USING ACCIDENT
DATA IN TRAFFIC ENGINEERING

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Earl John Reeder

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PURPOSE OF THIS STUDY

Street and highway traffic is a rapidly increasing problem. More than forty-eight million automobiles have been manufactured in the United States, and nearly twenty-seven million of these are still in use upon the streets and highways. With a potential daily mileage of many times that of the horse-drawn vehicle, the use of streets and highways has multiplied rapidly during the last fifteen years.

Traffic regulation and control have rapidly become engineering problems. In former days when street and highway capacities were seldom taxed in handling even the maximum traffic flow, parking restrictions, traffic control by officers, signals and signs, and special routing of traffic were seldom necessary because efficient use of the streets was not a problem. With fewer vehicles and slower potential speeds, accidents were less common and an unimportant factor in traffic handling.

But since street capacities, traffic flow, and the circumstances of traffic accidents have become governing factors in deciding what kind of regulations should be applied, what type of equipment should be installed, and how and where police officers should be used, the use of engineering methods in attacking the new problems has become imperative.

The purpose of this study is to present methods by which the circumstances of traffic accidents can be used in the solution of traffic problems. Some of the methods here presented have been in use in some form for several years; others are of more recent development. But this discussion is intended to present the most recent interpretations and develepments as to their uses and limitations. An important objective is to make these methods available to students and practicing engineers who are interested in traffic regulation and control.

HOW ACCIDENTS SHOW CHARACTERISTICS OF TRAFFIC MOVEMENT

Traffic accidents are traffic movements that fail. They are usually conflicts between traffic units in their use of the street or highway. Accidents are the test of whether traffic can successfully handle itself under existing regulations and restrictions or must be directed or controlled to avoid these conflicts.

One of the most common types of accidents is the right-angle collision of vehicles at a street intersection. Another type of conflict often occurs between vehicles running in the same or opposite directions, such as rear-end collisions, cutting in, head-on crashes, and collisions between motor vehicles and the overhanging ends of turning street cars.

Another type of accident that is common in urban districts is a collision between a vehicle and a pedestrian. Such accidents most commonly occur at street intersections, because by far the greatest number of pedestrians cross the street there. But they are not uncommon between intersections, and even pedestrians off the roadway are sometimes struck by vehicles out of control.

A fourth and smaller group of accidents involves only a single vehicle and, usually, a fixed object - a tree, pole, or wall. Such an accident occurs when a vehicle is out of control or when there is some unexpected change in the direction or character of the roadway.

When facts regarding accidents are properly assembled, visualized, and studied, they provide the best single indication of the extent and character of traffic difficulties and of what should be done about them. Data regarding traffic volume show the number of vehicular movements of different kinds at a given point and the opportunities for different kinds of accidents. But the accidents are the actual conflicts, and a study of their circumstances will usually reveal the reasons why the same movements frequently result in accidents at one location and are made safely at another.

The distribution of traffic accidents is significant. When they occur frequently at a given point - an intersection, a curve, or an embankment - the need for better regulation or the improvement of safeguards is indicated. When they occur frequently along a street, they show the need for regulation or supervision to relieve confusion and conflict. When they are common over an area, they usually indicate the need for better supervision or, in the case of child pedestrian accidents, better off-street play facilities. Thus, when their distribution is properly visualized by accident spot maps, the points where special study should be conducted are revealed.

The next important step is to study the circumstances of accident occurrence for clues as to the proper remedies. The directions of movement of the vehicles involved in several accidents at a street intersection will show what kind of conflicts predominate and will usually furnish a clue to the location of the difficulty. The times of day at which the accidents are most common will show when observations should be taken to determine what sort of movements and what kinds of traffic are most frequently involved. The dates of the accidents may point to seasonal hazards as the possible causes.

These location studies must always consider the accident experience in terms of the physical conditions at the hazardous locations. The grouping of accidents may point to a serious obstruction to view on one or more corners of an intersection. An unusual combination of grades in two or more directions may result in disastrous speeds. Poor location of a warning sign or "Stop and Go" signal may make it nearly invisible to approaching vehicles from one or more directions. Thus, the circumstances of the accidents themselves furnish the best clues to their prevention and, in many cases, to the regulations or the type of traffic control that will eliminate the confusion and the delays that result from poorly organized traffic movement.

When enough of such "case studies" have been made, correlation of accident circumstances with traffic flow and road conditions will make possible the prediction of accident experience. But the value of this is largely yet to be realized because the sources of accident data have only recently been so adequately developed as to make such studies possible. Inability to predict accident experience now often makes it difficult to foresee the types of safeguards that should be provided when a new street is opened or to anticipate the accident hazards in rerouting traffic.

The ultimate objective in the use of accident data in traffic engineering is, of course, to prevent the recurrence of accidents. It is to make possible the more expeditious movement of traffic with fewer accidents. But, so long as accidents occur in traffic, they will be the best single indications of what kind of measures should be adopted for preventing them. And they will continue to be one of the best indications of the desirable measures for regulating the flow of traffic. If accidents increase when traffic is speeded up as a result of inaugurating new methods of regulation or building new types of highways, the new developments are unsuccessful. If, on the contrary, accidents decrease, the success of the changes is evident.

No engineer or enforcement official who is responsible for traffic administration or control can afford to disregard the valuable indications of accident records which are properly visualized, compiled, and studied.

The most recently developed methods of visualizing accident experience and classifying accident circumstances for traffic engineering studies are discussed under their separate heads in the following sections.

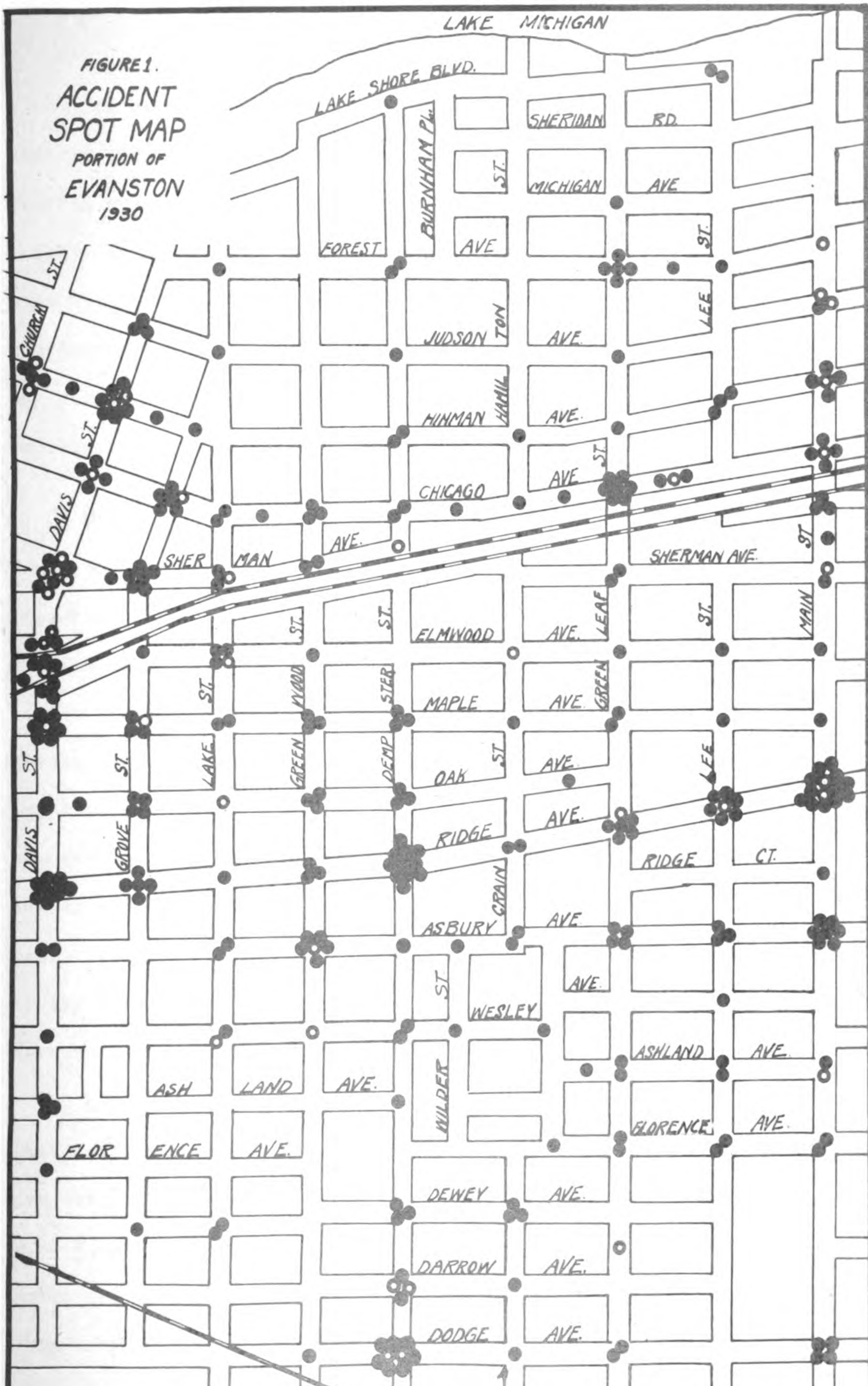


FIGURE 1.
ACCIDENT SPOT MAP
PORTION OF
EVANSTON
1930

ACCIDENT SPOT MAPS

Their Uses and Limitations in Traffic Engineering

For several years accident spot maps have been used to show the distribution of traffic accidents in cities or counties. Progressive traffic engineers, city engineers, highway officials, police officials, safety councils, chambers of commerce, and automobile clubs have relied upon spot maps for guidance in the application of corrective measures to accident problems. With each accident shown by a separate spot, the map visualizes the distribution of traffic accidents as no other graphic representation will do.

Figure 1 is a section of a spot map for the city of Evanston, Ill. Each spot shows the location of an accident during the year 1930. Three important facts regarding accident distribution are revealed. First, the map reveals dangerous locations such as the intersections of Main Street and Ridge Avenue, Dempster Street and Dodge Avenue, and Davis Street and Chicago Avenue. Then, those streets along which accidents are frequent, such as Ridge Avenue, Chicago Avenue, and Davis Street, are indicated. Again, the areas in which the most accidents have occurred are shown by the grouping of the spots. With the accident distribution thus represented, the engineer is able to make detailed studies of the danger points or areas for the development of appropriate safety measures.

Evanston furnishes an example of effective use of the spot map in guiding traffic law enforcement. Prior to 1930, motorcycle police were concentrating their attention on Sheridan Road, a heavily traveled federal highway along the shore of Lake Michigan. It was thought that the heavy through traffic on this route needed much supervision and that the less heavily traveled streets in other parts of the city were much safer.

But late in 1929 the Police Department organized its Accident Prevention Bureau which began to use a spot map. The map soon showed that Sheridan Road is relatively safe, since it follows the Lake and has few important intersections.

Dodge Avenue, only a few blocks from the western city limits, is a wide street traversing a sparsely populated district, although it is heavily traveled. Little police attention was given this street until the spot map showed that many accidents were occurring at its intersections with four heavily traveled cross streets. Then motorcycle officers were dispatched to patrol this street regularly and the accidents ceased.

In addition to revealing the areas, streets, or individual locations where special studies should be made, spot maps visualize the shifting of the accident experience as remedies are applied. In the city of Washington, D.C., the spot map is used extensively in directing the work of motorcycle officers. When the spots begin to accumulate along a certain street, more motorcycle officers are dispatched there.

Ernest W. Brown, Assistant Superintendent of Police, recently said that after transferring responsibility for the motorcycle activities from the fourteen police precincts to the central traffic bureau, it was possible to reduce the patrol from ninety to fifty men dispatched to points where the accident spot map showed developing problems. The number of fatal accidents was reduced from eighty-three in 1929 to seventy-seven in 1930 in the face of a substantial increase for the entire country.

