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PUBLIC ROADS ▸▸▸ *A Journal of Highway Research*

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D. M. BEACH, *Editor*

Volume 19, No. 5 July 1938

The reports of research published in this magazine are necessarily qualified by the conditions of the tests from which the data are obtained. Whenever it is deemed possible to do so, generalizations are drawn from the results of the tests; and, unless this is done, the conclusions formulated must be considered as specifically pertinent only to described conditions.

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ACCIDENTS ON THE ROAD

BASES OF STATISTICS AND THEIR UNIFICATION; DETERMINATION OF CAUSES OF ACCIDENTS AND MEANS FOR DIMINISHING THEM [1]

By SIDNEY J. WILLIAMS, Director, Public Safety Division, National Safety Council

THE HIGHWAY ACCIDENT PROBLEM, like any other, demands searching diagnosis before treatment may be attempted. Our chief diagnostic instrument in this case is statistics. They provide the information by which we can weigh each element to determine its relative importance and decide where and how to apply remedies.

Fatality statistics are collected in the United States mostly by departments of the various States, usually the health department or the body administering the motor-vehicle laws. This system is facilitated by laws, in force in 35 of the 48 States and the District of Columbia, that require drivers involved in accidents resulting in injury or death to report them to some enforcement or administrative agency. In 31 of these States, property damage accidents likewise must be reported.

The Federal Bureau of the Census compiles the Nation-wide figures in connection with its tabulation of general vital statistics. Its annual motor-vehicle fatalities statistics are the ultimate authority.

The National Safety Council is constantly compiling monthly and annual statistics from States and cities and shortly after the close of each year publishes its statistical summary, Accident Facts. Since this publication is issued before the Census Bureau figures are released, it is necessary to estimate the total fatalities and other figures which this total governs.

These estimates have been exceedingly close from year to year and should tend to be more so in the future because a growing number of city and State departments are working to improve their accident reporting systems, thereby reducing the element of guess to a minimum. The increase in accident reporting activity is being furthered by the Council both by personal visits of staff members to reporting agencies and in consultations by mail.

Regarding the need for full reports of accidents, Mr. C. H. Purcell, State Highway Engineer of California, says: "The one principal source from which we may obtain information * * * is the individual accident report. Too much emphasis cannot be placed upon its importance. Great care should be used in the preparation of these report forms, with a clear understanding at all times of what use is later to be made of their contents. What is actually recorded on the form—and not what the designer of the form may have expected to be recorded—is all that is of any value. For this reason only disappointment can follow if due consideration has not been given to the type of person upon whom we must depend for the common, standard accident report. Only by the accumulation of thousands of such reports can any sufficiently broad statistical base be built up.

" * * * The common, or standard, accident report will provide pertinent data as to the apparent physical condition of the persons involved and also as to their actions, but, except in the most obvious cases, will of course contain no direct reference to mental condition.

" * * * While complete statistics on the persons, the machines and the roads, are all basically essential, there still remains the one elemental factor without which there can be no meaning to any study of highway accidents. This is the amount and character of traffic. The number of accidents, judged solely on the basis of drivers, cars, and miles of road, may appear either excessive or inconsequential, but there can be no real basis for judgment until we know what kind of, and how much travel was involved during the period in which these accidents occurred."

Since 1924, the National Safety Council has sponsored the Standard Accident Reporting System not only as a means of presenting statistics uniformly, but also of bringing out those details which are necessary in complete diagnosis. Approximately 30 of the 48 States and some 300 cities now use the Standard System.

Another effort toward uniform accident reporting and wider coverage is being made by the Joint Committee on Uniform Accident Statistics, sponsored by the National Safety Council and the American Association of Motor Vehicle Administrators. The committee represents leading governmental agencies dealing with statistics who are cooperating to obtain similar definitions for the various types of vehicle accidents, and generally to improve the collection and compilation of figures so that those who are trying to reduce accidents will have the fullest information.

Concerning the need for complete statistics, and the possibilities they open, Mr. A. A. Anderson, Manager of the Highways and Municipal Bureau of the Portland Cement Association, contributes the following:

Until recently no concerted action has been taken to obtain complete information regarding all factors contributing to highway accidents. Previous information has generally been confined to recording the few facts necessary to establish the responsibility for the accidents, and such general data as location, time, and weather.

The inadequacy of such information is apparent. There is also a lack of uniformity in methods of reporting but with greater emphasis on the need of complete accident records, undoubtedly a uniform report will be developed.

Many States now require, by law, a detailed report of all highway accidents and it is expected that greater light will soon be thrown on the real factors affecting conditions which cause accidents.

Just as facts are required for proper planning of the highway system and structural design of the road, so are accident facts necessary before highway safety can be built into the highways and existing defects corrected.

Basic information is needed from original accident reports. This should be collected and compiled in a uniform manner. It is essential that such information include data which will permit:

a. Listing accidents on a vehicle-mile basis for specific highways (day and night).

b. A rating to be made of the physical safety of each highway in relation to conditions causing accidents.

This will mean mandatory provisions by the State or local government for reporting all details incident to highway accidents. Many States have already taken such steps.

When all contributing factors are obtained it will be possible to develop an accident expectancy formula based on traffic volume and the physical rating of the highway. When such a formula is developed it will enable traffic engineers to:

a. Predict the number of accidents on a highway having a given traffic and known physical rating.

[1] Report for the United States to the Eighth International Road Congress held at The Hague, June 19–July 2, 1938.

b. Determine the accident reduction which would follow if the physical hazards were eliminated.
c. Estimate the expenditure which could be justified to remove physical hazards.

Every road has its own characteristics and by studying these along with the detailed accident reports, then without doubt the causes of accidents can be segregated and evaluated.

To get an idea of the size of the problem confronting us, it is only necessary to review the annual motor-vehicle fatality totals since 1913. These show clearly how the motor car is claiming more and more attention in accident prevention (table 1).

TABLE 1.—*Accident fatality totals*

Year	Number of motor-vehicle fatalities	Number of fatalities resulting from all accidents	Ratio of motor-vehicle to all accident fatalities
			Percent
1936	[1] 37,800	[1] 111,000	34
1935	36,369	99,967	36
1934	36,101	101,139	36
1933	31,363	91,087	34
1932	29,451	89,167	33
1927	25,796	92,874	28
1922	15,326	76,420	20
1917	10,235	90,116	11
1913	4,227	82,460	5

[1] Estimated.

This rising importance is shown also by the fact that in the United States there are only 4.55 people per vehicle of all types and 5.31 persons for each passenger automobile (1936).

Other facts that come to light in studying accident causes are shown in a general way by the following article, What Causes Traffic Accidents? published in the 1937 edition of Accident Facts:

No one can say exactly how many motor-vehicle accidents in the United States are due to particular causes, because few accidents are investigated carefully enough to determine exactly what was the cause, and because most accidents have not one but a combination of several causes.

Highway defects.—Starting with the less important causes, we know that many highways are not yet as safe as they could be made. They are too narrow, curves are too sharp, signs and signals are not standard, and so on. These, when combined with inattention or ignorance on the part of the driver, often result in accidents. The careful, skillful driver, however, rarely has an accident even on a defective highway.

Vehicular defects.—Defects of the vehicle itself are estimated to cause or help to cause at least 15 percent of the accidents. The most important vehicular defects are defective brakes and deficient or glaring headlights. As with unsafe highways, however, the careful, skillful driver can generally avoid accidents, even if his vehicle is somewhat defective.

The pedestrian.—Pedestrians act unsafely under many circumstances; children play in the street, * * * adults take foolish chances by crossing a street in mid-block, or against the signal, or when intoxicated—with disastrous results.

The driver.—The driver is the most important element in our traffic accident situation. Some drivers have accidents because they are actually defective in mind or body * * *.

A much greater number have accidents because they do not know how to drive. They have never learned proper methods of making turns, backing, or signaling; they do not observe right-of-way rules, stop signs, or traffic signals, to say nothing of their obligation toward pedestrians and other highway users.

The greatest number of drivers who have accidents, however, are neither physically defective nor ignorant of traffic rules. They don't really want to have an accident, but neither do they sufficiently want not to have one. They take chances by going too fast; they pass other cars on hills and curves; they cross railroad tracks without looking; they do not slow down at intersections; they expect other drivers and pedestrians to get out of their way regardless of traffic conditions.

The remedy.—After all, it is not so important that we cannot determine exactly what percentage of accidents is due to any one of these complex causes. We are interested in eliminating the accidents, and these causes tell us how to proceed. First, we must improve our highways and keep our vehicles in good condition. Second, and more important, we must teach drivers and pedestrians to realize the accident possibilities of all their actions on streets and highways and to act accordingly.

In discussing accidents chargeable to the driver, Dr. H. C. Dickinson, National Bureau of Standards, says:

It seems that highway accidents for which drivers are responsible might be represented in two classes between which classes, of course, there is no rigid line of separation but which still possess important differences.

Suppose we picture two classes of drivers which may be called good and bad for lack of a better distinction.

The question which the writer wants to ask in all seriousness is: "What percentage of our accidents is due to drivers who individually would be classed as good drivers, drivers who do not customarily permit themselves to do the things which they know have caused accidents?"

There seems to be no way of making even an intelligent guess as to what percentage of accidents is due to good drivers, mainly because we have no means as yet of finding out who are good and who are bad drivers.

About all that can be said as to the relative number of accidents to good drivers as compared to bad drivers is that both are of parallel importance, either of them may be the more important.

Dr. Dickinson refers to what he terms an "accidental accident" as one in which all drivers involved are "good" drivers and explains that such an accident must result from a momentary lapse of the good qualities of one or more drivers.

This type, he says:

* * * cannot be greatly reduced by punishment or enforcement. The good drivers cannot be improved by exhortation or by instilling fear because they already are doing the best they know how. * * * Confusing signs, bad visibility, curves which deceive the eye * * * all invite accidents on the part of the best and most careful driver.

A more fruitful source of good-driver accidents may be the confusion of the regulations themselves. Rules of the road that ambiguously prescribe the right thing to do cause confusion and errors of judgment even among the best of drivers.

One point about the class of good-driver accidents should be kept in mind. These drivers will differ greatly in their liability to accident. Equally well-trained, experienced, and conscientious persons in every line of activity differ in this way.

The bad drivers on the other hand have received most of the attention. In their numbers they certainly are vastly in the minority, and they may be so even in respect to the number of accidents in which they are involved. Accidents that are due to this group presumably can be reduced by legal restraint and enforcement. They might be reduced more effectively if the minority who take chances would be identified and educated or disciplined.

We need more information as to the relative importance of accidents which can be avoided and those which practically can not, if appropriate measures are to be applied to reduce highway accidents.

If we are to greatly improve the situation, driving practices and rules of the road must be simplified and clarified so that they will subject the good drivers to a minimum of distraction from their normal safe behavior. We must find some means of catching and educating or punishing those who are really bad drivers, and we should get them before they cause an accident.

Before leaving the subject of accident causes, it may be interesting to present some of the significant circumstances which research has revealed as surrounding accidents in the United States.

For instance, it has been found that four out of five accidents occur on dry roads in clear weather and while the car is traveling straight ahead. Although only one-third of our traffic moves on the highways at night, two-thirds of the motor vehicle fatalities occur during the hours of darkness. This is explained by the fact that the total accident rate on a mileage basis during the night is much higher and that a higher percentage of all the accidents occurring at night result in fatalities.

More accidents happen on Sunday than any other day. Five p. m. is the most dangerous hour and 4 a. m. shows the lowest number of mishaps. A consensus of 26 State accident summaries for 1936 shows the 7 most important improper acts to be:

1. Exceeding the speed limit or driving too fast for conditions.
2. Driving on the wrong side of the road.
3. Disregarded stop signs and signals.
4. Improperly failing to yield the right-of-way at intersections.
5. Attempting to force entrance between moving vehicles to avoid collision with an oncoming vehicle.
6. Attempting to pass on a curve or hill a vehicle moving in the same direction.
7. Failing to signal intention to stop or turn.

Since repeal of the Federal liquor prohibition law a few years ago, a great deal of attention has been centered on the intoxicated motorist. Accident Facts makes the following comment:

> During 1936, the reported percentages in 26 States of "had been drinking" or "intoxicated" participants in fatal accidents averaged 7 percent for drivers and 11 percent for pedestrians. Cities reported an average of 8 percent for fatal accident drivers and 10 percent for pedestrians killed. That these percentages understate by an unknown amount the true situation is the belief of most traffic authorities. How high is the true percentage? That is the question.

A later paragraph in the same article says:

> The reported percentages of "alcohol accidents" have been increasing for the past several years with the exception of1936 in which year the percentage of drivers who "had been drinking" remained at 7 percent, the same as in 1935; only 6 percent were so recorded in 1934; and 5 percent in 1933. "Had been drinking" pedestrians were reported in only 9 percent of the 1935 fatal accidents, 8 percent in 1934, and 6 percent of the 1933 fatal accidents, compared with the 11 percent shown for 1936. Drinking drivers and pedestrians are playing an increasing part in the accident problem.

The discovery of accident causes is a challenge to safety agencies to start remedial measures. Accident reduction programs are carried on by a great many different organizations, each taking that part of the task for which it is best equipped.

Serving as a national clearing house for safety information, both public and industrial, is the National Safety Council. We shall, for the sake of brevity, emphasize its work in public safety.

The chief activity of this division is preventing street and highway accidents, although it also carries on home-safety and child-education programs. Membership comprises city, State, and national governmental departments, local safety councils, chambers of commerce, automobile clubs and other civic organizations, insurance, transportation, public utility, and other industrial companies. The Council is supported by the dues of these members and, thus, is nonpolitical and nonpartisan. It is in no way controlled by any branch of Government. Its services consist of technical advice and promotional activities, both by letters and personal visits as well as booklets and posters covering every phase of the problem.

The Council also conducts the National Traffic Safety Contest in which 1,101 cities compete for annual awards based on safety activities and reduction of motor-vehicle fatalities. Cities compete in their own population groups with a prize for the winner in each group and grand prize covering all groups. Forty-two States also are entered and are graded roughly on the same basis as cities.

Within the past few years, the automobile industry has taken an important part in accident prevention. The Automobile Manufacturers' Association has established the Automotive Safety Foundation, the main function of which is the giving of financial support to organizations working directly in the interest of safety. These organizations include the National Safety Council, International Association of Chiefs of Police, Harvard and Northwestern Universities, General Federation of Women's Clubs, National Congress of Parents and Teachers, and others.

Motor clubs and their associations, such as the American Automobile Association, are carrying on an active public safety program comprising such things as driving and safety courses for schools, dissemination of safe driving literature, and the support of safety legislation.

Insurance companies, both individually and through their organizations, are spending large sums to educate the public in the fundamentals of safety. They distribute booklets and other information as well as providing specific services to their clients. Operators of motor-vehicle fleets, for instance, can obtain the advice of their insurance company's fleet safety engineers.

Public safety is largely the responsibility of public officials who have authority to put the various measures into effect. The excellent manner in which many groups of officials have assumed this responsibility is demonstrated by the American Association of State Highway Officials. For several years it has actively advocated the standardization of traffic signs, signals, and markings as well as the incorporation of safety features in road construction. The American Association of Motor Vehicle Administrators is another safety-minded organization which has promoted uniformity of traffic laws and their administration.

The International Association of Chiefs of Police maintains a Safety Division with a full time director and a staff of assistants. The Safety Division conducts a service by which it trains police squads in scientific accident investigation. It also helps sponsor traffic officers' training schools in which working traffic officers are schooled in the latest developments of their job.

