Present Trends in Traffic Speeds

Warren S. Quimby
Graduate Assistant, Joint Highway Research Project
Purdue University

This paper is a continuation of the studies presented at the 1943 and 1944 Road School by Mr. R. E. Frost, entitled "Wartime Traffic Speeds in Indiana," and at the 1945 session by Mr. W. B. Wilson, entitled "The Effect upon Indiana Speeds of Lifting Gasoline Rationing." The data presented in these papers must be reconsidered if one is to obtain a conception of the present trends in traffic speeds.

All data reported were recorded by means of the photo-velaxometer, designed and developed for the Joint Highway Research Project by Mr. A. K. Branham. This machine, intended primarily to record acceleration and deceleration patterns, operates through a series of eight rubber air tubes and switches laid at given equal intervals across the highway. The switches are connected by a cable to a series of interrelated relays, which are the operating mechanism for the various parts of the photo-velaxometer, within the machine. As the front wheels of a vehicle cross the first tube, the air pressure built up in the tube forces on and closes the switch, thus closing the first relay, lighting the first panel light, and starting the clock. At the same instant current flows through a strobotron tube, which flashes and illuminates the clock dial. This allows the camera mounted above the clock face to record an initial image of the hands. The dial is calibrated in seconds and hundredths of a second. When relay No. 1 is closed, relay No. 2 is ready to be activated. As tube No. 2 is crossed, this relay is closed, the second panel light goes on, the strobotron tube flashes, and a second clock reading is recorded on the same negative. This process continues until all eight tubes have been crossed. When the last relay is activated, the clock is stopped. This operation gives a picture of the clock hands in eight different positions, and when the picture is developed and read, seven time intervals are recorded, each interval representing the time required for the vehicle to travel the known distance between one tube or station and the next tube or station. The machine must then be cleared before another recording is made. The panel lights mentioned serve to locate any source of trouble. Since relay No. 1 must be closed
AVERAGE INDIANA SPEEDS FOR THE FIVE YEAR PERIOD ENDING FEBRUARY 1947

![Graph showing average Indiana speeds for prewar, during war, and postwar periods, with data for all cars, Indiana cars, foreign cars, and trucks]

Before relay No. 2 can operate, and relays Nos. 1 and 2 closed before No. 3 can function, and so on for the entire series, if a car in crossing the section under study causes only the first four lights to go on, the trouble must be in the fifth circuit.

In using the photo-velaxometer to record spot speeds, a slightly different procedure is followed. The first two tubes only are used. These are placed across the lane in which data are to be obtained, to produce a trap 100 feet in length. The camera is not used, and the clock is read by the operator directly, and the reading recorded. Before starting, a switch must be thrown which causes relay No. 2 to act as relay No. 8, in that it stops the clock when activated. In all other respects the machine operates as described above. Any desired length of trap can be constructed, but 100 feet has been used in these tests for convenience. By the use of a reversing switch, data can be taken in both lanes of a two-lane pavement without altering the set up. Three 6-volt batteries are required to power the machine.

All equipment required is carried in a panel truck to the location to be studied. At the location, the truck is parked in a convenient place off the highway, if possible several hundred feet from the highway on a side road, but in a position so that the approach to the trap and the trap are visible. Under these conditions the photo-velaxometer can be set up in the truck, and the leads can be run from the truck to the section of the roadway to be studied. This is a very desirable setup as there
will then be nothing on or near the pavement, except the two tubes
stretched across the roadway, to distract the driver and cause him to
alter his normal driving habits. The effect of the tubes on the driver is
negligible. If these conditions are not available, the machine is set up
near the roadway, but in as inconspicuous location as possible. Two
men are required for satisfactory operation at a location, one to record
data and the other to handle the machine.

