

FUNCTIONS OF A HIGHWAY-PLANNING SURVEY
DEPARTMENT

W. J. Sapp,
Director, Indiana State-Wide Highway Planning Survey,
Indianapolis

The rapid growth of our highway transportation system has been responsible for the development of a concern in the mind of the highway engineer closely parallel to that of a young graduate. Her anxiety over the trend of affairs in the world at large was reflected in the subject she selected for the auspicious occasion of her graduation from high school. The subject chosen, "Whither Are We Bound and If So to What Extent?", is ungrammatical, perhaps, but a pertinent question, nevertheless, for the highway engineer to raise as he views with awe and trepidation the seemingly uncontrollable growth of our present-day highway transportation system and its associated facilities.

To what extent have the system and its facilities grown? Is it logically devised and is it adequate for our present needs? What further planning and co-ordination of funds and efforts are necessary for its future requirements?

These queries have been annoying our highway engineers since the beginning of the transition from the buffalo trail to the high-speed super-highway of our day. Highway engineers and administrative groups, widely separated and working under different conditions and procedure, have had their own solutions. As might be expected from the thousands of such groups existent in the United States, the solutions varied as the number of agencies. From the uncorrelated and scanty information available, in most instances, it is not surprising that the attainment of a fairly satisfactory answer to the questions was accomplished by only a few engineers and administrative groups in the past; consequently, hit-and-miss, "you-guess-and-I'll-guess" methods have been resorted to from time to time in the solution of the highway problems as they developed. Dependence was placed on the good judgment of the engineers and administrators and on a relatively small amount of factual data available.

By the hit-and-miss methods was accomplished the gigantic task of building the main intercity and interstate highways of first importance. This was made possible by a stage-construction process by which the highway funds available were spread over a great network of comparatively low-construction-cost highways designed to meet the existing traffic needs and to serve mainly the areas of concentrated population.

We are now emerging from the stage-construction era to find that many of the sections of highways first built are

inadequate in carrying capacity or are antiquated by reason of steep grades, poor horizontal and vertical alignment, bottle necks, and other traffic hazards.

Faced with the insistent demands for more improved roads in the rural areas, with the redesign and reconstruction of a sizable part of our trunk-line system to required safe standards, and with the necessity of continually improving and maintaining the secondary state and county systems, the highway engineer realizes that the improvement and expansion of the highway system has reached such proportions that meager funds available for highway purposes must be guarded zealously and expended wisely. He realizes that he must take cognizance of all the supporting highway data accessible in arriving at decisions involving the expenditures of limited public funds.

Projects for construction, reconstruction, and maintenance must be based on their merits and on the order of their importance; otherwise, we overbuild in the wrong direction and underbuild in the right direction. Unworthy projects are always a barrier to improvements badly needed elsewhere. The engineer must be able to distinguish between the worthy and unworthy projects and have the supporting data available to substantiate his decisions.

PIONEERS IN TRANSPORTATION PROBLEMS

That the ancients were aware of the need of factual highway data is widely known. Probably the most historical and greatest detailed records of bridge and road construction are those compiled by C. J. Caesar for the use of his Roman engineers and highway executives. It may be beside the point to state that in those days the actual construction, while laborious, was less complicated and less nerve-racking than are now the translation and interpretation of the recorder's field notes. That, of course, is a matter of scholastic opinion. The fact remains that, even in the ancient days, transportation services were given serious consideration. Problems involving traffic congestion in the large urban centers were of grave concern to the Roman authorities, and effective restrictions of vehicle movement in certain areas were necessary to permit the free flow of commercial traffic. The Roman restriction of traffic movement and elimination of parking in congested areas constituted the first attempted approach toward traffic control.

France, a pioneer in the field of planning surveys, realized, before 1845, the value of knowing the volume of traffic her roads were carrying. Her highway interests in those early days were, as today, primarily in maintaining her military arteries of transportation, which had in many cases been inherited from the Romans. The most scientific methods of the day were employed to maintain those well-constructed and serviceable highways. Traffic surveys were made to determine

the amount of traffic the important military roads carried in order that, from the known number of vehicles using the roads within a definite period, accurate estimates might be made of the material and labor necessary to keep the highways in first-class condition; thus, we see an early attempt to establish a workable and scientific phase of planning surveys. Incidentally, the present-day practice of measuring traffic by the use of periodic traffic counts was developed from the French studies of road maintenance.

