to determine present policies and practices, it was necessary to develop separate questionnaires for county road commissions and city public works departments because of certain differences between construction site problems in urban and rural areas (mainly relating to average daily traffic volumes on particular types of roadways).

Because no single pattern of traffic alignment, operating speed, or sequence of signs or control devices can be established to effectively satisfy all the diverse situations involving work on the roadway or roadside, a wide range of requirements must be considered for application to particular locations--ranging from a simple warning sign on low-volume, low-speed roads and streets to extensive traffic guidance systems and illuminated barricades on high-volume arterial routes and freeways.

For these reasons, the questionnaires developed for both county and city government agencies were designed to seek

narrative answers to 7 inquiries relating to construction area traffic control, and 10 inquiries relative to roadway and roadside maintenance.

In addition, it was deemed desirable to interview many individuals within county road commissions and city public works departments, as well as within the Michigan Department of State Highways, Michigan Department of State Police, County Road Association, Michigan Municipal Association, and other organizations which have first-hand knowledge of both the problems and practices of local highway agencies. This was helpful in gaining better insight into the effectiveness of current practices and in developing recommendations for legislative and administrative programs where the findings indicated they were needed.

It is hoped that the conclusions of this report will provide guidance for overcoming existing obstacles to maximum effectiveness in both city and county highway safety activities, in the areas of highway maintenance, and in protection of passing motorists as well as highway workers from accident involvement at highway construction and maintenance sites.

Acknowledgements

We wish to acknowledge the assistance of the numerous county and city officials who were willing to spend their time and effort in filling out the detailed questionnaires, and who in many instances were called upon to supplement their written material by answering additional questions during personal interviews. Their help was very critical to completion of the report; without their assistance it would have been very difficult, if not impossible, to acquire much of the data upon which this study is based. The counties and cities which provided this essential information, through their respective officials, are listed in Table 4, Page 32.

Acknowledgement is also due the following individuals, whose suggestions, comments, and assistance in evaluation of the questionnaire answers, contributed greatly to a better insight into both the problems involved in administration of the programs covered in this study and the appraisal of current policies and practices:

NAME	POSITION	AGENCY
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William G. Davis	Manager, State Affairs Division	Michigan Municipal League
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Harold H. Cooper	Engineer of Traffic and Safety	Michigan Department of State Highways
Arthur H. Wiley	Supervisor, Construction Permits	Michigan Department of State Highways
Lt. Bryce Gray	Ass't Commanding Officer, Safety & Traffic Division	Michigan Department of State Police
Russell E. Harrison	Engineer of Traffic and Safety	Wayne County Road Commission

Chapter 2

REFERENCE REVIEW AND RECOMMENDED PRACTICES

As an initial step in development of questionnaire forms for this study, a review was made of pertinent recommended practices in highway maintenance, construction site protection, training of maintenance personnel, and identification and correction of hazards within highway rights-of-way.

Reference Review

In addition to Part II of the Michigan Manual of Uniform Traffic Control Devices (Traffic Controls for Highway, Utility and Other Construction and Maintenance Operations), all pertinent references contained in Highway Safety Program Manual Vol. 12 were reviewed to determine recommended standards and practices of the American Association of State Highway Officials, the Institute of Traffic Engineers, and other national organizations.

Included in this review were:

1. Highway Design and Operational Practices Related to Highway Safety (1967). American Association of State Highway Officials, 341 National Press Building, Washington, D. C. 20004.

2. Handbook of Safe Highway Design and Operating Practices (1968). Federal Highway Administration, Washington, D.C. 20591.

3. Manual on Uniform Traffic Control Devices for Streets and Highways (1961). Superintendent of Documents, U. S. Goverment Printing Office, Washington, D. C. 20402. (NOTE: At the time this report was in preparation, a new edition of this manual was being printed.)

4. Location, Selection and Maintenance of Highway Guardrails and Median Barriers (1964). NCHRP Report No. 54, Highway Research Board, 2101 Constitution Avenue, Washington, D. C. 20418.

5. Measuring Road Surface Slipperiness. Special Technical Publication No. 366, American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pa. 19103.

6. Tentative Method of Test for Skid Resistance of Highway Pavements Using a Two-Wheel Trailer. American Society for Testing and Materials, Standard E274-65T.

7. Tentative Skid Resistance Requirements for Main Rural Highways (1967). NCHRP Report No. 37, Highway Research Board.

8. The following Highway Safety Program Manuals:

   Vol. 9: Identification and Surveillance of Accident Locations

   Vol. 13: Traffic Control Devices

   Vol. 14: Pedestrian Safety

   Vol. 16: Debris Hazard Control and Cleanup

Construction Site Protection

Part II of the Michigan Manual of Uniform Traffic Control Devices sets forth basic principles and prescribes certain standards to be followed in the design, application, installation, and

maintenance of all types of traffic control devices required for highway construction and maintenance operations, on or adjacent to the traveled way.

These requirements apply not only to highway maintenance crews, but also to private contractors engaged in construction or maintenance operations for highway agencies or public utility companies, as well as to work crews directly employed by utility companies.

The traffic control devices are of four types:

1. Warning Signs: For minor construction or maintenance operations requiring 15 minutes or less, the work vehicle itself, provided with high-visibility color or reflecting markings plus flashing lights, is usually sufficient. For all other operations, special signs are required--which must be reflectorized if used in hours of darkness.

The recommended spacing, number and height of warning signs for various road situations are listed in the manual. When a road or traffic lane is closed to traffic, two kinds of barricades (Class I and II) are specified for particular types of roads. These must be reflectorized. If used in hours of darkness,

barricades must be provided with red danger lights, operating from one hour before sunset to one hour after sunrise.

2. Auxiliary Barriers and Channelizing Devices: These include flexible traffic cones, barrels, and barrels with temporary guardrail or fencing attached. Barrels should be marked with at least two horizontal circumferential reflectorized white stripes. Such channelization devices are recommended as temporary supplements to other traffic controls, to guide motorists into necessary lane changes upon approaching construction or maintenance sites.

3. Lighting Devices: Portable lighting devices--torches, lanterns, and flashers--are required by the Michigan Department of State Highways as advance warning installations on state trunklines when traffic lanes are closed, or traffic is detoured, during construction or maintenance operations, and are covered under the Standard Specifications of Road and Bridge Construction issued by the Department. They also are recommended for daytime work operations on main county roads and city streets, and are mandatory when road or street lanes are closed at night.

Overhead barricade beacons are specified when traffic must be diverted from its normal path into a curving path that calls for reducing speed for a safe turn. They are recommended when the difference between the 85th percentile speed of approaching traffic, and the safe curve speed of the temporary road, is 15 to 25 miles per hour, and when the ADT (Average Daily Traffic Volume) is greater than 1,500 vehicles.

4. Traffic Regulators: These are individuals charged with responsibility for controlling traffic through a highway maintenance or construction site. The Michigan Manual specifies that such persons must wear a high-visibility safety vest of a particular design, and shall carry a sign containing the words "STOP" or "SLOW"--depending on traffic control requirements at the site. The Michigan Department of State Highways has a special publication, Instructions for Traffic Regulators, available, upon request, to all highway agencies in the state, as well as public utility companies that do work on public roadways.

Maintenance Standards

In order to provide for safe and efficient movement of traffic, it is essential that all aspects of the road and

right-of-way be maintained in proper condition when opened to traffic. Recommended basic maintenance standards of AASHO, the Federal Highway Administration and the Michigan Department of State Highways were reviewed in order to evaluate current practices of county and city highway agencies.

The Highway Safety Program Manual, Vol. 12, lists the following elements as necessary for an effective maintenance program:

1. Regular clearing of debris from pavement surfaces and road shoulders, and triming of vegetation to provide clear sight distances and traversable driver-control recovery areas.

2. Pavement surfaces and shoulders should be maintained on a regularly scheduled basis to prevent hazards created by deterioration of road surfaces, erosion of shoulders, edge dropoffs, etc.

3. Emergency procedures for debris removal and roadway repair required by damage caused by traffic accidents or storms.

4. A plan of operation for repair of crash-damanged highway safety features, and for making temporary repairs on an

emergency basis to damaged highway features that may create a hazard to the traveling public.

5. Improper parking of work vehicles or equipment in a position exposed to out-of-control vehicles, inadequate or missing traffic control and protective devices, and other deficiencies, should be corrected immediately.

6. There should be a systematic plan or schedule for preventive maintenance of highway appurtenances, such as traffic control devices, highway lighting, guardrails, and other safety devices. (Pertinent information is contained in Highway Safety Program Manual, Vol. 13, Traffic Control Devices.)

7. A manual on maintenance operations should be developed to aid such operations at all levels of government. Appropriate sections of the Manual on Uniform Traffic Control Devices for Streets and Highways should be used as a guide in developing this material.

8. The maintenance program should include provisions to remove all signs, markings and other control devices when they are no longer needed. This is mandatory in order to create and maintain respect for traffic control devices that are necessary for safe operations.

9. There should be an established procedure for notifying the public, and maintenance personnel, of the possibility of weather conditions which may create adverse road conditions, and for alerting and assembling snow removal forces.

10. There should be a plan for coordinated snow removal and application of corrective materials on continuous road systems between adjacent jurisdictions. The plan also should establish priority routes for snow removal to ensure that the more important roadways are safe for traffic as soon as possible.

11. There should be continuing inspection of the road system for detection of unsafe conditions, and a procedure for dispatching equipment to hazardous locations on a priority basis. Surveillance operations should be active not only during actual snow or ice storms but also immediately after roads are cleared, to detect unforeseen hazards--such as patches of ice on the roadway.

12. There should be a method of advising motorists, and of correcting road surfaces known to be hazardous, before normal roadway conditions deteriorate. An example of a potential hazard would be pavement surfaces on structures. In addition to warnings,

these locations should be given special attention by snow operation personnel to minimize the danger to the travelling public.

Identification of Hazards

Standard 12 lists a number of guidelines for identification of hazards within or near the roadway, and for corrective action to eliminate the hazards or minimize the severity of crashes. Special emphasis is placed on problems involving out-of-control vehicles which strike roadside obstructions.

Highway Appurtenances - Careful documentation and analysis of crash-damaged highway appurtenances should be a feature of any maintenance program. Fixed objects struck by vehicles should be studied to determine if they can be relocated or redesigned to reduce both crash frequency and severity.

Highway appurtenances which are repeatedly damaged by vehicles should not be repaired without corrective action to reduce both the hazard to the road user and frequency of maintenance.

An analysis should be made of every fixed object involved in a collision to determine (a) whether it is needed, (b) whether

it can be put in a better location, (c) whether its energy-absorption properties upon impact can be improved by breakaway or yielding provisions, or (d) whether guardrails or energy-absorbing barriers can be installed in a manner that will minimize crash severity.

Roadside Obstacles - Roadsides should be clear of obstacles that could be struck by out-of-control vehicles. It is recommended by AASHO that all rural roadsides (both new and old) be clear of obstructions for a distance of at least 30 feet from the edge of the pavement, and that driver-control recovery areas should have gentle slopes which can be safely negotiated--with ditch sections fully rounded and having gentle side slopes.

Guardrail installations should have the ability to gradually decelerate a vehicle striking them, reduce the possibility of rebound, and allow the vehicle to continue along the rail at a decreasing velocity. Approach ends of guardrails should be designed in a manner so as to minimize hazards to motorists, while retaining the structural integrity of the installation.

A number of conditions along the roadside--such as a bridge parapet nosing, a heavy sign support, bridge piers, and signal or lighting supports--present serious hazards to an out-of-control vehicle. When such installations cannot be relocated, several types of impact attenuation devices are available to reduce the force of gravity due to sudden deceleration. One of the most effective ways is the use of sand-filled plastic barrels.

Roadway Lighting - Standard 12 lists three methods of identifying hazardous night-driving locations where provision of, or upgrading of, roadway lighting often can bring about significant reduction in accidents. The three identification methods are:

1. Streets and roads where the ratio of night-to-day crashes is more than 1.5 times the night-to-day ratios of similar locations. "Similar locations" as defined here are those with comparable traffic volumes, traffic speeds, access control, highway geometrics, adjacent land use, and ambient nighttime light levels.

2. In urban areas, locations where over 30 per cent of nighttime crashes involve injuries or fatalities.

3. In rural areas, locations where over 50 per cent of nighttime crashes involve injuries or fatalities. (This last rating method is meaningful only for locations which have a relatively high nighttime crash experience).

Pavement Skid Resistance - Standard 12 states that each highway agency should have a program for resurfacing or other surface treatments to correct street and highway locations where inadequate skid resistance contributes to high accident rates (particularly on curves and at intersection approaches).

Because skid resistance of pavement deteriorates with use, a systematic plan is needed for checking it periodically at problem locations--particularly where the pavement is constructed of materials know to wear rapidly. Criteria for identifying problem locations are (a) high accident experience and (b) repeated indications of excessive skidding.

Any method of determining skid resistance is satisfactory if it produces reliable results that can be correlated with standard skid-trailer tests. Road surfaces with a skid resistance value less than the interim skid numbers listed in Tables 1 and 2 should be analyzed for corrective treatment.

Table 1

RECOMMENDED MINIMUM INTERIM SKID NUMBERS[1]

MEAN TRAFFIC SPEED, V (MPH)	SKID NUMBER	
	SN[2]	SN 40[3]
0	60	-
10	50	-
20	40	-
30	36	31
40	33	33
50	32	37
60	31	41
70	31	46
80	31	51

(1) Skid numbers measured in accordance with ASTM E-274 Method of Test.
(2) SN = skid number, measured by mean traffic speeds.
(3) SN 40 = skid number, measured by 40 mph, including allowance for the skid number reduction with speed, using a mean gradient of G = 0.5.

SOURCE: Highway Safety Program Manual, Vol. 12

Table 2

RECOMMENDED MINIMUM INTERIM SKID-RESISTANCE REQUIREMENTS FOR STOPPING DISTANCE, CARS AND PORTABLE TESTERS(1)

MEAN TRAFFIC SPEED V (MPH)	SKID NUMBER(2) SN 40	STOPPING DISTANCE NUMBER(3) SDN 40	BRITISH PENDULUM NUMBER(4) BPN	DRAG TESTER NUMBER(5) DTN
30	31	39	50	35
40	33	41	55	40
50	37	46	60	45
60	41	51	65	50
70	46	57	-	-
80	51	64	-	-

(1) Derived from skid numbers of Table 1. All values based on use of ASTM E-249 rubber.
(2) Measured at 40 mph in accordance with ASTM E-274 Method of Test.
(3) Measured in accordance with current practice (ASTM Method of Test in preparation).
(4) Measured in accordance with ASTM E-303 Method of Test.
(5) Measured in accordance with manufacturer's recommended test procedure.

SOURCE: Highway Safety Program Manual, Vol. 12.

New pavement should be designed to maintain skid numbers well above those given in Tables 1 and 2. Records of the coefficient of skid resistance for new pavement surfaces, and periodic additional tests, will assist the roadway designer in determining which design mixes and construction procedures produce high skid resistance qualities.(4)

Training of Personnel

Standard 12 recommends that training programs be established for all personnel with responsibilities in highway maintenance and construction site protection, with emphasis on those safety fundamentals that bear directly on their specific work. Elements of the recommended program include:

1. Office personnel should be trained to include safety principles in all phases of planning and design--with particular stress on materials and techniques which result in pavements with high skid resistant qualities.

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(4) The skid number is defined as 100 times (100x) the coefficient of friction of a tire sliding on wet pavement when tested at 40 mph with a two-wheel skid trailer or equivalent device, following procedures outlined in ASTM E274-65T. See also NCHRP Report No. 37. Both reports referenced on Page 12 of this chapter.

2. All field personnel should be able to identify hazards not recognized during the design phase but which become obvious during the course of construction and maintenance--such as the location and condition of utility poles, control devices, drainage structures, roadway slopes, and shoulders.

3. Field personnel also should be trained in use of equipment for identifying pavements with low skid resistance, and should know how to initiate action for elimination of all hazards they identify.

4. Films depicting clear roadside concepts and the dynamic characteristics of vehicles striking guardrails have been prepared by several organizations. Field personnel should have an opportunity to view illustrations of all facets of clear roadsides, breakaway post features, guardrail design, and other crash survivability techniques.

5. Personnel education in safety may be conducted in any accepted method, ranging from formal courses to on-the-job training.