The spot map is of value in selecting new traffic routes. Certain streets or highways naturally become heavily traveled. They often lead into centers of great congestion, and, as local traffic increases and larger numbers of through vehicles use these streets, the establishment of new routes for dispersing this traffic often becomes necessary. In selecting these routes, it is unwise to direct large numbers of vehicles through an area or along a street that the spot map shows to have many accidents unless adequate supervision and proper safeguards can be provided. For example, such a district may be a densely populated residential area, an outlying business district, or an industrial area with much pedestrian traffic. If such districts cannot be entirely avoided in routing heavy traffic, the spot map will show where and what safeguards are needed.

The practical use of a spot map, then, is to reveal the danger points. The map visualizes the relation between these danger spots as nothing else can do, showing how they are distributed along certain streets or over certain areas. From the spot map the engineer can readily pick and list those locations where corrective measures are required. But, for this purpose simplicity and clarity are required. An attempt to show too many classes of accidents by different kinds of symbols is certain to be confusing and ineffective. About three of the most important classes are all that can be successfully shown on a spot map, and more should seldom, if ever, be used.

One of the large groups of traffic accidents consists of those involving motor vehicles and pedestrians. This group is always significant and should be shown on the map by a distinctive symbol. Another large group that should be separately shown consists of all other motor vehicle accidents. In many cases these are more numerous than those involving pedestrians. The third class is usually much smaller, including only those accidents that occur upon the streets but do not involve motor vehicles.

Sometimes an attempt is made to distinguish between fatal, personal injury, and property damage accidents by the sizes of the spots or by their design. But there is little need of trying to indicate the severity, because there is so little difference in the manner of occurrence of minor and serious accidents that it is not significant in accident prevention. Such information is about as unimportant in visualizing accident distribution as that regarding the number of persons injured in an accident.

In either case, a slight change of circumstances may make a great deal of difference. The age of a victim may determine whether an injury will be minor or fatal. The number of occupants of a vehicle may determine whether one or more will be injured. But neither fact shown on the spot map will aid in visualizing the traffic problem at any location. Each spot should represent one accident rather than one person injured.

Several important facts about individual traffic accidents cannot be shown on an ordinary spot map. Even the location can be only approximately shown when several spots accumulate at a single street intersection. Some of them must necessarily be placed out of position. In such cases it shortly becomes impossible to determine whether a given accident occurred within an intersection or several feet from it, an important distinction in deciding what should be done for accident prevention.

One of the most important single classes of information for preventing accidents is the directions of travel of the traffic units involved. Yet to attempt to show this information for each accident would require a map too large for practical use. While dates and times of day are important accident facts, they cannot be shown on a spot map without destroying its value for graphic representation.

Specifications for accident spot maps will largely depend upon local conditions, particularly the size of the area to be mapped. In

several surveys I have used 1/8-inch black India ink spots on maps of a scale of 600 to 1,000 feet per inch. When such a map is reduced for use in a printed report, the street lines and names are still visible and the spots show clearly.

Black spots of different design are better for distinguishing between the significant classes of accidents than different colored spots. Distinction between colors will not be shown in photographic reproduction. For several years I have indicated pedestrian accidents by circles in black India ink, and all other motor vehicle accidents by black dots. Where there is an appreciable number of accidents of the third class listed above, another symbol is necessary, a square or triangle. But in many cases these are so few that they can be combined with the "all other motor vehicle" group under a classification of "all other traffic accidents."

Pins with heads of different design can be used in a mounted map where photographic reproduction is not intended and permanence is not important. But such a map can be neither transported nor stored conveniently because the pins are apt to drop out. Confusing shadows are likely to result in photographing, Usually a spot map that is worth making is worth preserving as a permanent record for comparison with subsequent maps.

The useful spot map, then, shows a limited number of different kinds of accidents classified by types of traffic units involved. All the spot map can do successfully is reveal that a certain number of accidents were distributed over the area covered by the map in a specified period of time with a limited number of points, streets, or areas shown to be particularly hazardous.

But this is vital to a successful accident prevention program. It is the necessary first step in a traffic accident study by the engineer, the enforcement official, or the promoter of a campaign of traffic education. Where the spot map as a means for visualizing the distribution of the traffic problem ends, methods for detailed study of the hazards at individual locations begin.

COLLISION DIAGRAMS

Their Uses in Detecting and Solving Traffic Engineering Problems

After the traffic accident spot map has localized the traffic problems, detailed study must be given each revealed danger spot or area to decide upon corrective measures. For this purpose the engineer should visualize by graphic methods the occurrence of each accident. The collision diagram furnishes the best means yet devised for doing this.

Nothing can reveal quite so clearly how an individual traffic accident occurred as a diagram showing the paths of vehicles, street cars, railway trains, or pedestrians involved. A collision diagram is simply an outline map of a given street location on which several such accident diagrams have been plotted.

Figures 2 and 3 show two steps in the cumulative development of a collision diagram. They show the accidents that occurred at the intersection of Main Street and Ridge Avenue, Evanston, during 1930. The arrows show the approximate paths of the vehicles and pedestrians, and the dates and hours show the seasonal and daily trends in the accident experience. Figure 2 shows the first eight accidents at this location. The seven accidents added in Figure 3 further emphasize the turning hazards and, in addition, pedestrian accidents began to appear.

For several years traffic at this intersection has been controlled by automatic signals. They operate on a total cycle of 60 seconds, 39 seconds of "Go" north and south, 18 seconds east and west, and 3 seconds of change interval between the green and red in each direction. The right-angle collisions on the diagram indicate either poor operation of the signals or frequent violations. One important investigation at this location was to determine whether the signals were accurately timed

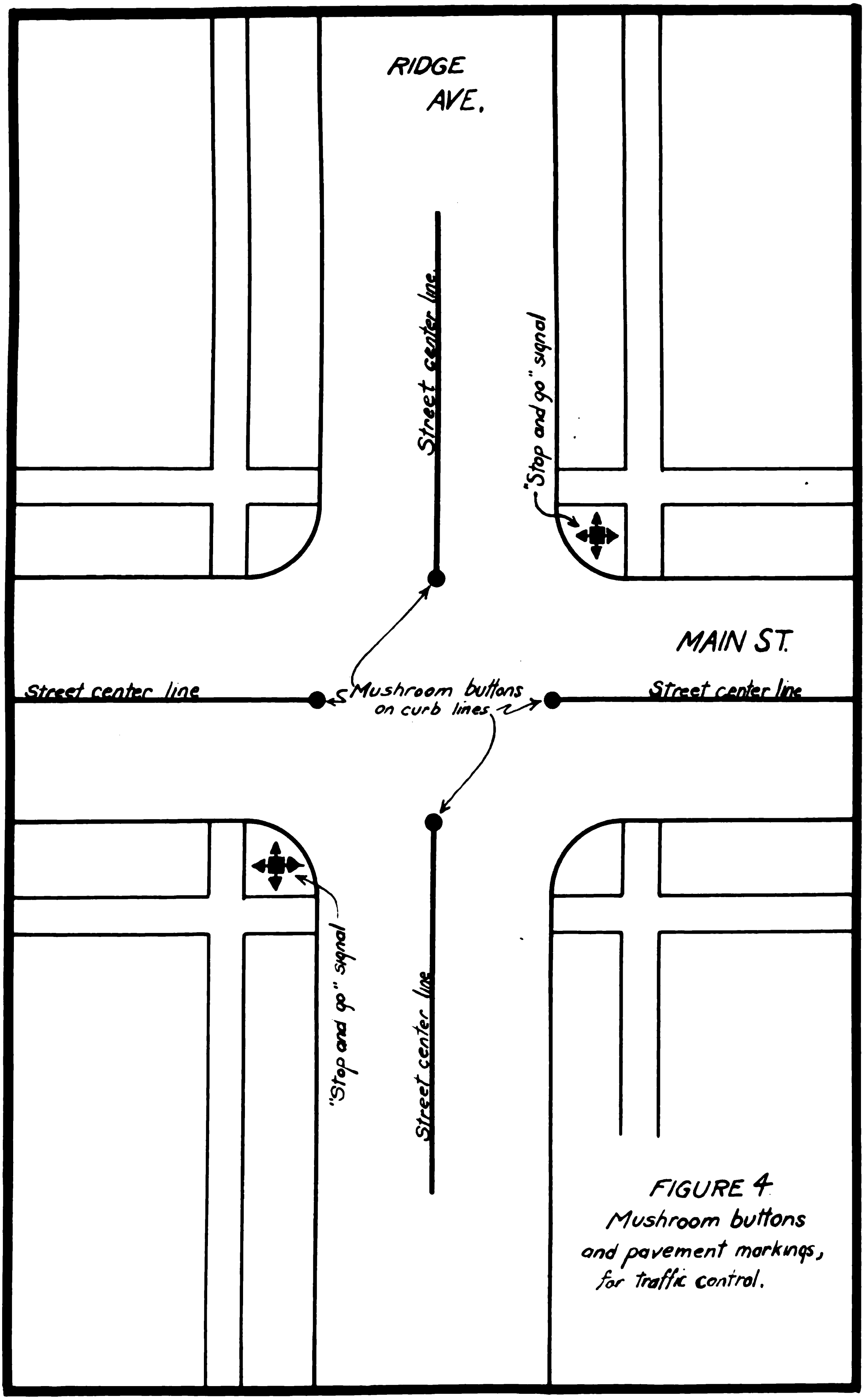


FIGURE 4
Mushroom buttons and pavement markings, for traffic control.

to handle the traffic safely and avoid delays.

Traffic counts were taken at representative half-hour periods during a normal business day, and a recently developed formula for signal timing was applied to determine the length and division of cycle for best accommodation of the traffic flow. (See formula in appendix) From this computation it was shown that a total cycle of 40 seconds, with 20 seconds of green north and south, 12 seconds of green east and west, and 4 seconds of change interval between the green and red each way, would be adequate to handle the traffic flow at the peak which occurs between 5:00 and 5:30 P.M. With the cycle now 20 seconds too long for peak traffic, it can be easily seen that during the major part of the day the delays are much greater, averaging nearly 50 per cent of the total cycle. The right-angle collisions occurred during the periods of lighter traffic showing the effect of traffic delays on accidents at signalized intersections.

Quite a different condition was responsible for the turning accidents. Observations showed that left turns, particularly from the north, were often being made at unsafe speeds. Such turns were started before reaching the intersection and were made by cutting the corner, across the path of oncoming vehicles. Right turns were often made from the wrong lane of traffic, near the center of the street, instead of from the lane next to the curb. Too high speed often carried these vehicles across to the far side of the intersecting street and sometimes into collision with standing or approaching vehicles.