At a given location the clock reading for each vehicle is recorded
on the data sheet, together with its classification—Indiana car, out-of-
state car, type of truck, or bus—and any other pertinent information
desired. For ease in operating and recording, the time intervals are
allowed to accumulate, instead of resetting the clock to zero after each
reading. From the clock readings the time interval for each car to cross
the trap is computed, and the speed for this time is read directly from
a chart to the nearest tenth of a mile per hour. These computations
can be easily made during the recording. The time of day is also re-
corded on the sheets at approximately 15 minute intervals to give an
indication of the volume of traffic.

Unrestricted pre-war speeds can be thought of as having been the
result of a gradual inoculation into human behavior of the idea that
time had become a very precious commodity, to be best conserved by
arriving at one's destination at the quickest possible moment. This fact
is easily proved by the steady increase in speeds within the past twenty
years, and by the steady refinement in highway design to meet ever-
increasing rates of travel. A further indication is given in the Indiana
speeds recorded in the periods immediately preceding the war-time re-
strictions. The President made a request on March 18, 1942, that a
voluntary speed limit of 45 m.p.h. be enforced. Just prior to this re-
quest, the average speed was 49.6 m.p.h. for passenger cars and 41.2
m.p.h. for trucks. Of the passenger cars observed, 15% were traveling
faster than 60 m.p.h. and 7% faster than 65 m.p.h. Within the truck
classification 8% were recorded at speeds greater than 50 m.p.h. and 4% at speeds exceeding 55 m.p.h. During the period from March 18,
1942, to July 25, 1942, when an enforced speed limit of 40 m.p.h. was
put into effect, the average speed recorded was 49.9 m.p.h. for passen-
gger cars and 41.6 m.p.h. for trucks. Both of these averages are slightly
higher than those of the preceding period, but they are close enough to
show that the average driver was maintaining his normal speed despite
the President's plea. Twelve percent of the cars recorded were above
60 m.p.h. and 5% above 65 m.p.h. Ten percent of the trucks exceeded
50 m.p.h. and 4%, 55 m.p.h.
Figure 2

Traffic speeds for the year ending February, 1947.

As a basis of comparison, average speeds in neighboring states at approximately the same time are listed below: the figures in parentheses are for night-time averages.

As can be noted, the Indiana speeds run slightly higher than those in Illinois or Ohio, but approximate those recorded in Iowa.

From July 25, 1942, until the lifting of gas rationing on August 15, 1945, there was an over-all decrease in speed as noted in Figure 1. The first reduction is probably due to the enforcement of the restricted speed limits. Beyond this point, the driver began to feel the pinch from lack of gas, tires, and new parts. Volume of traffic dropped, as well as speed, as the motorist was forced to conserve his equipment. The majority of drivers, especially those on longer trips, as shown by the speeds recorded for out-of-state vehicles, were reducing their speed more from this scarcity than from the 35 m.p.h. enforced speed limit of the O.D.T. of October 1, 1942. During any of the checking periods the percentage of cars traveling at or less than the limit was only 15 to 20% of the total number checked. The over-all effect of the O.D.T. regulation and, later on, gas rationing, was to reduce the averages generally below 43.5 m.p.h. for all cars checked, and 43 m.p.h. for Indiana cars recorded. The lowest averages came during the first gas major curtailment period (September 30, 1942, to December 1, 1942), 42.3 m.p.h. for all cars and 41.4 m.p.h. for Indiana cars. Trucks traveled at correspondingly slower rates, the averages during the periods under consideration running below 40.5 m.p.h. with a low average of 39.7 m.p.h. To summarize briefly, wartime restrictions reduced average truck speeds between 1.5 and 2 m.p.h. and average car speeds between 6 and 7 m.p.h.
In the months immediately following the war, data were taken to test the effect of the lifting of gas and speed restrictions. While volume of traffic showed a marked increase, replacement parts were still hard to find, and cars were, in general, in a rundown condition. Trucks, still running on wartime schedules, continued at wartime speeds, the average being 39.4 m.p.h., slightly under the average of the preceding period. On the other hand, passenger car speeds increased approximately 2 m.p.h., the average being 45.5 m.p.h. for all cars checked, 44.3 m.p.h. for local traffic, and 47.3 m.p.h. for through traffic. These figures are lower than the pre-war speeds by approximately 4 m.p.h. for cars and 2 m.p.h. for trucks. The average driver had not become accustomed to his post-war freedom. He unconsciously fell back to his wartime habits. His equipment was not yet safe for high-speed travel.