6. States are encouraged to assist local highway agencies in meeting the training requirements by making instruction available

to employees of local agencies or by assisting local officials in organizing their own training programs.

7. All highway field personnel should be trained to summon aid in emergency situations. Because maintenance forces often are the first to appear at an accident scene, they can materially assist by summoning police, medical aid, and other equipment. They should, therefore, be trained in summoning aid of all kinds, placing protective devices at the scene, assisting in the extraction of injured persons, and advising on the best route to emergency medical facilities.

8. First aid training is encouraged, particularly for maintenance personnel in remote areas.

9. States and local agencies should make sure that employees of contractors have been trained in correct use of signs, barricades and other traffic warning devices at construction and maintenance locations, and that this training is applied to work in progress.

Chapter 3

QUESTIONNAIRES

Following review of current recommended practices on highway maintenance, construction site protection, training of maintenance personnel, and identification and correction of hazards within the highway right-of-way, as discussed in Chapter 2, a questionnaire was developed for submission to county road commissions in Michigan, containing 7 inquiries relative to construction area traffic control and 10 inquiries relative to roadway and roadside maintenance.

A slightly modified questionnaire was prepared for submission to city public works departments. Both questionnaires solicited narrative answers rather than numerical values, since the purpose was to obtain information on operating procedures in dealing with a wide range of requirements in particular localities.

Mailing and Follow-Up

The questionnaires were mailed on October 9, 1970, to the 83 county road commissions and to 114 cities of over 5,000 population. A cover letter explained the purpose of the inquiry, and a three-page attachment provided a general description of the contents of the questionnaire.

The letter explained that the questionnaire represented a continuation of the previous study on the Highway Design Standard phases of Highway Safety Standard 12, on which reports had been submitted by 71 counties and 73 cities, and that cooperation in filling out and returning the new questionnaire would make possible development of information and recommendations on important safety aspects of the highway environment about which little meaningful data had been compiled previously.

A follow-up letter was sent December 7, 1970, to those counties and cities which had then not yet responded to the first request. The result was that reports were received from 65 per cent of agencies contacted (Table 3).

Table 3

REPORT COVERAGE

TYPE AGENCY	NUMBER OF AGENCIES Contacted	Reporting	COVERAGE (per cent)
Counties	83	70	84
Cities	114	59	52
TOTAL	197	129	65

Follow-up contacts were made with approximately 25 of the local highway agencies, to obtain certain information missing from their written answers, to seek clarification of answers containing incomplete or unclear information, or to request further explanation for replies given to particular questions.

Processing of Replies

Although a total of only 17 questions were listed in the county and city questionnaires, the majority of questions actually had two or more parts, with the result that a total of 36 inquiries were made of county road commissions and 39 of city public works departments.

Summaries covering the replies of each of the 70 counties and 59 cities reporting were computed and analyzed. In addition, notations were made of significant comments made by particular reporting agencies, or when references were made to special published materials issued by a city or county agency. The special notations became the basis for follow-up interviews, in person or by telephone, to obtain copies of published materials or to develop more insight into the problems and practices of the particular agencies.

All reporting counties and cities were then classified (Table 4) into five groups, based on their total 1969 expenditures for road or street construction, maintenance and administration.

Group I represents agencies with $5 million or more in yearly expenditures; Group II, from $2 million to less than $5 million; Group III, $1 million to less than $2 million; Group IV, $500,000 to less than $1 million; Group V, under $500,000.

These classifications permitted comparisons between practices in cities and counties with large highway construction and maintenance budgets and those with lesser budgets.

From these tabulations and follow-up discussions, the summaries of existing practices (Chapters 4 and 5) were developed, along with Study Findings (Chapter 6) and Recommendations (Chapter 7) for strengthening current safety practices in Michigan counties and cities relative to highway maintenance, and traffic protection at construction and maintenance work locations.

Table 4

YEARLY HIGHWAY EXPENDITURES OF REPORTING COUNTIES AND CITIES

GROUP I
(Over $5 Million)

Counties

- Genesee
- Kent
- Macomb
- Oakland
- Wayne

Cities

- Detroit
- Flint
- Grand Rapids

GROUP II
($2-$5 Million)

Counties

- Allegan
- Bay
- Huron
- Ingham
- Jackson
- Kalamazoo
- Monroe
- Muskegon
- Ottawa
- Saginaw
- St. Clair
- Washtenaw

Cities

- Dearborn
- Dearborn Hts.
- Kalamazoo
- Lansing
- Saginaw

GROUP III
($1-$2 Million)

Counties

- Alpena
- Barry
- Branch
- Cass
- Clinton
- Gratiot
- Hillsdale
- Houghton
- Ionia
- Isabella
- Lapeer
- Lenawee
- Livingston
- Marquette
- Midland
- Ontonagon
- Sanilac
- Shiwassee
- St. Joseph
- Tuscola
- Van Buren

Cities

- Alma
- Battle Creek
- East Lansing
- Midland
- Sterling Hts.

GROUP IV
($500,000-$1 Million)

Counties

- Alcona
- Antrim
- Arenac
- Baraga
- Charlevoix
- Cheboygan
- Dickinson
- Emmett
- Gogebic
- Grand Traverse
- Iron
- Kalkaska
- Lake
- Leelanau
- Mackinac
- Manistee
- Mason
- Mecosta
- Missaukee
- Oceana
- Ogemaw
- Otsego
- Presque Isle
- Roscommon
- Wexford

Cities

- Bay City
- Birmingham
- East Detroit
- Ferndale
- Holland
- Ludington
- Muskegon Hts.
- Madison Hts.
- Mt. Clemens
- Oak Park
- Portage
- Sault Ste. Marie
- Wayne

GROUP V
(Below $500,000)

Counties

- Alger
- Benzie
- Crawford
- Keweenaw
- Montmorcey
- Oscoda
- Schoolcraft

Cities

- Albion
- Allegan
- Beverly Hills
- Big Rapids
- Bloomfield Hills
- Cadillac
- Centerline
- Charlotte
- Coldwater
- Escanaba
- E. Grand Rapids
- Ecorse
- Grosse Pt. Park
- Greenville
- Grand Haven
- Hastings
- Houghton
- Gladstone
- Hamtramck
- Hillsdale
- Iron Mountain
- Ishpeming
- Ionia
- Kingsford
- Kentwood
- Lapeer
- Negaunee
- Riverview
- Rochester
- River Rouge
- Sturgis
- South Haven
- St. Joseph

Chapter 4

COUNTY REPORTS

In the previous report on Michigan highway agencies' standards and practices relative to highway design standards contained in Standard 12 of the National Highway Safety Standards, referenced in Chapter 1 of this report, the following observation was made:

"Evaluation of design standards is not a mechanical process. Some items have greater importance than others; some vary in importance depending upon other considerations. There is disagreement among professionals as to the extent that various geometric items affect accidents."

This comment applies with even greater force to evaluation of county and city practices relative to the safety maintenance and construction site protection phases of Standard 12.

County Road Systems

The 83 county road commissions in Michigan have the responsibility for maintaining and improving 87,725 miles of roads and streets, which account for 77 per cent of the State's total highway network.

Except for state trunklines, all rural roads are under the jurisdiction of the county road agencies. In addition, over 900 miles of city and village streets (generally streets with high traffic volumes) come under the jurisdiction of county road agencies. In some counties, maintenance work on state trunklines also is done by the county road agency, under contract with the Michigan Department of State Highways.

County road systems are of two types, primary and local. The primary systems total 25,281 miles, or 29 per cent of all county roads. These are major routes which interconnect cities and villages, and which also carry relatively high traffic volumes to and from the state trunkline system.

The remaining 62,444 miles of county roads, on the local systems, carry low traffic volumes and serve mainly a land-access function. A breakdown of mileage of county road systems and rural state trunklines is given in Table 5.

Table 5

MICHIGAN COUNTY ROAD AND RURAL TRUNKLINE MILEAGE

COUNTY PRIMARY		COUNTY LOCAL		TOTAL	RURAL	
Rural	Urban	Rural	Urban	COUNTY	TRUNKLINES	TOTAL
24,502	779	62,317	127	87,725	7,953	95,678

While the statewide average for county road systems is just over 1,000 miles, actual county road mileages range from a low of 175 in Keweenaw County to a high of 2,166 miles in Oakland County.

Total population served ranges from little more than 2,000 people in some counties to 2.6 million residents in Wayne County. Yearly county road commission budgets, for construction, maintenance, engineering, administration, and debt service, range from little more than $200,000 in some counties to over $26 million in Wayne County.

General

Given the wide variations in problems of highway maintenance and construction operations, from sparsely settled counties with low traffic volumes to highly industrialized counties with large population concentrations, differences in operating standards and practices must be expected.

Within the great majority of counties, standards and practices in the activity areas under study are seldom formalized. They have evolved on a basis of practical experience in dealing with particular local requirements.

In view of the operating budget limitations within which these highway agencies must work, and the extensive road mileages over which the typical county road commission has jurisdiction, decentralized responsibility and considerable operational latitude for district supervisory personnel often are essential to an effective and prompt response to local problems.

Construction Area Traffic Control

One of the most hazardous highway environments is the construction or repair location at which traffic operations are maintained. These work areas create conditions affecting the normal pattern of traffic flow, thereby increasing the possibility of confusion or mishap by drivers.

Accordingly, these sites merit the maximum possible protection and treatment. Accident risks increase substantially if the construction or repair work must continue into nighttime hours, or if one or more traffic lanes must be blocked overnight during the operation.

To ensure maximum safety to both highway users and highway workers, it is essential that all roadway facilities (from high-speed, high-volume arterial routes to minor subdivision

streets) be adequately protected in administration of construction and repair site programs. The same requirement applies not only to major construction and repair projects but also to such daily routine activities as roadside maintenance and public utility operations.

Michigan Statutory Requirements

The Michigan Motor Vehicle Code (Section 608, Act 300, Public Acts of 1949, as amended) makes it mandatory that the provisions of the Michigan Manual of Uniform Traffic Control Devices be applied to all traffic control devices installed or otherwise used on all public highways, roads, and streets within the state.

Part II of the manual applies specifically to traffic warning signs, lights, and barricades to be installed at roadway construction or maintenance work sites.

The provisions are, by state law, applicable not only to state and local highway agencies, but also to private contractors and public utility companies doing any type of construction or repair work within the public right-of-way of streets or highways, including roadsides.

Figure 1 is the permit form used by the Michigan Department of State Highways in authorizing construction or maintenance work within rights-of-way of state trunklines. Figure 2 shows the Construction Signing Handbook listing traffic-protective devices and practices that must be applied. These requirements apply to private contractors doing work for the department, to county road commission employees doing maintenance work on state trunklines, and to public utility companies.

Construction Site Practices of Counties

Following are the seven inquiries listed in Part I of the questionnaire sent to county road commissions, all pertaining to Construction Area Traffic Control, and a summary of replies received:

> Question 1: Do you have a manual or published instructions that serves as a guide to requirements for the control of traffic through construction or repair sites?

Of the 70 jurisdictions responding to the questionnaire, only two declared that they have supplemental published instructions other than the Michigan Manual on Uniform Traffic Control Devices. One other county is in the process of writing supplemental instructions.

Form 409 (Rev. 3/68)

MICHIGAN STATE HIGHWAY COMMISSION

APPLICATION AND PERMIT TO CONSTRUCT, OPERATE, USE AND/OR MAINTAIN WITHIN THE RIGHT-OF-WAY; OR TO CLOSE A STATE TRUNKLINE

DO NOT WRITE IN THIS BOX
Application No.
Permit No.
Date of Issuance

If a contractor is to perform the construction entailed in this application and permit, and is supplying the bond, he will fill out the information block provided, and thereby assumes responsibility, along with the applicant, for any provisions of this application and permit which apply to him.

Applicant's Name (Property Owner, Corp., City, County, Etc.) (Date)	Contractor's Name (Individual, Company, Etc.) (Date)
Applicant's Mailing Address	Contractor's Mailing Address
Applicant's Phone No.	Tel. No.
Applicant's Signature (If other than Property Owner give Title)	Contractor's Signature (If signing for Contractor, give Title)

The above named applicant hereby makes application for a permit to Construct, Operate, Use and/or Maintain; or Close a State Trunkline within the right-of-way of _____ ; the exact location is as follows: _____ ;

(Trunkline No.) (City) (Township) (County)

(Give distance and direction from nearest main intersection, and Station numbers if known.)

for a period commencing _____ and ending _____ ; a detailed description of the desired facility and/or activity is as follows: (Include size, length, type of facility. If crossing under roadbed, describe method. If buried, indicate depth from top of facility to surface. If facility to run parallel to highway, indicate distance from facility to Pavement Edge and Right-of-Way Line. If driveway approach, state if Residential or Commercial; if Commercial, state type of establishment it will service. If Tree Trimming or Tree Removal, state number, species and sizes of trees involved. If application for Banner, state Legend)

_____

_____

_____

_____

The above stated intentions will be carried out in the manner applied for and in accordance with plans, specifications, map and statements filed with the State Highway Commission as part of this application, and if said permit is granted, the above named applicant agrees to do the following:

1. Give written notice to the District Utility Engineer of the Michigan Department of State Highways for the District in which said work is to be performed at least five (5) days prior to commencement of operations covered by this permit.
2. In any and all operations under this permit, meet all requirements of the Michigan State Highway Commission Standard Specifications and Supplemental Specifications set forth on the reverse side of this application and permit.
3. Take, provide and maintain all necessary precautions to prevent injury or damage to persons and property from operations covered by this permit and use safety devices which are in accordance with the Michigan Manual of Uniform Traffic Control Devices.
4. Save harmless the Michigan State Highway Commission against any and all claims for damages arising from operations covered by this permit and upon request, furnish proof of insurance coverage for the term of this permit.
5. Surrender the permit herein applied for, cease operations, and surrender all rights thereunder whenever notified to do so by the State Highway Commission because of its need for the area covered by the permit or because of a default in any of the conditions of the permit.
6. Nothing in this permit shall be construed to grant any rights whatsoever to any public utilities whatsoever except as to the consent herein specifically given, nor to impair anywise any existing rights granted in accordance with the constitution or laws of this State.
7. Immediately remove, alter, relocate at applicant's own expense the facility for which this permit is granted, if requested by the Michigan State Highway Commission to do so. Upon failure to remove, alter, relocate or surrender the facility pursuant to the request of the Michigan Department of State Highways, reimburse the Michigan Department of State Highways for its cost in doing same.
8. Upon request, the applicant, if other than a governmental agency, or the contractor when the applicant is a governmental agency, shall file a bond in the sum of _____ acceptable to the Michigan State Highway Commission and conditioned upon performance of the conditions of the permit and compliance with all requirements of law.
9. Any operation in the right of way not covered by this permit and attachments thereto, or the Michigan Department of State Highways Standard Specifications is in violation unless approved by the District Utility Engineer.
10. (SEE REVERSE SIDE OF THIS APPLICATION AND PERMIT FOR ANY ADDITIONAL CONDITIONS.)

A permit as requested in the foregoing application subject to the conditions to which applicant therein agrees, is hereby granted for the period commencing _____ and ending _____ . The period applied for and granted in this application and permit covers activity within the right-of-way. The obligation to operate, use and/or maintain the facility to the satisfaction of the Michigan State Highway Commission remains in force as long as the facility exists and is within an area under the jurisdiction of the Commission.

RECOMMENDED FOR ISSUANCE:

(County or Municipality) (Date)

(Date)

(Date)

(District Utility Engineer) (Date)

Reviewed by	Appr.	Disapproved
Constr.		
Maint		
Traffic		
Design		
Trans. Plan		

APPROVED BY
MICHIGAN STATE HIGHWAY COMMISSION

_____
State Highway Engineer

NOTE: This permit does not relieve applicant from meeting any applicable requirements of law or of other public bodies or agencies.

FIGURE 1

FRONT OF WORK PERMIT FORM

STATE OF MICHIGAN

ADDITIONAL CONDITIONS
10. (Continued from other side)

Form 409-R
(Rev. 3/68)

SUPPLEMENTAL SPECIFICATIONS;

1. *Maintenance of Utility Facilities* – To construct and service utility crossings of limited access highways, access for the utility's service vehicles may be from county roads, service roads, and openings provided in limited access right of way fences.

   Utility vehicles will not operate within a distance of 30 feet from the edge of the pavement of roadways or ramps on limited access highways. At locations where utility installations have been approved in medians having a width greater than 80 feet, ingress and egress will be by such routes as specified by the State Highway Engineer.

