Traffic Assignment

COMPARATIVE TRAFFIC USAGE OF KANAWHA BOULEVARD AND ALTERNATE CITY ARTERIALS AT CHARLESTON, WEST VIRGINIA

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DURING the operation of an origin-and-destination survey of Charleston, West Virginia, in the fall of 1950, it was decided to extend the field work to provide material for analysis to determine the driver preference between competing routes of travel. Two separate supplemental surveys were made, providing data for two individual analyses.

The main part of Charleston lies along a relatively narrow, flat section of land between the Kanawha River on the south and hills on the north. This is responsible for a street layout of which the principal arterial routes are parallel and run east and west, connected by cross streets at varying intervals. One of these arterials is Kanawha Boulevard extending along the north bank of the river, a multilane, divided highway of superior travel characteristics. There is no restriction of access to the boulevard but access from abutting property is infrequent and only from the north side. There is no access either from side streets or from abutting property from the south side along the bank of the river, except for two individual driveways to parking lots located adjacent to the business section of the city.

The speed limit on the boulevard is 40 mph. Traffic is restricted to passenger cars only. There are 5 traffic control signals in a length of 4.8 mi. On the other arterials paralleling the boulevard the speed limit is 25 mph. Parts of several of the streets are limited to one-way traffic, signalized at approximately 25 mph., and there are frequent signals. There is no limitation of access.

The first supplemental survey to gather data for research was made by house-to-house interviews at a selected number of addresses in a selected area containing several zones of the original survey and comprising a belt extending across that section of the city between the river and the hills. Interviewers obtained data on origins and destinations and routes of travel for three types of trips: (1) trips from home to work, occurring during the morning peak of travel between the hours of 7 a.m. and 9 a.m.; (2) trips from work to home, occurring during the afternoon peak of travel between the hours of 4 p.m. and 6 p.m.; and (3) trips for any purpose occurring between the hours of 7 p.m. and 9 p.m.

Travel-time studies were made by the floating-car method during each of these three periods to establish the average time of travel between check points located at each intersection on the boulevard, on all the parallel arterials, and on each of the cross streets.

Measurements of distance between intersections were also obtained for each route and cross street.

The second supplemental survey to obtain data for investigation consisted of the operation of a station located on the boulevard, on the screen line for the comprehensive traffic survey, to obtain origins and destinations of all trips using that facility to compare with the total transfer across the screen line as determined by the larger survey. Thus, by a process of elimination, an indication of the relative choices of routes by the trips of the different zone to zone transfers could be obtained. Extra time-delay studies were also necessary to this analysis. This study is not completed at this time and no results are available.

The relationships, presented in this study, were determined by comparisons of time and distance components between the points of choice of the trips for which information was obtained. Point of choice is the point where the driver must decide which route he will use in making his trip. For example, A and E are the points of choice for the trips shown in Figure 1. Trip components from origin (O) to point of choice (A) and from point of choice (E) to destination (D) were not used in determining any of the relationships. Since these components were the same for both the trip via the boulevard and the trip via a city arterial, it was reasoned that they would have little or no influence on the choice of route.

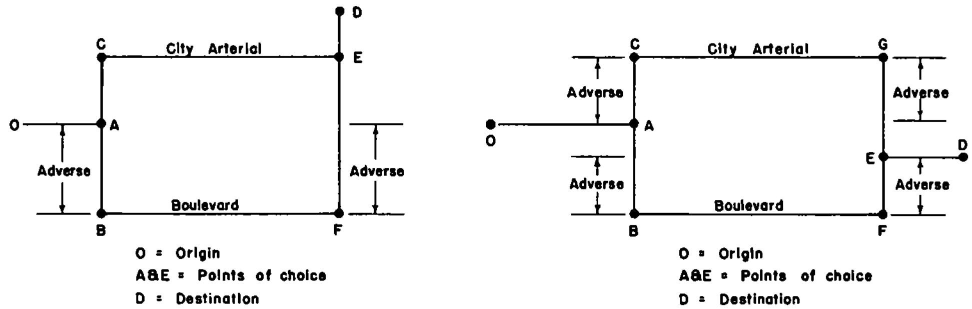

Figure 1. Sketches showing points of choice and adverse travel.

Figure 2 shows the percentage of trips using the boulevard for various ratios of time via the boulevard to time via city arterials. This figure clearly shows that as the ratio of travel time increases the percent of trips via the boulevard decreased. The relationship between the variables is not linear but curvilinear.