Although motor-vehicle laws are made and enforced primarily by the States, the Federal Government is attacking the traffic safety problem on many fronts. The Bureau of Public Roads administers Federal financial aid to State highway construction and thereby exerts a powerful influence in seeing that highway construction and alteration include the best safety principles. The Bureau has recently completed its Report to Congress on Study and Research of Traffic Conditions and Measures for Their Improvement. This report is a study of vehicle death rates, safety legislation, accident causes and suggested "cures" and is, in fact, a complete investigation of the problem.

The Federal Government does administer directly the regulation of trucks operating in interstate commerce through the Interstate Commerce Commission. It specifies the maximum size, weight, and loads of such vehicles, the safety equipment (such as distinguishing lights) each truck must carry, and similar safety measures.

Transit companies, such as tram and bus lines, are working to solve two big problems: One is the operation

of their vehicles in such way as to cause a minimum of traffic congestion. This includes the elimination of collisions and the development of means for taking on and discharging passengers without obstructing other vehicles. The other is the reduction of accidents in which pedestrians and passengers are hurt either by being struck by the vehicle or falling while entering, riding, or alighting.

Such groups as the General Federation of Women's Clubs and the National Federation of Business and Professional Women's Clubs also cooperate in broad safety programs. The General Federation encourages its local affiliates to sponsor a safety program in their States and communities, including the support of safety legislation.

The promotion of general public safety now is carried on in 37 States by organizations of citizens and officials comprising what we shall call here State safety councils, although they may bear a variety of names, such as traffic commissions and safety committees.

A typical State safety council consists of a board of directors comprising the president, vice president, and representatives of all bodies concerned. These include State officials, such as the Governor, highway commissioner, motor-vehicle administrator, chief of the highway patrol, chairman of the public utilities and industrial commissions, commissioner of education, and others. There are also representatives of business and industrial groups who have an active interest in safety and civic leaders representing local, civic, patriotic, and other interested organizations. Another group represented on the board of directors is the chairman of each recognized county and local safety council in the State. Responsible to the board of directors is an executive committee made up of council officers and the chairmen of standing committees handling such work as legislation, education, statistics, engineering, and enforcement. There is also an executive who devotes his full time to handling council affairs. These councils may be supported financially by the State or by private subscriptions.

The accompanying chart, "Highway Safety Program for States," outlines the seven points necessary in a comprehensive accident reduction campaign. Not every State having a safety organization has all of these seven program activities in effect, but the States that have the best accident reduction records have more of them than the States with poorer records.

The above described program is not intended for cities or local communities. A plan of action suitable for these smaller and more compact units may include all or any part of the following:

1. *Statistics.*—Endeavor to introduce modern accident-reporting systems and convenient record systems; compile and interpret monthly accidents totals and release them through newspapers; study and use the statistics as a basis for suggested remedies directed along lines of engineering, education, and enforcement.
2. *Traffic engineering.*—Work for the revision of local ordinances to conform with the model advocated by the National Conference on Street and Highway Safety; promote the installation of a traffic engineering department in the city government; conduct independent studies of traffic conditions; and support all efforts toward the standardization of signs, signals, and markings.
3. *Public education.*—Develop a regular publicity program to keep the public informed of the council's work; have the city entered in the National Traffic Safety Contest; conduct safety meetings and special campaigns for safe driving.
4. *School and child safety.*—Encourage safety instruction in schools, to be supervised by a responsible official; organize school safety patrols and junior safety councils; and carry out a program of playground safety.
5. *Commercial vehicle safety.*—Conduct an interfleet safety contest, holding regular meetings of superintendents and drivers to promote the safe operation of commercial vehicles.
6. *Traffic law enforcement.*—In cooperation with the police and the courts, urge the establishment of a traffic division and accident investigation squads as part of the police force; help eliminate official misconduct which allows violators to escape punishment; and encourage the separation of traffic courts from those handling other kinds of cases.

Safety work is done in the local communities by county or city safety councils. If the towns in a county are all small, a single county safety council is most effective. For the larger cities, on the other hand, separate city councils function better.

A typical community safety council should include persons with an economic interest in safety, officials with a public responsibility, and public spirited citizens. The organizations should be headed by a director who may devote all or only a portion of his time to the work depending upon the size of the council and the fullness of its program.

Legislation.—Uniform motor-vehicle laws for all States and communities is the goal of most safety organizations. In addition to uniformity, these organizations also are striving for the adoption of the most modern legislation, as represented by the several proposed acts sponsored by the National Conference on Street and Highway Safety, collectively known as the Uniform Vehicle Code. Special emphasis is placed upon Acts II, the "Uniform Operators' and Chauffeurs' License Act" and V, "Uniform Act Regulating Traffic on the Highways." The three other measures in the Code deal with registration of vehicles, civil liability, and financial responsibility; hence, they are not concerned directly with accident reduction.

Cities are urged to adopt the Model Traffic Ordinances so that their laws also will be uniform and of an approved type.

The third portion of the legislative program involves the installation of uniform signs, signals, and markings. The different types of warning and directional signs, for instance, can be identified, if they are standard, not only by the legend they bear, but by their shape and coloring. The value of this to a motorist in strange territory is obvious.

Motor-vehicle administration.—It is, of course, of no value to have good laws if they are not properly administered. The State program under this heading includes, first of all, an adequate uniform accident reporting system. Next is the alert administration of the uniform drivers' license law which includes examination of all new applicants for permits and the reexamination of drivers with bad records.

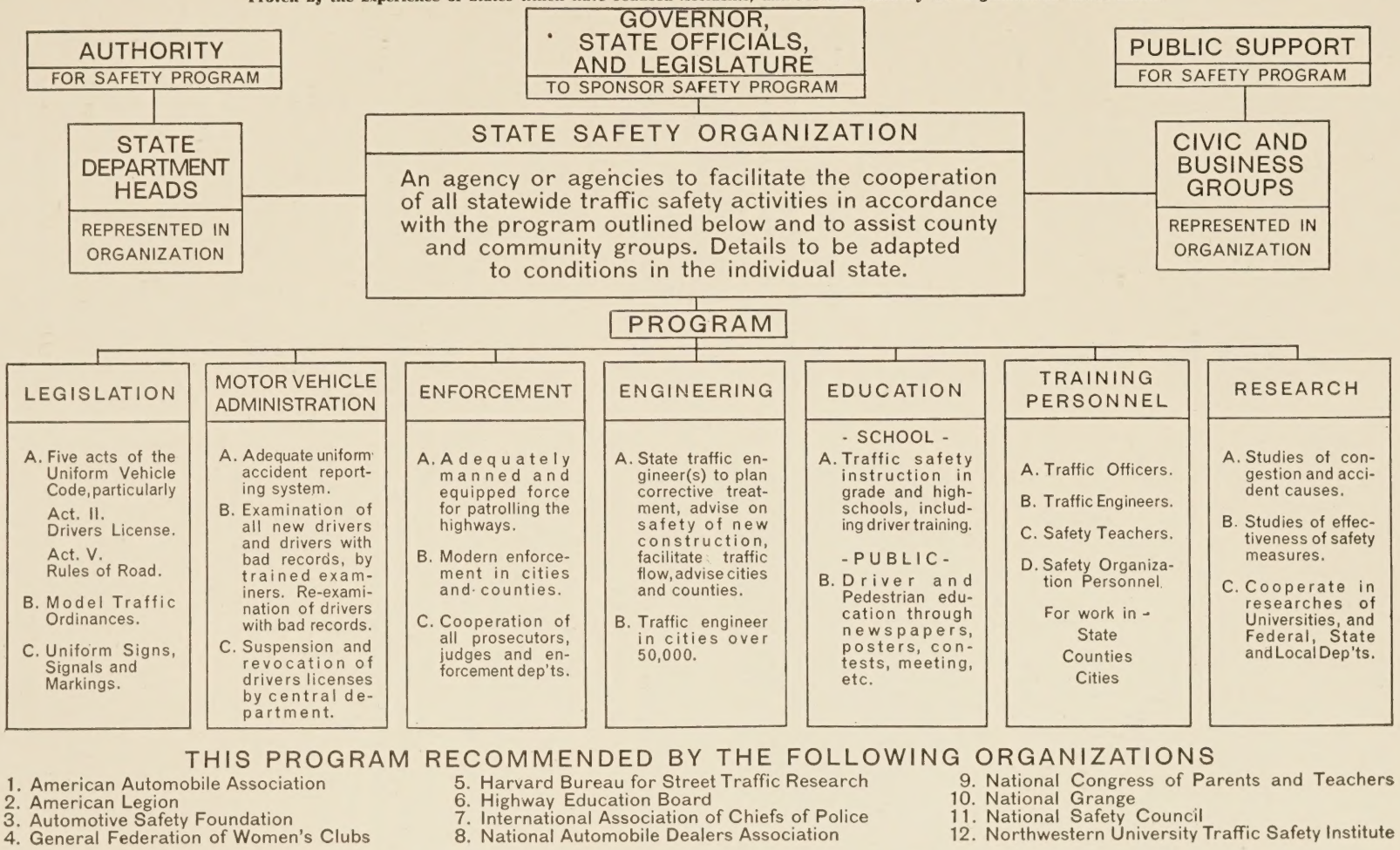
Since a drivers' license law is, in effect, a method of eliminating dangerous drivers, proper machinery for revoking and suspending the permits of such drivers is an important function. Experience has shown that this works best when controlled by some department of the State government rather than by local courts.

Enforcement.—The first requisite of enforcement is sufficient personnel. This includes not only an adequate, well-equipped highway patrol for the State, but similarly well organized forces in the counties and cities. The police and judges must cooperate if vio-

HIGHWAY SAFETY PROGRAM FOR STATES

TO INCREASE TRAFFIC EFFICIENCY AND REDUCE ACCIDENTS

Proven by the Experience of States which have reduced Accidents, and recommended by the Organizations listed below.



THIS PROGRAM RECOMMENDED BY THE FOLLOWING ORGANIZATIONS

1. American Automobile Association
2. American Legion
3. Automotive Safety Foundation
4. General Federation of Women's Clubs
5. Harvard Bureau for Street Traffic Research
6. Highway Education Board
7. International Association of Chiefs of Police
8. National Automobile Dealers Association
9. National Congress of Parents and Teachers
10. National Grange
11. National Safety Council
12. Northwestern University Traffic Safety Institute

HIGHWAY SAFETY PROGRAM FOR STATES.

lators of the vehicle laws are to be punished. For the officer this means the gathering of sufficient and convincing evidence and the ability to present it properly in court. For the judge it means a fair attitude, no mistaken ideas of leniency or persecution, and a realization of the seriousness of the accident problem. Honesty and freedom from political pressure are vital in both officials.

Engineering.—A good traffic engineering bureau in the State government can do two things. It can put the best and most modern engineering treatment into effect on highways controlled by the State, and it can advise cities and counties in their problems. The State also should do whatever it can to induce cities over 50,000 population to have their own traffic engineers.

Education.—Inclusion of definite safety courses in school curricula is spreading in the United States. This should be furthered in the State program, and should provide for actual courses in driving automobiles. Public education also is an important factor which should be carried on through the newspapers and radio, in much the same way as it is carried on by the community safety councils.

Training personnel.—The promotion of public safety has brought into existence a new profession for which the training of leaders and personnel is necessary. These include traffic officers, who now attend the half dozen or so training schools held in various parts of the United States, traffic engineers, and general safety organizers, whose job it is to stimulate interest and to carry these safety programs through to a worth-while conclusion.

Research.—This report has discussed earlier several of the accident causes and significant circumstances of accidents. Constant research is necessary to discover more and more of these facts and to hunt for any new ideas that may make remedies more effective. Research is necessary also to determine the relative effectiveness of new safety measures as they are proposed and assign each to the place in the whole safety scheme in which it will do the most good.

Results of organized effort.—That a well-rounded safety program will work, that it will reduce accidents, is proved conclusively by several American cities. Table 2 shows the accident experience of these cities which applied the recommended programs.

TABLE 2.—*Accident records of cities that applied recommended safety programs*

City	Population	Average death rate 5 years ending 1931	Average death rate 5 years ending 1936	Percent change
New York, N. Y.	6,930,400	16.4	13.7	−16.5
Baltimore, Md.	804,800	18.5	16.7	−9.7
Milwaukee, Wis.	578,200	17.2	12.1	−29.7
Rochester, N. Y.	328,100	12.8	12.3	−3.9
Dallas, Tex.	260,500	21.2	16.4	−22.6
Providence, R. I.	253,000	13.9	9.8	−29.5
Syracuse, N. Y.	209,300	16.4	9.8	−40.2
Wilmington, Del.	106,600	15.0	13.5	−10.0
Allentown, Pa.	92,600	14.5	14.1	−2.8
Evanston, Ill.	63,300	13.7	7.7	−43.8

Figures for cities which did not employ effective safety programs reveal much higher death rates, especially during the 5-year period ending with 1936. Not one of the cities listed above had a death rate as high as the average of all cities in its own population group.

This demonstrates that accidents can be reduced with intelligent leadership, cooperation of all interested groups including the general public, and a comprehensive program attacking the problem along lines of engineering, education, and enforcement. We certainly do not know all there is to know about accidents, but we do know their chief causes and something of how to remedy them. The process, then, is one of recruiting an army of officials and citizens to help, and of educating everyone to his own responsibility whether it be for walking safely across the street or for establishing a State-wide program.

The United States is awake to the need for safety as it never has been in the past. The big task of the moment is to coordinate all the good work that is being done and to guide enthusiasm into channels by which it will achieve the best results.

ACKNOWLEDGMENTS

The Principal Reporter acknowledges the very valuable papers contributed by Mr. A. A. Anderson, Manager of the Highways and Municipal Bureau of the Portland Cement Association; Dr. H. C. Dickinson, of the National Bureau of Standards; and Mr. C. H. Purcell, State Highway Engineer of California.

Mr. Anderson's shorter paper is quoted in this report in its entirety and excerpts have been taken as indicated from the papers by Dr. Dickinson and Mr. Purcell.

SEGREGATION OF THE VARIOUS CLASSES OF TRAFFIC ON THE HIGHWAY

Reported by R. E. TOMS, Chief, Division of Design, United States Bureau of Public Roads

Introduction.—The increase in the number of motor vehicles in the United States from 640,000 to 28,000,000 over a period of 25 years, together with steady increases in the mileage traveled by each vehicle and in the speed of traffic, has made necessary the development and construction of many ingenious designs for traffic movement, segregation, and safety.

Carriageways.—The principal items controlling the distribution of vehicular traffic on the road are traffic density, character of traffic and assumed design speed. The American Association of State Highway Officials is considering the classification of all highways in terms of these essential factors to indicate readily the services which may be expected of a highway in each class. Each classification is indicated therein by two figures and a letter. For example, the classification 1000 M 50 indicates a highway on which a mixed vehicular traffic of 1,000 vehicles per hour can be accommodated at an assumed design speed of 50 miles per hour; 600 T 30 indicates a highway on which 600 vehicles per hour, mostly heavy trucks, can be accommodated at an assumed design speed of 30 miles per hour. Likewise, a 3000 P 50 classification indicates a highway capable of accommodating essentially 3,000 passenger cars per hour at a speed of 50 miles per hour.