   Normally, no maintenance of utility facilities will be permitted with access from the main roadways or ramps of limited access highways. In time of disaster or emergency, or when utility lines or facilities are so damaged as to constitute a danger to the life or property of the public, access to the same may be had by the most expeditious route and the work is to be done in a manner which will provide the traveling public with maximum possible safety. Notice of such situation shall be given to the nearest police authority and the State Highway Engineer of the Highway Commission as soon as can reasonably be done under the circumstances. The surfaced area of the right of way may be used to approach the distressed lines or facilities and the surfaced shoulder may be used for temporary parking, provided all reasonable provisions for the safety of the general traveling public are made.
2. *Permit* – The foreman in charge of the work shall have the permit and the approved plans or sketches in his possession on the job at all times.
3. *Inspection* – In all cases the applicant shall notify the District Utility Engineer when the work will commence so, if necessary, arrangements may be made to have an inspector present while the work is in progress. The applicant will be billed for the necessary expense of the inspector.
4. *Excavation and Disposal of Excavated Material*—The Contractor and/or the Utility Company shall provide and place the necessary sheeting, shoring and bracing required to prevent caving, loss or settlement of foundation material supporting the pavement, or any other highway installation such as sewers, culverts, etc. The Contractor and/or Utility Co. shall assume the full responsibility for this protection and shall not proceed in these areas before approval of methods by the Utility Engineer.

   Excavated material shall be stocked in such locations that it does not obstruct vision on the traveled portion of the highway and in such a manner that it will not interfere with the flow of traffic. Sod and top soil shall be stocked separately from other excavated material. The applicant shall dispose of all surplus and unsuitable material outside of the limits of the highway unless the permit provides for disposal at approved locations within the right of way. In the latter case, the material shall be leveled and trimmed in an approved manner.
5. *Backfilling and Compacting Backfill* – All trenches, holes, and pits shall be filled with sound earth or with sand-gravel if so provided, placed in successive layers not more than 9 inches in depth, loose measure, and each layer shall be thoroughly compacted by tamping and all backfill compaction will be subject to check by the Controlled Density Method. Restoration shall be such that it will provide a condition equal to or better than the original condition and in accordance with Michigan Department of State Highways Standard Specifications.

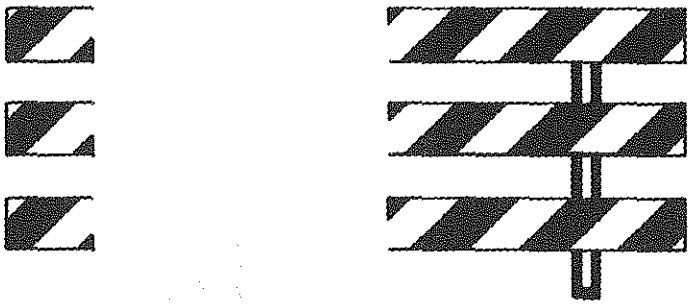
   Sand-gravel backfill material shall consist of approved bank-run sand or gravel or a mixture of approved sand or stone screenings with gravel or crushed stone, provided that there shall be a substantial excess of sand or stone screenings in the mixture. All of the material shall be of such size that it will pass through a screen having 2½ inch square openings, unless otherwise authorized.
6. *Crossing Roadbed by Tunneling or Boring and Jacking* – When the pipe is installed by Tunneling without cutting the existing pavement, all remaining voids around the installation shall be filled by a method approved by the District Utility Engineer. When the pipe is installed by Boring and Jacking, the leading edge of the pipe must always precede the Auger. Soil borings may be required at boring pit locations and the cost of these borings will be at the expense of the applicant.
7. *Crossing by Cutting Pavement and Trenching* – When this method is approved by the District Utility Engineer, the pavement shall be cut so that the opening is a minimum of 5' wide and at least 1' wider on each side than the trench. When applicable, Standard Plan For Utility Trenches (E-4-A-37) shall be used as a guide. In no case shall an open cut result in a remaining slab width of less than 5' from patch to an existing joint. The cut shall be made by sawing to a minimum depth of 5''. Cuts in concrete residential and commercial drives shall be as above except that the patch width shall be a minimum of 3' and the remaining slab from patch to existing joint to be a minimum of 3'. Backfill shall be made with sand-gravel as specified in paragraph 5. After the backfill has been placed by control density method and throughly compacted, the pavement shall be replaced with new pavement of the original type and quality, unless at a season of the year when it is not feasible to replace pavement in kind, in which case a temporary surface of bituminous material shall be placed, and later replaced with pavement of original type at the applicant's expense.
8. *Depth of Cover Material* – Pipes shall be placed to a depth that will provide not less than 4 feet of cover between the top of roadway surface and the pipe.
9. *Trees* – (a) When tree trimming or removal, secure permission from abutting property owner when required. (b) Dispose of all limbs, logs, stumps and litter in a manner acceptable to the District Forester. (c) Comply with any additional conditions deemed necessary to protect the interest of the Michigan Department of State Highways. (d) Tree roots shall be bored a distance of 1 foot for each 1 inch of trunk diameter for underground utility installations.

THE FOLLOWING MUST BE ATTACHED TO APPLICATION WHEN APPLICABLE: 1. Bond, except for residential driveways. 2. Plans, specifications and location of facility. 3. Copy of Resolution – for local units of government. 4. Traffic plan in cases of street closures.

BACK OF WORK PERMIT FORM

CONSTRUCTION
Signing

EDITION II



Issued by
Michigan Department of State Highways

FIGURE 2
COVER OF HIGHWAY CONSTRUCTION SIGN MANUAL
STATE OF MICHIGAN

The two counties which issue supplemental instructions use the Michigan Manual as a basis, but elaborate further, with detailed plans and roadway sketches for all construction or maintenance projects that involve blocking of traffic lanes. Both counties are in Group I, with yearly highway expenditures above $5 million.

Question 2: Do you follow Part II of the 1963 Michigan Manual on Uniform Traffic Control Devices, or do you supplement or adjust this to your own special requirements?

A total of 50 counties replied that they follow Part II of the manual. Sixteen counties replied that they make adjustments due to unusual local conditions--such as very low traffic volumes. Four counties indicated that they use no written rules and give verbal instructions to field personnel for each specific job.

While the four counties operating without written guides all are rural in character, with low population densities, three of the four counties are in Group IV, with yearly highway budgets in excess of $500,000. The fourth county is in Group V, with less than $500,000 in yearly road budget.

Special interviews with a number of county road commission supervisory personnel disclosed that many private contractors doing work within the rights-of-way of county roads do not always use proper warning signs and barricades.

In the words of one county official: "Every day we see violations of the Michigan Manual on Uniform Traffic Control Devices on the part of private contractors working on our county roads on public utility construction or repair projects.

"When we are unable to get these contractors to install the proper signs and other devices required by the Michigan Manual, we have attempted to persuade the State Police or the Sheriff's Department to issue traffic violation citations. However, the police tell us they consider this a 'gray area' in law enforcement and say they have no clear-out authority to issue tickets on the spot.

"By the time we go through the process of filing a formal complaint against the contractor, or revoking his permit to work on the roadway, he has generally completed his job and is no longer at the particular work location."

Question 3: What application of traffic control devices and measures (signs, signals, markings, cones, barricades, lighting, flagmen, etc.) is made to ensure protection of both the highway user and the highway worker on the approach to and throughout a construction or repair site on the following classifications of county roadways when traffic is maintained? If you have developed any special diagrammatic layouts of your traffic control requirements in typical situations, please attach copies. (The questionnaire specified separate answers for county primary and county local road systems).

For county primary systems, 45 counties replied that they follow the Michigan Manual. Four specified use of warning signs, barricades, and flagmen. The following five combinations, each used by three counties, also were specified: signs, barricades, and flagmen; signs and flagmen; signs and barricades; signs, barricades, cones, and flagmen; signs, barricades, flagmen, and flasher lights. Two counties use signs and flasher lights; two, signs only. One county uses flashers, flagmen, and barricades. Another uses only flashers.

Only two counties--both in the Group I expenditure class--submitted copies of special diagrammatic layouts for traffic control in typical construction or maintenance situations. Both indicated that detailed instructions and diagrams are developed for all but the most routine work projects (See Figure 3 for an example).

For county local roads, 41 jurisdictions indicated they follow the Michigan Manual, while 29 others indicated that they make adjustments because of low traffic volumes and low driving speeds. In some instances, local roads are closed to all but neighborhood traffic during repair work.

The following three combinations on local roads were listed by each of four counties: signs, barricades, and flashers; signs and barricades; signs, barricades, and flagmen. These four combinations are used also, each in three counties: barricades, cones, and flagmen; signs and flagmen; signs and flashers; signs only.

Two counties use barricades and flashers. One county specified barricades only; another, flashers only. One county listed signs, barricades, flashers, and flagmen, depending on route location.

> Question 4: What application is made of traffic control devices and measures to ensure pedestrian protection when a walking area (whether paved or natural earth) must be maintained throughout construction or repair sites? Please attach a copy of any special layouts you may have developed of pedestrian protection requirements in such situations.

Special facilities for pedestrian protection on county roads are not generally required, since most locations are in rural areas with virtually no pedestrian travel. A total of 49 counties replied that pedestrian facilities were not needed. Seven counties stated they follow the Michigan Manual (which, however, contains no material relating to pedestrian protection as such).

In 14 counties, all with heavily urban characteristics, some degree of special pedestrian protection was indicated. Replies included use of snow fence to separate pedestrians from construction areas; signs, barricades, and lighting, or "engineer determines protection as needed."

Two counties--both in the Group I budget class--submitted copies of special layouts developed for pedestrian protection at specific construction sites.

> Question 5: Is an inspection (day and night) made of construction and maintenance projects to assure conformance to the minimum traffic control requirements prescribed? If so, what is the frequency of such inspection and whose responsibility is it to make the inspection?

A total of 34 counties reported that inspection is made by road commission employees at construction and maintenance

sites both day and night, while 30 counties stated that inspection is made in daytime only. Six counties reported that no provision is made for such inspection, but three of these counties added that arrangements have been made with police to make periodic checks of the work locations.

Of the 64 counties reporting some type of inspection by road commission employees, 39 stated that this responsibility is placed on supervisory personnel, while 25 declared that the responsibility is given to any employee working in the area.

Of the five counties in the Group I expenditure class, two reported that only daytime inspections are made.

> Question 6: Do you regularly advise the law enforcement agency when construction or maintenance activities will result in a major interruption of the normal traffic pattern?

A total of 63 counties answered "yes" to this question. Of the seven counties replying in the negative, six are in the Group IV expenditure class, the other in Group III.

When inquiry was made of several of these counties to seek an explanation of their replies, they answered that their traffic volumes are relatively low and they have never found a

need to notify police agencies of road closings--particularly since these agencies generally are already aware of the construction or maintenance activities through their normal highway patrol routines.

> Question 7: Does your initial and refresher training program for personnel with construction and maintenance responsibilities provide sufficient instruction on safe performance of these activities with minimum hazard to themselves and passing traffic? Please attach a copy of your training program outline for construction and maintenance personnel. What is the normal frequency of your refresher training for such personnel?

A total of 36 counties reported that their employees receive sufficient instruction for safe performance of construction and maintenance operations, although only 18 counties indicated that such training involves more than verbal instructions at the time employees are hired.

A total of 33 counties stated they have no training program for employees, and one county reported that training is given only to employees who do maintenance work on state trunklines.

Of the 18 counties that reported periodic training courses for employees, 9 stated that such courses are given at irregular intervals. Four listed one-year intervals; two, one month; one,

three months; one, one year. The remaining county stated that construction employees are given training only at the time they are hired, while maintenance employees receive refresher training each six months.

Three counties stated that foremen are given refresher courses each month, and another county listed two-month intervals for foremen courses.

One county (Oakland) submitted a copy of an employee training outline which is the basis for a yearly refresher course. (See Appendix B). Another county reported it has completed a training manual and plans to use it in the future.

Of the five Group I counties, only one stated it now has more than "on-the-job" training.

Roadway and Roadside Maintenance

Highway Safety Program Standard 12 declares that an effective maintenance program must provide, on a systematic basis, for surveillance and corrective treatment of all safety-related aspects of pavement surface condition, highway appurtenances, and the adjacent roadside.

The following 10 questions were asked of county road commissions in Part II of the questionnaire, relative to maintenance practices:

> Question 1: Do you have a preventive maintenance program delineating minimum criteria, requirements, and procedures to be adhered to in assuring that the roadway and roadsides are maintained at a reasonable level of safety at all times? If so, please attach a copy.

A total of 39 counties reported that they have no formal program of preventive maintenance. Another 30 counties declared they rely on verbal instructions to employees regarding deficiencies to watch for. One county reported it is developing a preventive maintenance program. Two Group I counties reported no such program, and the other three stated they rely on verbal instructions to employees.

> Question 2: What is the scope, procedure and schedule of your plan for systematic surveillance and maintenance of both the roadway and roadside to identify and correct deficiencies or potentially hazardous conditions? Please describe briefly; or, if this plan has been specifically delineated in written instructions, please attach a copy.

A total of 61 counties replied that they rely on employees and supervisory personnel to watch for deficiencies and potential hazards during the course of their normal operations.

Three counties said that supervisory personnel check all roads once per month. One county reported two-week checks, and three counties reported weekly inspections.

One county reported it relies on reports from employees, police reports on accidents, and citizen complaints. Another stated it makes daily patrols of primary routes, and weekly patrols of local routes, to check for deficiencies or hazards.

> Question 3: What is the nature and frequency of inspection (day and night) of such traffic appurtenances (signs, signals, markings, lighting, guardrails, etc.) to insure that they are properly maintained in effective condition to fulfill their intended purpose or to determine that they are no longer required and should be removed? Whose responsibility is it to conduct such systematic inspections?

A total of 18 counties declared daily inspection is made by employees or supervisory personnel in their normal working operations. Another 25 counties listed inspection by employees and police without specifying any particular frequency.

Inspection by supervisory personnel, at no stated frequency, was listed by 20 counties. Four counties gave an inspection frequency of one to two weeks. Three counties listed a three-month frequency.

It is noteworthy that the five Group I counties--Genesee, Kent, Macomb, Oakland, and Wayne--all reported specific schedules of inspection by supervisory personnel, ranging from daily to a maximum of one-week inspection, and covering the entire road system.

> Question 4: Do you have a specific cooperative program with the law enforcement agencies whereby they regularly notify you of observed deficiencies in the safe condition of both the roadway and roadside, including appurtenances? If so, please describe briefly. If special forms have been developed for use of enforcement personnel in this regard, please attach a copy of such forms.

Formal arrangements for area law enforcement agencies to notify them of observed safety hazards were reported by 61 counties. The remaining nine counties indicated that such reports are made by police agencies without any formal arrangement. Two counties reported they receive written reports from law enforcement agencies, along with telephone notification in emergency situations.

> Question 5: Does your maintenance program provide for dry pavement winter maintenance of roadways? Please indicate the basic nature and priorities of your normal snow removal program.

Only 23 counties reported that they attempt to remove snow and ice from all roads and subdivision streets within their juris-

dictions. Five counties limit their operations to state trunklines, and 15 provide dry pavement maintenance only for state trunklines and county primary roads.

The remaining 27 counties have varying coverages--some including school bus routes, mail routes, "milk and feed" roads, fire and hospital routes, and other locally important routes.

Priority in snow removal and salting of icy roads generally is given to freeways, state trunklines, county primary and county local routes, and subdivision streets, in that order.

However, some counties give high priority to school bus routes, routes with high traffic volumes (such as those serving major employment centers), certain hills, curves, and railroad crossings which become hazardous when slippery, and fire and hospital routes. In all, a total of 52 types of routes or locations were listed in the priority schedules.

Especially in northern and Upper Peninsula counties which regularly experience heavy snowfalls, the general practice is to have snow removal crews permanently located at strategic points. Each crew is given a particular territory to service, and has wide latitude to use its judgment as to priorities--which are governed

by the nature and timing of the storm, personal knowledge of locations that are subject to heavy drifts or other special hazards, and knowledge of essential travel requirements of the local population.

> Question 6: Do you have a plan for coordination of snow removal activities with adjacent jurisdictions? If so, please attach a copy or describe briefly, including jurisdictions involved.