DATA DESIRED

Today, more than in the past, the need is evident for factual data about: (1) the physical condition of our highways; (2) the use of our highways; and (3) the financing of our highways.

It is not sufficient that such data be secured in only one municipality, one township, one county, or one state. Every governmental unit in the United States should be represented. The need for factual highway information is not localized, but is state-wide and nation-wide in its scope.

With the realization that the condition and extent of the existent highway transportation system could be determined by a concerted effort, and that, fortified with a knowledge of what now exists, it would be possible to plan funds and efforts more intelligently, the Bureau of Public Roads and various interested states, beginning in 1935, launched an extensive program of highway-planning surveys. The surveys as conceived were to be nation-wide in their extent and were to correlate the interests of the states with those of the Federal Government.

Under the provisions of the Hayden-Cartwright Act of 1934, and subsequent acts, the way was cleared for the financing of the planning projects partly by State funds and partly by Federal Aid funds.

Agreements on procedure and financing were made by the Bureau of Public Roads and several of the states in 1935. In November of that year the State-Wide Highway-Planning Survey in Indiana was begun by the State Highway Commission of Indiana, assisted by the Bureau of Public Roads.

The functions of a Highway-Planning Survey Department are basically those functions necessary to carry forward to final completion the various phases of the survey designed to provide the needed factual data relative to the condition of our highways, the use of our highways, and the financing of our highways.

To determine the condition of the highways, inventory surveys are employed; to cover the use of the highways, traffic surveys have been necessary; to study the methods of financing the highway system, financial surveys are used.

These three basic surveys are so broad in their scope that

it is necessary that they be subdivided for administrative and supervisory purposes and to simplify field operations. While several phases of each major type of survey may be operated simultaneously, each requires a distinctive approach and procedure in the field work and in the final analysis in the office.

The basic surveys and their subdivisional surveys conducted as preliminaries to analysis are as follows:

- A. Inventory Surveys
 - 1. Road, Bridge, and Cultural Survey
 - 2. Railroad Crossing Surveys—Rural and Municipal
 - 3. Railroad Crossing Accident Survey
 - 4. Sight Distance and Grade Survey
- B. Traffic Surveys
 - 1. Traffic Density Surveys
 - (a) Key station
 - (b) Blanket count
 - (c) Automatic traffic recorder
 - 2. Weight Surveys
 - (a) Loadometer
 - (b) Pit scale
 - 3. Origin-Destination Surveys
 - (a) Blanket
 - (b) Questionnaire
 - (c) Special problem
- C. Financial Surveys
 - 1. Road Use Survey
 - 2. Motor Vehicle Allocation Survey
 - 3. Financial Survey
 - 4. Road Life Survey

To appreciate the scope of the field work involved, let us consider the nature of the information secured by means of each phase of the basic surveys.

INVENTORY SURVEY

From the Road, Bridge, and Cultural Survey, the following information is secured on state and county roads: type of road, width of surface, and width of right-of-way, as determinable; type, width, length, and other dimensional measurements of bridges; population factors influencing traffic, such as cities, towns, recreational areas, airports, churches, cemeteries, mines, quarries, mills, railroad stations, ferries, business establishments, and dwellings; plats of additions and subdivisions outside municipalities, plats of all unincorporated towns, and maps of municipalities with city or corporation limits determined or checked in the field.

The Railroad Crossing Survey embraces the securing of data pertaining to railroad and road alignment, approach grades, visibility, signals and warning signs, traffic hazards,

and all other physical and cultural features which might influence the movement of railroad and highway vehicular traffic in the immediate area of the crossing.

While the Railroad Crossing Surveys have been confined to crossings in rural areas and in unincorporated towns, it is apparent that before the completion of the Highway-Planning Survey Project, all crossings in municipalities will be included in the surveys. A survey of accidents occurring at railroad and road crossings covering a period of five years is being made. The Highway-Planning Survey Department and the Association of American Railroads are co-operating in this phase of the survey.

By means of the Accident Survey, the points of greatest accident frequency are determinable. By correlating the number and type of accidents with the information available concerning the physical condition of the crossing, we can, in most instances, arrive at the logical reasons for such accidents and the corresponding remedies.

