transportation, so far as highway improvement can do it. To this task it pledges its best efforts and consistent attention. For its more effective performance, it seeks the endorsement and support of every individual and every group that may share in the same responsibility for progress in motor transportation.

REPORT ON INDIANA HIGHWAY PLANNING SURVEY

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During the session of the 79th General Assembly two years ago a joint resolution of the House and Senate was passed creating the Indiana Highway Survey Commission; its charge was that it "shall make, or cause to be made, a scientific study and survey of the traffic needs and requirements of this state, shall investigate the desirability or necessity for widening the roads in congested areas, for highway and railway grade separation, for the repair, construction or maintenance of existing highways, and shall formulate a complete highway building and maintenance program for this state, and shall make recommendations relative to the means of financing the same. The Commission shall make a thorough study of the engineering, economic and practical problems involved and shall submit a report embodying their recommendations and program to the 80th General Assembly."

The Commission consisted of three members of the Senate, five members of the House, three citizens at large and two ex-officio members—the chairman of the State Planning Board and the chief engineer of the State Highway Commission.

Shortly before the organization meeting of the Commission on September 3, 1935, a communication was received from the chief of the Bureau of Public Roads to the effect that in the near future rural highway surveys would in all probability be undertaken by the Bureau of Public Roads through the several states.

At its organization meeting, the Commission requested the State Highway Commission to secure the advice and cooperation of the Bureau of Public Roads in obtaining the data required in the report for the Legislature and to cooperate with the Highway Survey Commission in making the survey.

In this letter from the chief of the Bureau of Public Roads were outlined briefly the proposed requirements for a comprehensive rural highway survey. The actual work of the Legislative Commission was commenced about December 1, 1935; and the elements of the survey as outlined in the Bureau letter were followed with respect to the inventory until the Bureau assigned its representative to Indiana about the first of May, 1936.
Since that time the standards recommended for adoption by all states engaged in similar surveys for which federal funds are provided in part have been followed by the Legislative Commission and have been supplemented with additional material.

The foregoing explanation is submitted in order that the Legislative Highway Survey Commission will not be confused with the Indiana State Highway Commission or with the U. S. Bureau of Public Roads.

The work of the Legislative Highway Survey Commission was completed and the duties of its members discharged upon the adoption of its report on December 17, 1936.

SCOPE

In order that the Bureau of Public Roads may receive traffic information in all four seasons of the year, a number of our traffic studies must be carried on until July 1, 1937.

Since additional traffic information must be obtained through the operation of pit scales in four localities in the state, these operations will soon be underway. Up to this time they have not been conducted because of the vast amount of work to be carried on and the time required to design the pit scale layouts.

Financial studies of the various municipal units, a motor vehicle allocation study, a road use survey, and road life studies are now under way in conformance with the requirements of the U. S. Bureau of Public Roads.

In order to submit the report of this Commission, it has been necessary to make a complete inventory of the physical assets which make up the highway systems in Indiana and also to determine the traffic, both as to kind and amount, which uses the highway systems.

The traffic studies whereby a vehicles-per-mile-per-day rating was given to all roads were taken during July, August, September, and part of October, 1936, and represent, therefore, an average maximum traffic load.

The inventory included all state highways through cities and towns of less than 3,500 population and all important county highways into or through the same towns and cities. The inventory did not include rural subdivision streets unless they were through-streets with the importance of highways. It did include all bridges and structures of a span of twenty feet and over and all grade separations regardless of their span length on such highways.

INVENTORY

In conjunction with the inventory, all population factors pertinent to the use of the highways were obtained, including school bus routes, mail routes, cities and towns, railroads
and their stations, parks and resorts, airports, rural schools, grange halls, fairgrounds, churches, cemeteries, sawmills, elevators, mines and quarries, gas-filling stations, dwellings, and the like. These were located on county maps.

Two maps were made for each county, one showing type of highways, state roads, important county roads, and other county roads, depth and width of surfacing, width of right-of-way, steam and electric railways, structures, and cities and towns; the other showing the features previously listed as population factors. These maps were drawn to a uniform scale of one inch to the mile.

In addition to the width and height of roadway and safe load of structures as shown on the county maps, the inventory obtained the type of the structure, the number and length of spans and their condition, the height in feet from the floor to the stream bed, the type of floor construction, its condition, and the size of the members, the kind of substructures and their condition, the alignment of the structure, and the condition of the approach grades.