Only 20 of the 70 reporting counties indicated they have arrangements with adjoining counties, or with cities within the county, for cooperation on snow removal. In some cases, certain route mileages are "traded," with two or more jurisdictions each clearing a section of an adjoining road system. In other cases, one county takes over a portion of another jurisdiction's routes on a fee basis.

In all instances, the arrangements are made for greater efficiency and economy in routing and scheduling snow removal operations. Counties which do not have such cooperative plans indicate that there would be no advantage to be achieved in their particular cases.

> Question 7: Does your maintenance program include a plan for testing of pavement surfaces to identify, for

corrective treatment, roadway sections with inadequate skid resistance characteristics? If so, please describe briefly the criteria, nature, and frequency of the skid resistance check program and indicate types of corrective surface treatments that have been applied.

Only 13 of the 70 reporting counties indicated that they have a program to identify pavement skid resistance deficiencies. Of these, only six counties submitted any details on their programs.

Follow-up discussions with several county road engineers who had reported no programs in this field disclosed that their general attitude is that the normal pavement resurfacing cycle meets most of the problem, and that the time and cost involved in special testing programs for pavement skid resistance is better spent on other highway projects. It also is worth noting that only one of the five Group I counties (Macomb) has a regular program to identify and correct skid resistance deficiencies.

Of the six counties submitting information on their programs in this area, one merely stated that deficient sections are identified by accident records. Another county reported tests are conducted by independent testing companies, and corrective measures are applied by private contractors acquainted with proper procedures.

Two counties reported that slippery conditions were noted visually, through accident records, or through braking tests with automobiles. Four counties reported on corrective treatments, including: prime and seal the area with pea stone; heat asphalt to approximately 400 degrees and roll in a mixture of sand and fine stone; spot treat with non-paraffin-base kerosene and sand; apply kerosene or No. 1 fuel oil to cut the glaze, then mop up with sand.

Several counties reported adverse effects of studded tires on skid resistance qualities of pavements, particularly at intersection approaches where braking occur frequently. They declared that anti-skid pavement overlays are quickly "scrubbed off" by application of brakes on cars with studded tires, and that even concrete pavement develops vertical ruts up to 1.5-inch depths at heavy traffic intersections in areas where studded tires are widely used in winter. (Further discussion of studded tires is contained in Chapter 7).

> Question 8: Do you have a plan of emergency procedures for removal of debris and to repair damage caused by traffic accidents and storms? If so, please describe briefly.

A total of 50 counties reported they do have emergency procedures for removal of debris and repair of damage caused by

accidents and storms. Most of the 20 other reporting counties indicated they rely on police and the public to notify them of need for dispatching repair crews, and "do what is needed."

A number of counties report that emergency plans for major disasters, such as a tornado, have been developed through the county Civil Defense Office. Others report 24-hour two-way radio communications with repair crews, who are notified by police of any need for emergency work.

One county reports a county-wide emergency plan has been developed, involving utility companies, police agencies, and the road commission personnel. A "ready" room for central control operates on a 24-hour basis at the sheriff's office. Reports on minor damages are relayed to the road department dispatcher, who notifies the proper supervisor.

> Question 9: Do you have a program for the analysis and documentation, for corrective treatment, of crash-damaged highway appurtenances? If so, please describe briefly.

A total of 50 counties, of the 70 reporting, indicated they have no program for analysis of crash-damaged appurtenances (signs, signals, markings, lighting, guardrails, etc.) for the purpose of determining whether the damaged item should be re-

located, redesigned or given some other treatment to minimize the chance that it will be struck again.

However, a review of the replies of the 20 counties reporting that they do have such a program showed that only three actually have established procedures for studying the damaged item and determining whether something more than mere repair of the damage should be considered. Two of the three counties with such programs are in the Group I expenditure class.

> Question 10: What are your procedures for notifying the public and maintenance personnel of adverse weather that might create generally hazardous driving conditions, or of specific roadway locations requiring special early attention?

Of the 70 reporting counties, 16 listed use of two-way radio to notify employees of predicted adverse weather conditions, with the remainder relying on telephone communication. In 14 counties, local schools are given bad weather warning by the road commission, if schools are in session.

A total of 50 counties reported they notify local news media--radio, television, and newspapers--of expected hazardous driving conditions or of particular locations where special driving hazards exist.

Chapter 5

CITY REPORTS

The 538 incorporated cities and villages in Michigan have a total of 20,024 miles of streets. However, only 17,847 miles are under local jurisdiction. The Department of State Highways has jurisdiction over 1,271 miles of urban state trunklines, and county road commissions are responsible for 906 miles.

Just as in the case of county roads, urban street systems in Michigan fall into two classes, major and local. Major streets are arterial routes which provide a city-wide traffic service, interconnect with state trunklines and county primary routes, carry high average daily traffic volumes and carry traffic to and from major business, industrial and other high traffic generating areas, including terminals of other modes of transportation. Local streets carry relatively lower traffic volumes and serve primarily to give access to single-family residential property.

Street Mileage Changes

While total street mileage in Michigan increased nearly 46 per cent over the last 17 years, according to records compiled by the Michigan State Highway Department, the bulk of the

increased mileage was on the local street systems--due to development of new residential subdivisions.

Major street systems increased by 1,662 miles, or 29.6 per cent, while local street systems increased by 3,934 miles, or over 70 per cent. Local streets now make up 72 per cent of total street mileage (see Table 6).

Table 6

STREET MILEAGE IN MICHIGAN CITIES AND VILLAGES

CITY AND VILLAGE STREETS			URBAN COUNTY		STATE	
Major	Local	Total	Primary	Local	TRUNKLINES	TOTAL
4,994	12,855	17,847	779	127	1,271	20,024

Just as in the case of county road commissions, wide variations exist in street mileages within urban communities--ranging from 2,824 miles in Detroit to as little as two miles in some small towns and villages. Similarly, Detroit's yearly street budget of nearly $36 million contrasts with yearly budgets of little more than $2,000 in some small communities.

General Apprisal of City Practices

Answers given to the questionnaire sent to city public works departments indicated that the Michigan Manual of Uniform

Traffic Control Devices is more widely ignored in urban communities than on county road construction and maintenance projects. This observation is particularly true of work on local streets.

Only in the larger cities with substantial yearly budgets for street construction and repair work does there appear to be general adherence to the Michigan Manual requirements.

A special problem mentioned in a number of replies from cities is the theft and vandalism of construction site warning signs, flashers, and barricades. Following are comments obtained in interviews with public work directors in two communities of less than 20,000 population.

In one city, the public works director stated:

> "We work only on the local street system, because the county road commission handles the major streets. It is impossible for us to follow the Michigan Manual completely, because our signs and barricades are continually being stolen, or wrecked by cars or vandals. We are forced to use whatever signs or makeshift barricades are available."

In another community, a suburb of Detroit, the statement was:

> "We are forced to construct an average of 500 barricades each year, to replace those stolen by people who apparently want the lumber for private use, or those wrecked by cars.

"We lose each year an average of 50 barricades equipped with flasher lights. Often we find that the stealing is by small contractors who repaint the barricades and use them on their own work projects.

"We rarely need barricading of work locations at night, and when we do the police check the barricades regularly--but the stealing goes on anyhow. However, since all our work is on minor streets, with little traffic and low speeds, we haven't had an accident at a work location in many years."

Construction Site Practices of Cities

Following are the seven inquiries listed in Part I of the questionnaire sent to city public works departments, all pertaining to Construction Area Traffic Control, and a summary of replies received:

Question 1: Do you have a manual or published instructions that serves as a guide to requirements for the control of traffic through construction or repair sites? If so, please attach a copy.

Of the 59 cities replying to the questionnaire, only five stated that they have special published material to supplement the Michigan Manual. One city stated it uses the national Manual on Uniform Traffic Control Devices for Streets and Highways in addition to the Michigan Manual.

Another city (Detroit) replied that all proposed work on major arterial routes must be reviewed in advance by the Department of Streets and Traffic, which prepares special sketches and instructions that must be followed, prior to issuance of work permits by the Permit Division of the Department of Public Works.

Three cities submitted copies of published manuals they have prepared for construction site protection. The cover of Street Barricading and Channelization Manual for Temporary Traffic Control, issued in 1969 by the City of Flint Department of Public Works, Traffic Engineering Division, is shown in Figure 4.

> Question 2: Do you follow Part II of the 1963 Michigan Manual on Uniform Traffic Control Devices, or do you supplement or adjust this with your own special requirements? If so, please attach a copy.

A total of 40 cities replied that they follow the Michigan Manual. Twelve cities indicated they supplemented the manual with special instructions, while seven cities replied that they do not follow the Michigan Manual or any other published guide.

> Question 3: What application of traffic control devices and measures (signs, signals, markings, cones, barricades, lighting, flagmen, etc.) is made to insure protection of both the highway user and the highway worker on the approach to and throughout a construction or repair site on the following classifications of roadway facilities

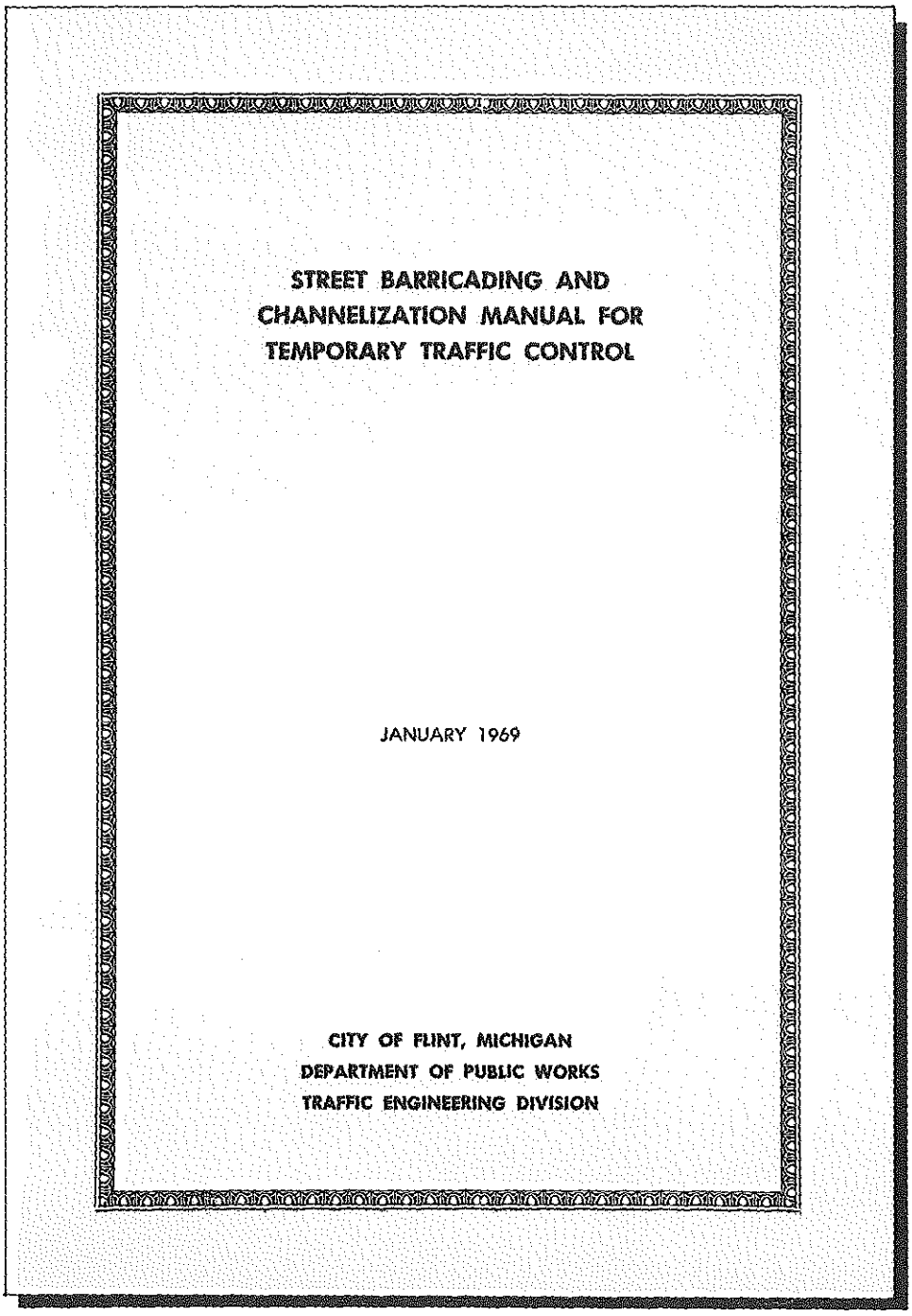


FIGURE 4

COVER OF TEMPORARY TRAFFIC CONTROL MANUAL

CITY OF FLINT, MICHIGAN

when traffic is maintained? If you have developed any special diagrammatic layouts of your traffic control requirements in these or other typical situations, please attach copies. (The inquiry listed six classes of roadways: two-lane road with less than 750 vehicles per day; two-lane road with 750 to 2,000 vehicles per day; two-lane road with more than 2,000 ADT; four-lane road with less than 8,000 ADT; four-lane road with more than 8,000 ADT, and roads with more than four lanes).

A total of 32 cities replied that they follow requirements of the Michigan Manual (which, however, does not contain specific requirements for the six roadway classifications given in the questionnaire).

Most of the remaining 27 cities replying to the inquiry gave general answers, such as "barricades, cones, flashers, and flagmen, as needed." However, several cities indicate they follow the pattern listed below:

1. Two-lane road, less than 750 ADT: cones and portable signs, with lighted barricades at night.

2. Two-lane road, 750 to 2,000 ADT: cones, portable signs, lighted barricades at night, flagmen when needed for particular traffic safety requirements.

3. Two-lane road, over 2,000 ADT: same as Item 2, above, but use of flagmen is mandatory.

4. Four-lane road, less than 8,000 ADT: same as Item 3 above.

5. Four-lane road, over 8,000 ADT, and roads with more than four lanes: same as in Items 3 and 4, but with metal barrels added to the traffic-channelization devices.

Several cities quoted from the texts of their construction contract and construction permit forms, which require contractors to provide "adequate protective devices"--but which do not define the number, type or location of such devices. In contrast, three large cities submitted sample copies of specific requirements and layout sketches developed for each individual work permit issued for major street projects.

> Question 4: What application is made of traffic control devices and measures to insure pedestrian protection when a walking area (whether paved or natural earth) must be maintained throughout construction or repair sites? Please attach a copy of any special layouts you may have developed of pedestrian protection requirements for such situations.

The importance of adequate protection for pedestrian traffic at city road construction or repair locations is indicated by the fact that all 59 cities replying to the questionnaire

stated that they do make such special provisions--in contrast to the county road commission questionnaire replies, in which only 14 of the 70 responses indicated a need for special facilities in this regard.

A total of 23 cities replied that they use lights and barricades for pedestrian control and protection at street construction locations. Another 34 cities stated that they provide whatever facilities are needed for each particular situation. The two remaining cities include pedestrian protection instructions and sketches in their special manuals on construction site practices (see Figure 5).

> Question 5: Is an inspection (day and night) made of construction and maintenance projects to assure conformance to the minimum traffic control requirements prescribed? If so, what is the frequency of such inspection and whose responsibility is it to make the inspection?

A total of 31 cities stated that both day and night inspections are made of protective devices at construction and repair sites. Thirteen cities declared that such inspections are made only in daytime. Seven cities replied that such inspections are made "as needed". Eight cities declared no provision is made for such inspections.