The Sight Distance and Grade Survey covering all state roads is being made to determine the location, extent, and degree of horizontal and vertical sight restrictions, as well as the determination of all major grades and the amount of super-elevation of curves. Besides recording the points of restricted sight, the survey parties determine the reasons for sight restriction. Short curves, deep cuts, trees, growing grain, buildings, and all other obstacles to vision are catalogued. The recording of the factors contributing to restricted sight is of importance in the view of future improvements. Many of the obstacles may be removed or corrected by minor expenditures and efforts. Other corrections may involve heavy expenditures. It is of major importance, therefore, to know the type of obstruction in order to determine the feasibility of its correction.

With the increase of heavy truck traffic on the highways, there is an insistent demand that either heavy grades be reduced or that the speed of the commercial vehicle on hills be increased. Since the former involves a reduction of operating costs, as well as facilitates a speedier movement of the commercial vehicle, it is logical that a reduction of major grades is now, and will continue to be, considered essential. With this in mind, the Highway-Planning Survey Department is locating and determining the percentage of grades on all state highways.

TRAFFIC SURVEY

At strategic locations, 162 key or traffic-control stations were established on state highways. From these stations, traffic was counted and recorded in cycles of approximately 26 days for the duration of one year. Each day of the week and month of the year was represented in these counts, so

that it was possible to determine the annual average 24-hour volume of traffic on each road leading into the intersection at which the station was located. From these control stations, factors are determined for converting short counts of 8-hour duration to an annual average 24 hours.

Blanket Count Surveys are employed on county and state highway systems in a coverage sufficient to determine the traffic on practically every mile of road in the state. The blanket or short traffic counts are expanded to an annual average 24-hour count by means of key-station traffic counts or special repeat counts from traffic stations established for control purposes.

Six automatic traffic recorders located on important state roads are kept in continuous operation for the purpose of gauging the trend of traffic by hours, days, months, and years. When properly functioning, these electric devices are of invaluable assistance in determining traffic trends.

Loadometer Surveys consist of weighing commercial vehicles by the use of portable scales. On state roads ninety weight stations were established where commercial vehicles were weighed and information was secured relative to commodities carried, trip origin and destination, trip mileage, type of vehicle, registration, rated capacity, ownership, wheel loads, and other items of interest. This type of traffic survey is developing a wealth of information pertaining to loading practices and to the movement of commercial vehicles on the highways.

The Pit-Scale Surveys have been conducted at four pit-scale stations on principal truck routes on state highways. At these stations, two scales, each with a weighing capacity of 60,000 lbs., have been installed. The use of a scale on each side of the road at these stations permits the simultaneous weighing of commercial vehicles from opposite directions and minimizes the possibility of accidents at the stations.

A pit-scale survey consists principally of a determination of vehicle weights and measurements. Height, width, length, wheel base, axle spacing and arrangement, tire sizes, axle weights, gross weights, net weights, and other items of interest are determined. This type of survey provides valuable data covering commercial vehicle design, as well as loading practices.

The Origin-Destination Surveys are devised for the purpose of vehicle movement studies. Ordinarily the situs of ownership, trip origin, trip destination, trip mileage, type of roads used, and type of vehicle used are determined in the field by interviewing the drivers of commercial and passenger-car vehicles at some point on their trip.

At times, where traffic is exceptionally heavy, a questionnaire-card method of survey is used. In such cases, vehicles are stopped only long enough to permit return cards to be

passed to the driver with the request that the card be filled out and returned at the driver's convenience. The cards are so devised that, if properly filled out, the required information can be secured with a minimum amount of time or effort. A return of 16% of cards passed out may be expected by this method.

At the blanket-count stations, where the volume of traffic is light, vehicles are stopped and the driver is questioned until all desired information is obtained.

During the Indiana Highway-Planning Survey, we have resorted to a blanket-count, origin-destination survey for a coverage of most county and some state roads. On the main state highways we use the questionnaire method for a coverage of passenger cars, and make the origin-destination survey of commercial vehicles at the weight stations while the vehicles are being weighed.

Special problem origin-destination surveys are localized in areas where specific information is desired—studies involving the probable traffic on proposed highways; the use of free or toll bridges as against existent ferries; the desirability of by-pass construction; and other problems the solutions of which are dependent on the movement of traffic or on the desires of a sufficiently large number of motorists. A few such special studies have been made by the Highway-Planning Survey Department and more are planned for the coming year.

FINANCIAL SURVEYS

The basic problems to be solved by the means of Financial Surveys are: who uses the highways and how much; who pays for the highways and how much; what do the highways earn; how much can the motorist reasonably afford to pay for transportation services; and what are the operating costs necessary to maintain and improve a highway transportation system adequate for our needs?