Figure 4 shows the arrangement of traffic markers and lines that was recommended for requiring these turns to be made more abruptly from the proper position in the street. Traffic would be required to keep

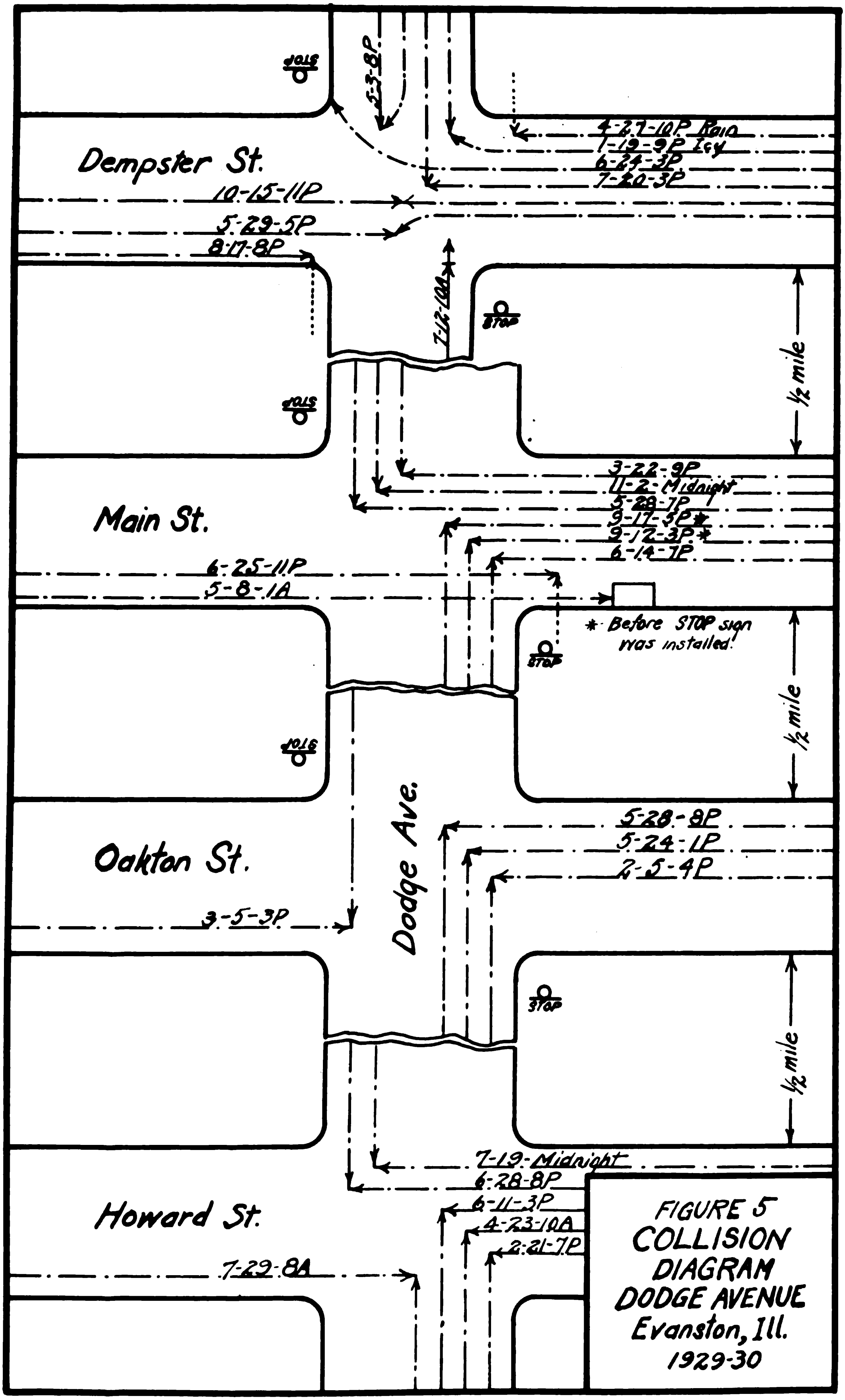


FIGURE 5
COLLISION
DIAGRAM
DODGE AVENUE
Evanston, Ill.
1929-30

to the right of the buttons and avoid crossing center line markings in making turns..

Figure 5 is a collision diagram used in the study of the accident problem on Dodge Avenue. This street was opened to traffic after paving late in the summer of 1929. When this diagram was prepared a year later, it revealed twenty-seven accidents at the intersections with Howard, Oakton, Main, and Dempster Streets. Three deaths, several injuries, and much property damage resulted.

"Stop" signs had been installed at Oakton, Main, and Dempster Streets, warning drivers on Dodge Avenue to stop before entering these streets. But the high frequency of right-angle collisions at the first two of these intersections indicated that they were no safer than the intersection of Howard Street and Dodge Avenue where no "Stop" signs had been installed.

There was some agitation for making Dodge Avenue a "through street" with all vehicles required to come to a full stop before entering. But the heavier cross traffic at the important intersections made it impracticable to give the traffic on Dodge Avenue the preference, and the older "Stop" signs were displaced by new illuminated ones in the same positions and similar signs were installed at Howard Street. Then no driver could plead that he "could not see the stop sign" as a defense in case of arrest for failure to stop.

But several accidents had occurred during daylight when there could be little question about visibility of the older signs. Enforcement was needed. Motorcycle officers were assigned to patrol the street and watch for violations. The police court imposed maximum fines upon traffic violators. The result was the elimination of all accidents for more than six months. The spot map had called attention to the problem, the collision diagram had revealed its character, traffic observations had shown the relative volumes of traffic on the different streets, and these had obtained agreement upon successful measures of control and regulation.

Another type of accident problem is shown in Figure 6. Main and Third Streets in Richmond, Va., intersect in a business district. The former is an important east and west thoroughfare and carries much heavier traffic than the latter, which leads north fifteen blocks from the James River and terminates at an unimportant street. Main Street has a double track street car line.

The collision diagram shows how the accidents have grouped at three of the four corners of the intersection. It is apparent that any regulations or safeguards should relate to conditions on the northwest, southwest, and southeast corners. Stores obstruct the view across the northwest and southwest corners, but no obstruction to view is apparent on the southeast corner which is occupied by a gasoline filling station. In contrast with this only one accident occurred at the northeast corner, though a store obstructs the view.

This case illustrates a condition that the collision diagram often reveals. Hazards that are plainly apparent to drivers cause few accidents, while those that are not apparent often cause many. The collision diagram method of studying traffic hazards helps to identify conditions that are actually causing accidents. It prevents expenditures for measures that are not applicable to existing hazards.

It was evident that obstructionsto view on the northwest and southwest corners could not be eliminated and that future accidents must be prevented by regulating driving practices in approaching these corners rather than by physical changes. Computations of safe approach speeds were made. (See appendix for formulae)

Observations showed approximate speeds of 25 miles per hour east and west on Main Street. The computations showed that to permit this speed, vehicles should not approach the intersection from the south at a speed exceeding 7 miles per hour, and from the north at a speed exceeding 9 miles per hour. A "Slow" sign was believed to be sufficient warning to reduce speeds from the north to 9 miles per hour and such a sign was recommended at the north approach to the intersection. But a "Slow" sign was not considered adequate warning to reduce speeds from the south to 7 miles per hour and a "Stop" sign was recommended at that approach. This sign would protect both the southeast and southwest corners, and further investigation of the hazards in the south approach was not considered necessary.

Parking near the intersection often further obstructs the view across the corners. As the new restrictions will require all vehicles from the south to stop, this obstruction across the southwest and southeast corners will not be hazardous. Since only a "Slow" sign will protect the northwest corner, no parking can be permitted to obstruct the view past the store building. No parked vehicle should extend into the "visibility triangle" used in computing safe speeds, as shown in the appendix. This required prohibition of all standing of vehicles within 50 feet of the intersection on the north side of Main Street west of Third.

Another important use of the collision diagram is to determine the effect of measures for prevention on the accident experience. Comparison of diagrams for corresponding periods before and after making a change

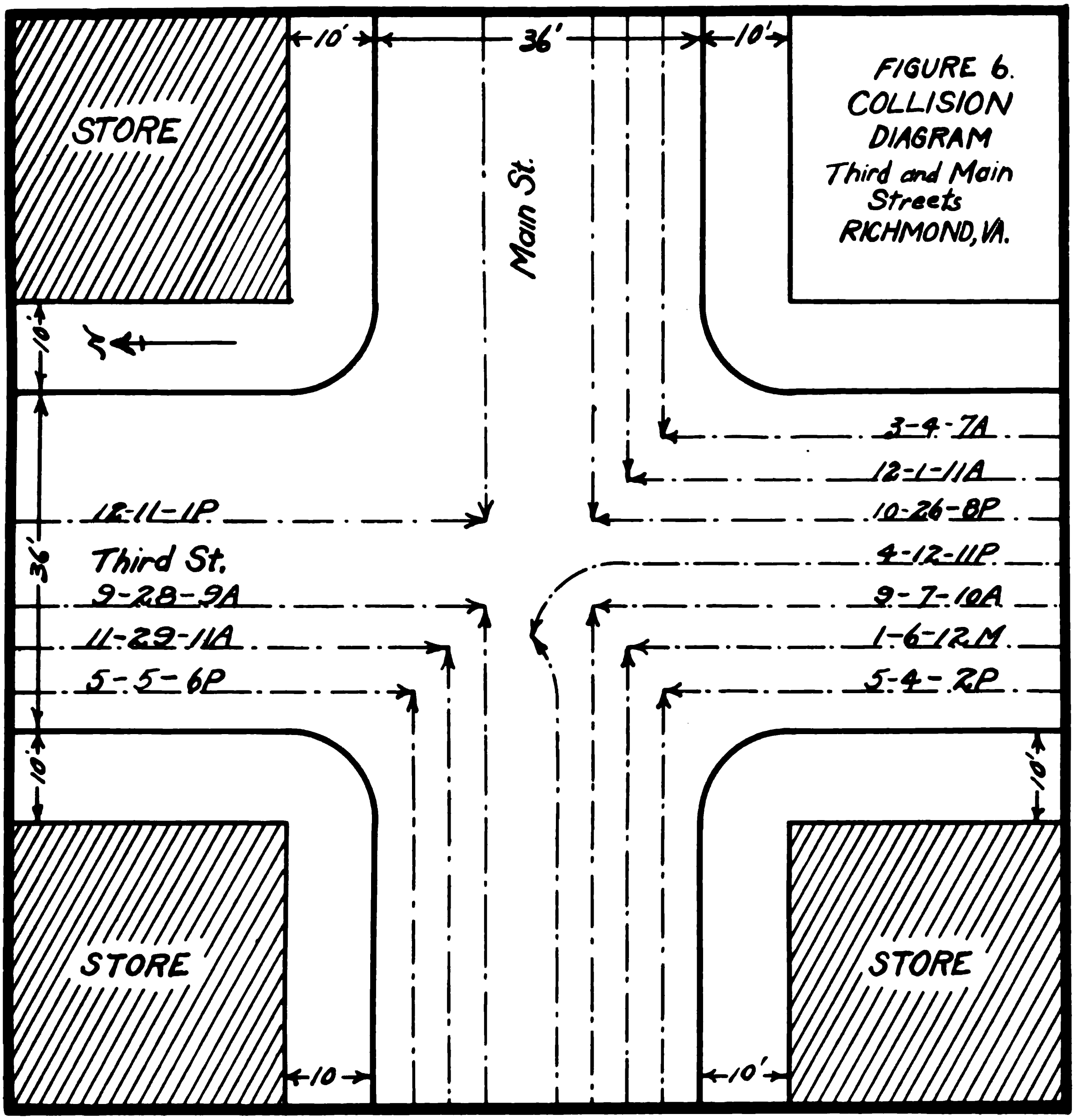


FIGURE 6. COLLISION DIAGRAM Third and Main Streets RICHMOND, VA.