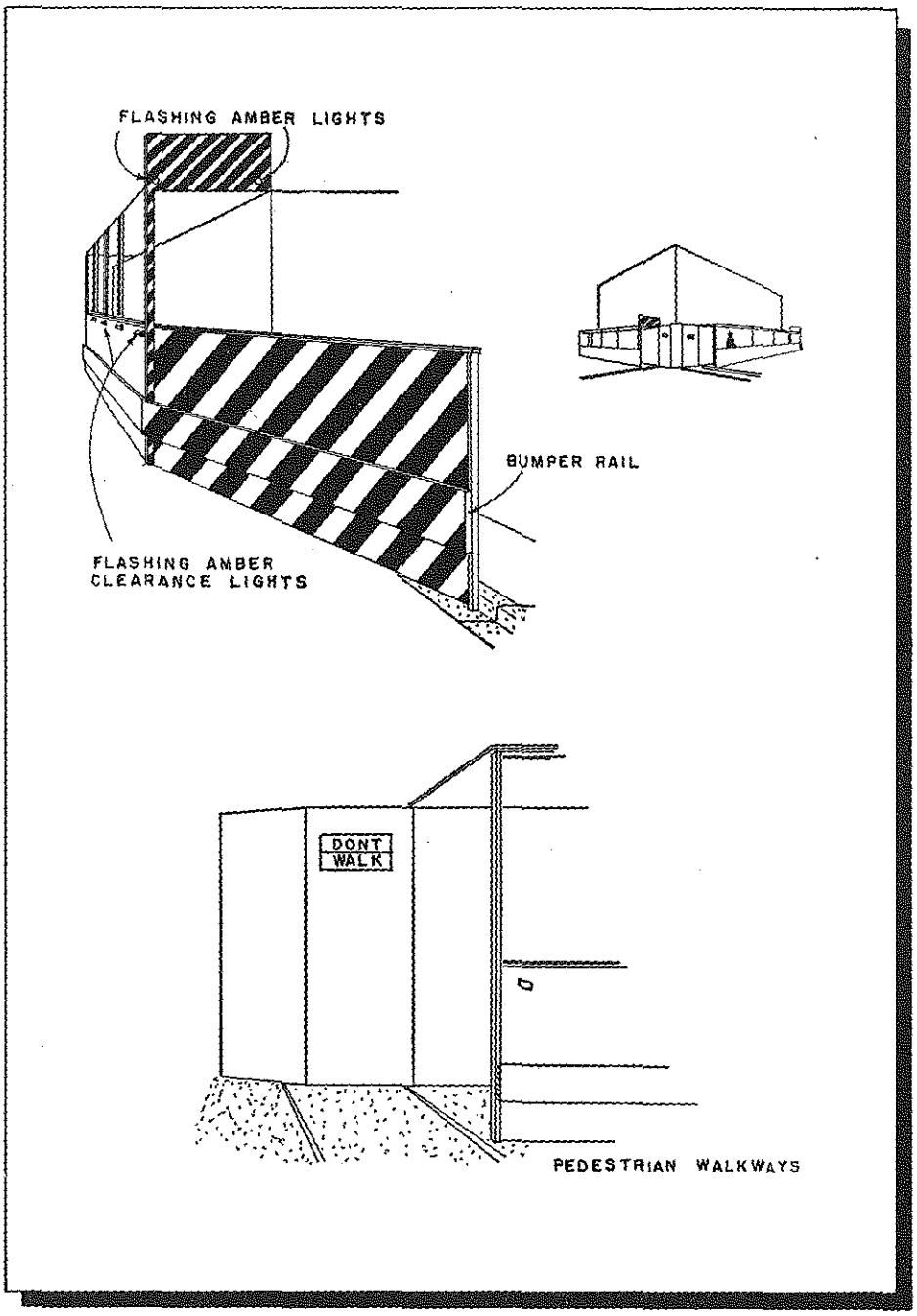


FIGURE 5

PEDESTRIAN PROTECTION SKETCHES

CITY OF FLINT, MICHIGAN, MANUAL

Of the three cities in the Group I expenditure class (above $5 million in yearly street budgets), two replied that only daytime inspection is made, and one replied that the frequency of inspection depends on the type of project.

Seven cities declared that night inspections are made by the police agencies. All other cities making inspections put the responsibility on public works department personnel.

> Question 6: Do you regularly advise the law enforcement agency when construction or maintenance activities will result in a major interruption of the normal traffic patterns?

Only one city replied "no" to this question, with all others replying in the affirmative. The particular city has a population of less than 10,000. A follow-up inquiry brought the reply that the city does not do work on major streets and has found no need to inform police of its street repair work because no serious traffic disruptions arise.

> Question 7: Does your initial and refresher training program for personnel with construction and maintenance responsibilities provide specific instruction on safe performance of those activites with minimum hazard to themselves and passing traffic? Please attach a copy of your training program outline for construction and maintenance personnel. What is the normal frequency of your refresher training for such personnel?

No city reported it has any published material for personnel training, but two cities declared that a training manual is in preparation and five others expressed interest in developing a training program and requested information on how to do it.

A total of 38 cities reported they have no training program--with several adding a comment that none is needed. The other 21 cities stated that training is handled verbally by supervisiors or foremen, on the job. Only five cities report they have periodic refresher training, with frequency ranging from two months to one year. One city said that a yearly training program, including films, is sponsored by the insurance company which provides coverage for city employees.

Roadway and Roadside Maintenance

Following is a summary of answers to the 10 questions put to city public works departments relative to safety-related practices in street maintenance:

> Question 1: Do you have a preventive maintenance program delineating minimum criteria, requirements, and procedures to be adhered to in assuring that the roadway and roadsides are maintained at a reasonable level of safety at all times? If so, please attach a copy.

A total of 39 cities replied that they have no formal program of preventive maintenance (the same number of negative replies as were received from county road commissions). Nineteen cities stated they do have such programs--including Detroit, which stated that chuckholes on city streets are filled once per month. One city stated it relies on police to report on roadway deficiencies. No city submitted published materials regarding its preventive maintenance program, and several cities added that only "verbal instructions" were used.

> Question 2: What is the scope, procedure, and schedule of your plan for systematic surveillance and maintenance of both the roadway and roadside to identify and correct deficiencies or potentially hazardous conditions? Please describe briefly, or if this plan has been specifically delineated in written instructions, please attach a copy.

Thirty-three cities replied that both public works department employees and city police are requested to watch for hazardous street conditions in their daily operations. Twelve cities stated they have no special program to detect potential street deficiencies or hazards.

Of the 14 remaining cities, seven specified weekly inspections; three listed one-month intervals; one specified six-month intervals; two said inspection was done yearly; and one

(Detroit) stated that state trunklines are checked once per month while all city streets were checked once per month from November 15 to April 1.

Several city reports mentioned a special hazard created by tall bushes and shrubs on street-corner lots, which block the side view of drivers at intersection approaches and create high accident locations. One city report mentioned a similar problem at driveways on mid-block residential lots. Copies of local zoning ordinances requiring trimming of bushes and hedges to a maximum of three feet in height, for a distance of 35 feet from the intersection, were submitted by three jurisdictions. (See Figure 7, Chapter 7.)

> Question 3: What is the nature and frequency of inspection (day and night) of traffic appurtenances (signs, signals, markings, lighting, guardrails, etc.) to ensure that they are properly maintained in effective condition to fulfill their intended purpose or to determine that they are no longer required and should be removed? Whose responsibility is it to conduct such systematic inspections?

A total of 48 cities replied that they rely on street maintenance personnel and police to note and report damaged or malfunctioning traffic control devices. Four cities reported these items are checked weekly, and four others specified

inspections ranging from one month to six months. Two cities reported no inspection program.

Detroit declared that traffic signs are replaced every four years, and repaired as needed; traffic signals are relamped twice yearly, and their timing is checked yearly; pavement marking is done twice yearly; guardrails are inspected annually; and street lights are relamped periodically, based on the average expected life of each type of light.

Twelve cities reported they rely on police to watch for defects in traffic control devices. Only three cities reported that this responsibility was given to the city traffic engineer or supervisory personnel.

> Question 4: Do you have a specific cooperative program with the law enforcement agencies whereby they regularly notify you of observed deficiencies in the safe condition of both the roadway and roadsides, including appurtenances? Please describe briefly. If special forms have been developed for use of enforcement personnel in this regard, please attach a copy of such forms.

Only three of the 59 reporting cities indicated that they have no specific arrangement with police for reporting on observed street safety deficiencies. Three cities submitted copies of special forms which police use to report safety deficiences (see

Figure 6, the Kalamazoo Police Department report form). However, a number of cities reported that police call in reports on hazards requiring immediate attention, and submit written reports on non-emergency items.

> Question 5: Does your maintenance program provide for dry pavement winter maintenance of roadways? Please indicate the basic nature and priorities of your normal snow removal program.

Only nine of the 59 reporting cities replied that their winter maintenance program limits dry pavement snow removal and salting work to state trunklines and main streets. All others reported all streets are included.

General priorities in snow removal are freeways, state trunklines, central business district streets, other main streets, and local streets, in that order. In some cities, special attention also is given to fire department and hospital routes, school bus routes, and particular hills, curves, and railroad crossings know to present hazardous driving problems when pavements are slippery.

> Question 6: Do you have a plan for coordination of snow removal activities with adjacent jurisdicitons? If so, please attach a copy or describe briefly, including jurisdictions involved.

KALAMAZOO POLICE DEPARTMENT

REPORT OF CONDITIONS AFFECTING OTHER DEPARTMENTS

DEPARTMENT AFFECTED		REPORT OF	
POLICE DISTRICT NO.	BEAT NO.	DATE OF OCCURRENCE	19
PLACE OF OCCURRENCE		TIME OF OCCURRENCE	M

(DESCRIBE CONDITION HERE)

DETAILS

ACTION TAKEN BY POLICE

NAME OF PERSON NOTIFIED	AT	DEPARTMENT OR PLACE
NOTIFIED BY	TIME	HOW

OFFICER	RANK	BADGE	OFFICER IN CHARGE	RANK	BADGE

REPORT OF DEPARTMENT AFFECTED

CONDITION REMEDIED ON	SIGNED
JOB COMPLETED ON	SIGNED

PP-110

FIGURE 6

FORM USED TO REPORT HAZARDOUS ROAD SITUATIONS

KALAMAZOO, MICHIGAN, POLICE DEPARTMENT

Seventeen of the 59 responding cities declared they do have plans for coordination of snow removal operations with adjacent jurisdictions--generally with county road commissions. The remaining 42 cities reported no advantage would accrue from such arrangements.

> Question 7: Does your maintenance program include a plan for testing of pavement surfaces to identify for corrective treatment roadway sections with inadequate skid resistance characteristics? If so, please describe briefly the criteria, nature and frequency of the skid resistance check program and indicate types of corrective surface treatments that have been applied.

Only three cities--Detroit, Flint, and Kalamazoo--indicated any activity or plans for checking street pavement for anti-skid qualities, and for corrective treatment.

Detroit reported such testing is not normally done, but that tests are made when traffic accident records indicate that pavement skid resistance has deteriorated or when other reasons exist to suspect that this condition exists.

Flint reported it is planning a standard evaluation of skid resistance performance and maintenance minimum standards for use in establishing priorities on street resurfacing, pavement widening, and other reconstruction work.

Kalamazoo replied that all high accident locations are inspected by traffic engineering personnel, with skid resistance qualities included in the inspections.

The city's report added: "Most slippery areas are known, because they result from use of polishing aggregates in bituminous mixes in the mid-1950s. Some skid tests are made on state trunklines. Corrective treatment is resurfacing: some sand mix, mostly 31A aggregate mix."

> Question 8: Do you have a plan of emergency procedures for removal of debris and to repair damage caused by traffic accidents and storms? If so, please describe briefly.

A total of 25 cities reported they have procedures within the public works department for emergency removal of debris and repair of road or roadside damage after traffic accidents--including, in several cities, specific reference to radio dispatching of cleanup and repair crews.

Another 19 cities reported they rely on police to notify them of a need to dispatch emergency crews. In the remaining 15 cities, no specific plan is reported for dealing with such emergencies.

Question 9: Do you have a program for the analysis, and documentation for corrective treatment, of crash-damaged highway appurtenances? If so, please describe briefly.

Sixteen of the 59 reporting cities declared that they do have a program for study and corrective treatment of crash-damaged traffic signs, signals and other highway appurtenances. However, in all but three instances, the reports showed that the post-crash programs were limited to replacement of the damaged items or installation of temporary signs or barricades until the damage was repaired.

Detroit reported that the city's Department of Streets and Traffic currently is cooperating with the Michigan Department of State Highways to develop a program for analysis of crash-damaged highway appurtenances with the objective of recommending relocation, redesign or other corrective treatment when it is believed that such action will minimize future chances of accidents.

Question 10: What are your procedures for notifying the public and maintenance personnel of adverse weather that might create generally hazardous driving conditions or of specific roadway locations requiring early special attention?

All cities reported use of telephone or two-way radio communication to notify employees needed for special maintenance operations. Four cities reported they rely on messages from the police agency to alert they to hazardous driving conditions.

A total of 24 city reports state the street department notifies local news media--radio, television and newspapers--when adverse weather conditions are expected to create bad driving conditions, or when specific roadway locations present special driving problems.

Chapter 6

STUDY FINDINGS

As indicated previously, this study is based primarily on analysis of the questionnaire replies from county road commissions and city public works departments, supplemented by personal interviews with selected officials in state, county, and city highway agencies as well as with officials of other Michigan organizations having responsibilities and knowledge of the subjects covered by the questionnaires, and from field observations made in some 25 local jurisdictions. From this, the following general conclusions have been developed.

Construction Area Traffic Control

One of the most serious deficiencies disclosed by the study relates to very frequent failure, of many counties and cities and many contractors employed by public utility companies, to follow requirements of Part II of the 1963 Michigan Manual on Uniform Traffic Control Devices when doing construction or maintenance work on roadways or along roadsides.

Violation of the manual's provisions are most frequent within cities and counties in the smaller population and highway

budget classes. However, violations also have been observed during field checks in cities above 100,000 population, and in counties with over $2 million in yearly road construction and maintenance budgets.

One reason for the high frequency of violation of the manual's provisions appears to be that insufficient guidance is given in the manual for minimum traffic control and warning installations for particular classes of roads and streets.

While it is recognized that the need for particular protective installations will vary with the nature of the roadway work, the period of day or night during which work is done, and the traffic volumes and normal speeds of the particular roadway section, certain minimum requirements should be specified for work on designated classes of roadways, and for daytime and night conditions. Such specifications are provided only in part in the manual, with much latitude for omitting critical protective measures.

Following are conclusions drawn from replies to the seven inquiries in Part I of the study questionnaire, and from follow-up interviews and field observations:

1. Use of material supplementing the Michigan Manual.

Only 2 counties and 5 cities, out of a total of 129 jurisdictions reporting, have supplemental manuals or published instructions relative to construction area traffic control. Only in a few large cities and heavily populated counties are special sketches and specific written instructions developed for the guidance of work crews at particular construction or maintenance locations where traffic moves through the job site.

The need for specific sketches and detailed work orders for individual locations may not exist on roads and streets carrying low traffic volumes at low speeds, and particularly in cities and counties whose highway budgets do not permit employment of a traffic engineer, supervisory personnel generally are able to do an adequate job of traffic protection and guidance through verbal instructions to employees.

However, there is a need for other cities and counties to follow the practice of those jurisdictions which have developed local manuals for traffic protection at construction and maintenance locations. Preferably, a special statewide manual should be written on the basis of the experience of counties and cities

in their local operations, to apply the general guidelines of the Michigan Manual to a range of local conditions and local road and street classes.

2. Adherence to Part II of the Michigan Manual

Of the 129 reporting jurisdictions, 90 stated that they follow the manual; 28 make adjustments for local conditions; and 11 follow no written procedures and give verbal instructions to employees on each job.

However, even among those jurisdictions reporting that they follow the Michigan Manual, the additional comment was frequently added to the effect that the manual is "not always followed." This fact was confirmed by field observations during the study.

One of the most commonly observed hazards was the failure of many standing or slow-moving road maintenance vehicles (such as snowplows) to be equipped with high-mounted flashing-arrow signs, or flashing, oscillating or rotating lights -- and failure of many maintenance vehicles to have high visibility color or reflective markings.

The Michigan Manual currently makes mandatory only the provision for simultaneously flashing of all turn signals on such vehicles. This does not always provide adequate warning to oncoming traffic.

Similar failure (of utility company contractors) to meet the manual's provision was reported by several county road commissions -- along with the comment that more clear-cut authority should be provided police agencies so that such contractors can be given traffic violation citations, and be subject to court fines, for failure to meet the manual's provisions.

The observation made under Point 1, above, relative to a need for more specific minimum requirements to be covered by the Michigan Manual for particular roadway and traffic situations, also applies here.

3. Control devices and measures used at construction sites.

Of the 129 reporting jurisdictions, 77 declared they follow the Michigan Manual, while the remaining 52 agencies listed various items or combinations of signs, barricades, cones, flashers, flagmen, and metal drums. (Since the manual provides

considerable latitude for selection of proper control devices it is not possible to evaluate the significance of the answers given.)

