

togler of the Bureau of Public Roads at the recent meeting of the Highway Research Board. At the present time apparatus of a similar type, which also includes a method for measuring stability, is being developed for field use. Such an apparatus will prove of particular value, as it will eliminate the extended programs of study or research which have heretofore been necessary.

When due consideration is given the results which may be obtained by proper construction and the saving in maintenance which will result from proper manipulation of the road surface, the study of the more satisfactory maintenance of roads is justified; rather than the method of following the common practice of using any available material regardless of existing conditions and, by the application of a deliquescent product, endeavoring to keep the road material from being dissipated by the wind and traffic. In other words, investigate the available coarse and fine material and combine them so as to secure in fact a "concrete" road, but one in which the cementing medium is clay or some other binding material in place of portland cement.

Calcium chloride will save enough in material replacement to pay for its use; and though the proper study and combination of materials will incur some original expenditure, the saving in maintenance brought about by this consideration will more than pay this cost and the public will be provided with a smooth and dustless road surface.

HIGHWAY TRANSPORT SURVEY IN INDIANA

By Ralph E. Simpson, Assistant Director, Indiana State Highway Commission

When history records events of the last ten or fifteen years, I believe this period will be known as "The Era of the Development of Automotive Transportation." This development has truly been phenomenal. In the ten years between 1920 and 1930, automobile registration in Indiana increased 300 per cent, and the number of trucks was increased more than four times. These tremendous increases in numbers were accompanied by a similar increase in the diversity of uses of automotive transport until our highway traffic problem has become of such a magnitude and variety that it is impossible for any individual, no matter how experienced, to comprehend all its details without the assistance of facts obtained from careful studies. We of the state highway department have realized this for some time.

We have also believed that the period of rapid expansion is at a close and that we are now in a period of transition, which will be characterized by refinements and economies. Using military terms, we might say that we have advanced. Our advance has been halted. We pause to consolidate our position and to estimate the situation. Today, among some people, there is a feeling that road construction has caught up in a large measure with traffic demands, and that future improvements should be made only as they are warranted by future developments of other phases of our social and economic life. Studies should be conducted to determine the value of past accomplishments and to obtain a clearer view of future needs. Also, the business depression terminated the period when taxpayers generously and eagerly contributed immense sums for road construction, feeling that no matter how this money was spent, the returns would be far greater in value than the money invested. In other words, the "boom" days are over. Automotive transportation has become an established routine part of our everyday business and social life.

The Highway Commission feels there should be a better basis for improvement programs than there has been in the past. Indiana uses the "pay-as-you-go" system, and because of this, it was not possible to pave a very large mileage in a few years as was done in other states. An attempt was made to pave continuous routes across the state and also to complete pavement on federal highways before working on secondary or less traveled roads. Other improvements were made as the need was manifested. However, every individual feels that the road to the door of his home is the most important road of all. His opinion of the necessity of improving his road may possibly be, and probably is, exaggerated. It becomes impracticable to longer continue to base construction programs on such opinions.

It was decided to organize a transportation survey department and to make studies of traffic, both on state roads and on local roads, in order that our picture of the traffic situation might be more complete. We found that the U. S. Bureau of Public Roads has co-operated with several states in traffic studies. Among the first was our neighboring state of Ohio, and later Pennsylvania. In these two states, in which this pioneer work was done, the principal purpose was to determine the density of the traffic on each state road; to determine its variations, hourly, daily, and seasonal; and from these to prophesy as accurately as possible future traffic. From these studies, a future improvement program was determined. The studies disclosed that some roads which had been highly improved really needed to be widened, straightened, and otherwise greatly improved, although construction work had only recently been completed on them.