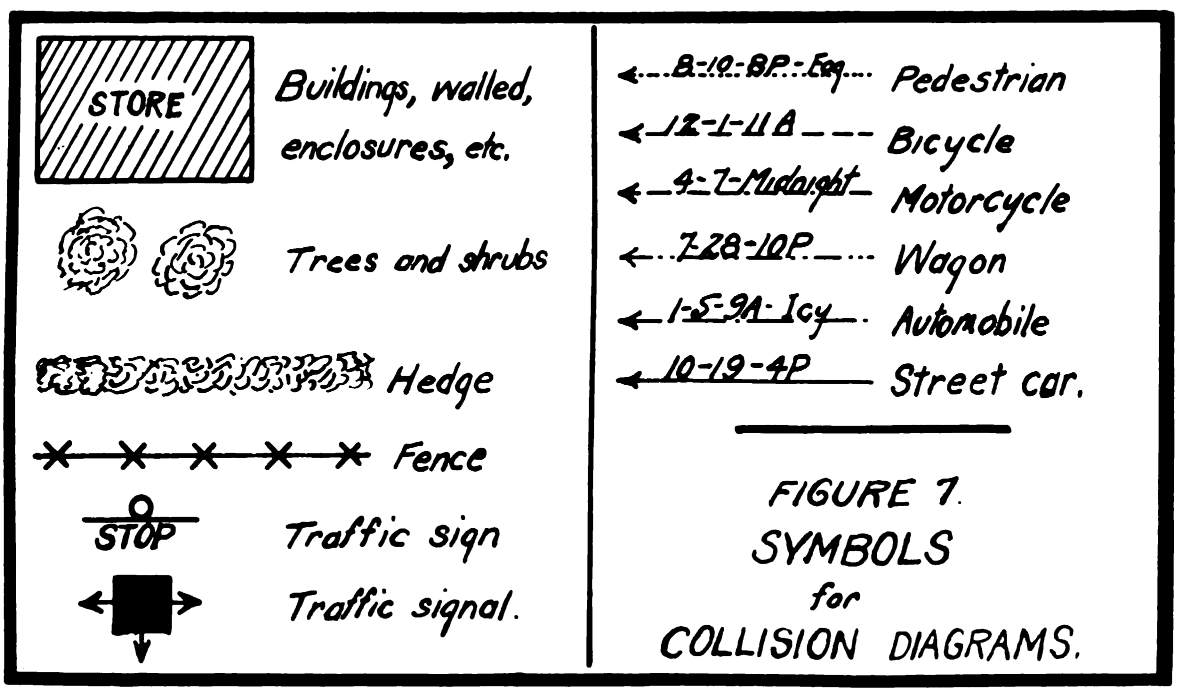


FIGURE 7. SYMBOLS for COLLISION DIAGRAMS.

shows the kinds of accidents that have been prevented as well as any new types that have resulted. The second diagram should be drawn as soon as sufficient time for comparison has expired after the improvements have been made. If similar accidents continue, the corrective measures have failed. If certain types disappear, the measures were only partially successful.

The collision diagram enables the engineer to avoid measures that are not adapted to the accident experience. For example, a "Stop and Go" signal will be useless in preventing head-on or rear-end collisions at an intersection. It will not protect pedestrians crossing diagonally. But it can prevent right-angle collisions if the traffic volume warrants its installation and if it is properly located and timed. And it can protect pedestrians who cross in obedience to it. The collision diagram shows which of these and other movements must be protected.

The collision diagram has not been used long enough to develop extensive specifications. In fact, these may be varied materially to meet local conditions. But from the use of more than a hundred diagrams, I have developed certain specifications that I have found convenient and practical.

The experience used in preparing a collision diagram should cover at least a year to include seasonal hazards. Less than three accidents of one kind should not be considered significant. No diagram with less than five accidents should be used unless three or more are of the same type. A large number is preferable.

Like the spot map, the collision diagram should omit confusing details. The curb lines should be shown to indicate the general street layout. The approximate path and direction of travel of each traffic unit in each accident should be shown. The dates and hours are important, the former identifying the accidents with seasonal trends and the latter with hourly traffic fluctuations. Where the information is given it is often desirable to add brief statements of weather and road conditions, such as "rain, slippery," to identify hazards that exist only in such special cases.

Physical features adjacent to the roadway that affect the hazards may often be shown on the collision diagram. These include buildings, walls, trees, shrubs, signs, and signals. Special features of the roadway, such as street-car tracks and unusual grades, can seldom be shown because they will be confused with the accident data. When there is any chance of such confusion, a supplementary diagram should be prepared to show these conditions. For computations of safe speeds at intersections, the widths of roadways, the distances of obstructions to view from the curb lines, and the common parking practices adjacent to the intersection must be known.

The symbols that I have found must useful in preparing collision diagrams are shown in Figure 7. Moving street cars, vehicles, and pedestrians can best be shown by lines representing their paths. For stationary objects, such as parked or standing vehicles, trees, poles, and monuments, symbols indicating size or shape must be used.

The collision diagram should not be carried to a greater degree of refinement than is necessary for the purpose for which it is used. For a preliminary study a rough pencil drawing will be adequate. When it is to be photographed, blueprinted, or reproduced in a printed report, it should be drawn to scale and inked in. A scale of 10 feet to the inch is usually convenient for this purpose.

Proper visualization is the best aid to solving traffic accident problems. The collision diagram can carry this to any degree of completeness that accident records will permit. Circumstances not discussed here can be shown and perhaps should be in some unusual cases. But the same time applied to several studies is usually more important than extreme refinement in drawing the diagram for a single location.

TRAFFIC ACCIDENT STATISTICS

Their Uses and Limitations in Traffic Engineering

The spot map and collision diagram deal with traffic accidents individually, retaining the identity of each accident. They are most useful in identifying and treating locations of greatest hazard - "case studies" in traffic engineering.

Mass statistics compile and classify the same circumstances of many accidents to determine which are most common and most need attention. Individual accidents lose their identity in such compilations. Many different classifications of accident circumstances can be made to suit best the uses that are to be made of them. Some that are considered particularly valuable for traffic studies are discussed here.

TABLE 1.

Persons Injured and Killed in Traffic Accidents
Evanston, Illinois
1930

Type of Accident	Age Groups of Victims					
	All Ages	0-4	5-14	15-64	65 and Over	Unclassified
Motor Vehicle - Total	367	25	75	232	31	4
M.V. with Pedestrian	137	12	43	65	17	-
M.V. with M.V.	171	10	17	131	13	-
M.V. with Electric Car	5	-	2	3	-	-
M.V. with Bicycle	19	-	6	11	-	2
M.V. with Horse Vehicle	5	-	1	4	-	-
M.V. with Fixed Object	13	1	3	8	-	1
Non-Collision Operating	13	2	3	7	-	1
Non-Operating	3	-	-	3	-	-
Unclassified M.V.	1	-	-	-	1	-
Other Traffic - Total	46	-	16	25	5	-
Railroad - not with M.V.	2	-	-	2	-	-
Electric Car - not with M.V.	1	-	-	1	-	-
Other Vehicle- " " " "	10	-	5	5	-	-
Other Street Accidents	33	-	11	17	5	-
Total Traffic	413	25	91	257	36	4

A common classification of traffic accidents is by age groups to determine what ages are most commonly involved in accidents. Table 1 is such a classification of the ages of persons injured and killed in traffic accidents in Evanston, Ill., during 1930. It shows the types of accidents to which the different age groups are most susceptible. For example, take the two most common types of motor vehicle accidents, "Motor Vehicle with Pedestrian" and "Motor Vehicle with Motor Vehicle." In the pre-school age, the number of pedestrians was slightly higher than the victims of motor vehicle collisions. But in the group of school age pedestrian injuries were much higher. Then in the third group, ages 15 to 64, injuries from collisions were much higher. In this group the use of motor vehicles was more common and the use of the streets by pedestrians somewhat more cautious. Among the aged, pedestrian accidents predominated again. This table revealed clearly the need of safeguarding the young and the aged pedestrians in all localities where they commonly use the streets - in densely populated districts, near schools and playgrounds, and at institutions for the aged.

TABLE 2.

Violations Involved in Motor Vehicle Accidents
Evanston, Illinois

Violations	Drivers Violating	Per Cent
Exceeding speed limit	48	41.1
Did not have right-of-way	25	21.3
Failed to stop for "Stop" sign	15	12.8
On wrong side of road	9	7.7
Cutting in	6	5.1
Improper turning	5	4.3
Disregarded officer or signal	4	3.4
Failed to signal	2	1.7
Drove off roadway	2	1.7
Passing on wrong side	1	0.9
Total	117	100.0

Table 2 classifies the violations of 117 drivers who were involved in motor vehicle accidents. Illegal speeds stood at the top. Contesting the right of way at street intersections was next. Failure to stop at "Stop" signs was third, with other less important violations forming a minor part of the total. What could be more helpful to the enforcement officials of a city than such an indication of the violations on which their emphasis should be placed?

TABLE 3.

Residence of Drivers in Motor Vehicle Accidents
Evanston, Illinois

Residence	Drivers	
	Number	Per Cent
Out of State	3	0.8
Out of City	186	46.6
Resident of City	210	52.6
	399	100.0

Owing to the large amount of through traffic in Evanston, another important traffic problem is the non-resident driver. Table 3 shows 399 drivers who were involved in accidents, classified by places of residence. Nearly half were from outside the city. Among these the local enforcement and educational program had not been so effective as among local drivers with a much greater mileage in the city. This table showed the need for careful selection of the locations and types of traffic signs and markings to warn drivers regarding the local regulations and danger points.

TABLE 4.

Actions of Pedestrians Involved in Accidents
Evanston, Illinois

What Pedestrian Was Doing	Pedestrians	
	Number	Per Cent
Crossing at intersection, with signal	7	5.6
" " " against signal	7	5.6
" " " no signal	51	41.2
" " " diagonally	3	2.4
Crossing between intersections	22	17.8
Playing in street	11	8.9
Riding or hitching on vehicle	5	4.0
Getting on or off street car at safety zone	1	0.8
Getting on or off other vehicle	4	3.2
At work in roadway	3	2.4
Unclassified	10	8.1
	124	100.0

Table 4 shows what 124 pedestrians were doing when they were injured. More than 40 per cent were crossing street intersections without the protection of traffic signals. Nearly 18 per cent were crossing streets between intersections where they were not expected by drivers. Nearly 9 per cent were using the street for a playground. The remainder were scattered over eight minor classes. This classification showed what pedestrian hazards should be emphasized in training the public for traffic safety.

These are a few of the important classifications for compiling traffic accident statistics. The monthly summary form of the Standard Accident Reporting System, shown in the appendix, gives the most commonly used classifications forperiodic compilations. Where there is access to the original accident reports, other classifications may be desirable for special studies. For this purpose, as well as for providing the records for detailed location studies, the original accident reports should be carefully preserved.

To guide the community's traffic activities, the engineer should arrange for periodic classification of the traffic accident experience. He should see that these compilations are regularly studied to ascertain what results are being obtained from the different phases of the traffic program. He should see that emphasis is shifted as accident trends change, so that the community may derive the greatest benefit from its traffic engineering, legislative, educational, and enforcement activities, as expressed in lives saved, injuries prevented, property damage avoided, and traffic congestion relieved.

ACCIDENT FACTS REQUIRED FOR ENGINEERING STUDIES

A traffic accident report should give facts that will aid in preventing future accidents of the same kind. It should provide some information that is useful in identifying and prosecuting traffic law violations. It should provide much information that is useful in making studies for correcting unsafe conditions. This section is devoted to discussion of the information for engineering study that must be recorded at the time of the accident.

The report should tell clearly where the accident occurred. This information is necessary for plotting the accident on a spot map or a collision diagram. The required degree of accuracy depends upon the kind of accident and the character of the location. If a pedestrian is struck in a crosswalk at an intersection, the report should state which walk; if near an intersection, the direction and distance from it. If two vehicles collide the report should show that it occurred within a stated intersection or indicate the distance and direction from the intersection. If a vehicle strikes a stationary object, the report should state the location in distance and direction from an intersection or other fixed point.

In a rural district a location between intersections should be shown in feet in a stated direction from a numbered survey station, culvert, bridge, curve, or other fixed point that can be located on a spot map. If the accident occurs on a straight, level highway, statement of location within 100 feet is accurate enough. Before an accident report is accepted, it should be checked to make sure that the accident can be located on a map or a collision diagram.