The proper number, spacing and width of traffic lanes is an extremely important consideration in the segregation of motor vehicles and their safe use on the highways. The State highway systems of the United States comprise approximately 340,000 miles of highways that represent the main routes of highway travel in the United States. Of this total, 4,704 miles are three-lane highways, 3,082 miles are four-lane highways, and 221 miles are six-lane highways. Of the 3,303 miles of four- and six-lane highways only 604 miles are constructed so that traffic in opposing directions is separated by a raised parkway or median strip. The remainder or approximately 332,000 miles are of two-lane construction, and there is now no evidence that more than 95 percent of all roads in the State highway systems can or will need to be advanced beyond the stage of adequate two-lane improvement. A properly constructed two-lane highway is capable of carrying traffic of from 3,000 to 5,000 vehicles per day without serious congestion. There is, therefore, no need or economic justification to provide three- or four-lane construction where expected traffic densities are not likely to exceed those mentioned.

Opinion is sharply divided as to the wisdom of three-lane construction. In the vicinity of cities where the predominating flow of traffic is in one direction at different periods during the day and ample sight distance is available, three-lane highways add to the flexibility of movement and traffic capacity of the road. It is believed by some who have observed the operation of three-lane highways that as traffic increases the hazards increase at a greater ratio than in the case of the two-lane or four-lane highways. However, there appears to be no factual data indicating that the number of accidents on three-lane highways is greater than the number of accidents on two-lane highways when the number of vehicles on each is less than enough to fill the road and to make turning out impracticable.

In general, a three-lane highway for safe usage should have very good sight distances at frequent intervals to permit passing at high speed. Present knowledge and experience does not support a contention that a properly designed three-lane highway has no place in the highway program. While it may not be wholly desirable, economic considerations cannot be disregarded. Certainly a three-lane highway that lends itself to future expansion into a four-lane divided highway seems to be a logical phase of stage development. In the State of California three-lane highways are being constructed as part of a program of progressive stage development to afford increased capacity, better service to traffic and better economic use of the funds available. A greater mileage of improved facilities is being provided by stage construction than would be possible in using available funds for an ultimate divided four-lane highway.

A Three-Lane Dual Pavement on U S 30 in Pennsylvania.

Designs for these three-lane pavements in the State of California incorporate features which make them readily convertible into divided four-lane highways. Outside lanes are of portland-cement concrete and the middle lane is of less costly bituminous construction. The outer permanent lanes carry most of the traffic load and the center lane is used primarily for passing purposes. When future expansion to a four-lane highway becomes necessary because of increased traffic, the surfacing material of the center lane will be removed and salvaged for shoulder treatment. The original center lane then becomes the dividing strip for planting and the two permanent lanes become the inside lanes of a four-lane divided highway after two new outside lanes of concrete have been added. The center lane is usually of a darker color than the outer lanes and the contrasting color and difference in surface texture seem to prevent its indiscriminate use for other-than-passing purposes. Without adequate sight distance the three-lane highway is little better than a two-lane highway.

Three and four-lane highways of dual type surfacing using bituminous mixtures for interior lanes and portland cement concrete for exterior lanes have been used

A Four-Lane Divided Highway in Massachusetts.

for a number of years in the States of Massachusetts and Pennsylvania with considerable satisfaction.

When traffic is sufficient in volume to require the use of 4 traffic lanes the physical separation of traffic moving in opposite directions is desirable to reduce traffic hazards. A raised diving strip is preferable to a median strip flush with the elevation of the adjacent pavement. The width of the separating strip and its treatment are important. Raised separations may be from 4 to 6 feet in width, or from 12 to 30 feet or more in width. Sections 4 to 6 feet wide are too narrow for planting and should be paved, preferably with an all-weather type of surfacing of a color contrasting with the traffic lanes. This is to reduce maintenance of surface and emphasize its presence. The width, however, should not be so great as to permit the use of the separating strip for the passing or parking of vehicles. A separation 12 to 30 feet or more in width is ample to support a vegetative cover that will serve to prevent its use by vehicles except in emergencies.

The distance between roads need not be uniform. Advantage may be taken of the peculiarities of the topography and available right-of-way to construct two highways with sweeping graceful alinement and avoid the bare hardness in appearance resulting from uniform widths, grades, and side slopes. The danger and undesirability of a monotonous road also may be avoided by variable widths and differences in grade between roads.

The wider dividing strips are to be preferred to the narrow dividing strips for the reason that they reduce the traffic hazards caused by glare from headlights, particularly when planted with low-growing vegetation, such as shrubs or low-growing trees. They also provide at intersections an intermediate stop zone between the two roadways for crossing traffic and for turning traffic.

On two- and three-lane highways physical separation of opposing traffic is impracticable. On four, and six-lane undivided highways median strips to separate opposing traffic may be considered. However, new hazards should not be created when attempting to reduce existing hazards. In such cases the value of a vertical curb as a desirable and safe method of controlling traffic is open to serious question. Separators should be designed so as to permit vehicles traveling in the same direction to overtake and pass each other in safety without hazards which are likely to result from colliding with or sideswiping a curb and without encouraging vehicles to veer from it and thus reduce the effective width of surfacing. The high curb with vertical face commonly used in urban areas around dividing parkways is not satisfactory to use on rural, high-speed highways. It is preferable on rural highways to use a curb or other type of separator designed to warn drivers encroaching on the median neutral strip but to permit a vehicle to ride over it with a minimum of hazard in cases of emergency.

The question of what constitutes suitable or necessary road widths as determined by a study of the passing of vehicles on 2-lane highways was reported in the September 1937 issue of Public Roads published by the United States Bureau of Public Roads. The con-

clusions of that study indicate that pavements of 18-foot width are too narrow for modern passenger cars alone or for mixed traffic. Pavements of 20-foot width are reasonably adequate for light traffic roads used infrequently by wide trucks, but are inadequate for mixed traffic. Pavements of 22-foot width are entirely adequate for modern mixed traffic. It is also evident from the study that further increases in speed of vehicles will tend to make necessary road widths greater than 22 feet. A number of States already are using for two-lane roads a width of 24 feet or more.

The behavior of traffic on four- and six-lane highways depends largely upon whether the highway is urban or rural in character. On rural highways all traffic tends to use the outside lanes and to pass on the inside lanes. In urban areas, particularly where vehicles are permitted to park along the outer curbs, traffic tends to follow the inner or midlanes, usually, of course, to avoid slow moving traffic and hazards encountered near curbs.

The State of California is giving intensive study to proper laning of highways, particularly in the design of divided highways.

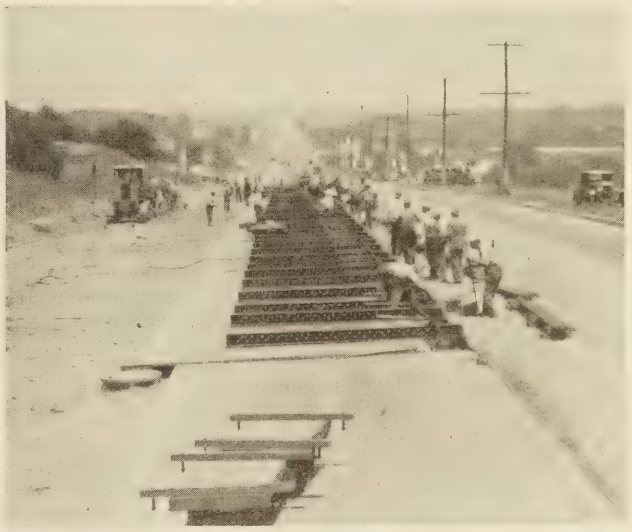
In some designs lanes 12 feet wide are used adjacent to the dividing strip, and lanes 11 feet wide are used adjacent to the roadway shoulder. The 12-foot width for the inside lane provides a greater operating space for vehicles overtaking and passing and thus reduces the possibility of sideswipes or other accidents. The outer 11-foot lane because of its proximity to the shoulder is entirely adequate for traffic in motion and the adjacent shoulders may be used for parking or emergency purposes.

In urban areas traffic tends to travel at appreciable distances from the edge of pavement particularly where curbs are used. Outside lanes, therefore, equal in width or wider than the inside lanes often are used to prevent encroachment on the inside lanes and to permit busses and other vehicles to approach and leave curbs without seriously interrupting the higher speed traffic.

Where extra width of outer lane or continuously wide shoulders cannot be had, provision should be made at predetermined intervals for widened areas in which busses may receive and discharge passengers or service trucks may load and unload merchandise without interrupting through traffic. To assist in segregating traffic and keeping vehicles in their proper lane, broad black, white, or bright yellow lines are painted along edges of lanes. The results are fairly good but the method is not effective against the irresponsible driver who uses the middle of the road or straddles the lane markers.

The State of New Jersey has undertaken many major improvements to reduce traffic accidents on its State highway system. Studies of accident records before and after the improvements were made are enlightening and in some cases contrary to common belief. An analysis of accidents occurring on roadways having hard surfaces of two-lane, of three-lane, and of four-lane widths showed as an average for all sections an accident rate of 3.10 accidents per million vehicle-miles traveled; on two-lane roadways 2.75; on three-lane roadways 3.53; and on roadways having four contiguous lanes the number of accidents was 3.61 per million vehicle-miles. In other words, an increased accident rate ocurred with increased width on roadways on which traffic lanes are contiguous. It is interesting to note that contrary to general belief the study showed that four-lane highways of the undivided type are more hazardous than three-lane highways. The apparent reason is that the wider road makes possible excessive weaving, that is, the uncontrolled movement of traffic from one lane to another.

Officials of the State of New Jersey obtained interesting data relating to accidents for sections of highways that had been converted from an undivided highway to a divided type. The following examples are cited: A study was made on a 2.1-mile section of State Highway Route No. 26 (US 1) in the township of New Brunswick where the change from a four-lane undivided highway to a four-lane divided highway was accomplished by the extremely novel method of using compressed air in fire hose to force apart and slide over one outer lane of the existing concrete pavement, thus providing space for a 12 foot center island. The addition of another



Moving an Existing Concrete Slab to Provide a Four-Lane Divided Highway on US 1, 16 Miles North of Trenton, N. J.

lane outside the moved section made available a two-lane roadway on both sides of the island. After the widening, observations indicated a reduction of 36 percent in accidents of all types. With the exception of the construction of the dividing strip and wider roadway the characteristics of the converted highway remained the same as before.

Another example is a 7-mile section of State Highway Route No. 25 in Cinnaminson and Delran Townships where a two-lane road was converted into a four-lane divided road. On this section there was found a total reduction of more than 46 percent in all types of accidents. This case, however, is somewhat different from that of Route No. 26 for the reason that in addition to the construction of the 10- to 12-foot center island separating the original traffic lanes from the two new traffic lanes, alinement also was improved. It may be concluded from these and other reports that on multiple-lane highways segregating vehicular traffic in each direction is conducive to increased safety, convenience, and utility.

Bypass roads.—Where main highways pass through urban areas it is inevitable that they are crossed by numerous streets. Each crossing, with its conflicts between through, cross, and turning traffic, constitutes a hindrance to smooth operation and a hazard to life and property. The accessibility of a main highway

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A Rotary Intersection in New Jersey.

encourages the commercial development of the roadside, the servicing of which adds to the congestion and hazard. It also is inevitable that the hazard to life and property, loss of time, inconvenience, and general confusion increase with the size of the city and the density of through and cross traffic.

A study of the problem shows that the original routings through many cities or towns were not objectionable when traffic was light and congestion unknown. In those early days when traffic was largely local in character, there were few improved roads and nearly all roads of importance passed directly through business centers of communities. When engineers first proposed traffic relief through bypass roads around towns and cities, merchants along the main streets strongly opposed such proposals claiming that valuable transient business would be lost thereby. To meet the needs of through traffic which neither belonged on the local streets nor desired to use them, and at the same time meet the needs of local traffic and satisfy the local businessmen, roads have been improved through the communities and bypass roads later constructed skirting the built-up sections so that the traveler may select the route to follow.

The belt-line or bypass road has proved an effective means of segregating through traffic from local traffic, expediting traffic, and reducing accidents. However, unless access from abutting properties on bypass roads is controlled by the State, the continued development of such frontage for business and residential purposes gradually tends to reproduce the very traffic conditions that the bypass road was designed to alleviate.

Widening of a highway instead of constructing a bypass road will not always satisfy the demands of traffic of mixed character. Moreover, widening and straightening local streets to accommodate through traffic is costly, although relatively minor improvements in many cases will make them entirely adequate to handle local and short-distance traffic. Safe, high-speed operation cannot be obtained where vehicles are parked along curbs or in operating lanes, nor can it be expected in built-up communities where adjacent property owners have unrestricted right of access.

In St. Louis, Mo., the major thoroughfare system was developed by widening existing streets to as much as 76 feet, thus providing six traffic lanes. It was found that traffic did not uniformly distribute itself over the six-lane main highway. The largest volume traveled near the center of the roadway, a smaller volume traveled in the second lanes adjacent to parked cars. The principal improvement apparent from the widening was less congestion at intersections where the extra space was occupied by cars awaiting the go signal.

Bypassing centers of population is an established policy of the highway department of the State of New Jersey and is generally satisfactory to through and local traffic. It has been found that bypass routes around New Jersey cities shorten distances for traffic destined beyond the municipality bypassed, improve the alinement of the main route, separate through and local traffic, eliminate the costly operation of widening existing streets, provide double traffic routes where needed, and reduce danger to local traffic and pedestrians. Although numerous examples of bypassing cities in that State can be cited, only the Keyport bypass is mentioned here. One of the most annoying and dangerous obstacles to travel by way of the sea-

shore route from the New York City, Jersey City, and Newark area to the coastal resorts to the south, was removed by the Keyport bypass. The old route through the borough passed over narrow streets and included a railroad grade crossing carrying many trains. Before construction of the bypass road traffic up to 47,529 vehicles daily wormed its way through the city and on busy days a delay of 2 hours was not unusual. The bypass eliminated all traffic hazards and delays and justified the cost of $1,000,000 for the 2.6 mile improvement.

Where bypasses of the limited or freeway type are in use they have demonstrated an ability to carry large volumes of traffic around highly congested areas without appreciable reduction in speed and under conditions approximating complete safety.

Traffic on any heavily traveled highway in which there is no segregation with respect to vehicle types frequently comprises heavy freight trucks, light freight trucks, light service trucks, passenger automobiles, and pedestrians. Each class of traffic should be able to function efficiently, conveniently, and safely. If the volume of traffic on a highway is great enough, slow-moving traffic may be segregated from fast-moving traffic by the construction of separate roads. The most practical means of segregating slow-moving and fast-moving traffic is by restricting roads for fast-moving traffic to passenger vehicles, though there appears to be an increasing tendency to construct and maintain high-speed trucks particularly of the lighter weights.

Frequently bypass roads are restricted to passenger vehicles, thus segregating high-speed from slow-speed traffic and segregating passenger-vehicle through traffic from passenger-vehicle local traffic, but complete vehicular segregation is not accomplished because all truck traffic is required to use the road nominally devoted to local traffic. The Pulaski Skyway, an elevated bypass route in the State of New Jersey approaching New York City, was first opened to mixed traffic. In spite of no grade crossings, side entrances, or other hindrances, smooth operation did not result. Trucks now are prohibited and daily traffic densities of more than 50,000 vehicles on this four-lane highway frequently are recorded.

Freeways and parkways.—A freeway is a roadway in which the traveled surface is devoted to the exclusive use of motor vehicles; direct access to and from abutting properties is eliminated; access is restricted to properly located and designed entrances and exits at infrequent intervals; all intersections are separated or eliminated so that no traffic crosses at grade; and opposing streams of traffic are separated physically.

A parkway is a freeway with recreational facilities, parks, and scenic areas provided by the acquisition and development of an appreciable though variable width of right-of-way.