To the research engineer, however, a most interesting thing about the surveys was the striking similarity of the variations of traffic flow in the various parts of the state. This study has been made by actually counting traffic on all state roads for the period of an entire year. The volume of data was tremendous. After further studies were made in Pennsylvania, Vermont, New Hampshire, eleven western states, and the State of Michigan, it became obvious that it was not necessary to count all of the traffic for an entire year to determine what the traffic characteristics at any one place actually were. Samples properly taken would give just as accurate information. These surveys were analyzed by workers under a fellowship in the University of Wisconsin, and methods further developed by H. R. Olson, Highway Engineer of the Chicago Regional Planning Association. Surveys of the density of traffic have been undertaken by the Illinois Department of Highways on state roads in Illinois, using these methods of abbreviated counting. This survey was started about a year and a half ago, and sufficient data had been developed in the State of Illinois to lead us to believe the method of abbreviated counting could be utilized to give us all the information we needed about traffic density on our own state roads. All of this could be done at a cost which would be a fraction of that expended in various states where long-time counts had been completed.

INDIANA METHODS

Our Transportation Survey Department was organized in March, 1932, and the first counts were made in May. Traffic at a few selected stations was counted for a full week, and at others for 24-hour periods, but at the greater number of stations—approximately 800—only 8-hour counts were made. Step-up factors were computed for each station, based upon the data assembled by us and the experience obtained from prior counts in other states.

A traffic-flow map has been prepared and distributed, showing the traffic on our state highways on this date of Tuesday, May 10. In other states, it had been found that the month of May is a month of average traffic. It had also been found that Tuesday traffic is usually an average of week-day traffic. Our counts show that the assumption that Tuesday is an average week-day is probably also true for Indiana. We, of course, can not yet state accurately what our seasonal variation will show about May being an average month.

In June and again in July, the full-week stations and the 24-hour stations were counted, this time for 8 hours only. In August, the month of maximum traffic as shown by other studies, full-week and 24-hour stations were counted for the entire time. On Tuesday, Saturday, and Sunday, 97 stations

were counted for 8 hours, it being developed that Saturday and Sunday traffic was different from average week-day traffic, as reported by Tuesday. Other stations were counted for 8 hours for Tuesday only. In November, the full-week count was repeated and 8-hour counts were made at 122 stations.

Traffic volumes on the state highway system have been plotted on two other maps, showing a week-day in August and a Sunday in August. We expect that the August Sunday map will show the peak of traffic of the year. We found that week-day traffic in August was approximately $1\frac{1}{2}$ times that of week-day traffic in May. This quite agrees with findings in Illinois, Michigan, and Ohio. Average traffic on an August Sunday was approximately twice that on a May week-day.

While this survey gave us a measure of the density of traffic on state roads, we were still without any knowledge of other characteristics of the traffic on state roads and had no knowledge whatever of the traffic on other roads in this state. We discussed this need with representatives of the Bureau of Public Roads who had been in charge of traffic surveys in other states, and they advised us that in their opinion an abbreviated method could also be used to determine other characteristics, and that it was equally applicable on state roads as well as others. This method was developed from studies in the State of Michigan, where full studies were made of both state and local roads. In analyzing their counts on local roads, they noticed a great similarity between the characteristics of certain counties, and found that these counties could be grouped, and these groups determined by characteristics other than by characteristics of the traffic. They found that in rich agricultural counties the traffic characteristics on local roads were quite similar. Likewise, industrial counties had similar characteristics.

After studying the State of Indiana, it was determined to count traffic on local roads in 11 representative counties; Lake, St. Joseph, Marion, and Vanderburgh were chosen to represent industrial counties. Our results so far show a surprising similarity between characteristics in St. Joseph, Marion, and Vanderburgh Counties, but Lake County is entirely dissimilar from all others. Adams and Boone Counties were chosen to represent rich agricultural counties, and Adams County also represented counties in which dairying was a major industry. Scott County was chosen because of the canning industry. Orange County was representative of fruit growing as a major industry. Pulaski County was chosen as representative of those counties in what were once the marshy, flat lands in the northern part of the state. It was also found that in certain counties the largest factor in traffic variation was caused by people going to and coming from pleasure resorts. Kosciusko County was chosen to represent the lake district, and Brown County was chosen to represent the scenic,

hill country. Using methods similar to those in use in our volume count in the state system, we have been able to actually make a volume count on all of the highways in two representative townships in each of the counties, with the exception of Brown, where only one was selected.