The direction of travel of each traffic unit involved in an accident is necessary for preparing the collision diagram. This should include the direction from which it approached and the movement that was being made when the accident occurred. At an ordinary four-way intersection, a vehicle approaching from any direction may collide with another vehicle in any one of at least seventeen combinations of movements. Each of these combinations is a distinct type of accident.

The date of an accident fixes it in the cycle of seasonal hazards. Five accidents of a given type at a single location may indicate the need for much different treatment if they occur in a single month than if they are scattered over the year. In the first case a seasonal obstruction to view such as the foliage of a hedge or tree may be the cause. But if scattered over the year some more permanent cause should be sought.

The time of day is quite as important as the date. It relates the accident to hourly changes of traffic volume and conditions of daylight and darkness. For engineering purposes, statement of time to the nearest hour is close enough.

Weather and road surface conditions may have considerable effect on accident occurrence and prevention. For example, a down-grade approach to a street intersection may be hazardous only when it is slippery. But if many accidents occur, then some regulation favoring vehicles approaching from that direction may be necessary. Each accident report should state whether the weather was fair, cloudy, foggy , rainy, or snowy. It should also show whether the road surface was dry, wet, muddy, snowy, or icy.

The types of traffic units involved in an accident should be shown. A statement of whether the units were motor vehicles, street cars, horse-drawn vehicles, or pedestrians will aid in reconstructing the picture of the accident and determining what kind of improvements can be considered. For example, street car movements are governed by the track layout, motor vehicles have greater freedom, and pedestrian movements are the most elastic.

The condition of the driver or pedestrian is significant. Evidence of intoxication, physical defect, or other abnormal condition is valuable for enforcement but should seldom be considered in making engineering studies.

The extent of injury or damage inflicted by each accident gives some indication of the seriousness of the problem at that location. The number of persons injured in a single accident is, of course, largely a matter of chance, depending upon the number of persons involved in the accident. But the number of accidents in a group that involved personal injury or death may determine whether the hazards are serious or minor.

The foregoing circumstances are the most important ones for engineering study. They are circumstances that are constantly changing and must be recorded at the time of the accident. For purposes of enforcement, other important information is needed, such as names of witnesses, names of participants, and license numbers of vehicles, none of them of much significance for engineering study. For public education still other circumstances are desirable, such as the ages, sex, and residences of the drivers and the persons injured. A complete accident report must provide the information that makes the accident record most useful for any of the four important features of traffic administration - engineering, legislation, public education, and enforcement.

FACILITIES NEEDED FOR RECORDING AND STUDYING TRAFFIC ACCIDENTS

The possibility of using the methods of study outlined here depends first upon the accident records that are available. In too many cases inadequate report forms afford only a part of the desirable information regarding each accident. In other cases only a part of the accidents are reported at all. Again, reports may be filed in such a way that all of those for a given location are available only after search through an entire file. This discourages the use of accident records for individual location studies. In many cities and states the responsibility for making thorough statistical and engineering studies of the traffic accident records has not been placed in any department, and much of the value of the available accident records is being sacrificed on this account.

Every traffic accident should be reported. Unless there is a state law requiring such universal reporting by those involved in accidents, every city should have its own compulsory reporting ordinance. Some jurisdictions require the reporting of only those accidents that involve personal injury. Others go farther and require, in addition, the reporting of all accidents involving property damage of more than a specified minimum amount (some $25, others $50). A low limit is desirable to provide the maximum number of reports at a given location and as great a spread of accident experience as possible. The circumstances of two different accidents may be so similar as to give them practically equal weight in traffic engineering studies, yet circumstances of no significance in prevention may cause one to result in only property damage and the other in the deaths of one or more persons.

To meet the needs for an adequate traffic accident reporting system, the National Safety Council in cooperation with city police departments and state departments of motor vehicles has developed the Standard Accident Reporting System. The basis of this is a model accident report card designed to obtain the necessary information for detailed study and permanent record. In several states the departments of motor vehicles and highways have adapted this form to their needs for rural highway reporting. In the appendix are exhibited copies of the Standard Accident Reporting card, a monthly summary form, and the report form of the Indiana State Highway Department. It should be pointed out that this is not a copyrighted or commercialized system but has been developed by the National Safety Council and endorsed by the International Association of Chiefs of Police and the National Conference on Street and Highway Safety as a model for local use.

Filing systems for accident reports should be designed to provide most quickly the information for which there is the greatest demand. Formerly accident records were kept for the information of interested persons - attorneys, newspaper reporters, and relatives of victims. Requests for information were usually made by the names of drivers or injured persons, and the reports were often filed by these names in alphabetical order. Some cities continue to use this method.

But many cities and states are realizing that the greatest benefit to be derived from keeping accident records is the prevention of similar accidents at the same or other places. For this purpose, the best method of filing is by locations. In a city an alphabetical file of streets with the intersecting streets along them kept in alphabetical order is the most satisfactory. The cards for accidents at Main Street and Ridge Avenue would thus be placed in the Main Street file at the Ridge Avenue intersection. Of course, there are some cases where reports may be filed in either of two places because of complicated intersections; but a warning card is inserted in one place calling attention to the other.

Other methods of filing by location may be preferable in certain communities because of special conditions. But, in general, this method is the one most widely adaptable. For accidents between intersections in municipalities, a separate file by streets and street numbers is preferable, although these accidents may be filed with those for the nearest street intersection. For rural districts the entire filing system may need to be upon a different basis. Accident reporting is relatively new in rural areas and filing methods are yet largely to be developed on the basis of the different means of designating locations.

Who shall condust the traffic engineering studies in any given state and city? These studies are technical in nature and experience has shown that engineers only are likely to become interested in conducting them. But every traffic jurisdiction should prepare itself to have such studies made regularly by some division of its engineering staff.

In the state government, the logical place is in or closely related to the state highway department. Being responsible for the design and maintenance of highways, this department should avail itself of all possible information from the highway accident experience. Highway widths, elevation of curves, alignment, and safeguarding, all must be governed by the requirements for safe travel if the highway is to be a success. Accidents reveal the failures in existing highways and their circumstances often point to the proper remedies and conditions to be avoided in future construction.

Legislation governing the use of the highways is not likely to be passed until the state highway department has been asked for recommendations. Much of such legislation is for safe use of the highway. In the absence of accident experience, properly gathered and assembled, who can advise regarding the propriety of proposed legislative measures?

The enforcement of state traffic laws on the rural highways is sometimes a responsibility of the state highway department. But wherever the responsibility may be placed, the enforcement program, the installation of signs and signals, and the proper dispatching of highway patrols should be governed by the accident experience. The guesswork of well-meaning officials is not sufficiently accurate. Proper investigation of the facts regarding the accidents will enable the highway department either to guide its own enforcement policy or recommend to the proper enforcement agency the steps for safer and better use of the highways which that department is building.

The proper organization for handling technical traffic studies is subject to greater variation among cities of different sizes. In large cities like Chicago, Pittsburgh, and Philadelphia, the establishment of a Traffic Engineering Department is justified. Such a department usually has a staff of considerable size and it may properly be connected with the city's Department of Public Safety, its Department of Public Works, or other department.

In many cities the problem is not yet considered large enough to warrant the establishment of a separate division or city department. In such cases the City Engineer should assign a man in his department to devote as much attention to traffic engineering studies as the problem requires. In most small cities it will probably be less than the full time of one man qualified to direct such activity. He may require part-time assistance of draftsmen or clerks, with none of the demands sufficiently large to require full time.

A state or city sacrifices one of its most valuable aids when it fails to use facts regarding its traffic accidents for guidance in the design of its streets and highways, in the detection of hazards and danger points, and in the formulation of plans for better traffic regulation. The methods used in studying these data must, however, be properly applied to avoid incorrect conclusions from valuable information. For guidance in the traffic legislative, educational, enforcement, and engineering activities, such studies require facts which are properly gathered, filed, and classified.

APPENDIX A

Formula for Timing Traffic Signals

(Developed by the author in cooperation with other traffic engineers)

Any setting of a traffic signal must be able to handle the maximum traffic demand in each direction. If the setting is changed two or more times daily or if special changes are made for Sundays or holidays, this must apply to each setting.

So-called fixed-time signals operate automatically on an established setting. Traffic-actuated signals may have certain fixed-time settings within which the signals operate in accordance with the demand made through vehicle detectors placed in each approach to the intersection. The formula developed here gives the desirable length and division of the cycle for an observed maximum traffic flow in each direction.

Vehicles approaching a traffic signal in a given direction have an average spacing that depends upon the amount of traffic, the number of lanes, and the amount of interference by parked cars, street cars, and pedestrians. When the signal stops the traffic, the vehicles accumulate until they are released. Then they leave the intersection with a more compact spacing which is also determined by the character and use of the street.

When the "Go" signal is given, the accumulated vehicles must start from rest. Some arriving later will need only to slow down. Finally, all these delayed vehicles will have passed in a compact group and those following will be able to go through the intersection without changing speed. When this occurs the greater spacing makes the use of the intersection inefficient and the signal should change to red to compact another group while traffic crosses on the intersecting street.

On this basis the time which must be allotted to the green in any single direction may be computed thus:

Let n = Number of vehicles crossing the intersection in one direction in 15 minutes. This should be the maximum quarter hour in the period during which the signal is to control traffic on a single setting. If the signal is changed two or more times a day, it should be set for the maximum quarter hour in each period. n should be the number of vehicles crossing in the major flow, rather than the total number approaching from a single direction.

s = Average spacing of the vehicles in seconds as soon as normal speed is attained in the major flow after leaving the intersection. This is determined by counting the number of vehicles that cross in a compact group and determining the number of seconds required for them to pass a given point 50 to 100 feet beyond the intersection. Omit the first vehicle from each group in the count, sum up the total number of vehicles and seconds, and divide the time by the number of vehicles to obtain the spacing in seconds.

t = Length of total cycle of red, yellow, and green in seconds.

g = Length of green in seconds.

y = Length of yellow in seconds.

Then $\frac{nt}{900}$ is the average number of vehicles passing the intersection from this direction in each cycle during the peak traffic flow.

$\frac{snt}{900}$ is the number of seconds required for these vehicles to pass a given point after attaining normal speed.

Since the leading vehicles must start from rest, some time must be added for acceleration in determining the required amount of green signal. The accelerating distance is $\frac{v^2}{2a}$. For uniform movement, to go this same distance would require $\frac{v^2}{2a} \div v = \frac{v}{2a}$ seconds, where v is in miles per hour and a is in miles per hour per second. But for accelerated movement, the time is $\frac{v}{a}$ seconds. The delay is $\frac{v}{a} - \frac{v}{2a} = \frac{v}{2a}$.

Assuming a conservative acceleration of 3 miles per hour per second, the delay in seconds is $\frac{v}{2 \times 3} = 1/6v$, where v is the speed in miles per hour attained upon leaving the intersection.

The total necessary time for green in this direction is $g = \frac{snt}{900} + 1/6v = .0011snt + 1/6v$. For the ordinary four-way intersection, a green signal controls traffic from two opposite directions and the green period for the direction with the greater value of .0011sn at its traffic peak should be used.

The value of g for the other pair of directions can be computed in the same manner after making the necessary observations. Then the total cycle

$$t = .0011s_1n_1t + 1/6v_1 + y_1 + .0011s_2n_2t + 1/6v_2 + y_2$$

and solving, $$t = \frac{1/6(p_1 + p_2) + y_1 + y_2}{1-.0011(s_1n_1 + s_2n_2)}$$

The speeds v_1 and v_2 in miles per hour must be estimated from general observations.