In addition to the information on the maps concerning the roads, the inventory included information about alignment and grade, clear-sight distance, condition, and serviceability with respect to the weather.

Grade separation structures were inventoried at both railway and highway separations.

The inventory work was slowed up considerably by the severest winter experienced in half a century, entire counties being covered by a sheet of ice which prevented the parties from driving at any speed but a very slow one. And this severe winter was followed by one of the most severe and prolonged hot periods within our memory.

The only way in which a perfect inventory could be made and a perfect traffic survey conducted would be to stop all road and bridge construction for one year. This is impossible, of course, as there have been numerous construction projects going on from time to time which change the physical make-up of our roads and bridges and which, to a very great degree, influence the movement of traffic by putting the roads and bridges temporarily out of service and making detours necessary.

In the study of the traffic pattern for a given locality, we must take into account any features which are out of the ordinary. For example, county highways paralleling a state route which is under construction usually carry traffic far in excess of what they normally carry.

You will note on the county maps that the thickness of the road surface material and its width and also the width of the right-of-way are given for every road; this information should be of considerable value to county officials in the determination of improvements for traffic requirements. Infor-
mation was obtained from the records in county offices and was checked by actual field measurements.

Oftentimes the existing width of a right-of-way as represented by the difference in fence lines does not correspond with the legal width as reported by the viewers in their report. Since the latter is the correct width, you will find that this is the width which is shown on the maps if it was available.

The allowable safe load for structures is based upon the weakest members of the structure; the survey party reported their opinion of the main members and supplemented this information with measurements of the floor system on framed structures. The floor stringers or joists are oftentimes the weakest members in a framed structure; the floor beams and main members are usually designed so that they can carry some of our present day loadings even though they were designed during the horse and buggy days. You will agree that it is quite difficult to obtain allowable safe loads for a reinforced concrete slab or reinforced concrete girder structure when plans are not available; however, these two types of structures are generally safe for at least twenty tons loading if they are in fair condition.

The allowable safe load of a structure carrying a railway over a highway was not determined by this survey since this determination was not believed necessary.

Probably every county official in this group can find something in error in his particular county. This certainly is true if he is expecting to find short bends and curves in roads shown. On a scale as small as one inch to the mile it is impossible to show anything but the general direction of the highway.

TRAFFIC

The traffic studies have been quite extensive on the county highways as well as the state highways. We have located upon the state system one hundred and sixty-two stations where density and classification studies are carried on. At ninety of these stations we have in operation six field parties each equipped with portable traffic weighing scales. Five of these parties operate upon a schedule alternating between six o'clock in the morning to two o'clock in the afternoon and two o'clock in the afternoon to ten o'clock in the evening. The sixth party operates only between ten P.M. and six A.M. The parties which conduct the work at these stations are weighing trucks which pass through the station and are obtaining the classification of the carrier, the origin of the load and its destination, the distance which it is being transported, the kind of merchandise being carried, the type of origin, such as factory, warehouse, or farm, the type of destination to which the merchandise is consigned, and the location of the
truck registration, that is, whether the truck is an Indiana truck or a foreign truck.

The weighing parties are supplemented by additional recorders whose duties include the tabulation of all vehicular traffic passing through the stations during the same hours that the weighing takes place. Thus we will know the complete movement of traffic during the same period that we are obtaining particular information for freight transportation.

In order that our traffic study will be inclusive of conditions pertaining to local communities, we are studying the movement of traffic on every highway of any importance within the state and to this end we have located between eight thousand and nine thousand stations on our county roads and state highways not otherwise covered by the primary control system. This large number of stations is taking us into the highways and byways of Indiana in a manner which will surely produce the true traffic picture.

Schedules have been so worked out that all days in the week and all hours of the day will be fairly represented by our results. All counties, regardless of their topography and location and population, are accorded the same consideration throughout this survey.

The results of the information obtained to date show that the rated capacity of many trucks has little or no relation to the load being carried. Trucks having a rated capacity of one and one-half tons have a higher percentage in their classification which consistently overload beyond this rated capacity than any other classification of trucks. The percentage of trucks having wheel loads in excess of the allowable legal load limit is very low, around one per cent.

