

contract must procure from the contractor a certificate issued by the industrial board of Indiana that such contractor has complied with the compensation law. It is not sufficient, in order to avoid such liability, to take the contractor's statement, either written or otherwise, that he is carrying compensation insurance, but the certificate from the industrial board must be procured and filed with the contracting body. If this is not done and any workman on the job should be injured, the public body becomes liable to pay the compensation if the contractor is not able to do so.

#### INSPECTION

Another most important thing is the proper inspection of the work during its progress. This means that a competent inspector should be on the job not only to pass upon the material going into the job, but also on the manner in which the work is being done, whether it is according to the contract or not. It is too often the case that some person is appointed inspector who does not have sufficient knowledge to determine whether or not the work is being done according to the specifications or whether or not the materials provided for in the specifications are going into the job. After the work is done it will be too late in most cases to ascertain whether the specifications have been lived up to. The administrative body charged with the carrying out of these provisions should remember always that it is representing the public. No matter how well acquainted it may be with the contractor or how friendly it may be to him, it is at all times dealing at arm's length with him and its interest should be solely that the contract is lived up to in every detail and that the public at every step is protected. If this were always done there would be much less criticism of the conduct of public officials than we now have.

I seem to have somewhat digressed from the subject assigned to me. I feel, however, that the most benefit which could be derived from a discussion of the subject is the pointing out of how legal pitfalls can be avoided. My final, and I believe the most important, suggestion I have to make is to follow the advice of the attorney selected by you, and if, after doing so, you feel that his advice is wrong, then procure another attorney in whose advice you have confidence.

#### FINAL REPORT OF THE INDIANA TRAFFIC SURVEY

By W. F. Milner, Engineer of Special Assignments, Indiana State Highway Commission, Indianapolis

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Two years ago Mr. F. A. Henning (now district engineer at Greenfield) prepared and delivered to you here a "preliminary report" of our traffic survey, then in progress, and prob-

ably because of that a somewhat misleading title has been assigned to this paper. In May, 1932, we began a series of traffic-volume studies that were continued without interruption for a period of a year in order that all seasonal variations in the flow of traffic could be recorded. In August of that same year we began a series of observations of the various elements that made up the stream of traffic and carried them on also for a full year. The yearly records in each case were arranged in such a way that the volume and composition of traffic for an average day, that is, 1/365th part of the year's total, could be shown. Of course the seasonal variations were charted in usable form along with hourly and daily variations, but the yearly average figures are the ones that receive the most general attention and are the basis of most traffic calculations.

In July, 1934, we published a report of our work during those two 12-month periods and that report, in contrast to Mr. Henning's report just referred to, is the subject of this paper. It is not, however, final because since its publication additional studies have been made of the records, brief reports on individual roads and special subjects have been prepared from time to time, and the work has been co-ordinated with safety-and-traffic-control studies. As long as we have road problems to solve and we use the best methods at our command in their solution, traffic studies will continue. But our printed report contains an unusually complete picture of present conditions.

An examination of the printed report of our survey shows at a glance that most of the information it contains has been expressed either in charts or in figures. Only a very superficial picture of the facts produced in the course of our studies can be given without using many figures; so if you want the whole story you will have to read the report yourselves.

We learned many interesting things that we did not know and accumulated a wealth of information that will be of value for many years to come. New counts in the field can be made from time to time at a limited number of counting stations and the data used to bring the original records up to date. However, changes in the composition and nature of the traffic have been rapid during the last ten years and there is every indication that they will continue to occur; so before very long, complete new studies will probably have to be made. The deaths of 35,000 people in traffic accidents during the year just passed may result eventually in changes in our whole highway transportation system that none of us can visualize at this time. Methods of financing highway work have developed largely in accord with the characteristics of traffic, and full knowledge of these characteristics must be had if future methods are to be economically sound.

## CLASSIFICATIONS USED

Our studies covered only rural highways. They are all divided into two systems—state roads and county roads. The former system consists of U. S. numbered routes and all other state roads. It is also divided into the primary and secondary Federal Aid systems and into state roads that are not in either of the Federal Aid systems. The county roads comprise 89 per cent of the total mileage and carry one-third of the traffic. The state system represents only 11 per cent of the mileage, but it carries two-thirds of the traffic. Likewise the primary Federal Aid, secondary Federal Aid, and other state roads are of importance in the order named. The primary Federal Aid system, only 2.4 per cent of the total mileage in the state, carries 30 per cent of the traffic.