The fact that only a relatively few counties and cities indicated any systematic combination of control devices for major and minor roadways underscores conclusions stated above -- that minimum requirements should be developed for particular road operations, types of road and traffic volumes, and for day and night conditions.

4. Pedestrian protection at construction sites.

While all 59 reporting cities indicated that pedestrian protection facilities are provided (mainly lights or barricades), only 14 of the 70 reporting counties declared that special pedestrian protection is needed -- such as use of snow fence for barricades, and signs and lights.

The general conclusion in this instance is that adequate attention appears to be given to the problem of providing required pedestrian safeguards at construction locations. Where the potential for pedestrian hazards is greatest, in the larger cities, the replies indicated that considerable attention is given to installing protective devices.

5. Inspection of construction site traffic-protective devices.

Of the 129 reporting jurisdictions, 65 indicated that inspection of construction sites is made both in daytime and at night; 50 indicated daytime or "when needed" inspection, while 14 agencies reported no inspections are made after work crews leave the locations.

The total of eight jurisdictions with highway budgets above $5 million yearly were evenly split on this question. Four reported only daytime inspection, while the rest specified both day and night inspection.

Because of frequent comments in the questionnaire replies to theft and vandalism of traffic control signs, barricades and lights at construction sites, it would appear that insufficient attention is given in at least one-half of the jurisdictions to night-time inspection of control devices at construction sites.

6. Notifying police of major traffic-interrupting projects.

A total of 121 jurisdictions reported that they notify local law enforcement agencies when construction or maintenance

activities will result in major interruptions of normal traffic patterns, while eight jurisdictions reported they do not.

Follow-up inquiries indicated that those jurisdictions which do not give such notifications to local police agenices either have no main-roadway responsibilities or have such low traffic volumes that they do not encounter problems of major traffic interruptions.

The conclusion reached was that present practices are adequate and no special problems exist in this respect.

7. Safety training for construction and maintenance employees.

Only one of the 129 reporting jurisdictions stated it has a published training outline for employees, covering safe operations at construction and maintenance locations. Three others stated they have training manuals in preparation, and follow-up interviews with 10 jurisdictions brought the unanimous response that a written manual or "instruction outline" for foremen and supervisors would be valuable in order to insure that on-the-job instructions covered all important points in protecting traffic and employees at work locations.

A total of 71 jurisdictions reported they have no training programs, while 58 agencies reported "verbal training" courses at the time employees are hired. Refresher training, also verbal, was reported by 23 jurisdictions, with four such courses limited to foremen.

While a majority of all reporting agencies appeared satisfied with their present "on-the-job" verbal instruction programs for employees, and several agencies stated they have neither time nor need for more formal training, it seems obvious that current informal practices in this regard invite risks to safe traffic operations, and employee safety, at construction and maintenance locations--and that the lessons learned from experience in particular work situations will not always be passed on to all supervisory and work crew employees in other jurisdictions throughout the state.

Thus, the conclusion is that a manual should be prepared, drawing on first-hand experience of representative city and county road agencies throughout the state, covering key points and practices involved in avoiding accidents to vehicles or employees during road construction and maintenance operations.

Roadway and Roadside Maintenance for Traffic Safety

Part II of the study questionnaire deals with surveillance and corrective treatment of all safety-related aspects of pavement surface condition, highway traffic control signs and devices, and the adjacent roadside.

Conclusions drawn from replies to the 10 inquiries in this section of the questionnaire, and from follow-up interviews and field observations, follow:

1. Preventive maintenance program for road and roadside safety.

In 78 jurisdictions, no formal preventive maintenance program was reported for the maintenance of roadways and roadsides at a reasonable level of safety, but one agency reported that such a program is under development.

In another 59 jurisdictions, some type of preventive maintenance program was reported, but with the majority stating that this consists of verbal instructions to employees regarding deficiencies to watch for. One city reported it relies on police to report on road or roadside deficiencies.

The concensus of the questionnaire responses was that normal reconstruction and maintenance procedures meet the major needs of a preventive maintenance program, and that neither time nor money are available for going beyond current practices. No information was developed in the study to justify a different conclusion.

2. Identification of deficiencies and potential hazards.

Of the 129 reporting agencies, only 22 declared they have programs for systematic surveillance and maintenance of both the roadway and roadside which serve to identify and correct deficiences or potentially hazardous conditions. No agency submitted any written material on inspection programs.

Reports from the remaining 107 jurisdictions revealed that 96 road and street agencies rely on work crews, supervisory personnel, police, and citizens to notify them of hazardous roadway or roadside conditions.

Twelve cities reported they have no special program to detect potential hazards or deficiencies. One of these cities is in the Group III highway budget class, with yearly expenditures over $1 million. The remainder are in Groups IV or V, with budgets below $1 million yearly.

Special hazards created by tall bushes and shrubs on corner lots in residential areas were reported by several cities, which also supplied copies of local zoning ordinances relative to permitted heights of bushes at such locations.

The conclusion to be drawn is that the great majority of local highway agencies should develop a more systematic system, including specific guidelines on identification of deficiencies and potential hazards.

3. Inspection of traffic control devices, guardrails, etc.

A total of 92 agencies stated they rely on department employees, police, and citizen complaints to note and report on damaged or malfunctioning traffic control devices and highway appurtenances. Only 20 agencies stated that inspection is a responsibility of supervisory personnel, and only 15 agencies reported a specific time schedule for inspection. Two cities, both in the bottom group of yearly highway budgets, reported no inspection program.

All eight jurisdictions in the top highway budget group reported regular inspection programs. The conclusion drawn was that the majority of jurisdictions need a more formalized program

in this activity area, with supervisory personnel making inspections on a fixed schedule to supplement observations by employees and police.

4. Notification by police of unsafe road conditions.

A total of 117 jurisdicitions reported they have formal arrangements with law enforcement agencies to notify them of observed deficiencies in the safe condition of roadways and roadsides, and 20 jurisdictions reported that written reports are submitted by police to supplement verbal communication or when immediate repair work is not required.

In the remaining 12 jurisdictions, where no formal arrangements exist, the questionnaire answers indicate that police make road deficiency reports on a routine basis.

The conclusion drawn is that cooperation by Michigan law enforcement agencies in reporting unsafe roadway or roadside conditions is excellent, and that no special problems exist in this regard.

5. Ice and snow removal; mileage covered; and priorities.

A total of 73 agencies reported they provide dry pavement

winter maintenance for all public roads and streets within their jurisdictions. The remaining agencies provide only selective winter maintenance. In general, top priority is given to freeways, other state trunklines, major roads and streets, downtown streets, school bus, fire department and hospital access routes, and particular hills, curves or other locations known to be hazardous when slippery.

Snow removal procedures and practices, developed through many years of experience, appear excellent in all regions of the state, from the largest cities and counties to the smallest communities and most sparsely settled counties.

6. Cooperative snow removal programs with adjacent areas.

In 37 jurisdictions, programs exist for "trading" certain road or street sections with adjacent jurisdictions, or for doing work within an adjoining jurisdiction on a fee basis. The 92 agencies having no cooperative program indicate that no advantage of economy or efficiency would result from such programs.

Answers given to this inquiry, confirmed by personal interviews with a number of city and county highway officials, lead to the conclusion that cooperative snow removal programs

exist to the degree they are justified, and that no important problems exist in this activity.

7. Pavement skid resistance checking and corrective treatment

Only three of the 59 reporting cities, and 13 of the 70 reporting counties, indicated that they have any type of program for testing pavement surfaces to measure skid resistance performance, and for applying corrective surface treatment. Adverse effects of studded tires on anti-skid pavement overlays were cited by several counties.

Discussions held with testing and research engineers of the Michigan Department of State Highways led to the conclusion that serious traffic safety hazards exist in this phase of highway maintenance. Recommendations for corrective action are found in Chapter 7.

8. Roadway cleanup and repairs after accidents or storm damage.

A total of 75 jurisdictions have established emergency procedures for removal of debris and repair of damage caused by

accidents or storms. In 39 jurisdictions, reliance is placed on police or local citizens to provide notification of a need for emergency action. In 15 agencies, no specific program exists--with most of these agencies reporting that they "do what is needed."

No firm conclusions can be drawn from answers given to this inquiry. It is recognized that small communities and sparsely-settled counties put primary reliance on police calls and calls from local residents to learn of a requirement for emergency dispatching of repair crews.

Nevertheless, the fact that over 40 per cent of the reporting agencies declare they have no established method for handling emergency situations involving road blockage, or road damage due to accidents or storms, indicates that a weakness exists, and that consideration and study should be given to possible strengthening of procedures in this phase of highway safety activity.

9. Corrective treatment of crash-damaged highway appurtenances.

A total of 66 agencies reported they do have programs for

analysis and corrective treatment of traffic signs, signals, guardrails and other highway appurtenances damaged by traffic accidents. The remaining 63 agenicies reported they do not have such programs.

However, analysis of the detailed statements of the 66 agencies reporting they have such programs showed that only 6 of them do more than replace the damaged items or install temporary signs or barricades until the damage can be repaired.

The objective of analyzing damaged traffic control devices and other highway appurtenances should be to determine whether the item in question should be relocated, redesigned, or provided with some type of barricade that minimizes the risk of serious injury to vehicle occupants in the event of an accident. It seems clear that the great majority of city and county highway agencies in Michigan do not give sufficient attention to that portion of Highway Safety Program Standard 12 which deals with Identification of Hazards (discussed in Chapter 2 of this report, beginning on Page 19.

10. Notifying the public and employees of hazardous conditions.

All 129 reporting jurisdictions stated that they use two-way radio or telephone messages to alert employees to adverse weather conditions or roadway locations where hazardous driving problems require early attention.

A total of 74 jurisdicitons report they notify local news media (radio and television stations, and newspapers) of expected or existing hazardous driving conditions or locations. In 14 counties, local schools are notified of expected bad weather conditions if schools are in session.

Since the need for a highway agency to inform local news media of adverse weather conditions varies in different regions of the state, and radio and television stations regularly receive weather forecasts through their normal news service sources, as well as police reports on hazardous roadway locations, it is assumed that those highway agencies not supplying weather and road condition reports to the general news media have found that this service is unnecessary.

No indication was given in the questionnaire replies that deficiencies exist in communicating bad weather messages to road agency employees or the general public.

Summary of Findings

The foregoing review of replies and comments received from 129 local road and street agencies in Michigan, and of additional information obtained from personal interviews and field observations, relative to the construction area traffic control and roadway and roadside maintenance provisions of Standard 12 of the National Highway Safety Standards, leads to the following conclusions:

1. Of the seven activity areas dealing with traffic control at construction sites, performance by Michigan county road commissions and municipal public works departments is satisfactory in two areas and deficient in five.

2. Of the 10 activity areas dealing with roadway and roadside maintenance practices, performance is satisfactory in five areas and deficient in the others.

Areas of Adequate Performance - The seven activity areas in which Michigan county and city highway agencies merit ratings of excellent or satisfactory are:

1. Pedestrian protection at road construction sites.
2. Notifying police of major traffic-interrupting projects.
3. Preventive maintenance for road and roadside safety.
4. Notification by police of unsafe road conditions.
5. Winter ice and snow removal activities.
6. Cooperation with adjacent areas in snow removal.
7. Notifying employees and public of hazardous conditions.

Areas of Needed Improvement - The 10 activity areas in which Michigan counties and cities are, to varying degrees, in need of improved practices and procedures are:

1. Local manuals on construction area traffic control.
2. Adherence to Michigan Manual on construction area safety.
3. Control devices and measures at construction areas.
4. Checking construction site traffic protective devices.
5. Safety training for road work-crew employees.

6. Identification of road deficiencies and hazards.

7. Checking conditions of traffic control devices.

8. Pavement skid resistance tests and corrective action.

9. Road cleanup and repair after accidents or storm damage.

10. Corrective treatment of crash-damaged highway appurtenances.

Recommendations for appropriate action to strengthen or improve practices and procedures in the 10 areas of deficiency are contained in Chapter 7.

Chapter 7

RECOMMENDATIONS

Conclusions listed in the previous chapter identify ten areas where Michigan counties and cities and road construction and maintenance contractors, to varying degrees, fail to conform to highway safety practices and procedures contained in National Highway Safety Standard 12 and in the Michigan Manual on Uniform Traffic Control Devices.

In order to minimize the chances of traffic accidents, or injury to highway construction and maintenance employees, resulting from failure to follow approved practices and procedures, the following recommendations are made:

1. Revision of Michigan Manual - Upon publication in the near future of the revised Manual on Uniform Traffic Control Devices for Streets and Highways by the National Joint Committee on Uniform Traffic Control Devices, the Michigan Departments of State Highways and State Police plan a revision of the Michigan Manual to reflect, where Michigan statutes permit, changes made in the national manual.

It is recommended that in the process of revising the Michigan Manual, mandatory provision be made for appropriate minimum requirements in traffic control devices and other traffic control measures at roadway and roadside locations where construction or maintenance operations are under way.

Such minimum requirements should be specified for work on designated types of roadways, with designated traffic volumes and speeds, and for daytime and night operations. Included in these minimum requirements should be such basic items as hard hats, reflectorized safety vests for flagmen, and flashing beacon lights and warning flags on all construction and maintenance vehicles.

2. Supplemental Local Manual - Several Michigan counties and five cities have found it desirable to publish supplemental manuals or special instructional material, in addition to using the Michigan Manual, and this indicates that special circumstances exist in local areas which may not be appropriate for detailed coverage in the Michigan Manual.

It is recommended that the County Road Association of Michigan, the Michigan Municipal League, and the Michigan Department of State Highways, each designate several members to serve

on a joint committee whose function will be to draft one or more supplemental manuals intended for the guidance of county and municipal highway agencies in applying Part II of the Michigan Manual to local situations.

Such a manual, or manuals, should also list minimum required traffic control devices and measures for designated types of roadways, traffic volumes, and traffic speeds.

3. Enforcement Measures - In view of study questionnaire findings that a substantial number of cities and counties and private contractors engaged in construction or maintenance operations on public roadways for public utility firms, frequently violate the Michigan Manual's traffic control provisions, some improvement in enforcement provisions is indicated.

The Attorney General of Michigan should be requested to review the Michigan Motor Vehicle Code (Section 608, Act 300, Public Acts of 1949, as amended) to determine whether it contains sufficient authority to allow designated state, county, and city highway personnel to instantly revoke roadway or roadside work permits of private contractors employed by public utility firms when they are found to be in violation of provisions of Part II

of the Michigan Manual, and to obtain police cooperation in halting their operations if necessary.

In the event that legislation is required to achieve the above-listed objectives, it can be considered by the Michigan Legislature.

4. Checking Construction Sites - Since half of the reporting agencies declare that checking of traffic protective devices is not done at night, and since theft and damage to warning signs, barricades, and lights are frequently mentioned in county and city questionnaire replies, it is recommended that all local highway agencies in Michigan notify local police agencies when such traffic protective devices are to remain overnight at particular locations, and request periodic police checks--with special reference to disappearance of warning lights and reflectorized signs and barricades.

5. Safety Training - In view of widespread expressed interest in an "instruction outline" for foremen and supervisors, dealing with safe operations practices at roadway construction and maintenance locations, and the fact that only four of the 129 reporting agencies have such material available or under development, action on this item appears warranted.

It is recommended that the joint committee of state, county and city members proposed to develop local manuals on construction site traffic control be requested to develop a training manual for construction and maintenance employees of local highway agencies, which can be used as a guide by supervisory personnel in on-the-job instruction of work crews. A further recommendation is that, at least once per year, the manual should be reviewed with all employees having responsibilities for construction or maintenance work.

The manual should cover key points and practices involved in avoiding accidents to vehicles and employees during construction and maintenance operations. It should be based on the experience of county and city highway agencies in particular work situations, as well as draw on information contained in pertinent published material from local, state, and national sources.

The training manual also should include instruction to maintenance personnel on methods for summoning police, medical aid and other equipment to accident locations, placing protective devices at the scene, assisting injured persons, and advising on the best route to emergency medical facilities. Basic points of

the American Red Cross first aid training course also should be covered in the manual. This is particularly important in remote rural areas, where emergency medical services generally are not readily available.

6. Identification of Road Hazards - Since only 22 reporting agencies state that they have a systematic program for surveillance and maintenance of both the roadways and roadsides to identify and correct deficiencies or potentially hazardous conditions, and no agency reported that it has any written guidelines for such work, the need for strengthening this activity appears quite evident.