In this country an insignificant portion only of the improved highway mileage has been developed to the point of separating all traffic at intersections by means of overpasses or underpasses and only a relatively small mileage will need such improvement. To improve 5 percent of the State highway systems, comprising 340,000 miles, with four or more traffic lanes, with opposing traffic separated, grades at intersecting highways separated, border roads provided for unrestricted access from abutting property and sidewalks constructed where needed, would involve an expenditure of approximately $4,000,000,000. Except for relatively short sections, principally in the vicinity of New York City, and the Merritt Parkway in the nearby State of Connecticut, no freeways of appreciable length have been constructed in this country. However, the needs of traffic are forcing attention to this type of development as is evidenced by efforts on the part of some of the States to seek legislation to make possible this type of highway facility.

Cycle tracks, bridle paths, and provisions for horse-drawn traffic.—After some 30 years of relatively little use, the bicycle is coming back into favor in the United States. Its use is growing to such an extent that communities may well consider provision for this convenient and inexpensive vehicle. The estimated total number of bicycles in use in 1936 was 10,000,000. In that year the number of bicycles manufactured was 600,000 more than in 1933. At present, however, bicycles are used almost exclusively for recreational purposes and rarely as means of transportation except for very short distances such as to and from school.

With the increase in bicycle use has come a toll of accidents. In 1935 there were 13,000 accidents involving motor vehicles and bicycles resulting in 350 fatalities. From 85 to 95 percent of all the fatal accidents of this character occurs in urban areas. The most common types of collisions are those in which motorists run down insufficiently lighted bicycles at night, and those caused by cyclists suddenly entering the roadway from a sidewalk or driveway.

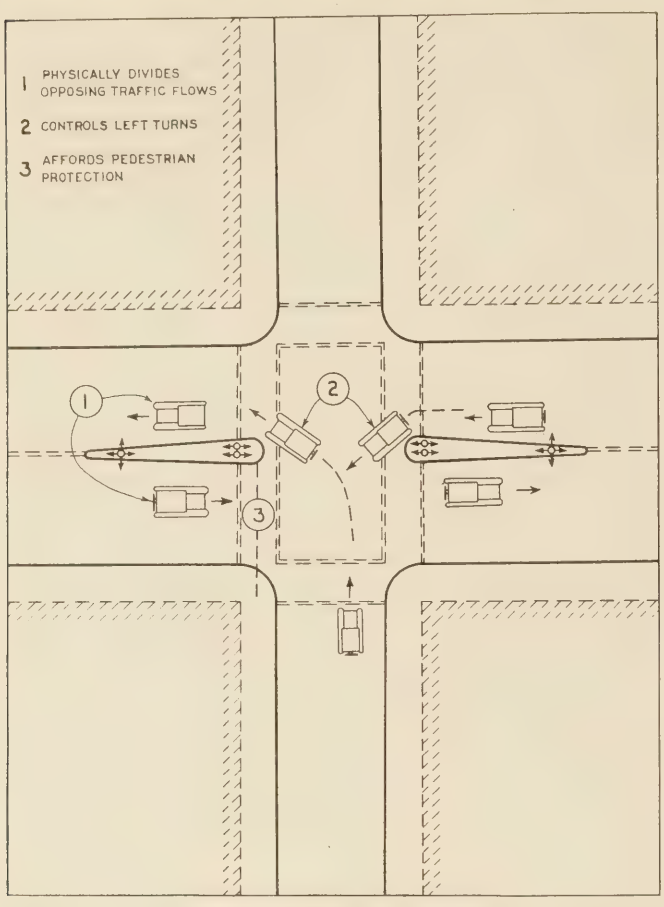
There have been few, if any, tracks constructed in the United States intended for the exclusive use of bicycles. As with footways, bicycle tracks should be entirely separated from the roadway. If there are few bicycles and few pedestrians, both may use the same pathway. In general, however, each should have its own track. The bicycle would probably be more extensively used in this country were it not for the extreme danger of cycling on streets and highways and because of legislation prohibiting its use on sidewalks.

The construction of bridle paths in this country has been confined almost exclusively to park areas in or adjacent to the larger centers of population. They should be kept a considerable distance from main traveled highways. There is no good reason why they should parallel highways except for the purpose of using the same right-of-way, as they do not have any close connection with an automobile highway. Where bridle paths cross main highways in park areas it frequently is common practice to protect such crossings by traffic signals that can be operated by equestrians approaching the crossing.

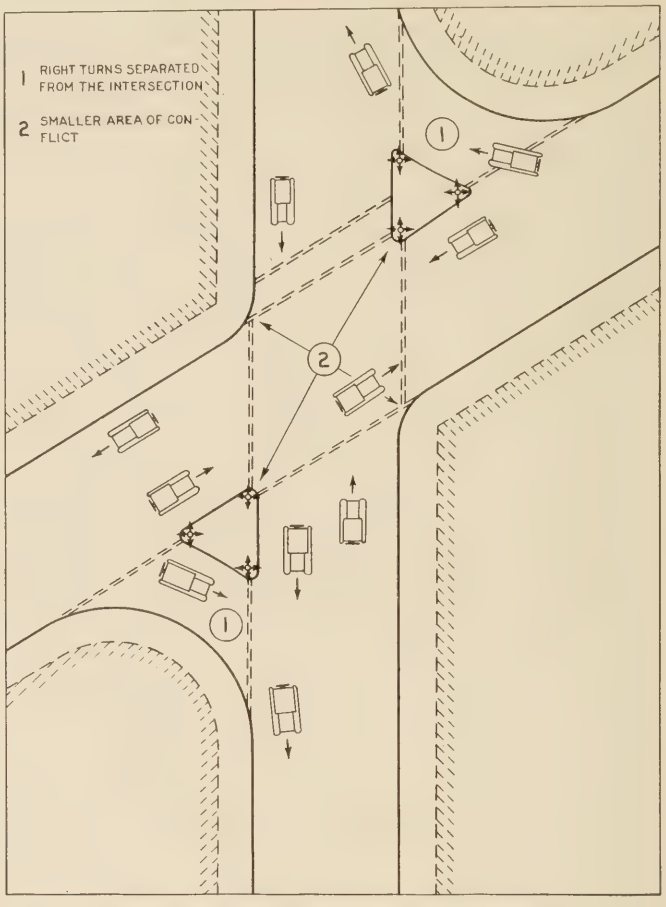
Horse-drawn traffic has practically disappeared from the main, trunk-line highways in the United States in spite of the fact that the horse is still an important factor in agricultural production. Modern highway structures are designed almost solely for motor traffic and are not well adapted to horses. In a relatively few States earth shoulders of extra width have been constructed to accommodate horse-drawn vehicles but these cases are rare and confined largely to relatively flat country where cost of grading is low.

Horse-drawn vehicles, flocks of sheep, and herds of cattle still may legally use the highways and sometimes do, but this type of traffic is confined almost exclusively to the farm and its adjacent earth roads.

Footways and sidewalks.—Sidewalks are common to city streets but walkways in rural areas have been constructed only to a limited extent, requiring pedestrians



CHANNELIZING RAISED TRAFFIC ISLANDS



BYPASS AND CHANNELIZING RAISED TRAFFIC ISLANDS

Channelizing Islands as Used on City Streets in Milwaukee, Wis.

to use the vehicular roadway. With the increase in the speed of travel and the density of vehicular traffic the vehicle-pedestrian hazard has increased and there is a growing movement for segregating pedestrian from vehicular traffic in rural areas by the construction of walkways.

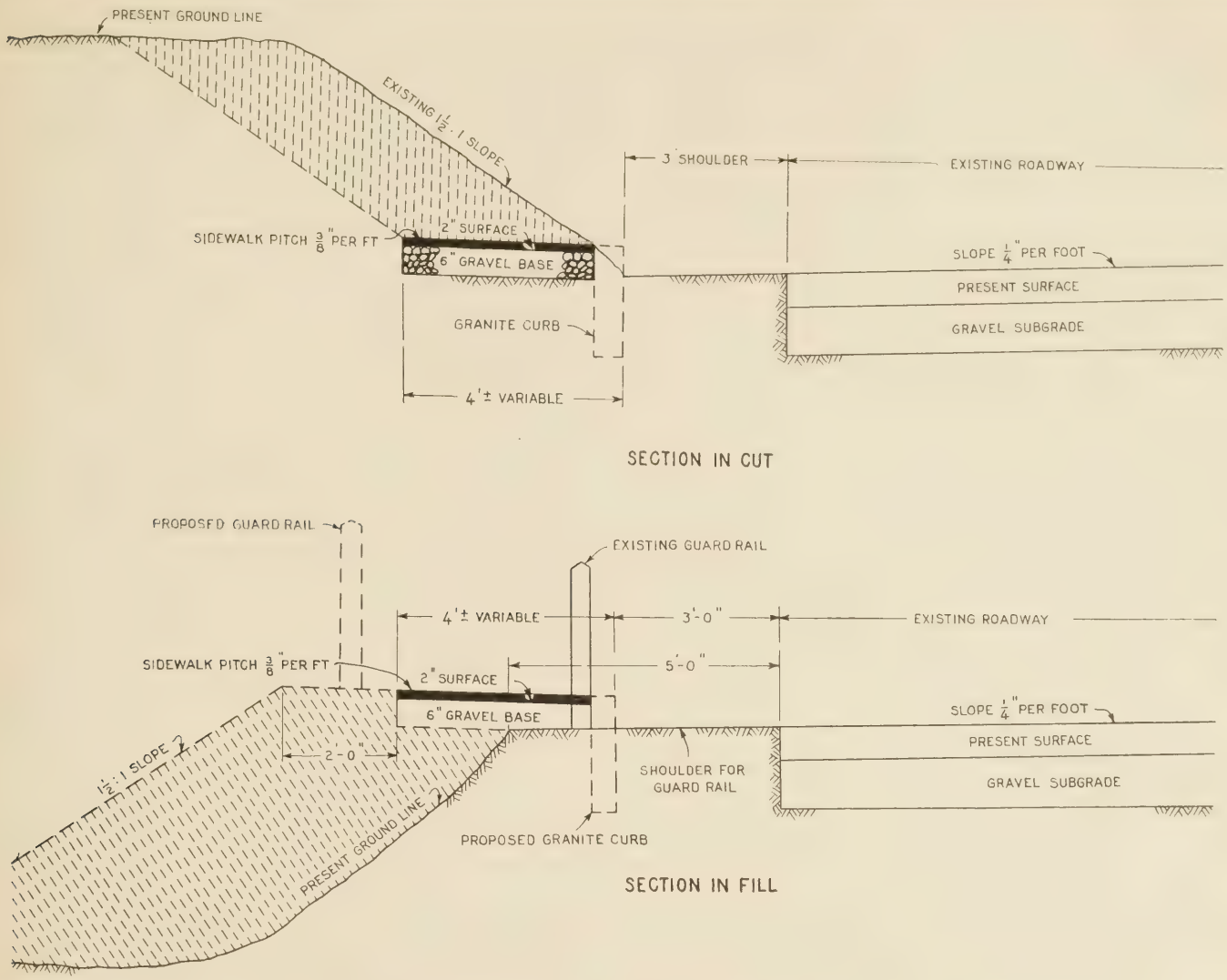
The "right-of-way" or strip of land dedicated to the use of the public for travel, is generally wide enough to allow for building sidewalks well outside the paved strip which is built for vehicles. On every important highway there should be such a pathway and if the needs of the walking public in the community demand it, sidewalks should be built on both sides of the street. They should, if possible, be several feet away from the vehicle pavement and the separation emphasized by a line of intervening shrubbery or trees. This serves the purpose of making it practically impossible for the vehicle driver to encroach on the space reserved for pedestrians and at the same time discourages pedestrians from wandering on or too near to the motorway.

Sidewalks should be so located, designed, and constructed that pedestrians will use them. They should attract pedestrian traffic from the highway to themselves. Unless the sidewalk is attractive and convenient the pedestrian will not use it. The use of two relatively narrow sidewalks on rural highways where pedestrians are encouraged to walk facing the traffic, may, in some cases, be more desirable than one sidewalk which compels pedestrians, frequently children, to cross a busy highway. Pedestrians should be able safely and conveniently to walk along the highway in either direction and to cross the highway at reasonably frequent intervals.

Sidewalks must be easily accessible to the roadway pavement without the necessity of wading through snow, slush, mud, or water. The question of snow removal from sidewalks as well as pavement, therefore, should be considered in snow States. In flat and rolling country where grading is relatively light, sidewalks may be located farther from the pavement than where grading is heavy and more costly, such as on relatively narrow fills with guardrails, through swamp or marsh land or in cuts and fills in mountainous areas and on bridges.

Vehicle-pedestrian accidents in urban areas generally occur while pedestrians cross the street. There is an increasing tendency to prohibit crossing of streets except at intersections where the crossings for pedestrians are marked clearly. Where pedestrian traffic density warrants it, traffic lights are adjusted to partially subordinate vehicular traffic to pedestrian traffic by inserting a time interval for pedestrians or restricting vehicular turning movements at a limited number of crossings.

Sometimes islands to separate opposing traffic at crossings are constructed at intersections of wide city streets so that pedestrians crossing the street may use them for refuge and need watch traffic in only one direction at a time. They also confine left-turning vehicular traffic to a limited width of street. Islands generally are unsatisfactory at intersections on rural highways because of (1) insufficient roadway width,



Cross Sections of Typical Sidewalk Designs in Cut and in Fill Used in Massachusetts.

unless adequate provision is made for gradual widening approaching the intersection, and (2) the additional hazard to high-speed vehicular traffic.

Places where the highway may be crossed by pedestrians should be clearly marked. These guiding marks should be made as clear and definite for the motorist who is approaching the crossing as for the pedestrian. Traffic signs for this purpose may be set on posts at the side of the pavement or painted on the pavement itself. They should be unmistakably clear—a single short word or phrase or, better still, a symbol whose meaning can be grasped at first glance.

Sidewalks or footways should be planned as an integral part of the roadway wherever their need is indicated. There are no available statistics indicating what traffic and what speeds justify the construction of one sidewalk or two sidewalks or of any sidewalk at all. In general, however, sidewalks are needed within and adjacent to industrial areas, along roads connecting villages situated relatively close to each other, in the vicinity of large schools, summer resort areas, unincorporated suburban areas, and elsewhere where considerable pedestrian traffic exists or may be expected.

The cost of grade separations for pedestrians usually cannot be justified, and experience has shown an unwillingness on their part to use either overhead bridges or underpasses. For this reason, safety islands or refuges for pedestrians crossing wide highways or wide streets in urban areas are likely to serve the greatest number.

Statistics available for the State of Pennsylvania show that 44 percent of the people killed by motor vehicles in that State in 1936 were pedestrians. A large percentage of the pedestrian fatalities were in built-up sections where sidewalks existed, indicating a need for a careful study of possible traffic control for pedestrian crossings.

The Department of Public Works of the State of Massachusetts has completed a State-wide program of construction calling for 500 miles of sidewalks along the State highway system of 1,890 miles for which the State appropriated $4,000,000. The purposes of this undertaking were to reduce accidents to pedestrians, provide employment, and indirectly to increase the value of abutting property. After the program was under way property owners offered easements for sidewalks without compensation.

The locations for sidewalk construction were based on a 6-year study of collisions between pedestrians and motor vehicles in the State from 1930 through 1935. For that period the study showed a total of 4,427 accidents of the above class in which 3,841 persons were injured and 586 killed. Before the program of

construction began in 1935 there was a progressive increase in the accident rate as well as a general increase in pedestrian accidents in rural counties as against a decrease in the larger cities.