Our report definitely classifies the roads into groups according to their relative importance from the standpoint of traffic volume and also shows the principal characteristics of the traffic on the state and county systems. Office records, too voluminous for inclusion in the report, show these characteristics in detail for each of the groups already mentioned. Passenger car, truck, and bus traffic is separated as to volume—traffic produced by vehicles owned in other states, in Indiana, in cities, villages, and on farms; by vehicles moving from city to city, from farm to farm, crossing the state from border to border or moving entirely within a township. These characteristics, shown relatively, indicate quite clearly to what degree each group of roads is of local or general interest. They are expressed as percentages and a few of them are worth quoting here.

On state roads 17.5 per cent of the traffic is foreign; that is, it is produced by vehicles registered in other states or countries. This item on county roads is 3.4 per cent. Trucks account for practically the same proportion of the traffic on both state and county roads, approximately 16 per cent. Busses do not seem to play a very important part on either system, producing 0.7 per cent of state road traffic and 0.2 per cent of county road traffic. School busses are not included in these figures because in Indiana they are registered as trucks. (There are only 878 busses registered as such in the state.) City vehicles, that is, those owned in cities of 2,500 or more population, account for 53 per cent of all rural traffic, village vehicles 20 per cent, and farm vehicles 27 per cent. There are approximately 7,000 school busses in the state. They travel an average of only 3,200 miles a year each. The average mile of the state highway system carries 818 vehicles a day, while the number on the average mile of county road is 51.

The unit of measure of traffic is the vehicle mile or the movement of one vehicle one mile. The report gives us a very convenient means of figuring whether or not a road is paying

its own way. One vehicle mile of travel each day for a year produces a revenue, in gas tax and license fee, of \$1.40. In this manner the average mile of the state system earns in a year \$1,145.00 and the average mile of county road earns \$70.00.

It is almost impossible to tell you the really interesting facts about our roads that were brought out by the survey and that were not already known to most of us without simply giving you one figure after another. The figures, however, were not the only things of real interest. We found, for instance, that the most highly improved group of roads carried by far the heaviest traffic and so on down to the least improved group in regular order; that the cost of maintenance of state highways was lowest on that first group, the primary Federal Aid roads, next lowest on the secondary Federal Aid group, and highest on those other state roads not in the Federal Aid system. The degree of improvement, of course, varied in the same order. We also found that the cost of maintaining gravel roads is not in direct proportion to the amount of traffic carried on them, but that somewhere in the neighborhood of a traffic volume of 350 vehicles a day there is a jump upward of from one to two hundred dollars per mile per year. Up to that point, and possibly somewhat beyond, the increase in cost is proportional to the increase in traffic. The state system earns, as a whole, more than its cost of upkeep, but the county system, with the lowest degree of improvement as a whole, does not.

#### TRAFFIC VARIATIONS

The report shows that August is the month of heaviest traffic for both trucks and passenger cars, but that the seasonal variation in truck traffic is much less than it is in passenger traffic. Passenger traffic in the high month is 50 per cent greater than in the winter, but the increase in truck traffic is only 20 per cent.

The variation in volume on the different days of the week is found to be fairly consistent throughout the year. Tuesday is the low day for passenger traffic, but there is but little difference between the five week days. Saturday shows an increase of 21 per cent over the average week day and Sunday shows a 67 per cent increase. Truck traffic is about the same on all the week days, but falls off about 20 per cent on Saturday and 60 per cent on Sunday.

The daily volume of traffic varied widely on different parts of the state system. The number of motor vehicles per average 24-hour day ranged from about 19,000 at the junction of U. S. 41, U. S. 12, and U. S. 20 to less than one hundred on some unimproved sections recently added to the system. On the county system the range was between a maximum of 3,943 and a minimum of 2.2. The most important through routes

in the state were clearly established as U. S. 12, 20, 30, 31, 40, 41, and 52.