It is recommended that the training manual discussed in Recommendation 5 above should include a listing of specific types of roadway or roadside defects, and potential hazards, which all employees should be instructed to watch for--and that a copy of this list be sent to local police agencies for their guidance in reporting deficiencies and potential hazards to local highway agencies.

7. Height of Bushes and Shrubs - One of the most serious roadside traffic hazards in urban areas, as well as in many rural locations, is the presence of bushes and shrubs on residential

lots which block the side view of drivers at road and street intersections and at driveways connecting with such roads and streets.

In general, traffic accidents at such locations substantially exceed those at other locations along the same roads and streets, because of obstructions to drivers' side vision. This specific hazard was mentioned in a number of city reports.

In the more heavily urbanized regions of Michigan, many cities, villages, and townships have local ordinances which restrict the height of bushes and shrubs at corner residential lots to three feet above the roadway or sidewalk grade, for a distance of 35 feet from the intersection. Less frequently, such restrictions also are applied to driveways giving access to frontage roads and streets.

Figure 7 is a typical notification form (by the City of Grosse Pointe Park) sent to corner lot property owners in areas of high accident frequency.

It is recommended that all cities, townships, and villages in Michigan adopt similar ordinances if they do not already have them, and that they be expanded to include driveways as well as

DEPARTMENT OF PUBLIC SAFETY

CITY OF

GROSSE POINTE PARK, MICHIGAN

15115 EAST JEFFERSON AVENUE

WILLIAM P. ELLENBURG
DIRECTOR
OF PUBLIC SAFETY

PHONE
POLICE 822-7400
FIRE 822-6400

Dear

Your City Police and Traffic Engineers recently made a traffic and accident survey in an attempt to find the cause of many accidents on the public streets and at the street intersections. Records show that many accidents in the City of Grosse Pointe Park have been caused by bushes and shrubs blocking the view at street intersections and that such bushes standing higher than three feet above the sidewalk grade are in violation.

Under regulations of Title 19, Chapter 19, Sec. 4.56, paragraph (4), of the City Ordinance, read as follows:

Paragraph 4: "In the case of a corner lot, bushes and shrubs within thirty-five (35) feet of the street intersection shall be trimmed and maintained so as not to stand more than three feet above established sidewalk grade. The street intersection shall be taken as the intersection of the projection of the two curbs adjoining the lot."

The Ordinance requirements indicate a three-foot maximum. It is suggested that you reduce the bush or shrub to a two-foot height, thereby providing for twelve inches of growth.

You are hereby notified that your bushes or shrubs at the street intersection are creating a hazard and you are requested under the provision of the Ordinance to trim and maintain said bushes or shrubs not to stand more than three feet above the grade on or before _____. After this date, if the work is not completed, you will be served with a second notice of violation and the provisions of the Ordinance will be enforced.

We trust that you will lend every assistance and cooperate to the fullest extent in aiding the City of Grosse Pointe Park in the elimination of these traffic hazards.

Yours very truly,

William Ellenburg
Director of Public Safety

FIGURE 7

NOTIFICATION OF REQUIRED BUSH OR SHRUB TREATMENT
CITY OF GROSSE POINT PARK, MICHIGAN

property adjacent to intersections--with the required limitation of height of bushes and shrubs alongside driveways also extending back 35 feet from the roadway or street.

8. Checking Traffic Control Devices - It is recommended that supervisory personnel be assigned the responsibility for making inspections at fixed intervals of all traffic control devices, guardrails, and other highway appurtenances within their jurisdictions, to check for damaged or malfunctioning items. This would be in addition to observations and reports by other employees and police.

9. Pavement Skid Resistance Maintenance - Only 16 of the 129 reporting agencies indicated that they have programs for testing pavement surfaces for anti-skid performance in wet weather, and for applying corrective measures.

However, discussions with officials of the Testing and Research Division of the Michigan Department of State Highways disclosed that deterioration of anti-skid qualities of pavements in wet weather, resulting from "polishing" effects of vehicle tires, is a major contributing factor in a high percentage of fatal traffic accidents in Michigan. The problem is most acute

on some types of bituminous pavement in wet weather, but concrete pavement also is sometimes involved.

The Michigan Department of State Highways pioneered use of a special Skidometer in the late 1950's to measure wet weather anti-skid performance of new pavement. Such testing is done regularly on state trunklines, with a thin anti-skid overlayment surface applied when needed. However, the cost of such special equipment (about $35,000) is such that local highway jurisdictions probably could not justify it unless the equipment was available, upon request, to a large number of local agencies.

It is recommended that all road and street agencies in Michigan follow state highway department anti-skid specifications in new pavement construction, and that the Michigan Department of State Highways apply for a grant under the Federal TOPICS (Traffic Operations Program to Improve Capacity and Safety) program for financial assistance in purchasing a special Skidometer which would be used exclusively to make skid resistance pavement tests upon request of county and city highway agencies at locations where accident records indicate a high percentage of accidents involving vehicles skidding on wet pavement.

The "Standard Specifications for Highway Construction" issued in a revised edition by the Michigan Department of State Highways on July 1, 1970, specifies bituminous mixes which maintain a high degree of wet weather anti-skid qualities with wear.

The revised edition also changed concrete finishing treatment from a burlap-drag method to transverse brushing with nylon brushes, which has been found to improve skid resistance qualities of concrete pavement. The Michigan Highway Department also initiated last July, under a Federal research grant, a five-year program of intensified research into problems involved in improving and maintaining wet weather skid-resistant pavement.

10. Studded Tires - The detrimental effects of studded tires on skid-resistant qualities of both concrete and bituminous pavements are documented in a special study sponsored by Michigan and six other states and conducted by the Minnesota Department of Highways.

A Research Progress Report, "The Effects of Studded Tires," was issued in December, 1970. The final report in this study is due in mid-April. Among findings disclosed by the research are:

(a) State highway departments have abandoned durability testing of various types of pavement lane markings,

because tungsten steel studded tires make it impossible to maintain any type of pavement markings in winter. This loss of "lane guides" for drivers, particularly for night travel, sharply increases the chances that drivers will veer by mistake out of their intended lanes and cause head-on or sideswipe accidents, or steer off the roadway.

(b) While studded tires reduce vehicle stopping distances on icy or snow-covered roads, this benefit is offset by the fact that they increase stopping distance up to 27 per cent on bare dry or wet pavement.

(c) Aside from quickly scrubbing off anti-skid overlays on bituminous pavement, studded tires have been found to dig ruts up to one and one-half inches deep on concrete pavements at heavy traffic locations where frequent braking is required. In winter, ice forms in these ruts and cannot be removed by snowplow blades. In rainstorms, water within the pavement depressions often creates a hydroplaning effect on vehicle tires, causing loss of steering control.

The problems caused by studded tires are present in all regions of Michigan, and are not limited to northern counties.

A Michigan State Highway Department survey for the 1970-1971 winter period during which studded tires were permitted (ending May 1, 1971) shows that more than 15 per cent of automobiles and light trucks--595,000 vehicles out of a registered total of 3,900,000--were equipped with such tires, or nearly a 30 per cent increase over the 1969-1970 season. In virtually every county, at least 10 per cent of cars and light trucks had studded tires this past winter. (See Table 7, based on Michigan State Highway Department survey for winter of 1969-70.)

It is recommended that, upon receipt of the final report on the study of the effects of studded tires, and any special report the Michigan Department of State Highways may submit on this subject, public officials and others concerned give further thought to what should be the ultimate state policy regarding use of studded tires on public roads and streets in Michigan.

11. Road Damage Repair - With over 40 per cent of the reporting local highway agencies declaring that they have no established procedure for handling emergency situations involving road blockage caused by debris resulting from accidents, or road damage resulting from accidents or storm damage, it is

Table 7

PERCENTAGE OF VEHICLES USING STUDDED TIRES BY COUNTIES

COUNTY	PER CENT	COUNTY	PER CENT	COUNTY	PER CENT
Houghton	42.00	Huron	18.50	Ontonagon	12.00
Marquette	40.33	Muskegon	18.33	Oakland	11.09
Keweenaw	35.00	Kalamazoo	18.09	Alcona	11.00
Emmet	33.00	Charlesvoix	18.00	Gladwin	11.00
Alger	30.00	Ionia	18.00	Washtenaw	10.42
Baraga	30.00	Mackinac	18.00	Calhoun	10.25
Schoolcraft	30.00	Otsego	18.00	Lake	10.00
Luce	29.00	Kent	17.87	Montmorency	10.00
Newaygo	25.50	Allegan	17.25	St. Joseph	10.00
Antrim	25.00	Gogebic	17.00	Wayne	9.69
Crawford	25.00	Leelanau	17.00	Clinton	9.50
Missaukee	25.00	Ogemaw	17.00	Hillsdale	9.00
Oceana	25.00	Chippewa	16.00	Macomb	9.00
Dickinson	24.00	Mecosta	16.00	Menominee	9.00
Manistee	24.00	Van Buren	16.00	Presque Isle	9.00
Wexford	24.00	Gratiot	15.50	Genesee	8.81
Barry	23.00	Isabella	15.50	Saginaw	8.67
Benzie	23.00	Midland	15.00	Branch	8.50
Cheboygan	23.00	Livingston	14.67	Bay	8.14
Grand Traverse	22.00	Arenac	14.00	Eaton	8.00
Kalkaska	22.00	Samilac	14.00	St. Clair	8.00
Tiscola	21.50	Shiawassee	13.33	Alpena	7.50
Delta	20.50	Cass	13.00	Iosco	7.00
Clare	20.00	Oscoda	13.00	Jackson	6.50
Osceola	20.00	Berrien	12.50	Lapeer	6.50
Ottawa	19.14	Ingham	12.50	Monroe	6.17
Mason	19.00	Iron	12.00	Lenawee	5.00
Roscommon	19.00	Montcalm	12.00		

SOURCE: Studded Tire Survey, Michigan State Highway Department, Winter 1969-1970.

evident that emergency procedures utilized by other road agencies should be reviewed, with a view to encouraging more widespread application of the best available procedures.

Here again, the special joint committee of state, county, and city highway agency representatives proposed in Recommendation 5 should examine the procedures of agencies which report satisfactory handling of this problem, and develop published materials for the guidance of all local highway agencies--taking into account the varying manpower and financial resources of highway agencies in the several classes of yearly highway budgets.

12. Analysis of Crash-Damaged Appurtenances - The finding in Chapter 6 that only 6 of the 129 reporting agencies actually analyze crash-damaged traffic control devices, guardrails and other highway appurtenances, to determine whether they should be relocated, redesigned, or given other corrective treatment to minimize the risk and severity of future accident involvement, indicates that insufficient attention is given to the possible contribution of such highway and roadside items to the frequency and severity of accidents.

It is recommended that all county and city agencies develop programs to determine why particular traffic signs,

guardrails, lights and other appurtenances are repeatedly damaged, and of searching for corrective treatment rather than merely, as so often occurs, repairing the damaged installation.

A cooperative program with the Michigan Department of State Highways, the Highway Traffic Safety Center of Michigan State University, and the Highway Safety Research Institute of Michigan, or other appropriate agencies, might be explored in an effort to develop guidelines on analysis of high-accident locations and application of remedial treatments.

Summary of Legislative Recommendations

Of the 12 listed recommendations, 3 involve legislative action or a possible need for such action:

Recommendation 3: Review of enforcement provisions of Michigan Motor Vehicle Code relative to traffic control devices at highway construction and maintenance sites.

Recommendation 7: City, village, and township ordinances to control height of bushes and shrubs on private property at intersections and driveways.

Recommendation 10: Consideration of what shall be the public policy in the state regarding the use of studded tires on Michigan roads and streets, following study of reports which deal with effects of such tires on pavements.

Summary of Administrative Recommendations

The remaining nine recommendations deal with required administrative actions. They are:

Recommendation 1: Revision of Michigan Manual of Uniform Traffic Control Devices.

Recommendation 2: Development of supplemental local manual (or manuals).

Recommendation 4: Improved procedures for checking highway construction sites where traffic warning devices remain overnight.

Recommendation 5: An instruction outline or training manual for employees with construction or maintenance responsibilities, relative to safe practices in traffic control at such locations.

Recommendation 6: Improved procedures for identification of roadway deficiencies or potential hazards.

Recommendation 8: Requirement that supervisory personnel check traffic control devices and other highway appurtenances at fixed intervals.

Recommendation 9: Adherence to Michigan Department of State Highways specifications for anti-skid qualities in new pavement, and proposed State assistance in providing Skidometer equipment.

Recommendation 11: Development of published material for guidance in establishing emergency procedures for removal of debris and repair of road damage caused by accidents or storms.

Recommendation 12: Improved programs for analyzing crash-damaged highway appurtenances, with a view to possible relocation, redesign, or other treatment to minimize accident frequency and severity.

APPENDICES

Appendix A

Issued June 27, 1967

Highway Safety Program Standard 12

HIGHWAY DESIGN, CONSTRUCTION AND MAINTENANCE

Introduction

Proper design, construction, and maintenance of streets and highways are important aspects of any effective highway safety program. Poor roads and inadequate maintenance can contribute directly to accidents and serious resulting injuries.

Background

There are, however, a great many things we can do in highway design, maintenance, and construction to improve their contribution to safety.

We can require that all new construction and reconstruction, regardless of where it is, to be built to no less than Federal-aid primary design standards, even if this does mean building fewer miles, and we can require that those primary geometric design standards be substantially raised...

We can require that median barriers and guardrails be constructed of impact absorption materials that return cars with the least possible damage to positions parallel to traffic, and we can require that this be done immediately. We can also start replacing the present impact-dangerous barriers and guardrails with the improved types....

We can require that maintenance standards and practices be high enough to keep highways up to original construction standards.

> Report No. 1700, House of Representatives
> 89th Congress, 2d Session, July 15, 1966,
> p. 15.

Purpose

To assure: (a) that existing streets and highways are maintained in a condition that promotes safety, (b) that capital improvements either to modernize existing roads or to provide new facilities meet approved safety standards, and (c) that appropriate precautions are taken to protect passing motorists as well as highway workers from accident involvement at highway construction sites.

Standard

Every State in cooperation with county and local governments shall have a program of highway design, construction, and maintenance to improve highway safety. Standards applicable to specific programs are those issued or endorsed by the Federal Highway Administrator.

I. The Program shall provide, as a minimum that:

A. There are design standards relating to safety features such as sight distance, horizontal and vertical curvature, spacing of decision points, width of lanes, etc., for all new construction or reconstruction, at least on expressways, major streets and highways, and through streets and highways.

B. Street systems are designed to provide a safe traffic environment for pedestrians and motorists when subdivisions and residential areas are developed or redeveloped.

C. Roadway lighting is provided or upgraded on a priority basis at the following locations:

1. Expressways and other major arteries in urbanized areas.

2. Junctions of major highways in rural areas.

3. Locations or sections of streets and highways having high ratios of night-to-day motor vehicle and/or pedestrian accidents.

4. Tunnels and long underpasses.

D. There are standards for pavement design and construction with specific provisions for high skid resistance qualities.

E. There is a program for resurfacing or other surface treatment with emphasis on correction of locations or sections of streets and highways with low skid resistance and high or potentially high accident rates susceptible to reduction by providing improved surfaces.

F. There is guidance, warning and regulation of traffic approaching and traveling over construction or repair sites and detours.

G. There is a systematic identification and tabulation of all rail-highway grade crossings and a program for the elimination of hazards and dangerous crossings.

H. Roadways and the roadsides are maintained consistent with the design standards which are followed in construction, to provide safe and efficient movement of traffic.

I. Hazards within the highway right-of-way are identified and corrected.

J. There are highway design and construction features wherever possible for accident prevention and survivability including at least the following:

1. Roadsides clear of obstacles, with clear distance being determined on the basis of traffic volumes, prevailing speeds, and the nature of development along the street or highway.

2. Supports for traffic control devices and lighting that are designed to yield or break away under impact wherever appropriate.

3. Protective devices that afford maximum protection to the occupants of vehicles wherever fixed objects cannot reasonably be removed or designed to yield.

4. Bridge railings and parapets which are designed to minimize severity of impact, to retain the vehicle, to redirect the vehicle so that it will move parallel to the roadway, and to minimize danger to traffic below.

5. Guardrails, and other design features which protect people from out-of-control vehicles at locations of special hazard such as playgrounds, schoolyards, and commercial areas.