A table of pedestrian accidents on routes where sidewalks were constructed gives a comparison of pedestrian injuries and deaths for the first 6 months of each year since 1933 (table 1).

TABLE 1.—*Pedestrian injuries and deaths on routes where sidewalks were constructed*

First 6 months of—	Injuries	Deaths
1934	240	21
1935	243	26
1936	212	24
1937	154	18

Records for the first 6 months of 1935, which was the period before the sidewalk program started, and the first 6 months of 1937, when the major part of the work had been completed, clearly indicate a decrease in pedestrian casualties.

Despite an increase during this period of 12 percent in registrations and 15 percent in gasoline consumption, the number of pedestrians injured on these State highway routes decreased over 36 percent, whereas total pedestrian accidents on all Massachusetts roads for the same period decreased only 11 percent.

Reductions in pedestrian fatalities on State highways are consistent with those in injury cases. On State highway routes where sidewalks were constructed, the pedestrian fatalities in the same 6-month periods showed a reduction from 26 to 18, or about 31 percent. This decrease is most significant when one considers that in the same period pedestrian fatalities in the State as a whole increased from 188 to 201, or about 6.9 percent.

The above figures are for all types of pedestrian accidents. Studies of accidents involving pedestrians walking along the highway show a general reduction of over 50 percent, and on many routes where sidewalks have been built, no accidents of this type have been recorded during the first 6 months of 1937, where formerly there were many serious casualties annually.

All new projects for the construction or reconstruction of State highways in Massachusetts now include the construction of sidewalks as an integral part of the design, except in unsettled areas where pedestrian movements are negligible. Even in these cases, provision is made in the design for future construction of sidewalks to allow for possible future development of abutting property. The present plan is to construct at least one continuous sidewalk for the entire length of each highway, except in undeveloped country, whereas the former plan was to construct no sidewalks at all except in highly developed country. The State authorities feel that the saving in life as shown by the above studies justifies a considerable expenditure of State funds for walkways.

Service roads and parking places.—In metropolitan areas additional facility and protection must be provided on main routes to reduce hazards, prevent congestion, and insure a free and easy flow of traffic. This need has come about largely because of the dispersion of city population in suburban areas.

Experience has shown that widening a roadway by adding more traffic lanes adjacent to those already in place does not increase roadway capacity in proportion to the traffic lanes added and does not reduce accidents to the extent desired. The capacity per lane decreases with an increase in the number of contiguous lanes beyond four, dropping sharply beyond six. In urban areas vehicles parking at and leaving curbs as well as those occasionally double-parked or cruising in front of business establishments slow down both through and local traffic and constitute serious hazards.

The bypass road often may not fully accomplish the object of diverting a considerable percentage of traffic from an existing through route. The destination of much of the traffic may be within the city and local conditions, such as extended areas of urban development, may make it difficult to construct a bypass road attractive to through traffic destined beyond the city. Under such conditions the existing routes through cities must be improved.

Through routes have been successfully improved and local traffic segregated from through traffic by providing roadway surfaces adjacent to abutting properties and separated from through traffic lanes in the central portion of the street by appropriate dividing strips. The roadways adjacent to abutting property may be termed service roads and in combination with the central, through-traffic lanes form the typical boulevard sections of many large cities.

In most urban areas existing streets generally are inadequate for the parking of vehicles. This is particularly true in commercial sections where parking facilities often are necessary for the success of the business establishments. Limiting parking on streets, parking meters, and other forms of enforcement relieve this situation to a limited extent. Garages expressly for parking have been constructed and much valuable land in the centers of many cities has been converted into pay parking lots. Many large business establishments have recognized the need for parking areas and have found it profitable to construct such areas on adjacent private property. Many others have found it necessary to move their establishments or establish branch offices in suburban areas where parking is provided readily. Small retail establishments have found it profitable to pool their resources to provide parking areas known as "park and shop" areas which serve a number of establishments at one time. On high-speed through routes in rural areas establishments such as eating places have found it inexpensive and desirable to provide parking areas for their patrons off the highway.

The need for providing parking areas off the public highways is being recognized to the extent that some municipalities have adopted zoning ordinances which require certain types of structures, such as theaters and apartment houses, to provide garages or parking areas in proportion to the number of persons for which the structures are designed.

Road junctions and crossings.—When two or more roads cross each other traffic hazards and impediments to smooth operation are created by the conflict between through and turning traffic on both roads. The ideal treatment of an intersection is one which results in the segregation of different types of traffic and the segregation of traffic in each and every direction. This is not always practical nor is it often economically advisable. The treatment of each intersection depends principally upon the density of traffic on each road and the density of traffic making each possible turn, but considerable leeway must be permitted the designer because of the effects of topography, cost, and diffi-

culty of procuring adequate right-of-way, probable speed of traffic, and other factors. Individual judgment is necessary also because thought is not as yet crystallized on the traffic densities for through and the various turning movements which justify the construction of the various types of intersections. A few fundamental principles, however, have been fairly well established.

When two highways intersect at grade, consideration of the traffic volume on each highway is the most important factor governing the design of the intersection. There are two general conditions, one in which the traffic volume is approximately equal on both roads and the other in which the traffic volume is greater on one highway than on the other. In the first case, unless stop signs are used, a driver on either highway should be able to see conditions at the intersection in sufficient time to allow the vehicle, if necessary, to be brought to a stop before reaching the intersection. Where visibility and sight distance are inadequate to accomplish this, one road should be subordinated to the other road by stop signs or slow signs, or stop signs used on both highways. In the second case movement on the road carrying the greater traffic volume should be given preference over the road carrying the lesser volume by the use of stop signs on the less important road.

The proper use of signs at intersections is most important and their selection should be based on sound engineering principles established by actual studies of accidents, speeds, delays, sight distance, braking distance, and physical conditions. Unfortunately there is a wide variation in official responsibility for the selection, installation, and maintenance of traffic control devices, particularly in metropolitan areas. Slow signs should indicate the safe approach speed and be placed far enough in advance of an intersection to enable a vehicle traveling at the speed for which the highway is designed to slow down to the speed indicated on the sign before reaching the critical point of the intersection. In no case should sight distance be less than the distance in which the vehicle can be stopped. The ability to see an appreciable length of the intersecting highway is fully as important as the ability to see on horizontal and vertical curves along a highway between intersections.

Experience in the State of Massachusetts indicates that to avoid collisions at intersections stop signs should be used where sight distance is so short as to require a 10-mile-per-hour speed.

Intersection designs preferably should enable traffic to enter slowly and to leave quickly. Approach visibility to an intersection having a high percentage of turning movement is of prime importance. The elements of uncertainty and surprise should be eliminated. An intersection should be so marked that no doubt can exist in the driver's mind as to what is the right thing to do. Intersections which readily can be recognized by a motorist as requiring caution have a more favorable accident record than those in which conditions are not clear. The lay-out of an intersection should favor the larger volumes of traffic movement. The roads approaching intersections at grade should be flared or widened but not to the extent of causing traffic to wander from its proper channel and cause congestion.

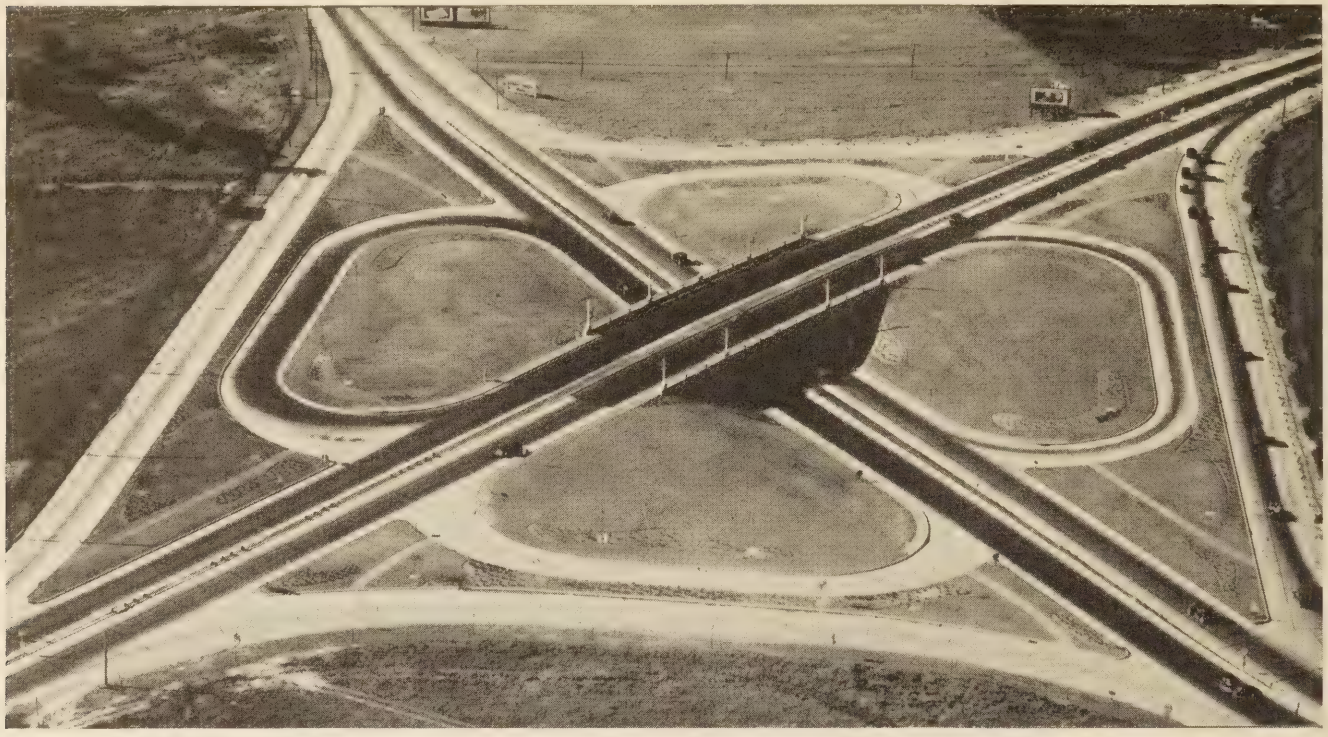
Heavy volumes of traffic may require installation of traffic lights and a greater widening of intersection than is needed for lesser traffic volumes. There should in any case be sufficient space in which to accomplish traffic movements without the necessity of encroaching on adjacent traffic lanes. Traffic lanes at intersections should be so located that it will be easy for traffic to make natural and smooth progress free from any abrupt changes in direction that are likely to cause collisions or sideswiping. Automatic control devices of a number of types have been used with excellent results, and the lighting at night of busy intersections has evident advantages. The character of control devices in use includes warning flashers of several types including the pretimed, the vehicle-pedestrian actuated, synchronous-progressive, and others. The selection of type of control device is dependent on local conditions, and the locations where signals are contemplated should be given careful field study before the adoption of one type or another. The vehicle actuated type of control is particularly effective in facilitating infrequent cross movements at intersections where the predominant traffic flow is on one route.

Rotary traffic may be defined as the movement of vehicles in one direction around a central area. The central area together with the one-way road around it and with the entrances and exits generally is called a "traffic circle" though it may more accurately be termed a traffic loop or circuit. It is usually used at the convergence of several streets or highways.

The circle is in effect a continuous series of one-way roads connecting the entrances and exits of the various intersecting roads. The length between roads on the one-way road or traffic circle should be about 250 feet and should be not less than 150 feet in order that traffic may weave from the entrance to the inside lane and back again as required at the moderate speeds prevailing on traffic circles. They may be longer but preferably not more than 700 or 800 feet.

The variation in the angles and locations of the several converging roads and the necessity for distorting the traffic circle to provide the minimum distances between roads, to avoid expensive parcels of land, and to avoid expensive construction results in so-called "traffic circles" of various shapes such as true circles, rounded squares, rectangles, triangles, or other polygons, ellipses, and many other unsymmetrical shapes. Parts of existing streets or roads may be included. Each road entering a "traffic circle" in rural areas should be divided into an odd-shaped Y by a conspicuous, distorted triangular island which performs the important function of guiding traffic to the right and making all one-way roads funnel-shaped, that is, wide at the entrance and narrow at the exit. The islands also may be used for signs and as stopping places for pedestrian traffic. The curbs generally are constructed with slight slopes so that the islands may be mounted in emergencies.

The four-lane highway with traffic in opposing directions separated by a parkway may be designed to decrease hazards at intersections at grade. On heavily traveled four-lane roads having adjacent lanes, it is difficult to obtain a sufficient break in traffic to permit safe crossing unless traffic control lights are used. If the roadways are separated a sufficient width to provide a safety island between the opposing lanes of traffic, cross movement may be effected in two operations. A break in the flow of traffic in one direction permits a vehicle to reach a point in the pavement adjacent to the safety island where a stop may be made and the crossing completed when there is a break in traffic in the opposite direction. The width of separation between opposing lanes of traffic should be not less than 30 feet for this



A Cloverleaf Intersection in New Jersey.

purpose. Such construction also permits the openings between islands to be used for turn-around purposes. Divided highways of this type offer a much safer crossing than an undivided highway and also offer a partial solution to the problem of handling traffic making left turns from main roads into secondary roads.

Accident statistics for the State of New Jersey show that rotary circles facilitate traffic flow better than intersections controlled by traffic lights and with fewer accidents. A traffic circle can be designed to carry any reasonable volume of traffic, whereas a traffic-light controlled intersection has a capacity equal only to about 50 percent of the combined capacities of intersecting roads. Illumination of circles at night is necessary. Warning signs should be placed well in advance of traffic circles and large lighted signs are needed at circles to direct traffic. As a further aid to traffic direction, reflectorized units set into the curbs have been used to some extent.

The extent to which traffic circles are justified by traffic volume at any given intersection is a matter of judgment. There are no conclusive data on which there is general agreement, nor is information available on which to base a change from a traffic circle to a grade separation. Much depends upon the traffic, topography, cost of land, and construction. If sufficient right-of-way has been purchased for the ultimate construction of a grade separation with ramps, there is generally sufficient area for a traffic circle and the initial improvement may begin with a circle and later as necessity arises be developed into a grade separation with connecting ramps.

The separation of grades is a most effective method of increasing the traffic capacity of intersections, and of eliminating conflicting traffic movements and reducing accidents. A properly designed highway grade separation has approximately the same capacity as that of the roadways bringing traffic to it. Connecting roadways or ramps complicate the construction and facility of grade separations and should be used only where access and egress are definitely needed. Rates of grade and of curvature on ramps should make possible an easy and continuous flow of traffic without the close grouping of vehicles which creates hazards at points of entry to the main highways.

The need for ramps sometimes has been overestimated. Four ramps are not always needed and construction may begin with two ramps, when the volume of traffic on the less important road permits left turns without any particular hazard. In case future traffic requires four ramps, two more can be added later. Designs and right-of-ways purchased for original construction should, of course, make proper provision for later development. Ramps at grade separations sometimes are confusing. Signs visible day and night must be placed well in advance of a grade separation. They must inform drivers desiring to turn how to do so. The wording or diagram must be as simple as possible.

The highway department of the State of New Jersey recently made before-and-after records to determine the efficiency of highway intersections constructed in that State. In a comparison between a grade separation with ramps and a signalized intersection a short way distant on the same highway, it was found that despite a considerably greater volume of traffic on the grade separation there were fewer accidents there than at the signalized crossing. A similar comparison between a traffic circle and a signalized intersection was made which indicated that despite the constant operation of traffic-control signals at the signalized intersection there were 13 times as many accidents as in the same period at the traffic circle.