CLASSIFICATION OF TRAFFIC

In order to obtain other characteristics which would enable us to classify our traffic, it was necessary that we stop a portion of the traffic and ask questions regarding the origin, destination, and the place of ownership of the car. An attempt to classify traffic by origin and destination had never previously been made; however, in Michigan, the surveys took cognizance of the origin of the traffic. It was there definitely proved that carefully selected samples of traffic gave just as accurate data as if all traffic had been stopped and questioned. We have checked this as far as we could in the somewhat meager data we have here, and found that this is probably true. Character of traffic as shown by an analysis of every third car and every fifth car, and even every fifteenth, shows striking resemblances; consequently, we do not attempt to stop all cars on heavily traveled state roads.

Before starting on this work, it was decided to run a short survey in Boone County, and from this, determine methods to be used on the general survey. This survey in Boone County was run for a period of two weeks. It was invaluable in determining methods to be used in the general survey.

From this classification survey, we have determined how much of the traffic is city-owned vehicles, how much farm-owned vehicles, and how much is owned by people living in the towns or villages. We have classified all towns of over 2,500 population or more as cities. There are only 92 of these cities in this state. One other reason for this classification is that in these cities it is customary for the property owners to pay for the pavement of the streets on which their property abuts.

Another classification has been as to passenger cars, trucks, and busses. We have also classified traffic as to state traffic or foreign traffic, foreign traffic being automobiles registered in other states. This foreign traffic is as high as 50 per cent at some of the stations in Lake County. You may be interested to know that we have had some really foreign cars pass through our stations. Our records show two cars bearing licenses from Germany, several with licenses from Hawaii and Cuba, and one with a French license.

We have further classified our traffic as traffic passing from one city to another city, from city to farm, from farm to city, and also from farm to farm. Our results are, of course, fragmentary at the present time, but I believe that the

analyses which we have been able to make will show the trend of the final results. More than one-half million cars were stopped in obtaining this data.

One of the factors for which we are unable to determine the proper weight at the present time is that this is a depression period. Traffic was, we believe, subnormal in July; it was less than in June, the decrease affecting both passenger and commercial traffic. Traffic, however, increased to what we would expect to be a normal rate in August. It may be of interest to you to know that these observed fluctuations in traffic have been accompanied by a corresponding fluctuation in the payment of gasoline taxes. This, we believe, adds weight to our belief in the veracity of our figures.

In conclusion, I wish to emphasize the fact that methods of studying traffic have been developed which are fundamentally and basically sound. These methods have been simplified so that the cost of making a study of this kind is very reasonable. The information which we develop in our studies can be taken by you as being accurate. I would like to urge that you study your local traffic along similar lines, and that thus you individually and severally add to the completeness of the picture, the general outlines of which will be determined by the state highway department's studies.

I urge that you plan a similar study of traffic in your own counties and from it develop the proper picture of your traffic situation, its needs and requirements, and from this picture plan and conduct your future improvement program. If this is done, I then believe you will be able to have confidence that the funds of the people which are intrusted to you will be properly and economically expended.

PRELIMINARY RESULTS OF HIGHWAY TRANSPORT SURVEY IN INDIANA

By F. A. Henning, Engineer, Special Assignment, Indiana
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Before entering into the discussion of the preliminary results as produced by our survey, I should like to impress upon you the necessity of having a fixed and definite objective in mind before collecting traffic data. The data procured must be in line with the results you are seeking. Much unnecessary expense can be incurred by collecting and later analyzing data which is of no value in the final analysis of the survey. Methods employed should produce a maximum of information of the kind required. The one outstanding item of all transportation survey work in our opinion is traffic density.