The war has been over for a year and a half. New cars are slowly replacing the old, and new tires and parts are available. The average driver has forgotten the many restrictions that held him in check. These effects are brought out in the speed pattern developed from data obtained within the past year. Figure 1 gives a graphic comparison of the periods mentioned previously and results of recent studies. Average speed for cars traveling on the open highway has advanced to 51.2 m.p.h., an increase of 1.6 m.p.h. over pre-war speeds, and 5.7 m.p.h. above immediate peacetime results. Truck speeds have increased in a comparable manner, the average of 44.3 m.p.h. exceeding pre-war travel by 3.1 m.p.h., and early post-war averages by 4.9 m.p.h. As previously noted, through traffic speeds exceed local rate.

A summary of the data collected during the past year is outlined below. The numbers in parentheses are the number of observations in each case.

<table>
<thead>
<tr>
<th>Route No.</th>
<th>Weather</th>
<th>Date</th>
<th>Indiana Cars</th>
<th>Foreign Cars</th>
<th>All Cars</th>
<th>Maximum</th>
<th>Trucks</th>
</tr>
</thead>
<tbody>
<tr>
<td>U.S. No. 52</td>
<td>Clear</td>
<td>Feb. 1, 1946</td>
<td>51.7 (72)</td>
<td>57.5 (50)</td>
<td>54.0 (122)</td>
<td>76</td>
<td>44.9 (26)</td>
</tr>
<tr>
<td>U.S. No. 52</td>
<td>Clear</td>
<td>Feb. 8, 1946</td>
<td>52.0 (191)</td>
<td>56.4 (89)</td>
<td>53.4 (280)</td>
<td>84</td>
<td>45.2 (63)</td>
</tr>
<tr>
<td>U.S. No. 41</td>
<td>Cloudy</td>
<td>May 16, 1946</td>
<td>46.9 (93)</td>
<td>52.6 (66)</td>
<td>49.1 (159)</td>
<td>76</td>
<td>40.6 (40)</td>
</tr>
<tr>
<td>U.S. No. 52</td>
<td>Clear</td>
<td>May 20, 1946</td>
<td>47.0 (140)</td>
<td>52.3 (125)</td>
<td>49.5 (265)</td>
<td>76</td>
<td>41.6 (76)</td>
</tr>
<tr>
<td>U.S. No. 52</td>
<td>Clear</td>
<td>May 30, 1946</td>
<td>51.1 (113)</td>
<td>60.3 (165)</td>
<td>56.8 (278)</td>
<td>86</td>
<td>..........</td>
</tr>
<tr>
<td>U.S. No. 30</td>
<td>Clear</td>
<td>July 9, 1946</td>
<td>43.6 (59)</td>
<td>46.1 (177)</td>
<td>45.5 (236)</td>
<td>61</td>
<td>41.2 (42)</td>
</tr>
<tr>
<td>U.S. No. 52</td>
<td>Clear</td>
<td>July 10, 1946</td>
<td>46.9 (38)</td>
<td>48.9 (44)</td>
<td>48.0 (82)</td>
<td>70</td>
<td>40.8 (33)</td>
</tr>
<tr>
<td>U.S. No. 52</td>
<td>Cloudy</td>
<td>Jan. 10, 1947</td>
<td>..........</td>
<td>..........</td>
<td>60.2 (304)</td>
<td>91</td>
<td>49.7 (94)</td>
</tr>
</tbody>
</table>