The purpose of the Road-Use Survey is to determine: who uses the highways and what portion of the use is on state highways, county highways, and municipal streets; and what percentage is for business, social, and recreational use, and the yearly driven mileage on these types of trips on the various highway systems? This type of survey to be effective requires a fairly large number of personal interviews with vehicle operators. In Indiana, approximately 20,000 vehicle owners have been questioned in personal interviews during the course of the Road-Use Survey.

A Motor Vehicle Allocation Survey was devised to secure information concerning the geographical distribution of motor vehicle taxes paid by the users of various types of vehicles. In addition, the survey was designed to determine the annual mileage driven and the gasoline consumption by vehicle types. The questionnaire-card method was used almost exclusively

in this survey. From cards mailed to about 25% of all motor vehicle owners registered in Indiana, approximately 60,000 cards were filled out and returned.

After determining who uses the roads and how much the different classes of users contribute through motor vehicle taxes, it logically follows that we should know the amount of receipts, expenditures, and indebtedness of governmental units and that we determine the proportion of each of those items chargeable for highway purposes. An analysis of finances involving highways is essential, therefore, if we are to know what our highways are costing the users. We should not only know what the transportation system is costing now in relation to other governmental costs, but we should also have an index to the financial resources available for the system in the future.

The Road-Life Survey embraces detailed study of the construction, reconstruction, and maintenance cost of the roads in the State Highway System. The purpose of such a study is to determine, from the case history of the roads, what the life expectancy of various types of roads may be, when replacements may be anticipated, and what operating costs may be expected between the period of construction and reconstruction. With full information available relative to the road-life expectancy and current highway operating expenses, the financial requirements of our future highway systems may be anticipated.

The various phases of the basic highway planning surveys have been discussed at considerable length so that, in some measure, an insight may be gained of the functions of the highway-planning survey department necessary for securing the raw and unrefined factual data required from the field surveys.

The analysis of the information secured is another function of no small proportions, fully equal to, if not greater than, the work involved in the field surveys. The information from field reports must be catalogued, coded, transferred to tabulation cards by a key-punching process, machine sorted, and machine tabulated. Approximately 1,000,000 machine tabulation cards covering all phases of the survey will be required for the analysis of the Indiana Highway-Planning Survey. Traffic flow and road maps, charts, graphs, tables, and analysis reports must be prepared before we can consider that the preliminary objectives of the survey have been reached.

To be of the maximum value to highway officials or to the vehicle users, the factual highway data secured in the present planning survey must be correlated at frequent intervals with changing highway developments. Highway data applicable this year may, and in most cases will, become obsolete in the years to follow. We must continually add to, correct, and

keep current the basic highway information now being assembled.

Co-operative steps should be taken by the various groups of highway officials to keep up to date all highway maps and data developed from the present planning surveys. This objective may be easily attained by the interchange of highway information at periodic intervals by governmental units.

The ultimate function of the various state highway-planning survey departments should be to provide and make available highway factual services necessary for logical highway planning.

OBJECTIVES OF THE INDIANA SOCIETY OF PROFESSIONAL ENGINEERS

S. G. Cohen, President

Engineer of Construction, State Highway Commission
of Indiana, Indianapolis

The Indiana Society of Professional Engineers is the agency in this state of the National Society of Professional Engineers. The National Society was organized in 1934 to deal with matters concerning the welfare of the engineering professions, and maintains offices in Washington, D. C. The Indiana Society was organized in January of 1937 and has concerned itself strictly with welfare matters and the development of a "professional consciousness" among the engineers of Indiana.

We leave to the so-called "Founder Societies" the task of disseminating current engineering literature and encouraging the advancement of science. We feel that they have done an excellent job of that in the past and can continue so to perform in the future. However, we feel that they have left much to be desired in the promotion and safeguarding of welfare. That is a field near to the hearts of many and the one to which we are dedicated. Our organization differs from most others in that we operate through our local chapters: local chapters are organized at various strategic points to handle local problems and co-operate with and through our state society.

By "professional consciousness," we mean the determination on the part of the engineering group so to conduct themselves that they will both obtain and deserve public recognition as a profession. Your attention is called to the fact that both the medical and legal professions are built about their legal status. No doctor will represent himself as such, offer to practice, or obtain recognition from a fellow physician, if he has not passed his State Board Examination and is not licensed to practice in the state. The lawyer occupies a similar position with reference to the bar. In the matter of their professional organizations, both the American Medical Asso-