We have found that the occupants of passenger vehicles operating within the first few hours after midnight are generally in a different frame of mind from those operating during the other hours, being often inebriated. While this has no bearing upon the results of traffic survey, it does have considerable influence upon the safety of our highways.

From the results obtained by periodic counts at the one hundred and sixty-two primary stations from July 1 to November 5, 1936, we found that passenger vehicles represented 82.4% and commercial vehicles represented 17.6% of all vehicular traffic on the state highways. The passenger vehicle traffic is divided into 73.3% local and 26.7% foreign. Commercial vehicle traffic on the same highway is divided into 77.2% local and 22.8% foreign. Local passenger vehicles represent 60.4% of all vehicles and foreign passenger vehicles represent 22.0% of all vehicles; local commercial vehicles represent 13.6% of all vehicles and foreign commercial vehicles represent 4.0% of all vehicles.

At ninety stations where trucks were weighed upon portable scales, the traffic study shows that 62.4% are engaged
in trucking within Indiana; trucks which come from another state and unload in Indiana represent 12.2% of truck traffic; trucks which load in Indiana and are destined to another state represent 11.4% of truck traffic; trucks which load outside Indiana and are destined for another state represent 14.0% of truck traffic. These percentages have been obtained on state highways only.

Some of our state highways are carrying a larger percentage of commercial vehicular traffic originating in a foreign state and destined to a foreign state than the percentage of commercial vehicles operating solely within the state over the same routes.

At six locations on state highways there have been located self-registering and recording devices operating upon the photoelectric cell principle and a time-clock mechanism. These six devices were placed in operation about September 20, 1936—one near LaPorte on U. S. Highway 20, one northwest of Fort Wayne on U. S. Highway 30, one west of Frankfort on U. S. Highway 52, one east of Indianapolis on U. S. Highway 40, one south of Seymour on U. S. Highway 31, and one near Vincennes on S. R. 67.

Traffic which passes these locations is registered and recorded hourly; thus a continuous record will be obtained for any time, and the results may be used in the determination of factors for other similar locations. While the operation of these devices has been rather troublesome because of mechanical difficulties due to manufacturing, the traffic information received will be very satisfactory.

The main state routes for commercial vehicular traffic remain the same as those reported in the traffic survey made for 1932; the bulk of the freight moving from one state across Indiana to another state is using principally U. S. Highways 20, 6, 30, 52, 40, 31, 24, 27 and 41, and State Road 67.

We may safely say that the truck traffic on county highways is confined almost exclusively to local vehicles. The traffic counts taken during the months of July, August, September, and part of October, 1936, represent what we term average maximum traffic counts; a maximum traffic count would be that obtained on an August Sunday and on Labor Day. We all know that the summer season is the season which finds more vehicles on our highways and that as the winter months approach, the traffic diminishes in accordance with weather conditions. If all of the highways are studied at the same time with respect to traffic, the results of the study will be fair to all communities; the one major difficulty in the interpretation of the results will be for those localities where detours are in effect as before mentioned.

In general there has been a marked increase in traffic throughout the state. The results show that there are ap-
proximately nine and one-half million vehicular-miles of traffic for an average maximum twenty-four-hour week day on the state highways and approximately four and one-half million vehicular-miles of traffic for an average maximum twenty-four-hour week day on all of the highways of the 92 counties; that is to say, the state highways are carrying about twice as much traffic as the county highways.

We may compare the traffic on heavily traveled state routes with the mass production line of a modern factory: the units go past so rapidly and continuously that it would be hard to say just how much influence an additional one hundred vehicles would have upon the road. The traffic upon the less traveled state highways and the more heavily traveled county highways is of such an amount that an additional one hundred or so vehicles a day might have quite a marked influence. The traffic upon the unimproved highways of the counties is of such a small amount that if it should increase by even a fraction of one hundred vehicles a day, the highway would require improving—perhaps it would be better to say that the public using the highway would demand that it be improved.

GENERAL

All of us are aware that the width of the wearing surface of our gravel and stone highways has apparently been increased by the throwing out of material to the edges and by the use of such edges by traffic, and yet we all agree that the traveled width of roadway cannot always be called the surface width. A highway which was improved with one-way surfacing soon may require two-way surfacing to accommodate the increased traffic; the width of the berms is then encroached upon by the traffic, the side ditches lose their identity, and we find ourselves with a road cross-section of inadequate width for both safety and drainage.