Heavy truck traffic was found as a rule to follow the principal routes. It is highly significant that the percentage of truck traffic in Indiana is practically the same on state and county roads and still more significant that the percentage of heavy trucks on county roads, as determined by inspection, is approximately half that of heavy trucks on state roads. It was found during the summer of 1933 that 47 per cent of the trucks passing the survey stations on state roads during daylight hours were either equipped with dual tires or were obviously large and heavy. This figure includes busses. On the county roads the proportion of similar heavy vehicles was 26 per cent. Dual tire equipment is principally used on vehicles which may be roughly classified as heavy. No classification by tonnage was attempted. On state roads the volume of truck traffic per average 24-hour day varied between a maximum of 3,790 and a minimum of less than 10. On the county system the maximum was 726 and the minimum none.

The hourly variation in the volume of truck traffic is of particular interest to most road users. On the average week day it is very uniform during daylight hours, reaching its peak in the morning between 8:00 A. M. and 9:00 A. M. After 4:00 o'clock in the afternoon there is a material drop, continuing until about 7:00 P. M. From then on it is fairly uniform until 6:00 in the morning. Between 1:00 A. M. and 6:00 A. M. the truck volume exceeds that of passenger cars, except on Sunday, when there are but few trucks on the roads. On some sections of U. S. 52 northwest of Indianapolis and on all of U. S. 12 there is more truck traffic at night than in the daytime, but this condition was not found anywhere else. Late night or early morning passenger car traffic is only about one-eighth of the average daytime volume.

One table in the report occupies twenty pages. It shows each road in the state system, section by section, according to important volume changes, the length of the section, the passenger, truck, and total traffic separately for the average day of the year, the total traffic on an August Sunday when it is highest, and the total traffic averaged for the thirty heaviest days. This last item usually amounts to 90 per cent of the August Sunday flow. This table is extremely interesting, especially when used with the six traffic flow maps which accompany the report. These maps indicate the traffic volume according to the width of the line representing each road and make comparisons easy. They show the traffic on a week day in each of the months of May, August, November, and February, on an August Sunday, and on the theoretical average day of the year. The latter map is particularly useful.

Undoubtedly the usefulness of the figures we have secured concerning the volume of traffic is evident to everyone, but

perhaps many of you will not see at a glance the value of the data showing traffic characteristics such as location of ownership, origin of movement, destination, percentage of truck traffic regardless of weight, county, township, state and foreign traffic, and other elements shown in the report. All these items and many others have direct bearing on the problem of revenue for use on the different road systems or groups and without such information the proper solution of that problem would be impossible.

Copies of the complete report are available upon written request addressed to the State Highway Commission at Indianapolis.

### USE OF TRAFFIC SURVEY DATA IN DEVELOPING THE STATE HIGHWAY SYSTEM

By John W. Wheeler, Member, Indiana State Highway  
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Some years ago a former Highway Commission realized that Indiana had many miles of improved road—to be exact, 2.14 miles for each square mile of territory; a figure exceeded only by England as a nation and by two states, Massachusetts and Connecticut. We had 8,423 miles of state highways and 68,822 miles of county highways, but did not know who was using them. The need existed for a traffic survey to ascertain:

1. The number of cars actually using the state highway system.
2. The number of cars actually using the county highway system.
3. The number of trucks actually using the state highway system.
4. The number of trucks actually using the county highway system.

Glib-tongued secretaries of chambers of commerce would bring delegations before the Highway Commission and state that the road they were promoting carried 10,000 vehicles per day. They could not prove that it did and the Highway Commission could not prove that it did not. It was hard to tell which road should be paved first and which road should be resurfaced instead of being paved. In fact we had a road system, but did not know what load it was carrying.

The traffic survey gave the Highway Commission what a fever thermometer gives the doctor—an accurate reading of the existing conditions.

It might be supposed that a Highway Commission should know by intuition which roads carry the traffic, but let us see how this works. We often speak of U. S. 41 in Indiana as being a heavily traveled road, but let us look at the record of 41 and read the average daily traffic as found by the traffic survey.

Between Evansville and the junction of 62, which goes to Boonville, the average daily traffic is 3,132, but farther north