Highway grade separations in urban areas have been constructed for many years, two notable examples being the Grand Concourse in New York City on which the

grades of all important cross streets were separated about 1916 and the first of the Westchester County parkways on which all crossings at grade were eliminated, the first bridges for this purpose being designed and constructed about 1914.

The first rural grade separation with ramps in the State of New Jersey was built in 1928. Its capacity was observed in 1930 when a 16-hour traffic count recorded a total of 62,527 vehicles passing through the intersection. The maximum hourly count was 6,074 vehicles or at the rate of more than 100 vehicles per minute. Eleven percent of the total traffic was right-turn traffic and 12 percent left-turn traffic. The State of New Jersey has 125 highway grade separations located for the most part on a few heavy-traffic routes. The highway that forms the main approach to the Holland tunnel under the Hudson River between Jersey City and New York City has a roadway without grade crossings for 9 miles that passes under and over many local roads. For part of its length this roadway is depressed in a rock cut and a part of the remainder is elevated on embankments or viaducts.

Summary.—

1. Two-lane highways properly designed and paved to a width of 22 feet are capable of carrying modern mixed traffic of from 3,000 to 5,000 vehicles per day.

2. Three-lane highways of the dual type having long sight distances for passing at frequent intervals are capable of carrying approximately two times as much traffic as two-lane highways.

3. Four-lane highways having connected lanes carrying two lanes of opposing traffic in each direction are unduly hazardous and their further construction for use by high-speed mixed traffic in rural areas is to be discouraged.

4. Four-lane highways with opposing traffic separated by a raised median or parking strip, preferably not less than 30 feet in width, practically eliminate head-on collisions, and reduce hazards at intersections at grade. Such construction is recommended.

5. A need for limited roadways of the freeway type is evidenced by traffic demands and legislative proposals for construction of this character.

6. Bypass roads constructed around built-up sections segregate through traffic from local traffic, remove it from city streets, and facilitate its free movement by eliminating hazards and reducing delays; but to be effective over long periods control over abutting property must be secured to prevent unrestricted access.

7. Inefficient intersections greatly reduce the capacity of highways and cause accidents. A limited widening of roadways at intersections with marked lanes and speed control signs with or without traffic control signals are reasonably effective for light to medium traffic volume. For heavier traffic volume traffic circles and grade separations with or without ramps are recommended.

8. In built-up sections traversed by through and local traffic some measure of relief from congestion is possible by the construction of service roads for the slow local traffic separated from the through traffic by raised strips or islands. Public parking lots and garages adjacent to main highways have been found to reduce hazards resulting from parking.

9. Studies of accidents involving pedestrians along the highways in the State of Massachusetts clearly indicate a substantial decrease in pedestrian casualties since the completion of 500 miles of sidewalk. Accidents involving pedestrians walking along the highway generally have been reduced 50 percent. On many roads formerly the scene of serious casualties no accidents since the construction of sidewalks were recorded for the first 6 months of the year 1937.

10. In the United States there is no immediate problem relating to the segregation of traffic using cycle tracks or bridle paths. Horse-drawn traffic is confined principally to light-traffic earth roads in agricultural areas.

STATE MOTOR-VEHICLE REGISTRATIONS, 1937

(Compiled for calendar year from reports of State authorities [1])

State	Registered motor vehicles, private and commercial [2]					Other registered vehicles		Publicly owned vehicles						Dealers' registrations and plates [7]		1936 total registered motor vehicles [8]	Year's change in motor-vehicle registrations	
		Passenger motor vehicles						Federal [5]			State, county, and municipal [6]							
	Total motor vehicles	Total	Automobiles (including taxicabs)	Motor busses [3]	Motor-trucks, tractor trucks, etc.	Trailers and semi-trailers [4]	Motor-cycles	Motor vehicles	Trailers and semi-trailers	Motor-cycles	Motor vehicles	Trailers and semi-trailers	Motor-cycles	Regular registrations	Extra sets of plates		Increase or decrease	Percentage change
Alabama	313,359	257,248	253,653	3,595	56,111	4,850	830	1,917	44	14	3,856	----------	191	2,914	----------	297,292	16,067	5.4
Arizona	129,210	106,237	105,793	444	22,973	4,321	423	2,236	80	7	1,891	114	27	2,179	----------	115,035	14,175	12.3
Arkansas	229,867	173,923	173,575	348	55,944	12,278	507	2,096	25	1	2,806	12	26	550	----------	217,227	12,640	5.8
California	2,484,653	2,189,378	2,189,378	[8]	295,275	132,932	11,260	7,140	280	90	23,359	1,523	1,074	5,145	----------	2,327,984	156,669	6.7
Colorado	337,217	282,123	281,080	1,043	55,094	1,468	1,316	1,899	12	22	(10)	(10)	(10)	3,492	----------	316,050	21,167	6.7
Connecticut	436,564	368,473	367,413	1,060	68,091	4,904	1,996	669	5	1	3,672	67	230	2,844	7,831	([11]) 403,263	33,301	8.3
Delaware	63,599	53,285	53,285	[9]	10,314	2,645	236	382	15	9	959	25	62	756	----------	59,629	3,970	6.7
Florida	418,145	347,837	346,230	1,607	70,308	16,238	1,244	1,646	43	15	5,131	----------	180	2,765	----------	386,907	31,238	8.1
Georgia	441,847	363,641	363,233	408	78,206	12,262	1,085	3,255	81	49	(10)	(10)	(10)	3,069	----------	410,583	31,264	7.6
Idaho	142,110	113,605	113,477	128	28,505	18,645	564	1,344	74	----------	1,447	112	11	486	----------	133,037	9,073	6.8
Illinois	1,768,946	1,554,567	1,554,567	[9]	214,379	23,210	5,827	3,484	137	25	8,395	265	663	4,329	----------	1,659,750	109,196	6.6
Indiana	956,016	815,724	814,564	1,160	140,292	61,102	4,092	1,631	118	7	[12] 5,704	----------	[12] 147	2,644	----------	905,088	50,928	5.6
Iowa	745,602	657,734	657,734	----------	87,868	[13] 66,172	2,292	1,225	17	3	[12] 5,393	[12] 300	[12] 75	2,069	----------	728,414	17,188	2.4
Kansas	586,685	493,639	493,293	346	93,046	5,862	986	1,511	58	12	(10)	(10)	(10)	1,867	1,544	577,906	8,779	1.5
Kentucky	404,455	345,114	344,542	572	59,341	([14])	951	1,754	12	130	[12] 3,990	----------	----------	854	----------	372,576	31,879	8.6
Louisiana	323,498	245,665	245,180	485	77,833	14,321	834	1,825	49	25	[12] 4,822	[12] 291	[12] 60	369	----------	302,420	21,078	7.0
Maine	200,907	157,736	157,596	140	43,171	[15] 9,751	874	673	15	10	2,096	150	30	794	----------	191,554	9,353	4.9
Maryland	387,410	332,928	331,944	984	54,482	3,422	1,549	2,082	95	57	(10)	(10)	(10)	9,375	----------	378,462	8,948	2.4
Massachusetts	846,556	742,521	737,604	4,917	104,035	11,311	1,169	2,472	60	12	[16] 5,400	----------	----------	3,446	20,710	816,711	29,845	3.7
Michigan	1,505,111	1,359,665	[17] 1,359,665	[9]	145,446	133,863	4,078	2,529	74	18	(10)	(10)	(10)	5,981	----------	1,373,676	131,435	9.6
Minnesota	822,598	704,437	704,155	282	118,161	29,704	2,074	2,490	55	10	4,723	----------	----------	([18])	----------	783,627	38,971	5.0
Mississippi	226,286	173,214	170,388	2,826	53,072	2,078	234	1,585	18	1	(10)	(10)	(10)	2,478	----------	205,890	20,396	9.9
Missouri	835,895	701,894	701,438	456	134,001	31,055	1,712	2,222	12	16	2,079	----------	8	2,105	----------	809,615	26,280	3.2
Montana	173,892	134,729	133,811	918	39,163	2,812	457	1,731	20	----------	[12] 1,846	[12] 36	----------	986	----------	167,150	6,742	4.0
Nebraska	412,726	350,833	350,569	264	61,893	30,091	985	1,166	9	2	2,339	----------	40	1,600	2,718	413,787	−1,061	−0.3
Nevada	40,655	32,563	32,384	179	8,092	1,262	113	565	17	1	610	38	7	88	109	38,509	2,146	5.6
New Hampshire	125,939	99,983	99,983	[5]	25,956	4,471	963	649	16	1	600	----------	----------	594	----------	122,236	3,703	3.0
New Jersey	994,497	861,795	856,423	5,372	132,702	6,692	4,674	2,653	75	9	9,490	----------	567	2,895	----------	943,412	51,085	5.4
New Mexico	118,106	90,833	90,322	511	27,273	2,660	337	1,905	99	----------	905	153	40	368	----------	108,729	9,377	8.6
New York	2,561,703	2,233,695	2,233,695	----------	328,008	36,213	10,230	5,859	542	108	[12] 25,006	[12] 896	[12] 1,121	5,369	----------	2,453,542	108,161	4.4
North Carolina	525,350	449,897	449,201	696	75,453	40,129	1,449	2,482	83	2	([18])	([18])	([18])	([18])	----------	504,517	20,833	4.1
North Dakota	173,188	141,104	141,018	86	32,084	816	262	719	9	----------	624	----------	----------	601	485	167,241	5,947	3.6
Ohio	1,876,132	1,695,648	1,695,648	[9]	180,484	119,269	8,194	2,595	117	16	18,881	829	----------	4,612	28,007	1,777,048	99,084	5.6
Oklahoma	547,263	448,588	446,083	2,505	98,675	26,471	1,143	2,472	96	13	6,456	----------	----------	3,468	----------	531,914	15,349	2.9
Oregon	360,348	299,689	298,971	718	60,659	[9]	1,559	2,457	33	3	4,289	----------	----------	715	1,093	332,729	27,619	8.3
Pennsylvania	1,984,821	1,738,797	1,733,014	5,783	246,024	26,889	10,864	4,187	84	28	17,327	480	1,349	33,126	----------	[19] 1,857,366	127,455	6.9
Rhode Island	167,586	148,583	148,145	438	19,003	571	724	466	17	1	1,325	22	105	384	----------	159,140	8,446	5.3
South Carolina	296,224	250,820	250,623	197	45,404	5,716	785	1,510	13	6	3,750	----------	178	814	1,679	278,829	17,395	6.2
South Dakota	184,743	155,948	155,856	92	28,795	20,121	419	1,177	16	3	1,062	117	11	670	----------	186,480	−1,737	−0.9
Tennessee	400,384	341,648	341,186	462	58,736	[9]	1,473	1,993	174	1	6,900	----------	----------	595	----------	380,792	19,592	5.1
Texas	1,552,114	1,237,348	1,236,440	908	314,766	47,162	3,667	5,228	191	150	14,256	1,052	372	3,725	----------	1,478,124	73,990	5.0
Utah	126,692	105,571	104,922	649	21,121	953	439	1,631	50	14	1,894	171	85	586	----------	116,816	9,876	8.5
Vermont	88,958	79,606	79,501	105	[20] 9,352	1,706	491	806	13	----------	(10)	(10)	(10)	595	----------	84,155	4,803	5.7
Virginia	440,713	371,708	371,708	----------	69,005	6,730	1,880	3,267	70	66	[12] 5,404	[12] 150	[12] 92	5,689	----------	417,463	23,250	5.6
Washington	535,483	450,906	450,143	763	84,577	16,031	2,055	2,961	39	24	6,872	297	163	1,473	3,488	499,760	35,723	7.1
West Virginia	290,837	246,162	245,440	722	44,675	3,164	1,161	1,075	6	----------	4,860	167	71	14,244	----------	280,015	10,822	3.9
Wisconsin	854,374	713,166	712,510	656	141,208	5,411	3,240	2,165	21	6	8,149	152	266	2,626	----------	835,178	19,196	2.3
Wyoming	81,837	64,459	64,459	----------	17,378	10,099	281	1,155	35	14	627	93	----------	361	----------	76,603	5,234	6.8
District of Columbia	184,119	165,257	163,886	1,371	18,862	2,152	708	1,419	22	60	[21] 2,094	94	170	3,803	----------	181,319	2,800	1.5
At large	----------	----------	----------	----------	----------	----------	----------	2,432	32	7	----------	----------	----------	----------	----------	----------	----------	----------
Total	29,705,220	25,449,924	25,405,728	44,196	4,255,296	1,019,985	104,686	104,792	3,278	1,069	231,280	7,606	7,421	150,498	67,664	28,165,550	1,539,670	5.5

[1] Registration periods ending not earlier than November 30 and not later than January 31 are considered as calendar-year periods. In the case of States in which the registration period is definitely removed from the calendar year, registration figures were obtained for the calendar-year period.

[2] Wherever possible publicly owned vehicles and vehicles not for highway use have been eliminated from these columns.

[3] A complete segregation of motorbusses from other vehicles is not available. The figures given represent common-carrier busses in most cases, although in some States contract busses and contract school busses are included. In a number of cases city busses are not included, rural and interurban carriers only being given. Where no busses are tabulated the busses are included with automobiles, except as otherwise noted.

[4] Figures for trailers and semitrailers are as reported. Apparent inconsistencies are due to the fact that some States require the registration of tourist trailers, light-work trailers, and similar vehicles, whereas other States register only freight-carrying trailers and semitrailers.

[5] Data on Federal vehicles obtained through agency of Procurement Division, Department of the Treasury.

[6] Data on State, county, and municipal vehicles are incomplete in many cases. Some States give State-owned vehicles only; others exclude from registration certain classes, such as fire apparatus and police vehicles.

[7] Figures include new-car, used-car, and motorcycle dealers' registrations, and in some cases wreckers' and repairers' registrations. Data on dealers' extra plates incomplete, although extra plates are apparently included with dealers' registrations in some cases.

[8] Revised totals for 1936 registrations, resulting from revisions in two States, are as follows: automobiles, 24,137,423; motorbusses, 40,788; motortrucks, 3,987,339; trailers, 868,398; motorcycles, 97,063.

[9] Included with motortrucks.

[10] Included with private and commercial registrations.

[11] 1936 registrations revised to include 5,009 farm trucks licensed for limited highway use, which were omitted from table of State motor-vehicle registrations in 1936, previously issued. Revised motortruck registrations, 65,067.

[12] Includes unknown number of Federal vehicles.

[13] Includes 59,200 light trailers registered without charge.

[14] Trailers of 1,000 pounds capacity or more prohibited on highways, although permitted in cities under city licenses. Tractor-semitrailers registered as motortrucks. Light trailers permitted but not registered.

[15] Includes light trailers and commercial semitrailers. Commercial full trailers included with motortrucks.

[16] Of these vehicles approximately 1,400 are included with private and commercial registrations.

[17] Taxicabs included with motortrucks.

[18] Not reported.

[19] 1936 registrations revised to eliminate publicly owned vehicles, reissues, and exchange transfers, which were included in figures given in table "State motor-vehicle registrations, 1936." Revised figures as follows: Automobiles, 1,615,955; motorbusses, 5,577; motor trucks, 235,834; trailers, 23,776; motorcycles, 10,540.

[20] Trucks under 1,500 pounds capacity included with passenger cars.

[21] Includes 444 automobiles of the diplomatic corps.