K. There is a post-crash program which includes at least the following:

1. Signs at freeway interchanges directing motorists to hospitals having emergency care capabilities.

2. Maintenance personnel trained in procedures for summoning aid, protecting others from hazards at accident sites, and removing debris.

3. Provisions for access and egress for emergency vehicles to freeway sections where this would significantly reduce travel time without reducing the safety benefits of access control.

II. This program shall be periodically evaluated by the State for its effectiveness in terms of reductions in accidents and their end results, and the National Highway Safety Bureau shall be provided with an evaluation summary.

Appendix B

OAKLAND COUNTY ROAD COMMISSION

MAINTENANCE DIVISION
TRAINING OUTLINE

General Instructions

1. Effort must be made to safeguard not only the public using the highways, but our own personnel, in the performance of maintenance work. Take every possible precaution to avoid accidents, by prompt removal of ordinary hazards.

2. Act with courtesy under any and all circumstances. There shall be no display of temper, and all arguments with the public, regardless of cause, shall be avoided.

3. In case of any accident being witnessed, regardless of whether or not county vehicles are involved, employees of the Department shall stop and offer all possible assistance.

4. Refer to the Oakland County Road Commission's established policy and general instructions on Accidents Involving County Owned Cars, which will be considered as a part of this Safety Code.

5. It must be constantly remembered that the necessary defense in case of any accident involving County employees, or equipment, demands that each man be acting entirely within the law himself, and that his occupational and personal conduct shall be above reproach.

Personal Safety of Employees

6. Conduct all operations in such a manner as to be safe for others as well as yourself.

7. Look in both directions before crossing traveled roadway.

8. Use a safety belt on any tree trimming operations requiring work above ground.

9. In filling joints and cracks in pavements with bituminous material confine the operations to one-half of the pavement, keeping the crew back of the truck to give the men all possible protection from traffic.

10. Use extreme care to guard against catching of loose clothing or hands in moving machinery.

11. Carefully avoid contact with live wires in trees and along the roadway.

12. Wear safety goggles when grinding, breaking concrete, or on any job where your eyes might be endangered by flying particles, and colored goggles when welding with a torch.

13. Under no condition should an employee ride on a truck or pickup in such a manner as to endanger his safety or that of his fellow workmen.

14. Truck operators when sanding should, if at all possible, park their vehicles on the shoulder of the road to allow their helper to get on the back of the truck, and to check lights and sander before starting.

15. At no time should a superintendent or foreman allow a man to ride on a sander or in any position outside of the box.

16. All wounds, no matter how small, should be properly dressed immediately. If nature of wound is such that serious results might occur, a physician should be consulted at once. Superintendents will provide order for medical service in all cases where the accident is compensable under the regulations of the Workman's Compensation Law.

17. If you see another employee conducting any operation in a manner dangerous to himself or others, his attention should be immediately called to this danger.

Education of Personnel

18. Much can be accomplished by the Maintenance Superintendent in a campaign of safety education with the personnel under his direction.

19. The Superintendent should devote some time to instructing his equipment operators in the matter of motor vehicle care and regulations.

20. The Superintendent should use considerable care and judgement in selecting drivers, who he has reason to believe, will operate the equipment carefully and sanely. We have no place in our maintenance organization for a reckless driver. Evidence of recklessness, disregard of rights of public, or refusal to abide by the conditions of this Safety Code by any employee, will mean the penalizing of that employee. Penalties, in this connection, may take the form of
    (1) Demotion
    (2) Discharge from service

Condition of Equipment and Accessories

21. See that all maintenance equipment meets legal requirements. This means that brakes, lights, horn, rear view mirrow, windshield wiper, etc., must be kept in good condition at all times. Any defects in equipment must be reported immediately by the operator to the Maintenance Superintendent or Mechanic. All trucks which are liable to be operated at night must be equipped front and rear with lights according to State Law.

22. Red flags should be prominently displayed on all maintenance equipment operating on the highways, such as at the extreme rear of any projecting loads, or at the extremes of any laterally projecting parts. Particular attention is called to the necessity for placing a red flag at the end of a grader blade which projects out further than the main body of the grader. This is inconspicuous to other traffic, and has been the cause of quite a few accidents. If night

floating is being done, the end of the projecting blade should be equipped with a cluster of reflector buttons showing both front and rear.

23. Red flags must be kept red. Discard and replace faded flags which are no longer conspicuous.

24. License plates must be legally displayed at all times.

25. No obstructions to be permitted on windshield, side, or back windows of cars, trucks, and tractors.

26. All devices being trailed must observe legal safety chain requirements.

27. All large trucks, such as used by tar crews, must be equipped with fire extinquishers which are to receive periodic inspection and be kept in serviceable condition. All garages must be equipped with First Aid Kits which must receive periodic inspection, and have used materials replaced.

Maintenance Operations

28. Maintenance equipment must be operated on the highways according to the same rules and regulations as applied to other highway traffic. Our organization has no special traffic rights. All local traffic ordinances must be observed without claim of special privilege or authority.

29. Equipment operators must keep to the right side of the road, not cross yellow lines, and observe reasonable speeds.

30. When operating maintenance equipment through cities and villages (even though villages may be very small and unincorporated), operator is required to reduce speed below normal, and to exercise increased vigilance. This also applies to crossroads, narrow bridges, blind curves, and hilltops. Never attempt to pass other moving vehicles on such portions of the road.

31. Operators must make complete stop at all posted stop streets and all unprotected railroad crossings. Observe carefully all traffic signals, and do not start across intersection on amber light, but wait until green light shows. Never drive unduly fast in attempting to cross an intersection before the green light changes.

32. Never dispute the right of way with another driver at an intersection. Better let the other driver go first (even though you have the right of way), than to be involved in an accident, with possible loss of life and property.

33. When slowing, stopping, passing, turning, or turning around give proper signals, and make sure that proposed action can be undertaken with complete safety to traffic. Do not attempt such action at the top of a hill, or on a curve, or at any place where you and other traffic from all directions do not have clear vision for a safe distance.

34. Operators of County equipment must drive at a safe distance to the rear of any vehicles ahead of them. The State Law places the burden of responsibility on the driver approaching from the rear in case of collision. Do not "Guess" but stay far enough back to "Know" whether the driver ahead is going to stop, turn right, or turn left.

35. Use extra precaution when operating equipment on the highway under conditions of poor visibility such as fog, heavy rain or snow storms. Under such conditions it is well for our drivers to put on dim lights, even though in daylight hours.

36. Do not park on the traveled portion of the roadway unless the nature of the work being performed makes it imperative to do so. When necessary to park equipment on the traveled roadway, in the performance of certain maintenance operations, a portion of the road should be marked as "Repair Zone", or with "Men Working" signs placed 500 feet to 1000 feet each side of the operation. If necessary to park equipment on the traveled roadway in a location which is particularly hazardous, the driver is required to direct traffic from a standing position alongside the truck, or from a position where he can be readily observed by traffic approaching from all directions.

37. If necessary for the driver to leave equipment parked within the traveled roadway, because of motor trouble or other emergency, the equipment must be parked to the extreme right side of roadway, and red flags, (if at night, red lights or torches) placed on the right-hand side of the road 200 feet each side of parked equipment. If at night, lights must also be placed at the left-hand side of the truck, both front and rear. Every effort must be made to remove such disabled equipment from the traveled roadway at the earliest possible moment.

38. No equipment shall be left unattended, without brakes being effectively set, and motor shut off. When parking on steep grades, do not depend upon brakes alone.

39. If necessary to park tar heaters or similar equipment over night, off the traveled roadway, but within the right-of-way, such equipment shall be placed well back of the ditch lines, and not in such positions, adjacent to curves, as would cause our equipment to be struck by traffic which might fail to round the curve properly.

40. If Maintenance Superintendents, Maintenance Foreman, or Engineers, observe trucks or equipment of any public utilities company, parked within the traveled roadway during the performance of any of that company's maintenance or construction operations, the company's foreman must be immediately warned to observe all of the regulations imposed on our own maintenance organization.

41. If it becomes necessary to park maintenance equipment on each side of the traveled roadway, there must be an interval of at least 300 feet between the parked vehicles, or the vehicles must be brought to the same side of the road. This applies when two employees of the Maintenance Division must confer on matters pertaining to the work. Unnecessary stopping of equipment for purpose of conversation on any subject other than County business is prohibited.

42. Drivers of maintenance equipment are not to pick up any strangers on the road. No passengers allowed. This applies to friends and relatives of the operators. This also applies to trucks hired by the day. Do not permit a greater number of employees to ride in the driver's seat than the seat is

built to accommodate, otherwise driver's control of equipment will be hampered.

43. When driving snow removal equipment extra precaution must be taken when passing, or being overtaken by other traffic, to avoid throwing frozen chunks of snow through windshields, or dangerously obscuring vision of toher drivers. Speed of snow plows must be reduced even to the point of stopping, if such is necessary for safety of other traffic; a sudden swerving of snow plow equipment when striking hard, frozen masses of snow, has been the frequent cause of collision with other vehicles; and equipment operators must exercise increased vigilance under such conditions.

44. In patching operations which require a removal of part of the road surface, the operation should be confined to one-half of the roadway, and thoroughly barricaded, signed and lighted. If absolutely necessary to conduct patching operations on both sides of the road, a minimum of 300 feet of clear roadway must be maintained between staggered patches.

45. Particular attention must be given by the Maintenance Superintendent and Foreman to giving proper advance warning to traffic where such patching operations are being conducted on a curve, or hill, and are hidden from the automobile driver until he is practically at the location of the work. The same applies to patching operations adjacent to narrow bridges or other hazardous points. Double advance warning with flags, signs, and lights is required in connection with these extra hazardous conditions, and the Maintenance Superintendent must give all such situations his most carefully study and attention. A watchman should be provided to direct traffic in any such particularly hazardous locations, if in the judgment of the Superintendent or Foreman such service is necessary to properly safeguard the public.

46. Caution markers shall be used at all hidden headwalls or similar hazardous places, where risk is involved.

47. It is the duty of the Maintenance Superintendent to see that there is absolutely clear vision of all highway signs, and particularly of warning signs. This involves giving careful attention to cutting weeds, trimming of trees, and clearing away of snow from in front of such signs.

48. No materials shall be stored at any point on the roadway between shoulder lines, which shall in any way present a hazard, unless the selection of such storage location cannot be avoided. If such hazard must be created, day and night warning shall be afforded.

49. The shoulders shall be kept free from ruts or obstructions which might interfere with emergency traffic thereon. Particularly dangerous is the deep shoulder rut immediately next to the edge of a rigid pavement, and such conditions require the constant attention of the Maintenance Superintendent.

50. The presence of mail box posts on the road shoulders is a serious memace to traffic. A great deal of attention has been given to these structures by our organization in the past, but there is still opportunity for further work along this line, and in many places the elimination of such structures is a continuous problem. Our standard location for mail box posts is one foot outside of the shoulder line, which should bring the mail box about flush with the outside edge of the shoulder. Considerable diplomacy and activity is required to secure such locations uniformly. Graveling of turnouts on the shoulders for the rural mail carrier is in many cases, an incidental expense of securing safe location of mail boxes.

51. Our organization has in many cases been reluctant to cut desirable trees located on the road shoulders. Safety has been prompted in many cases, by painting the tree trunk white. There are however, some trees on our shoulders which constitute undeniable traffic hazards, and it is believed that in such cases the aesthetic consideration should give way to that of safety. No tree is worth a human life, or a serious human injury.

52. Broken guard rails, bridge rails, signs and sign posts, must be repaired or replaced promptly.

53. Bumps or depressions in road surfaces are often regarded by members of our organization as of no particular hazard to traffic, due to their familiarity with these conditions, whereas a considerable hazard is presented to the stranger who is not aware of them. Superintendents must train themselves to view these conditions thru the eyes of the person

who is driving these roads for the first time. Immediate temporary repair must be made of all pavement inequalities which would cause accidents. A single depression or bump in a long stretch of smooth road is particularly dangerous as the motorist is naturally driving faster on such a section of road. Also, ten miles of excellent maintenance may be more than offset, in the mind of the motorist by one bad surface inequality.

54. In the event of the development of hazardous pavement inequalities of such extensive nature that their repair cannot be financed within existing maintenance budgets, Superintendents are instructed to immediately report these conditions to the central office for consideration as to special financing.

55. The frost heave is a type of road surface disturbance which is very difficult to repair during the winter. On gravel roads some extremely bad heaves have been eased out by the use of gravel approaches, if the materials are available. Ice approaches have also been used, with rather limited success, in the northern part of the State. The use of bituminous mixtures for temporary approaches, particularly on pavement heaves in the Southern part of the State, is a possibility. Study of this problem should be made by all Superintendents with a view to possibility of correcting these conditions by some form of winter patching. Warning signs in advance of all such conditions, must be erected and red flags placed directly over the heaved portions of the road, unless the heaved section can be patched into safe riding condition.

56. It is the duty of the Maintenance Superintendent (or of his Foreman as directed by him) to make immediate inspection of all routes after heavy wind or rain storms, to provide for removal of fallen trees or limbs, or filling of dangerous washouts. If the emergency condition resulting from storms, is such that immediate repair is impossible with the equipment or materials, at hand, the Superintendent or Foreman, must place necessary barricades, warning flags, and lights, to properly safeguard the public until repairs can be made. The necessary torches, lanterns, flags, axes, shovels, and other equipment required to provide immediate warning to the public, must be carried by Superintendents and Foremen

when inspecting roads after such storms. Promptness in handling these matters will prevent accidents, and reflect credit on our organization.

57. All dead and leaning trees or limbs, within the right-of-way, which are liable to fall into the roadway and cause an accident, should be cut.

58. In all tree trimming or tree cutting operations, extreme care must be given by the Foreman in charge, to avoid limbs or trees falling on traffic. Traffic should be flagged by the tree trimming crew where any such danger exists.

59. In any case where explosives are used within, or adjacent to, the roadway, and the road is not entirely closed to traffic, the Foreman must provide for flagging and holding traffic while blasts are being shot.

60. Defective manhole covers have been the cause of a number of serious accidents in the past. It is the duty of our maintenance organization to make regular inspection of the condition of all manhole covers on trunk lines or county roads, and to take steps to have any such covers which are warped and rock under traffic, firmly seated, to avoid their being thrown out of place.

61. Loose gravel shall not be permitted on the road surface in such quantity as will deflect the wheels of a car and cause the driver to lose control.

62. No ridge of loose gravel should be permitted to exist within the traveled roadway. If found necessary to temporarily store excess loose gravel along the edges of the roadway, this should be in a flattened section, and far enough out to avoid the general course of traffic.

63. The addition of an excessive amount of clay binder to gravel roads, such as will produce a slippery condition in wet weather is to be avoided. Regulations of the Maintenance Division confine the addition of clay to 8 per cent of the volume of loose gravel to be bound.

64. Maintenance operations should not be performed on the roads on Sundays unless conditions absolutely require same. It

is frequently necessary to do snow removal and ice control work on Sundays and holidays and sometimes advisable to do some floating on gravel roads during the early hours of Sunday, but this work should be confined to the minimum required to give proper service to the public.

65. Maintenance operations which interfere with traffic should be, so far as possible, curtailed on Saturdays, holidays, or any other occasions when an unusual amount of traffic is using the roads.

66. Occasional conditions make it desirable or imperative, that certain maintenance operations be carried on at night. Such operations might be snow removal, scraping of gravel roads, application of calcium chloride, removal of fallen trees or limbs, filling washouts, or barricading and lighting same. The presence of maintenance equipment on the roads at night is particularly hazardous because the general public is not expecting to see such operations in progress at night, and there is a general tendency toward fast and reckless driving late at night. These conditions must all be taken into account by the Maintenance Superintendents when planning to conduct any night operations. Extra precaution must be taken relative to condition of equipment, lights, and in methods of operation. Avoid, if possible, the grouping of two or more pieces of equipment close together. It is believed possible to conduct night opearations with safety to the public if every precaution is taken, but if the public must be unduly jeopardized by night operations, such work should be confined to daylight hours.

67. Our permits for movements of oversize, or overweight loads, are never given for such movements on Saturdays, Sundays, and holidays, or for other than daylight hours. Maintenance Superintendents, who may observe any such movements proceeding contrary to the above provisions, should stop these movements immediately, as they constitute additional hazards to highway traffic under these conditions.