When t is computed, the length of the "Go" period in each direction is shown by the formulae

$$g_1 = .0011s_1n_1t + 1/6v_1 \quad \text{and} \quad g_2 = .0011s_2n_2t + 1/6v_2.$$

Applied to the signal at Main Street and Ridge Avenue, this formula works out as follows:

Observations showed the heaviest movement on Ridge to be from the north, 175 vehicles in 15 minutes. Then

$n_1 = 175$, $s_1 = 1.8$, $v_1 = 30$.

For east and west traffic,

$n_2 = 50$, $s_2 = 3.35$, and $v_2 = 20$.

Then $$t = \frac{1/6(30 + 20) + 8}{1-.0011(1.8x175+3.35x50)} = 34 \text{ seconds.}$$

This assumes 4 seconds of yellow in each direction.

A cycle of less than 40 seconds is seldom used and this was assumed as the proper length. Then $g_1 = 20$, $g_2 = 12$, and two periods of yellow = 8, giving the total cycle of 40 seconds.

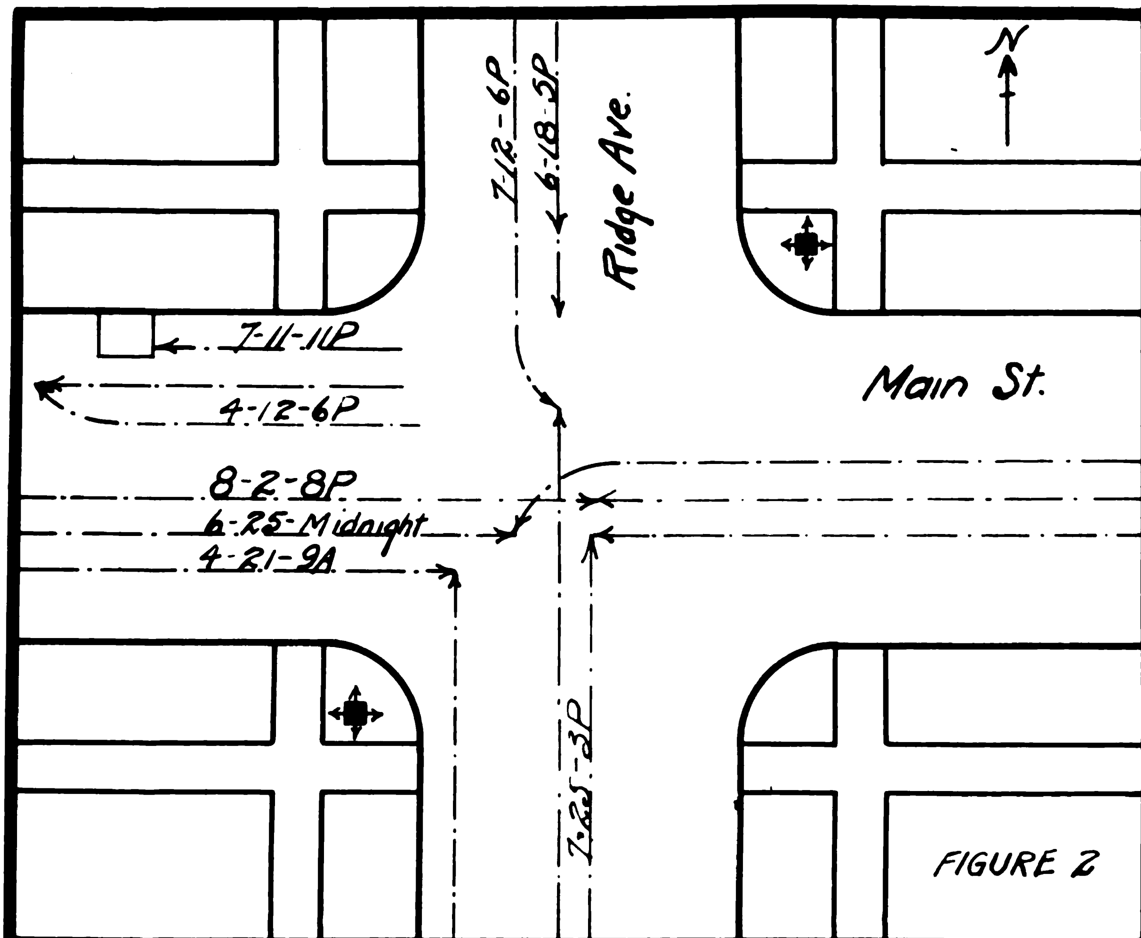


FIGURE 2

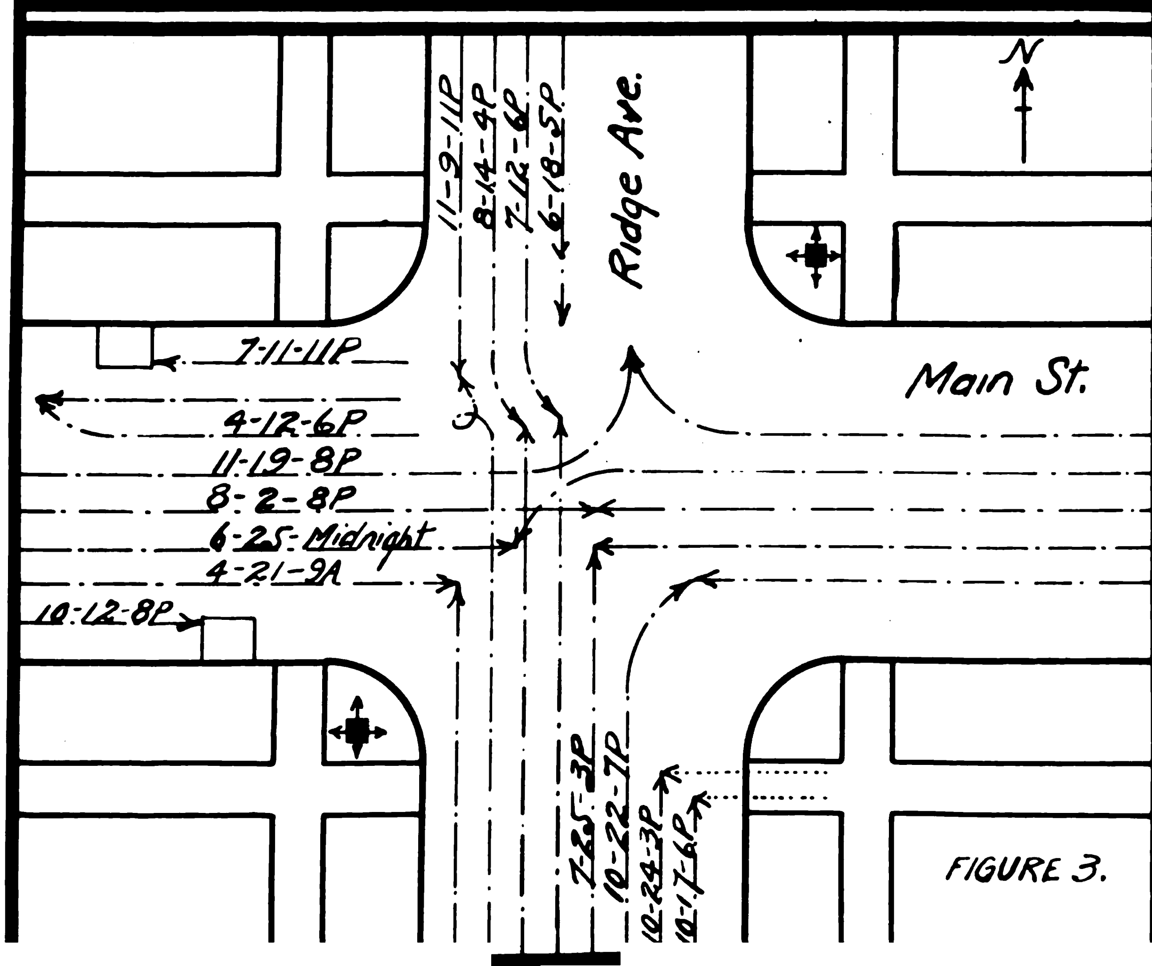


FIGURE 3.

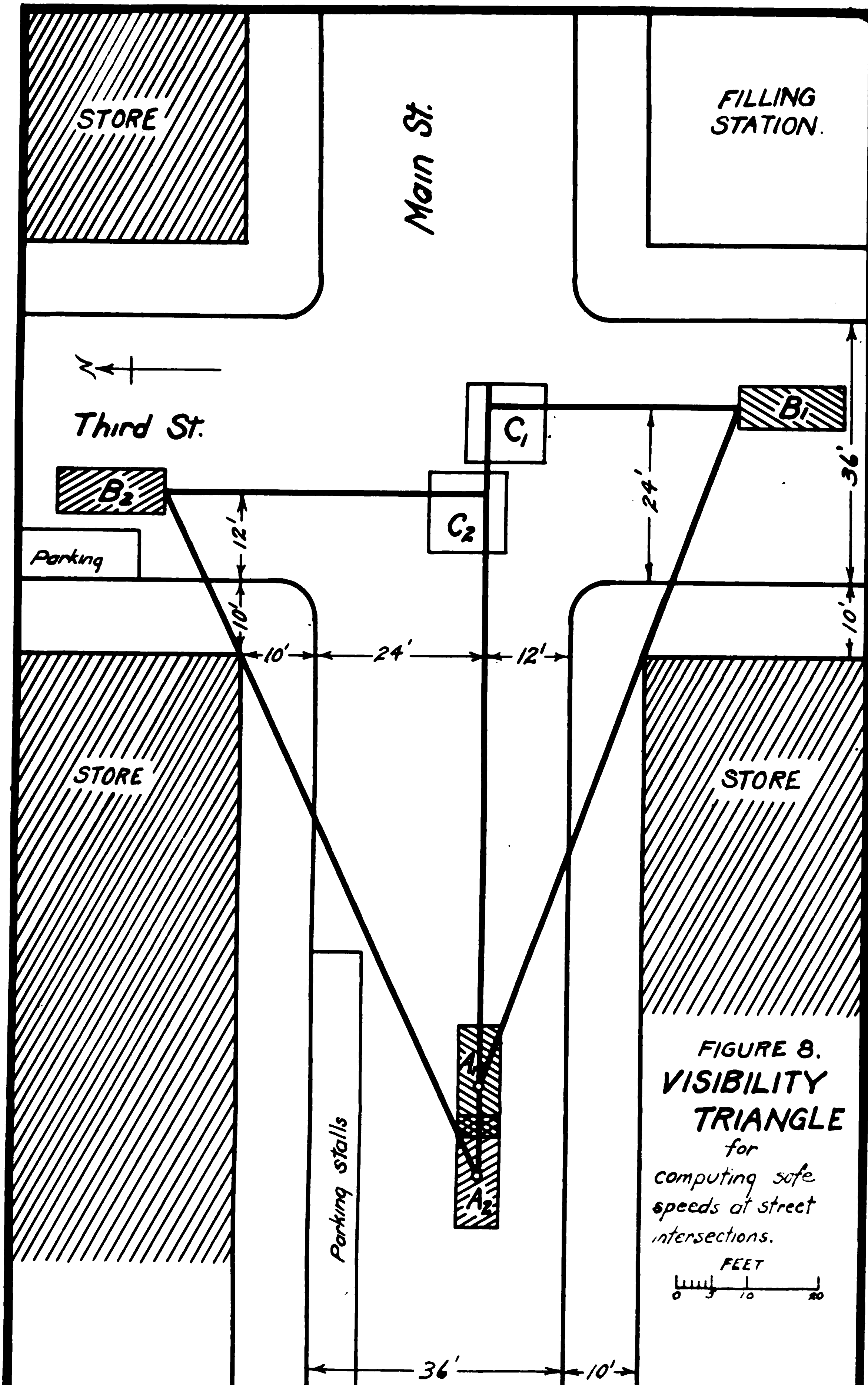


FIGURE 8.
VISIBILITY TRIANGLE
for computing safe speeds at street intersections.