STATE MOTOR-VEHICLE RECEIPTS, 1937

(Compiled for calendar year from reports of State authorities [1])

State	Total receipts, registration and other fees	Motor-vehicle registration fees					Registration fees, other vehicles		Total registration fees, all vehicles	Miscellaneous receipts								
		Total [2]	Passenger motor vehicles			Motor trucks, tractor trucks, etc.	Trailers and semi-trailers	Motorcycles		Total	Dealers' licenses and plates	Operators' and chauffeurs' permits	Certificates of title	Fines and penalties	Transfer or reregistration fees	Other receipts	Unclassified refunds	Estimated service charges, local collectors [4]
			Total	Automobiles (including taxicabs)	Motorbusses [3]													
	1,000 dollars	*1,000 dollars*	*1,000 dollars*	*1,000 dollars*	*1,000 dollars*	*1,000 dollars*	*1,000 dollars*	*1,000 dollars*	*1,000 dollars*	*1,000 dollars*	*1,000 dollars*	*1,000 dollars*	*1,000 dollars*	*1,000 dollars*	*1,000 dollars*	*1,000 dollars*	*1,000 dollars*	*1,000 dollars*
Alabama	4,439	3,979							3,979	460	(5)	261		189		11	−1	
Arizona	1,143	807	384	355	29	423	55	1	863	280	6	33	104	2	23	112		
Arkansas	3,241	2,553	1,185	1,116	69	1,368	416	1	2,970	271	75	176		4	10	6		
California [6]	24,003	21,172	16,645	16,645	(7)	4,527	979	57	22,208	1,795	65	121		255	1,250	104		
Colorado	2,603	2,051	1,557	1,557		[8] 494	29	2	2,082	521	42	150	197	33	94	10	−5	
Connecticut	6,691	4,247	2,820	2,691	129	1,427	22	6	4,275	2,416	107	1,675		217	141	285	−9	
Delaware	1,202	870	596	596	(7)	274	30	1	901	301	7	132	43	75	19	25		
Florida	6,196	5,597	3,895	3,729	166	1,702	236	6	5,839	357	23	9	220		1	24	−28	108
Georgia	2,368	1,875	1,163	1,098	65	712	125	3	2,003	365	9	339			8	9		
Idaho	2,498	2,295	1,647	1,620	27	648	34	3	2,332	166	29	125				12		
Illinois	21,430	19,455	13,563	13,563	(7)	5,892	170	15	19,640	1,790	93	339	559	8	674	115	−28	
Indiana	9,827	7,768	5,898	5,800	98	1,870	329	7	8,104	1,723	51	628	438		499	68	−197	236
Iowa	11,918	10,888	8,213	8,213		2,675	86	8	10,982	936	52	565		2	213	104		
Kansas	4,537	3,636	2,773	2,773	(7)	863	75	4	3,715	822	31	418	317		41	15		
Kentucky	5,125	2,706	1,534	1,454	80	1,172	(9)	2	2,708	2,417	25	498		1	206	[10] 1,485		202
Louisiana	4,710	4,052	2,807	2,746	61	1,245	569	4	4,625	85	13	87		11		2	−28	
Maine	3,865	2,932	2,172	2,159	13	760	[11] 57	5	2,994	871	55	564		29	164	59		
Maryland	5,577	3,497	2,880	2,728	152	617	115	7	3,619	1,958	48	703	[12] 802	298	131	33	−57	
Massachusetts	6,875	4,221	2,815	2,684	131	1,406	23	2	4,246	2,629	72	2,551		6		68	−68	
Michigan	22,085	18,514	13,025	[13] 13,025	(7)	5,489	1,015	15	19,544	2,541	79	955	925		395	187		
Minnesota	8,867	8,309	6,379	6,232	147	1,930	258	6	8,573	294	54	125		89		26		
Mississippi	2,248	2,198							2,198	50	2			44		4		
Missouri	9,638	8,184	6,842	6,842	(7)	1,342	129	9	8,322	1,316	83	460	454	2	305	16	−4	
Montana [14]	1,532	1,257	894	871	23	363	9	1	1,267	265	19	116	32	43	46	9		
Nebraska	2,603	1,980	1,239	1,218	21	741	39	2	2,021	582	24	395			136	34	−7	
Nevada	282	267	163	162	1	104	10	1	278	4	3			(*)	11	3	−13	
New Hampshire	2,347	2,067						5	2,072	275	18	164		66		27		
New Jersey	19,271	13,601	9,572	9,269	303	4,029	262	9	13,872	5,399	72	3,814	599	202	664	61	−13	
New Mexico	1,544	1,421	929	888	41	492	25	1	1,447	97	10			2	28	63	−6	
New York	52,901	42,947	31,114	31,114		11,833	556	47	43,550	9,351	212	6,902		665	1,268	304		
North Carolina	8,855	8,546	5,432	5,377	55	3,114	(7)	6	8,552	303	(5)	142	179	7			−25	
North Dakota	1,581	1,407	1,067	1,057	10	340	3	2	1,412	169	18	90	61			1	−1	
Ohio	25,635	22,747	14,612	14,612	(7)	8,135	1,183	38	23,968	1,667	147	763			374	41		342
Oklahoma [15]	5,584	4,131	2,535	2,458	77	1,596	195	4	4,330	1,254	48	280	335	15		258		318
Oregon	3,378	2,617	1,534	1,495	39	1,083	(7)	5	2,622	756	28	452	214	32		30		
Pennsylvania	38,332	27,747	19,061	18,451	610	8,686	383	30	28,160	10,172	385	5,491	2,241	280	1,384	485	−94	
Rhode Island	2,790	2,194	1,712	1,670	42	482	2	3	2,199	591	17	417			100	57		
South Carolina	1,690	1,156	725	725		431	56	1	1,213	477	20	387		25	25	38	−18	
South Dakota	1,650	1,572	1,352	1,349	3	220	28	1	1,601	49	16		25			8		
Tennessee	4,233	3,910							3,910	323	(5)	265		19		10	−1	
Texas	19,684	18,308	11,733	11,583	150	6,575	482	16	18,806	878	46	309			377	146		
Utah	1,049	865	500	500	(7)	365	29	1	895	154	15	18	81	5	26	10	−1	
Vermont	2,410	2,036	1,422	1,408	14	[16] 614	21	4	2,061	349	26	282			55	5	−19	
Virginia	6,153	5,449	3,999	3,999		1,450	57	6	5,512	641	61	87	275		186	32		
Washington	4,402	2,530	1,427	1,427		1,103	212	6	2,748	1,654	12	1,252	222	(*)		30		138
West Virginia	6,162	4,706	3,640	3,619	21	1,066	60	5	4,771	1,391	53	202	[17] 1,043		69	24		
Wisconsin	12,984	12,281	9,234	8,940	294	3,047	353	15	12,649	335	38	41			242	14		
Wyoming	597	549	357	357		192	31	1	581	16	8				7	1		
District of Columbia	878	188	165	164	1	23	2	1	191	687	5	223	92	329	35	3		
Partial totals [18]			223,211	220,339	2,872	92,920	8,750	375										
Full totals	399,613	328,285							337,410	62,203	2,322	33,036	9,458	2,955	9,207	4,504	−623	1,344

[1] Registration periods ending not earlier than November 30 and not later than January 31 are considered as calendar-year periods. In the case of States in which the registration period is definitely removed from the calendar year, data on receipts were obtained for the calendar-year period. Stars (*) indicate receipts less than $500.

[2] Segregation of registration fees by type of vehicle was not made in Alabama, Mississippi, New Hampshire, and Tennessee. For these States the total motor-vehicle registration fees include those of trailers and motorcycles, except in the case of New Hampshire, for which motorcycle fees were reported separately. Dealers license fees in Alabama and Tennessee are also included.

[3] The figures for registration fees of motorbusses are incomplete (see preceding table, note 3). Where no fees are tabulated, the fees of busses are included with those of automobiles, except as otherwise noted.

[4] In a large number of States service charges are collected or deducted by the county or local officers who issue registrations. In the majority of cases these charges are included in the registration and other fees as listed. The amounts shown in this column are estimates of service charges collected and retained by local officials and not reported elsewhere in the table.

[5] Included with motor-vehicle registration fees.

[6] Registration fees include proceeds of vehicle license fees, $10,728,000, imposed in addition to the regular registration fees, the proceeds of which were $11,480,000.

[7] Included with fees of motortrucks.

[8] Fees of 22,296 light trucks included with those of passenger vehicles.

[9] Trailers of 1,000 pounds capacity or more prohibited on highways, although permitted in cities under city licenses. Tractor-semitrailers registered as trucks. Light trailers permitted but not registered.

[10] Includes proceeds of motor usage tax, $1,422,000, imposed at 3 percent of retail price on all motor vehicles at time of first registration.

[11] Fees of light trailers and commercial semitrailers only. Fees of commercial full trailers included with those of motortrucks.

[12] Includes proceeds of 1 percent title tax on motor vehicles, $587,000, in addition to regular title fees.

[13] Fees of taxicabs included with those of motortrucks.

[14] Registration fees are collected by counties, and State does not maintain complete record. Figures given are estimates supplied by State.

[15] Receipts do not include proceeds of 2 percent motor-vehicle excise tax, which is imposed as part of a general sales tax. Proceeds of this tax in 1937 were $1,244,000.

[16] Fees of trucks under 1,500 pounds capacity included with those of passenger cars.

[17] Includes proceeds of 2 percent title privilege tax, $863,000, in addition to regular title fees.

[18] Totals of columns for which fully classified totals were not available for all States.

STATUS OF FEDERAL-AID HIGHWAY PROJECTS

AS OF JUNE 30, 1938

STATE	COMPLETED DURING CURRENT FISCAL YEAR			UNDER CONSTRUCTION			APPROVED FOR CONSTRUCTION			BALANCE OF FUNDS AVAILABLE FOR PROGRAMMED PROJECTS
	Estimated Total Cost	Federal Aid	Miles	Estimated Total Cost	Federal Aid	Miles	Estimated Total Cost	Federal Aid	Miles	
Alabama	$ 3,765,925	$ 1,700,138	70.7	$ 6,690,637	$ 3,340,190	272.8	$ 3,082,295	$ 1,536,555	135.8	$ 3,873,445
Arizona	2,504,264	1,730,523	115.6	1,669,555	1,264,931	91.9	168,163	110,953	11.3	1,799,834
Arkansas	3,127,464	3,098,036	188.7	1,110,835	1,100,169	75.9	14,040	12,962	4.0	4,320,542
California	7,255,457	3,911,392	158.4	11,139,156	5,864,481	204.0	3,305,292	1,756,799	80.1	2,209,182
Colorado	3,707,458	2,003,473	135.2	2,560,032	1,401,380	81.1	490,560	272,740	10.9	3,038,935
Connecticut	1,014,718	497,319	10.1	1,189,000	579,991	13.1	405,970	201,510	3.6	1,522,970
Delaware	534,818	263,575	21.0	499,605	249,615	8.5	817,877	404,920	15.2	1,184,277
Florida	1,487,243	740,764	38.0	2,705,351	1,352,676	55.0	2,538,156	1,269,078	35.8	2,724,162
Georgia	3,018,094	1,469,695	161.4	6,157,563	3,078,781	296.7	3,478,660	1,739,330	175.6	5,515,965
Idaho	2,775,318	1,605,670	211.8	1,544,315	914,117	143.8	1,151,688	686,653	49.4	1,305,659
Illinois	11,654,717	5,652,894	337.0	9,609,752	4,794,857	219.7	4,856,690	2,428,345	121.0	3,272,279
Indiana	6,336,691	3,111,645	153.1	5,164,872	2,576,390	131.3	2,933,620	1,466,440	61.6	2,596,312
Iowa	7,614,654	3,582,720	249.2	6,933,573	3,097,923	219.6	2,154,160	1,016,050	73.9	1,598,050
Kansas	4,712,215	2,313,656	259.8	4,348,427	2,174,144	167.2	5,178,900	2,545,771	737.0	3,576,379
Kentucky	3,038,093	1,507,265	95.2	5,189,644	2,594,822	167.7	3,278,186	1,626,351	92.0	2,255,884
Louisiana	582,531	286,501	15.0	11,793,628	2,304,315	54.8	2,032,266	900,022	36.6	2,516,382
Maine	2,275,114	1,120,950	62.4	2,511,280	1,253,210	57.7	649,164	324,581	12.0	672,327
Maryland	1,048,330	524,145	15.0	1,727,147	861,811	27.3	1,494,831	735,040	21.4	1,992,259
Massachusetts	4,423,400	2,211,667	20.3	2,690,859	1,345,426	10.6	302,491	151,244	2.7	2,847,916
Michigan	7,208,466	3,378,283	174.0	6,262,438	3,053,594	130.7	1,274,850	636,800	20.1	3,450,087
Minnesota	6,739,297	3,324,796	351.3	5,151,345	2,553,639	239.7	1,534,556	762,037	108.0	3,528,637
Mississippi	3,383,701	1,676,213	168.4	6,138,010	2,838,596	268.2	3,306,050	871,435	148.8	3,443,858
Missouri	9,243,761	4,514,211	490.9	5,005,396	2,473,036	137.3	4,001,940	1,673,031	153.0	3,963,961
Montana	4,410,403	2,466,168	323.5	1,726,038	970,524	70.4	274,393	154,344	8.7	4,462,564
Nebraska	3,370,938	1,657,038	356.6	5,802,086	2,892,572	519.0	4,065,158	1,397,582	189.0	2,785,460
Nevada	2,455,650	2,051,622	132.5	1,215,593	1,052,976	89.2	609,990	529,031	68.6	1,490,200
New Hampshire	451,364	221,487	7.1	1,041,513	518,292	19.0	270,427	134,435	7.0	1,172,082
New Jersey	1,941,364	953,171	19.0	2,852,361	1,424,918	21.2				2,776,553
New Mexico	5,362,486	3,286,151	365.7	1,535,623	1,036,718	118.5	1,169,118	713,038	120.8	1,134,063
New York	15,779,311	7,136,340	282.0	14,885,865	7,314,782	264.9	3,288,230	1,640,440	40.8	4,248,388
North Carolina	5,660,057	2,823,987	406.0	7,098,513	3,426,252	331.0	956,950	420,300	59.3	3,388,863
North Dakota	1,091,282	1,012,725	186.5	2,534,591	2,456,361	155.3	531,620	462,946	64.7	3,813,287
Ohio	5,722,429	2,781,464	73.7	8,554,132	4,246,620	91.4	3,681,450	1,840,514	25.8	7,760,747
Oklahoma	4,223,945	2,200,586	220.2	4,251,156	2,199,273	140.3	3,420,061	1,798,378	139.3	3,387,789
Oregon	4,301,657	2,527,049	170.2	2,166,046	1,315,165	84.8	607,825	327,325	11.9	2,326,410
Pennsylvania	14,807,231	7,319,221	206.2	6,684,602	3,328,502	103.0	2,850,976	1,410,844	43.3	6,093,096
Rhode Island	1,198,028	570,474	11.3	930,542	465,271	13.6	240,060	120,030	2.4	1,158,499
South Carolina	4,226,732	1,750,353	287.0	5,321,595	2,359,135	226.6	1,221,955	552,090	68.5	1,866,336
South Dakota	2,542,631	1,433,833	235.2	3,386,532	1,875,710	328.9	1,478,650	825,520	103.8	3,442,676
Tennessee	2,352,823	1,171,703	90.3	5,438,714	2,719,357	167.6	663,460	331,730	16.7	4,938,008
Texas	16,139,393	7,983,089	1,076.7	12,198,721	6,006,923	675.5	3,644,192	1,745,951	213.5	8,602,515
Utah	1,743,705	1,210,506	150.3	1,085,080	776,620	99.6	433,670	307,023	36.8	1,721,289
Vermont	1,646,108	792,849	44.5	1,416,851	588,252	34.6	517,668	243,048	15.0	294,747
Virginia	4,797,348	2,342,899	181.0	5,005,036	2,501,242	163.5	2,871,056	1,434,678	89.5	1,119,840
Washington	2,773,133	1,439,605	79.6	4,381,676	2,307,870	71.9	716,429	352,654	17.9	1,350,405
West Virginia	1,630,364	837,810	45.4	1,786,146	1,189,183	53.3	795,956	505,778	19.3	2,518,310
Wisconsin	8,511,485	4,144,419	281.4	6,088,787	2,804,877	140.9	3,002,004	1,322,280	109.0	2,161,311
Wyoming	2,996,278	1,868,132	321.7	1,963,252	1,204,506	208.3	386,250	238,640	50.6	893,056
District of Columbia	845,057	412,656	13.3	898,690	446,060	18.5	776,440	380,075	8.8	1,198,792
Hawaii				1,128,859	562,390	20.5				671,985
Puerto Rico										
TOTALS	218,432,931	112,620,868	9,069.4	219,171,020	109,058,445	7,305.9	86,924,393	42,317,321	3,640.8	139,986,573