The figures of the inventory bear out the statement that our county highways have right-of-way widths which are entirely inadequate. Fifty-one per cent of such highways have a right-of-way of thirty-three feet or less and an additional 42% have a right-of-way width between thirty-four feet and forty feet. If there is one thing that is needed more than any other to save the investment represented by our improved county highways, it is the acquisition of land to increase the width of our right-of-way. This is no reflection upon the ability of the county surveyors and the county highway supervisors, for it is physically impossible for either of these two public servants to do his job properly in the cramped quarters now existing. Some of these officials already have widening programs under way and are conducting them with practically no expenditure of funds.
We all recognize today as we have in the past that drainage is probably the most important feature of the highway and yet we are certainly unable to provide such drainage under present conditions.

Traffic generally takes the shortest route in point of time and distance as is evidenced by the heavy traffic which we find on county highways which skirt the limits of a metropolitan area. These highways may be called by-passes, and while they may not have been built with the intention of serving as a by-pass for traffic yet they are actually being used for this purpose.

CONCLUSION

We must agree first of all that all highways are a necessity. We must agree likewise that the highway is one-half of the unit of motor vehicle transportation. In addition, we must agree that the highways of Indiana represent a publicly-owned public utility and so do not have to pay dividends in actual dollars and cents to any stockholder.

We should also agree that in order to make any adequate highway survey we should obtain the facts and permit such facts to determine our conclusions. The engineers, surveyors, and recorders who have been engaged in the actual survey work have been instructed to obtain the facts and not to permit prejudice or opinions to influence the submission of facts. The services of the county officials, state officials, motor traffic association officials, and numerous other agencies have been sought in the conduct of this survey and they have been freely granted. For these services we wish to thank each and every one of you.

The answer to all our traffic problems has not yet been obtained. Perhaps we have only scratched the surface, but we hope that we are on the proper course and that all concerned will have the opportunity to contribute extensively to the answers of questions concerning traffic.

The county highway system of each county belongs to that particular county, and yet the neighboring county is interested in those highways because its residents occasionally use them. The state highway belongs to all of the counties, and therefore we are all interested in the state system. Certainly the meritorious park and playground program of Indiana depends upon our state system of highways as well as the moving of freight by motor vehicle depends upon them.

However, as the old saying goes, "You cannot have the cake and eat it," and we must face fairly and surely the problem of financing according to the facts obtained by this survey; we must plan wisely for the future both from an engineering and an economic standpoint. If areas are to be marked out as unsuitable for settlement, let us begin now to save ex-
penditures in such areas. If the public demands by-passes around our cities, let us begin now to plan them.

The supervision of any work requires a knowledge thereof and the ability to discharge the responsibilities thus incurred. This applies to municipal units of government as well as to individuals.

SOME KNOWNS AND UNKNOWNS IN BITUMINOUS ROAD WORK

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The path of human progress is marked with many fairly successful attempts at building without much knowledge of the materials used therein. Such is the case of bituminous mixes used in road work. The practical use of these mixtures has preceded our fundamental information concerning their constituents. We have thus developed the art rather than the science of bituminous construction. Perhaps this is fortunate, so long as everything goes well. When troubles arise, however, we find ourselves poorly equipped with fundamental knowledge to get us out of difficulty.

The net result of having let our individual practices so far outrun our ability to generalize has led to this extremity—the U. S. Bureau of Roads has on file over 250 patented or proprietary bituminous mixes or processes for road building beside those designed by highway groups everywhere trying to dodge some of these patents. And in spite of this multiplicity, or perhaps because of it, we usually get only a startled look in response to our request for a rational design of a bituminous mix that will give a certain kind of road surface of known behavior.

BASES

Until quite recently we had developed very little conscience as to the bases which are to support our bituminous surfaces. Any old base or none has too generally been the rule. Yet it takes but casual observation to satisfy oneself that the surface course does not carry the load of traffic, but merely distributes it to the base, protecting that base from the weather while it offers a smoothing course to traffic. Poor bases have been a prolific cause for distress in bituminous pavements as in all others as well.

NOMENCLATURE

We have "muffed" some of the simplest phases of this field. Take for example our most common terms and phrases.