APPENDIX B

Safe Speeds at Street Intersections

(Method of computation developed by the author)

The maximum speed at which a vehicle may safely approach an intersection depends upon obstructions to view and the speeds of other vehicles approaching at right angles. In Figure 8, if A_1 approaches the intersection at any given speed, the position of the building determines the maximum speed at which B_1 may approach in safety. I have developed the following method for computing the safe approach speed on a minor street corresponding to observed maximum speeds on an intersecting street carrying more traffic.

These computations are based on the following assumptions which I believe are valid:

1. A clearance of 5 feet between vehicles in intersecting paths is assumed, giving a collision zone, c_1 (or c_2) in Figure 8, 11 feet square for motor vehicles 6 feet wide.

2. Vehicles are assumed to approach an intersection 9 feet from the right-hand curb, giving 12 feet between the center line of the vehicle and the curb. This allows a 7-foot parking lane and 2 feet of clearance.

3. A reaction time of 1 second is assumed to elapse between the first sight of a vehicle on the intersecting street and the application of the brakes.

4. A deceleration of 17.2 feet per second per second is used, corresponding to a stopping distance of 25 feet from 20 miles per hour, which is normal for vehicles with good four-wheel brakes.

5. The driver in every case is assumed to be 8 feet back from the front of the vehicle, which is 15 feet long.

For safety vehicle A_1 must be able to stop before reaching the collision zone c_1 after vehicle B_1 is sighted. Where v_1 is the velocity of A_1 in feet per second, this distance must not be less than

$$v_1 + \frac{v_1^2}{34.4}.$$

The first item is the distance corresponding to a reaction time of one second, and the second item is the stopping distance in feet.

To continue without changing speed, A_1 must be able to cross the collision zone before B_1 reaches it. That is, after B_1 is sighted from the point computed above, it must run to the collision zone during the time required by A_1 to reach and clear this zone. To compute this time

$$t = (v_1 + \frac{v_1^2}{34.4} + 26) \div v_1 = 1 + \frac{v_1}{34.4} + \frac{26}{v_1}.$$

The paths of the two vehicles form two sides of a triangle of which the third side is the line of sight past the obstruction to view from the position of A_1 computed above.

Now let s_a = A_1's side of the visibility triangle.

s_b = B_1's side of the visibility triangle.

a = Distance from the path of the center line of A_1 to the obstruction.

b = Distance from the path of the center line of B_1 to the obstruction.

Then the fraction $\frac{s_a}{s_a - b} = \frac{s_b}{a}$, by similar triangles.

Solving, $s_b = \frac{a\,s_a}{s_a - b}$.

But B_1 runs only to the collision zone in t seconds. This distance is $s_b - 8$, and the velocity of v_1, $v_b = \frac{s_b - 8}{t} = \frac{s_a(a - 8) + 8b}{t(s_a - b)}$.

For substituting in this formula the computation of the value of t is shown above and A_1's side of the visibility triangle is

$$s_a = v_1 + \frac{v_1^2}{34.4} + 8 + 8 = v_1 + \frac{v_1^2}{34.4} + 16.$$

Applied to the street intersection layout at Main and Third Streets, Richmond, shown in Figure 8, the following is obtained for vehicles marked

A_1 and B_1:

v_1 = 36.7 feet per second (25 miles per hour).

$a = 10 + 12 = 22$ feet.

$b = 10 + 36 - 12 = 34$ feet.

$t = 1 + \frac{36.7}{34.4} + \frac{26}{36.7} = 2.8$ seconds.

$s_a = \frac{36.7^2}{34.4} + 36.7 + 16 = 92$ feet.

Then $v_b = \frac{92(22 - 8) + 8 \times 34}{2.8(92 - 34)}$ = 9.7 feet per second, or 6.6 miles per hour.

The computation for a_2 and b_2 is similar, values of s_a and t being the same as in the former case, but values of a and b being reversed.

Then $v_b = \frac{92(34 - 8) + 8 \times 22}{2.8(92 - 22)}$ = 13.1 feet per second, or 8.9 miles per hour.

STANDARD ACCIDENT REPORT CARD

1931

Traffic Acc. Rep. No.

Date..............193.....at..............A. M. / P. M. On.............................. (Street)

At.............................. In..............................
Intersecting St. or House No. — City, Town, Village or P.O. — County

Vehicle 1

A..............................Reg. No..............................Owned by..............................
Make and Type of Vehicle

Driven by.............................. Address..............................

Operator's License No.............Age.........Sex.........Driving Experience.......Yrs. Direction of Travel.............. Approx. Speed..............

Accident Also Involved: (Check X which) Pedestrian ☐ Railroad Train ☐ Bicycle ☐ Fixed Object ☐ Non-Operating ☐ Other Motor V. ☐ Electric Car ☐ Horse Dwn. Veh. ☐ Non-Collision Operating ☐

IF ANOTHER VEHICLE WAS INVOLVED, GIVE FOLLOWING INFORMATION FOR VEHICLE 2:

Vehicle 2

A..............................Reg. No..............................Owned by..............................
Make and Type of Vehicle

Driven by.............................. Address..............................

Operator's License No.............Age.........Sex.........Driving Experience.......Yrs. Direction of Travel.............. Approx. Speed..............

Names and Addresses of Persons Injured or Killed	Age	Check Which (X)		
1.		Male ☐ Female ☐	Killed ☐ Injured ☐	Passenger ☐ Pedestrian ☐
2.		Male ☐ Female ☐	Killed ☐ Injured ☐	Passenger ☐ Pedestrian ☐
3.		Male ☐ Female ☐	Killed ☐ Injured ☐	Passenger ☐ Pedestrian ☐

Injured Were Taken To..............................

Names and Addresses of Witnesses	Age	Phone No.
1.		
2.		
3.		

Obverse Side

CHECK WITH X EACH ITEM EXPLAINING THIS ACCIDENT

WHAT WAS EACH DRIVER DOING?	Vehicle 1	Vehicle 2
1. Turning right		
2. Turning left		
3. Going straight through		
4. Slowing down or stopping		
5. Backing		
6. Parked or standing still		
7. Skidding		
1. Exceeding speed limit		
2. On wrong side of road		
3. Didn't have right of way		
4. Cutting in		
5. Passing stand. street car		
6. Passing on curve or hill		
7. Passing on wrong side		
8. Failed to signal		
9. Improper turning		
10. Failed to stop—thru highway or street		
11. Disregarded officer or signal		
12. Drove off roadway		
13. Drove thru safety zone		
14. Double or prohibited parking		
1. Driver was intoxicated		
2. Had physical defect		
3. Was asleep		

CONDITION OF VEHICLE	V'hicle 1	V'hicle 2
1. Defective brakes		
2. Improper lights		
3. Defect steering mech.		
4. Other defects—describe		

WHAT WAS THE PEDESTRIAN DOING?	
1. Cross. at intersection with sig.	
2. Same—against signal	
3. Same—no signal	
4. Same—diagonally	
5. Crossing between intersect's	
6. Playing in street	
7. Riding or hitching on vehicle	
8. Waiting for or getting on or off street car at safety zone	
9. Same—no safety zone	
10. Getting on or off other vehicle	
11. At work in roadway	
12. Not in roadway	
13. Other actions—describe	
1. Pedestrian was intoxicated	
2. Had physical defect	
3. Was confused by traffic	
4. View obstructed	

ROAD CONDITION	
1. Defect in roadway	
2. Road under repair	
3. Obstruction not lighted	
1. Dry	
2. Wet	
3. Muddy	
4. Snowy	
5. Icy	
WEATHER CONDITIONS	
1. Clear	
2. Cloudy	
3. Fog or mist	
4. Rain	
5. Snow	
LIGHT CONDITIONS	
1. Daylight	
2. Dusk	
3. Darkness, good street lights	
4. Darkness, poor street lights	
5. Darkness, no street lights	
RAILROAD CROSSINGS	
1. Unguarded crossing	
2. Watchman or gate	
3. Automatic signal	

If arrest was made, state:

Name of person arrested — Charge — Disposition

Describe Further..............................

What Property Was Damaged.............................. Estimate of Property Damage $..............

National Safety Council, 1931

Date of Report — Name of Officer — Rank and Shield No. — No. 87 Rev.-12-30-40M

Reverse Side

(Send one copy of this report each month to the National Safety Council, Civic Opera Building—20 North Wacker Drive, Chicago)

CITY ACCIDENT SUMMARY, Month of.................................193...., City of..

TABLE A—TYPE OF ACCIDENT AND AGE GROUP

TYPE OF ACCIDENT	No. of Injury Accidents (A)	Number of Persons Killed: All ages (B)	Killed: 0-4 (C)	Killed: 5-14 (D)	Killed: 15-64 (E)	Killed: 65 and over (F)	Number of Persons Injured: All ages (G)	Injured: 0-4 (H)	Injured: 5-14 (I)	Injured: 15-64 (J)	Injured: 65 and over (K)	No. Motor Vehicle Accidents Causing Property Damage Only (L)
1. GRAND TOTAL												
2. MOTOR VEHICLE—TOTAL												
3. Motor vehicle with pedestrian												
4. Motor vehicle with motor vehicle												
5. Motor vehicle with railroad train												
6. Motor vehicle with electric car												
7. Motor vehicle with bicycle												
8. Motor veh. with horse-drawn vehicle												
9. Motor vehicle with fixed object												
10. Non-collision operating accident												
11. Non-operating accident												
12. PUBLIC (Not Motor Vehicle) TOTAL												
13. Railroad—not with motor vehicle												
14 Electric car—not with motor veh.												
15. Other vehicle—not with motor veh.												
16. Airplane												
17. Falls												
18. Burns, scalds, and explosions												
19. Drowning												
20. Fire arms												
21. Other public accidents												
22 HOME ACCIDENTS—TOTAL												
23. Falls												
24. Burns, scalds, and explosions												
25. Asphyxiation and suffocation												
26. Poisons												
27. Cuts and scratches												
28. Other home accidents												
29. INDUSTRIAL ACCIDENTS—TOTAL												
30. Manufacturing												
31. Public utilities and railroad												
32. Building and contracting												
33. Other industrial accidents												

IMPORTANT This report should show what accidents, especially fatal accidents, are covered. A police department can usually obtain a complete report on motor vehicle fatalities only; a complete report on other fatalities is available only from death certificates filed with the local health department. Please indicate by a check mark below whether Table A is complete for motor vehicle fatalities only or complete for all kinds of accidental deaths.

1. This report is complete for motor vehicle deaths only ☐
2. This report is complete for all accidental deaths ☐

Report only accidents that occur within the city or other territory covered. Do not report deaths that result from accidents occurring outside that territory.