STATUS OF FEDERAL-AID SECONDARY OR FEEDER ROAD PROJECTS

AS OF JUNE 30, 1938

STATE	COMPLETED DURING CURRENT FISCAL YEAR			UNDER CONSTRUCTION			APPROVED FOR CONSTRUCTION			BALANCE OF FUNDS AVAILABLE FOR PROGRAMMED PROJECTS
	Estimated Total Cost	Federal Aid	Miles	Estimated Total Cost	Federal Aid	Miles	Estimated Total Cost	Federal Aid	Miles	
Alabama	$ 98,773	$ 66,705	9.9	$ 415,800	$ 207,800	23.8	$ 250,400	$ 123,650	20.1	$ 721,522
Arizona				196,056	129,008	11.4	92,929	63,940	7.2	463,534
Arkansas				13,126	6,563					857,545
California	127,081	73,766	37.2	647,482	367,862	43.9	834,528	453,336	37.0	1,023,734
Colorado				408,026	225,303	19.3	318,330	176,990	14.1	519,275
Connecticut							47,530	23,750	.9	294,528
Delaware										246,875
Florida				20,122	10,061					664,791
Georgia	38,120	19,060	3.2	308,558	154,279	38.6	322,700	161,170	37.9	943,117
Idaho	304,816	150,274	43.1	285,338	131,709	12.4	139,383	53,490	32.7	286,300
Illinois	79,800	39,900	3.3	958,232	479,116	78.9	1,421,900	710,950	114.7	836,849
Indiana				356,500	134,200	40.2	912,853	416,800	87.7	691,438
Iowa	24,921	12,458	24.4	43,670	21,835	.5	177,100	88,550	26.3	1,298,449
Kansas	246,502	122,573	105.1	532,214	148,425	50.6	1,259,457	390,987	131.9	1,208,618
Kentucky										267,692
Louisiana	228,304	113,833	15.4	21,670	10,835		459,044	172,946	33.4	540,355
Maine				219,636	109,818	14.7	194,600	97,300	10.2	121,455
Maryland				6,264	3,132					409,344
Massachusetts				5,300	2,650					643,750
Michigan				23,362	11,681		316,000	158,000	26.3	1,365,858
Minnesota				351,318	156,010	32.0	55,560	25,417	13.4	1,198,153
Mississippi	972,621	468,046	246.5	325,020	161,215	36.8	343,610	125,900	38.6	888,927
Missouri				13,983	7,865					775,403
Montana										1,027,170
Nebraska	93,312	46,656	8.9	288,740	144,370	46.1	391,660	190,656	61.8	662,426
Nevada	178,752	153,067	26.5	229,813	199,011	23.5	182,643	158,316	30.6	134,117
New Hampshire				101,176	50,152	1.8	204,889	74,848	3.9	121,875
New Jersey							119,020	55,855	1.9	616,918
New Mexico				541,394	330,193	30.7				476,579
New York	230,525	114,312	19.0	2,161,360	1,080,680	144.5	213,400	106,700	3.7	1,171,081
North Carolina	203,170	101,472	46.4	678,440	339,220	75.3	308,373	123,750	22.6	619,115
North Dakota							57,640	30,870	9.0	756,382
Ohio				184,400	92,200	3.8	11,100	5,000	.9	1,734,441
Oklahoma				16,888	8,986		543,260	279,022	49.8	896,907
Oregon	133,066	75,035	36.4	261,775	158,752	29.3	239,493	136,300	29.8	458,070
Pennsylvania	58,660	29,330	5.9	955,311	458,307	70.5	1,087,460	530,830	59.2	1,126,751
Rhode Island	122,420	58,984	3.3	85,070	42,535	3.2	48,090	23,481	2.9	121,875
South Carolina				465,248	195,862	52.7	517,850	221,754	59.0	261,064
South Dakota				11,300	6,250					816,436
Tennessee				206,546	103,273	8.8	159,520	79,760	6.5	876,457
Texas	49,200	24,545	25.6	1,313,811	604,182	166.9	1,303,513	581,575	189.8	1,938,768
Utah	36,203	21,346	4.8	242,365	134,610	22.4	182,065	98,630	12.2	317,130
Vermont	76,012	37,335	4.3	200,056	87,853	11.6				121,687
Virginia	55,300	27,650	11.7	458,517	227,043	43.7	476,320	190,970	22.1	473,986
Washington	117,776	61,874	18.0	334,985	176,078	23.7	459,996	242,100	40.5	311,791
West Virginia				208,000	104,000	16.5	118,200	59,100	9.4	386,574
Wisconsin	30,710	15,250	6.7	564,015	266,305	22.7	194,099	86,470	8.1	859,453
Wyoming	75,809	46,849	7.2	378,420	233,820	43.8	61,500	38,000	5.1	313,373
District of Columbia				56,250	28,125	2.4				218,750
Hawaii				244,000	121,950	13.7				124,925
Puerto Rico										
TOTALS	3,581,853	1,880,320	712.8	15,339,557	7,673,124	1260.7	14,026,015	6,557,163	1,261.2	33,211,613

PUBLICATIONS of the BUREAU OF PUBLIC ROADS

Any of the following publications may be purchased from the Superintendent of Documents, Government Printing Office, Washington, D. C. As his office is not connected with the Department and as the Department does not sell publications, please send no remittance to the United States Department of Agriculture.

ANNUAL REPORTS

Report of the Chief of the Bureau of Public Roads, 1931. 10 cents.

Report of the Chief of the Bureau of Public Roads, 1933. 5 cents.

Report of the Chief of the Bureau of Public Roads, 1934. 10 cents.

Report of the Chief of the Bureau of Public Roads, 1935. 5 cents.

Report of the Chief of the Bureau of Public Roads, 1936. 10 cents.

Report of the Chief of the Bureau of Public Roads, 1937. 10 cents.

HOUSE DOCUMENT NO. 462

Part 1 . . . Nonuniformity of State Motor-Vehicle Traffic Laws. 15 cents.

Part 2 . . . Skilled Investigation at the Scene of the Accident Needed to Develop Causes. 10 cents.

Part 3 . . . Inadequacy of State Motor-Vehicle Accident Reporting. 10 cents.

Part 4 . . . Official Inspection of Vehicles. 10 cents.

Part 5 . . . Case Histories of Fatal Highway Accidents. 10 cents.

Part 6 . . . The Accident-Prone Driver. 10 cents.

MISCELLANEOUS PUBLICATIONS

No. 76MP . . The Results of Physical Tests of Road-Building Rock. 25 cents.

No. 191MP . . Roadside Improvement. 10 cents.

No. 272MP . . Construction of Private Driveways. 10 cents.

No. 279MP . . Bibliography on Highway Lighting. 5 cents.

Highway Accidents. 10 cents.

The Taxation of Motor Vehicles in 1932. 35 cents.

Guides to Traffic Safety. 10 cents.

Federal Legislation and Rules and Regulations Relating to Highway Construction. 15 cents.

An Economic and Statistical Analysis of Highway-Construction Expenditures. 15 cents.

Highway Bond Calculations. 10 cents.

DEPARTMENT BULLETINS

No. 1279D . . Rural Highway Mileage, Income, and Expenditures, 1921 and 1922. 15 cents.

No. 1486D . . Highway Bridge Location. 15 cents.

TECHNICAL BULLETINS

No. 55T . . . Highway Bridge Surveys. 20 cents.

No. 265T. . . Electrical Equipment on Movable Bridges. 35 cents.

Single copies of the following publications may be obtained from the Bureau of Public Roads upon request. They cannot be purchased from the Superintendent of Documents.

MISCELLANEOUS PUBLICATIONS

No. 296MP. . Bibliography on Highway Safety.

SEPARATE REPRINT FROM THE YEARBOOK

No. 1036Y . . Road Work on Farm Outlets Needs Skill and Right Equipment.

TRANSPORTATION SURVEY REPORTS

Report of a Survey of Transportation on the State Highway System of Ohio (1927).

Report of a Survey of Transportation on the State Highways of Vermont (1927).

Report of a Survey of Transportation on the State Highways of New Hampshire (1927).

Report of a Plan of Highway Improvement in the Regional Area of Cleveland, Ohio (1928).

Report of a Survey of Transportation on the State Highways of Pennsylvania (1928).

Report of a Survey of Traffic on the Federal-Aid Highway Systems of Eleven Western States (1930).

UNIFORM VEHICLE CODE

Act I.—Uniform Motor Vehicle Administration, Registration, Certificate of Title, and Antitheft Act.

Act II.—Uniform Motor Vehicle Operators' and Chauffeurs' License Act.

Act III.—Uniform Motor Vehicle Civil Liability Act.

Act IV.—Uniform Motor Vehicle Safety Responsibility Act.

Act V.—Uniform Act Regulating Traffic on Highways.

Model Traffic Ordinances.

A complete list of the publications of the Bureau of Public Roads, classified according to subject and including the more important articles in PUBLIC ROADS, may be obtained upon request addressed to the U. S. Bureau of Public Roads, Willard Building, Washington, D. C.

STATUS OF FEDERAL-AID GRADE CROSSING PROJECTS

AS OF JUNE 30, 1938

STATE	COMPLETED DURING CURRENT FISCAL YEAR					UNDER CONSTRUCTION					APPROVED FOR CONSTRUCTION					BALANCE OF FUNDS AVAILABLE FOR PROGRAMMED PROJECTS
			NUMBER					NUMBER					NUMBER			
	Estimated Total Cost	Federal Aid	Grade Crossings Eliminated by Separation or Relocation	Grade Crossing Structures Reconstructed	Grade Crossings Protected by Signals or Otherwise	Estimated Total Cost	Federal Aid	Grade Crossings Eliminated by Separation or Relocation	Grade Crossing Structures Reconstructed	Grade Crossings Protected by Signals or Otherwise	Estimated Total Cost	Federal Aid	Grade Crossings Eliminated by Separation or Relocation	Grade Crossing Structures Reconstructed	Grade Crossings Protected by Signals or Otherwise	
Alabama	$ 16,100	$ 16,100	1			$ 541,798	$ 541,724	7			$ 125,810	$ 125,810	2		6	$ 1,317,985
Arizona						4,718	4,718									625,495
Arkansas						279,639	278,482	7			110,000	110,000	1			1,370,287
California						1,200,958	1,200,383	3	4		144,157	144,157	1			2,355,669
Colorado	1,880	1,880			1	35,728	35,728	1			14,251	10,491			4	1,241,823
Connecticut																841,490
Delaware											77,270	77,270			23	416,480
Florida						10,616	10,616				178,800	178,800	1			1,216,381
Georgia						18,346	18,346									2,399,041
Idaho						100,167	99,994	1								722,876
Illinois	19,500	19,500		2		669,675	669,675	3			569,500	569,500	7		1	3,965,468
Indiana	165,790	165,790	2			791,590	687,313	5	5		720,260	683,600	1	1	86	1,041,793
Iowa	226,215	215,829	4	3	1	914,875	864,300	11	1	4	131,620	122,500	1		17	1,571,017
Kansas	6,290	6,290			3	471,660	471,660	10		3	500,719	500,719	7		3	1,600,424
Kentucky						145,000	145,000	1			283,724	283,724	2		31	1,385,321
Louisiana						23,648	23,648				273,828	273,680	6			1,279,743
Maine						188,647	188,647	2	1		248,140	248,140	3	1	1	254,416
Maryland						64,586	64,586	1								962,247
Massachusetts						70,420	70,420		1		162,480	162,480	1			1,680,388
Michigan						568,152	568,152	3		45	869,200	869,200	9	1		1,847,833
Minnesota	235,218	235,218	1		16	547,766	547,766	2	4	1	98,650	98,650		2		1,775,066
Mississippi						252,700	252,700	3			103,300	103,300	1			1,228,151
Missouri						236,070	236,070	4			149,140	149,140	2			2,640,043
Montana						365,654	360,772	4			276,614	276,614	2			687,085
Nebraska						311,783	311,783	11			13,880	13,880	2			1,438,747
Nevada	35,109	35,109		1		93,878	93,878		2	1	55,883	55,883		1	1	308,880
New Hampshire						65,482	65,175		1							428,575
New Jersey						210,005	204,779	2	1							1,765,478
New Mexico						122,441	122,441	4								729,050
New York						1,643,901	1,642,100	6	4	2	650,068	642,518	2	3		4,485,311
North Carolina	43,180	43,180	(*)			417,800	417,800	3	2		108,120	108,120	1	2		1,918,474
North Dakota						534,046	534,046	1	1		62,630	62,630	1	1		982,545
Ohio						32,120	32,120				267,110	267,110	4			3,929,938
Oklahoma						17,343	17,343									2,264,166
Oregon	178,890	178,890	3			293,683	293,683	1	1		32,021	31,372		1		650,276
Pennsylvania						224,030	208,824	1			75,086	75,086	1			5,448,625
Rhode Island						223,897	223,897	1								269,853
South Carolina						38,473	16,137		1		387,344	387,344	2	1	22	1,085,621
South Dakota	50,960	50,960			15	120,838	120,838	1	1		98,575	98,575	2		10	1,098,084
Tennessee						14,381	14,381									1,877,652
Texas	58,035	57,800	3			38,797	38,100	2			950,388	942,903	9	2		4,360,065
Utah	71,000	71,000	2		2	105,073	105,073	2			22,960	22,960	1		4	444,955
Vermont	14,268	14,233			5	210,288	205,288	6	1		28,850	24,570		1	1	249,659
Virginia	80,710	80,710	2	3		298,715	298,715	12	2		286,843	286,843	2		3	1,210,472
Washington	134,774	134,774	2	1		414,742	412,642	5	2		252,855	252,855	3	1	4	718,301
West Virginia						303,939	302,919	2			144,335	144,335	2		3	876,844
Wisconsin						947,357	936,787	8			207,138	175,000	2			1,361,722
Wyoming						144,884	141,884		2		14,530	14,530			6	517,316
District of Columbia	168,320	168,320		1												325,431
Hawaii											197,540	197,540	3	1		296,210
Puerto Rico						61,900	61,550	2			159,001	157,920	2			510,830
TOTALS	1,506,239	1,495,583	20	11	43	14,392,209	14,165,883	138	37	56	9,052,620	8,949,749	86	19	226	73,982,602

(*) PAVING ONLY - 1 GRADE CROSSING ELIMINATED BY SEPARATION BY WPGH PROJECT 219-D