These data can be presumed to be representative of the state, and in themselves show a trend for the checking period, and how this trend fits
into the over-all picture—the gradual increasing of speeds through the last few years, with the exception of the enforced slowdown during the war. The trend for the period is noted in the increased speeds recorded on U. S. No. 52—53 to 54 m.p.h. a year ago, 56.8 in the middle of the year, and 60.2 m.p.h. from the latest count. It is interesting to note that
this trend is due more to through traffic than to local traffic, the latter's speed remaining fairly constant while the speed of out-of-state vehicles increases. The list of maximum speeds is significant only in that it gives some indication as to just how fast people do drive on the open highway. The speeds on U. S. No. 41, an 18-foot concrete pavement widened to 22 feet 6 inches, were taken three miles south of Boswell. Both lanes were recorded. The trap on U. S. No. 52 was set approximately four miles south of Lafayette. At this location the pavement is dual. On U. S. No. 30, a dual highway, the speeds were recorded at a location one-half mile west of the intersection of U. S. No. 30 and S. R. No. 55. All records except those taken on January 10, 1947, are daylight speeds.

The last recordings include both day and night observations.

Some interesting information may be obtained in a breakdown of these last records as to speed compared with time of observation as shown below. The numbers in parentheses are total observations. These figures indicate a tendency for drivers to travel faster during evening hours, and no tendency to slow up during the period between sunset and darkness. The maximum speed was recorded at the time when the first drivers were turning on their lights (4:55 P.M.). This breakdown might give a possible clue to the cause of many of the accidents that occur during this period—fast driving combined with the mental and physical fatigue that comes with the end of a day's work, combined with poor visibility.

Figure 2 is a plot of the data obtained in the past year on a percentile basis. This chart shows that 20% of the cars were traveling at speeds exceeding 60 m.p.h. and 12% were exceeding 65 m.p.h. Both of these figures are significantly higher than those recorded in the pre-war periods. A very noticeable rise in truck speeds is shown. Twenty-three percent of truck travel was recorded at speeds greater than 50 m.p.h., and 10% were driving faster than 55 m.p.h. Figure 3 is a chart to show the percentage of cars checked that were traveling in each increment of 5 m.p.h. from 20 to 95 m.p.h. This graph, combined with the curve in Figure 2, gives ample reason for the increase in average speed noted during the past year. More than 53% of the cars checked were traveling between 45 and 60 m.p.h.

Because of the higher speeds noted during the recording period on January 10, 1947, it was deemed advisable to check the accuracy of the
photo-velaxometer as a recording mechanism for spot-speed studies. Therefore, several tests were run in conjunction with the study. These tests consisted of driving a car at a known speed through the trap.

A calibration of the clock was made. The photo-velaxometer was set up and the clock motor started. The clock was then timed against a stop watch, reading to 0.1 second, in increments of from 2 seconds to 3 minutes. The clock was noted to run slow by the amounts listed in the table below. These figures were obtained by using three different batteries to include any effect that change in current might produce in the speed of the clock motor. The data are plotted in Figure 4. The slope of the line produced follows the general equation \( y = mx + b \), where “\( y \)” equals the error in clock reading in seconds, “\( x \)” equals the stop watch or actual time, “\( m \)” is the slope of the line, and “\( b \)” is the y-intercept or constant. The value of “\( m \)” is obtained from the expression

\[
m = \frac{\Sigma N xy - \Sigma x \Sigma y}{N \Sigma x^2 - (\Sigma x)^2},
\]

where \( N \) equals the number of reading, and the value of “\( b \)” from the expression \( b = \frac{\Sigma y}{N} - \frac{N \Sigma x}{N} \). The solution of these equations gives the equation for the line as follows: \( y = 0.011 x + 0.0048 \). The “\( b \)” term or constant in this expression indicates that there is no appreciable error in starting or stopping the clock, that is, in the action of the relays. The slope of the line, the “\( m \)” term, indicates that time intervals computed from the clock readings are subject to a constant correction of 1%, and, as the constant is negligible, this is the only correction to which the speeds computed would be subject.