TABLE B—CIRCUMSTANCES ATTENDING OCCURRENCE OF MOTOR VEHICLE ACCIDENTS

I. LOCATION	No. of Accidents: Total	Fatal	Non-Fatal	Prop'ty Damage Only
1. Railroad crossing				
2. On bridge				
3. At intersection				
4. Not at intersection				

II. TYPE OF VEHICLE	No. of Vehicles: Total	Fatal	Non-Fatal	Prop'ty Damage Only
1. Private passenger car				
2. Truck or commercial				
3. Taxicab				
4. Bus and jitney				
5. Motorcycle				

TABLE B—(Continued)

	No. of Drivers			
III. RESIDENCE OF DRIVER	Total	Fatal	Non-Fatal	Prop'ty Damage Only
1. Out of State				
2. Out of city				
3. Resident of city				
IV. AGE OF DRIVER				
1. Under 16 years				
2. 16 years				
3. 17 years				
4. 18 to 24 years				
5. 25 to 64 years				
6. 65 years and over				
V. SEX OF DRIVER				
1. Male				
2. Female				
VI. ACTION OF DRIVER				
1. Turning right				
2. Turning left				
3. Going straight through				
4. Slowing down or stopping				
5. Backing				
6. Parked or standing still				
7. Skidding				
VII. ACTION OF DRIVER (Violations)				
1. Exceeding the speed limit				
2. On wrong side of road				
3. Did not have right of way				
4. Cutting in				
5. Passing standing street car				
6. Passing on curve or hill				
7. Passing on wrong side				
8. Failed to signal				
9. Improper turning				
10. Failed to stop—thru hwy. or st.				
11. Disregarded officer or signal				
12. Drove off roadway				
13. Drove through safety zone				
14. Double or prohibited parking				
VIII. CONDITION OF DRIVER				
1. Was intoxicated				
2. Had physical defect				
3. Was asleep				
IX. CONDITION OF VEHICLE	No. of Vehicles			
1. Defective brakes				
2. Improper lights				
3. Defect in steering mechanism				
4. Other defects				
X. SEX OF PEDESTRIAN	No. of Pedestrians			
1. Male				
2. Female				

	No. of Pedestrians			
XI. THE PEDESTRIAN	Total	Fatal	Non-Fatal	Prop'ty Damage Only
1 Crossing at intersection: with signal				
2. —Same—against signal				
3. —Same—no signal				
4. —Same—diagonally				
5 Crossing between intersections				
6 Playing in street				
7 Riding or hitching on vehicle				
8 Waiting for or getting on or off st. car—at safety zone				
9. —Same—no safety zone				
10. Getting on or off other vehicle				
11. At work in roadway				
12. Not in roadway				
13. Other actions				
XII. CONDITION OF PEDESTRIAN				
1. Pedestrian was intoxicated				
2. Pedestrian had physical defect				
3. Was confused by traffic				
4. View obstructed				
XIII. ROAD CONDITION	No. of Accidents			
1. Defect in roadway				
2. Road under repair				
3. Obstruction not lighted				
XIV. ROAD SURFACE CONDITION				
1. Dry surface				
2. Wet surface				
3. Muddy surface				
4. Snowy surface				
5. Icy surface				
XV. WEATHER CONDITION				
1. Clear				
2. Cloudy				
3. Fog				
4. Rain				
5. Snow				
XVI. LIGHT CONDITION				
1. Daylight				
2. Dusk				
3. Darkness, good street lights				
4. Darkness, poor street lights				
5. Darkness, no street lights				
XVII. RAILROAD CROSSING				
1. Unguarded crossing				
2. Watchman or gates				
3. Automatic signal				

This report was prepared in the office of

(Name of Department or Bureau)

By ....

(Person to whom correspondence should be addressed)

Form M-153
1928

Road................Section.................

District...

Sub-District....................................

INDIANA STATE HIGHWAY COMMISSION
DIVISION OF MAINTENANCE

REPORT OF MOTOR VEHICLE ACCIDENT

ACCIDENT REPORT
NUMBER ....
Do not write in this space.

INSTRUCTIONS

The purpose of this report is to collect statistical data as to the cause and source of accidents on State Highways, with the view of bringing about such changes and conditions as may be necessary to reduce same.

It is the duty of the Patrolman, Foreman, Superintendent or District Engineer to make out reports on this form of all accidents occurring on the State Highways, or detours, under their supervision, whenever any person is injured or killed in the accident, or when damage to machines or property amounts to more than $25.00. The person reporting the accident will secure the requested information on both sides of this sheet from any available source and to the fullest extent that it is practical to secure same.

ANSWER EVERY QUESTION CLEARLY AND SEND THIS REPORT THROUGH THE SUPERINTENDENT AND DISTRICT ENGINEER TO THE CENTRAL OFFICE AT INDIANAPOLIS.

LOCATION OF ACCIDENT IN CITY at... In...
(Intersecting street or house number) (City or village)
OR
IN COUNTRY:—.....................Miles.........................of...
(Direction) (City or other landmark)

DATE OF ACCIDENT.................................. 19........
at..................... A. M. P. M.

CAR NUMBER 1:—..Type of body..............................License number..............................State..............................
(Trade name)

Owned by...Operator's Number....................
(Name) (Street address) (City or village)

Driven by...Chauffeur's Number....................
(Name) (Street address) (City or village)

Operator's age..................Sex......................Driving experience..................years, Direction of travel..........................Approximate Speed..................

Damage to car...Estimated amount $..................

ACCIDENT ALSO INVOLVED (Check X which)

Pedestrian ☐	Railroad Train ☐	Bicycle ☐	Other Vehicle ☐	Fixed Object ☐
Another Motor Vehicle ☐	Interurban or Electric Car ☐	Horse Drawn Vehicle ☐	Animal ☐	Non-Collision ☐

CAR NUMBER 2:—..Type of body..............................License number..............................State..............................
(Trade name)

Owned by...Operator's Number....................
(Name) (Street address) (City or village)

Driven by...Chauffeur's Number....................
(Name) (Street address) (City or village)

Operator's age..................Sex......................Driving experience..................years, Direction of travel..........................Approximate Speed..................

Damage to car...Estimated amount $..................

NAMES AND ADDRESSES OF KILLED AND INJURED	AGE	(Check X which)			NATURE OF INJURY
1:—............ (Name) (Address)		Male ☐ Female ☐	Passenger ☐ Pedestrian ☐	Killed ☐ Injured ☐	
2:—............ (Name) (Address)		Male ☐ Female ☐	Passenger ☐ Pedestrian ☐	Killed ☐ Injured ☐	
3:—............ (Name) (Address)		Male ☐ Female ☐	Passenger ☐ Pedestrian ☐	Killed ☐ Injured ☐	

INJURED WERE TAKEN TO...

NAMES AND ADDRESSES OF WITNESSES

1:—...Age..............
(Name) (Street address) (City or village)

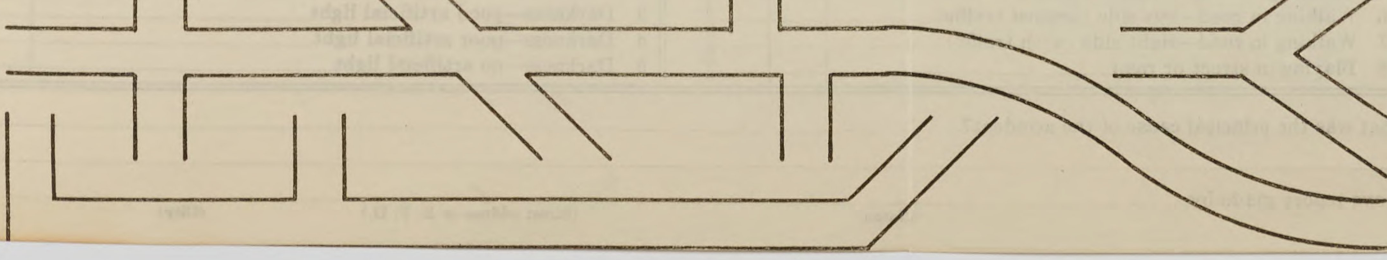
2:—...Age..............
(Name) (Street address) (City or village)

3:—...Age..............
(Name) (Street address) (City or village)

FOR POLICE OFFICERS ONLY:—If arrest was made state...
(Name of person arrested) (Address) (Charge)

....Name of officer.....................................Rank.....................................Shield Number..................
(Disposition)

IMPORTANT:—Select below the sketch that resembles most closely the section of the road or street where the accident occurred. Indicate on the sketch with lines and arrows, the path and direction of the vehicles, persons, etc. Indicate also the direction in miles to the nearest town. Mark a cross (X) at the exact point of the accident.



(CHECK ALL ITEMS THAT APPLY WITH "X")	CAR NUMBER 1	CAR NUMBER 2
WHAT WAS EACH DRIVER DOING	1	2
1 Turning right		
2 Turning left		
3 Going straight through		
4 Slowing down or stopping		
5 Backing		
6 Parked or standing still		
7 Avoiding pedestrian or vehicle		
8 Skidding		
9 Double or prohibited parking		
10 Exceeding speed limit		
11 On wrong side of road		
12 Did not have right of way		
13 Cutting in		
14 Passing standing street or interurban car		
15 Passing on curve or hill		
16 Passing on wrong side		
17 Failed to signal		
18 Improper turning		
19 Failed to stop at through highway or street		
20 Disregarded officer or signal		
21 Drove or crowded off roadway		
22 Drove through safety zone		
DRIVER'S CONDITION		
1 Driver was intoxicated		
2 Had physical defect		
3 Was asleep		
4 Extremely fatigued		
DRIVER'S VIEW OBSTRUCTED BY		
1 Growing crops		
2 Shrubbery or trees		
3 Embankment		
4 Buildings		
5 Fog or smoke		
6 Dust		
7 Curtains on car		
8 Rain, snow, etc., on windshield		
9 Other object—describe		
FIXED OBJECT STRUCK		
1 Bridge		
2 Culvert headwall		
3 Deep ditch		
4 Pole (telephone, power line, etc.)		
5 Tree		
6 Distance of pole or tree from center of road		
7 Other fixed object—describe		
CONDITION OF EACH VEHICLE		
1 Brakes defective		
2 Steering mechanism defective		
3 Glaring headlights		
4 Headlights too dim		
5 One or both headlights out		
6 Tail light out or obscured		
7 No chains on slippery road		
8 Puncture or blowout		
9 Other defects—describe		
WHAT WAS PEDESTRIAN DOING		
1 Crossing at intersection with signal		
2 Crossing at intersection against signal		
3 Crossing at intersection—no signal		
4 Crossing at intersection—diagonally		
5 Crossing between intersections		
6 Walking in road—left side (against traffic)		
7 Walking in road—right side (with traffic)		
8 Playing in street or road		

(CHECK ALL ITEMS THAT APPLY WITH "X")	
WHAT WAS PEDESTRIAN DOING (Continued)	
9 Riding or hitching on vehicle	
10 Waiting for or getting on or off street car at safety zone	
11 Waiting for or getting on or off street car no safety zone	
12 Getting on or off other vehicle	
13 At work in roadway	
14 Not in roadway	
15 Other actions—describe	
PEDESTRIAN'S CONDITION	
1 Intoxicated	
2 Had physical defect	
3 Was confused by traffic	
4 His view obstructed	
TYPE OF ROAD SURFACE	
1 Bituminous	
2 Brick	
3 Concrete	
4 Wood block	
5 Gravel or stone	
6 Earth	
7 Other type	
CONDITION OF ROAD	
1 Dry	
2 Wet	
3 Muddy	
4 Snowy or icy	
5 Roadway torn up	
6 Obstruction not lighted	
7 Loose gravel or stone	
8 Foreign material on surface	
9 Defect in roadway—describe	
GENERAL ROAD LOCATION	
1 Between intersections	
2 Road or street intersection	
3 Driveway or alley intersection	
4 Straight road	
5 Curve	
6 Turn	
7 Steep grade	
8 Narrow bridge or culvert	
9 Narrow roadway	
RAILROAD OR INTERURBAN CROSSINGS	
1 Unguarded crossing	
2 Gates down	
3 Gates up	
4 Automatic signal—working	
5 Automatic signal—not working	
6 Watchman—signalled properly	
7 Watchman—failed to signal	
8 Watchman (part time)—not on duty	
WEATHER CONDITIONS	
1 Clear	
2 Cloudy	
3 Fog or mist	
4 Rain	
5 Snow	
LIGHT CONDITIONS	
1 Daylight	
2 Dusk	
3 Darkness—good artificial light	
4 Darkness—poor artificial light	
5 Darkness—no artificial light	

What was the principal cause of the accident?..

Above report made by...
(Name) (Street address or R. F. D.) (City)