A speedometer calibration was also made. A car was driven over a one- and two-mile course at speeds of 50 to 60 m.p.h. Actual speed
was computed from the time required to cover the course as measured with a stop watch. These speeds were found to be 48.7 and 58.0 m.p.h. respectively with maximum variations of 0.2 and 0.6 m.p.h.—0.4 and 1% respectively. As it was noted that 50 m.p.h. was the easier speed to maintain constantly, several runs were made at this speed across the speed trap. The results of these test runs are listed below.

<table>
<thead>
<tr>
<th>Speedometer Reading (m.p.h.)</th>
<th>Computed Speed (m.p.h.)</th>
<th>Time Recorded (Seconds)</th>
<th>Photo-velaxometer Speed (m.p.h.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td>48.7</td>
<td>1.40</td>
<td>48.7</td>
</tr>
<tr>
<td>50</td>
<td>48.7</td>
<td>1.39</td>
<td>49.1</td>
</tr>
<tr>
<td>50.5</td>
<td>49.2</td>
<td>1.38</td>
<td>49.9</td>
</tr>
<tr>
<td>50</td>
<td>48.7</td>
<td>1.39</td>
<td>49.1</td>
</tr>
</tbody>
</table>

Several runs were also made at 60 m.p.h. with the following results:

<table>
<thead>
<tr>
<th>Speedometer Reading (m.p.h.)</th>
<th>Computed Speed (m.p.h.)</th>
<th>Time Recorded (Seconds)</th>
<th>Photo-velaxometer Speed (m.p.h.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>60</td>
<td>58.0</td>
<td>1.16</td>
<td>58.8</td>
</tr>
<tr>
<td>60</td>
<td>58.0</td>
<td>1.15</td>
<td>59.3</td>
</tr>
<tr>
<td>60</td>
<td>58.0</td>
<td>1.16</td>
<td>58.8</td>
</tr>
</tbody>
</table>

From these tests it may be concluded that errors in individual speed readings are almost negligible, and that the average as computed from a group of such readings varies from the actual average by the constant error of the clock. This discrepancy is not considered to be large enough at this time to necessitate applying any correction to the data obtained,

![Figure 4](image)

Calibration of photovelaxometer.
or to require any adjustment to the clock. Should this discrepancy become larger in the future, the clock will be adjusted to correct for this error.

An intangible benefit derived from these tests is the extra confidence that the close correlation shown gave the operators regarding the ability to record speeds to this accuracy with the machine. These tests also prove that it is possible to check the operation of the machine in the field at any given set up. A driver can hold his car at a constant speed within an accuracy of 1%. If the calibration of the speedometer of the car is known, the speed recorded by the photo-velaxometer can be checked against the actual speed within the limits of the accuracy of the machine.

Several conclusions can be drawn from a study of the speed data obtained in the past five years. The over-all trend in speeds is upward. The average driver reduced his normal speed during the war period because of scarcity of replacement equipment for his vehicle, and the necessity of conserving the equipment he had to keep his car in usable condition as long as possible, as well as from governmental action regarding speed limits. As it became easier for the essential driver, whose goings and comings made up the majority of the traffic tested during the later war years, to obtain replacements, and as these replacements are made available to all motorists now that the war is over, the speeds have shown a strong tendency to increase. This is proved in Figure 1. The averages recorded hit a low during the first major curtailment, but then as the war continued, there was a small, but noticeable, rise in the curve up to and including the two-months period immediately following the war. During the past year this curve has, of course, taken on a sharp upward slope. On a matter such as speed, any predictions of future trends are a matter of conjecture on the part of the individual. However, it is the belief of the author that average speeds will continue to increase, but at a slower rate, until the supply of new cars, parts, and tires meets the present demand. At this time the majority of drivers will be equipped to drive at the speed they consider as reasonable, and averages recorded will tend to level off. This assumption, of course, depends on the present speed regulations remaining in force. Fluctuations from the general average will naturally be noticeable, but these can be traced, in general, to the time of day, day of the week, weather, and type and condition of the pavement where and when the observations are made.