When the travel time via the boulevard was one-half the travel time via city arterials, over 90 percent of the trips were made via the boulevard. Conversely, when travel time via the boulevard was one and one half times the travel time on city arterials, the use of the boulevard dropped

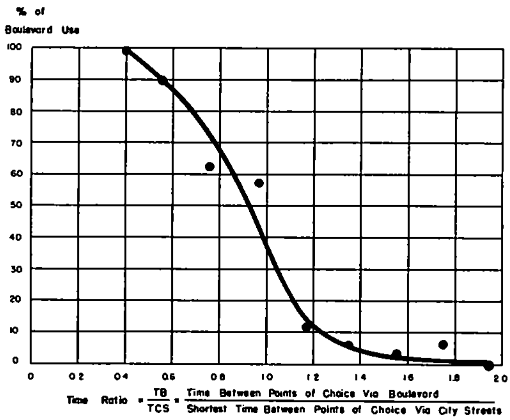

Figure 2. Percent of Kanawha Boulevard use based on time ratio.

to less than 5 percent. Between 35 and 40 percent of the trips were made on the boulevard when travel times were equal. The average overall speeds on the boulevard were 1.8 times as fast as speeds on the other arterials; therefore, when travel times were equal the trip by the boulevard was greater in distance. Thus 35 to 40 percent of the drivers chose the boulevard when they did not save time and definitely traveled further. This indicates an attractiveness of a superior facility beyond a saving of time and distance. More than 10 percent of the drivers used the boulevard even though the travel time was 0.2 longer and the distance one and one half times or more than the distance via an alternate city arterial. These drivers actually lost time and distance perhaps in an effort to gain freedom of movement, to relieve tension or for other intangible reasons. On the other hand more than 20 percent of the drivers chose a city arterial when it was possible to save 0.3 of the travel time by way of the boulevard. However, in most of these cases the distances traveled were very nearly equal for each route and the potential time saving was only a minute or two. Thus some drivers chose the boulevard although they lost time and distance and some chose other city arterials with a consequent loss of time. It would seem that some drivers place no precise value on time or distance savings, particularly if the potential savings are small.

Figure 3 shows the percent of trips via Kanawha Boulevard for various times savings in minutes. This curve indicates that as the amount of time saved by the boulevard increased the use of the boulevard increased. When there was a negative saving, i.e., a loss of a minute or more, less than 5 percent of the trips were made on the boulevard. This may be accounted for by the fact that a loss in distance accompanies a loss in time for a trip via the boulevard. When the time saved was 0 min., 30 percent of the trips were made by the boulevard. These trips, too, have a loss of distance. When the saving is 3 min. or more the use of the boulevard jumps to more than 90 percent. For most of these trips the distance is equal or less than via the boulevard.

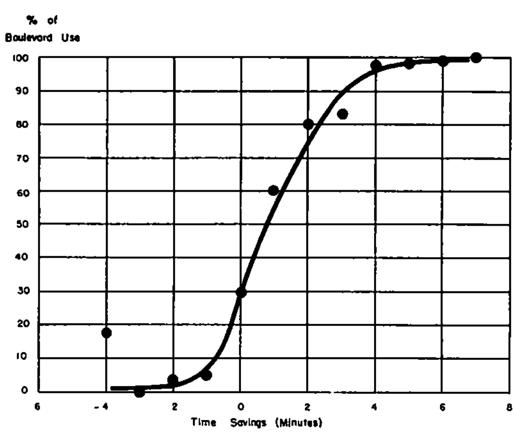

Figure 3. Percent of boulevard use based on time savings in minutes.

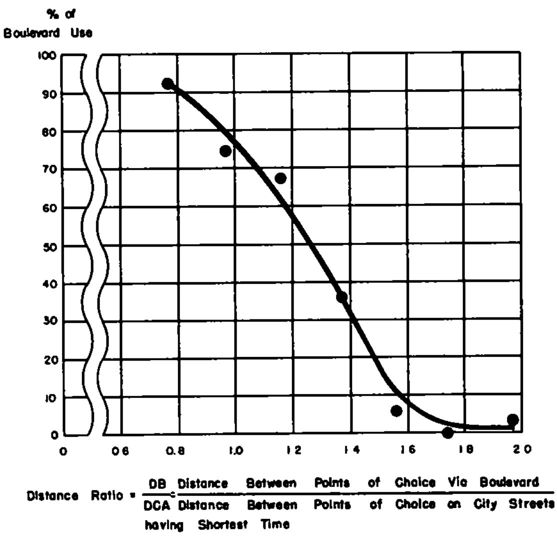

Figure 4. Percent of boulevard use based on distance ratio.

Figure 4 shows the percent of Kanawha Boulevard use based on distance ratios. The curve indicates that the percent of drivers using the boulevard decreased as the ratio of distance via the boulevard to distance via city arterials increased. Little more than 10 percent of the drivers chose Kanawha Boulevard when distances were 1.5 times that of an alternate city street. However, most of these trips had a loss in time, thus making the boulevard less attractive. When distance was the same by either route more than 75 percent of the trips were via the boulevard.

Figure 5 shows the effect of peak and off peak periods on the percent of drivers using the boulevard. This figure is based on time ratios. The curves indicate a greater use of the boulevard during the afternoon peak hours, 4 to 6 p.m., than during the other two periods. The least use occurred in the evening between 7 and 9 p.m. Evidently drivers sought the quickest route home during the 4 to 6 p.m., rush hours. Several factors might influence these curves. There is more congestion between 4 and 6 p.m. than between the hours of 7 and 9 a.m. This is probably due to working hours. People have different hours to report for work, however the majority quit at 5:00 p.m. Also, the one-way-street pattern presents fewer alternate city streets for the westbound traffic, which was the 4 to 6 p.m. traffic in this study. This should cause a greater use of the boulevard during the hours 4 to 6 p.m.

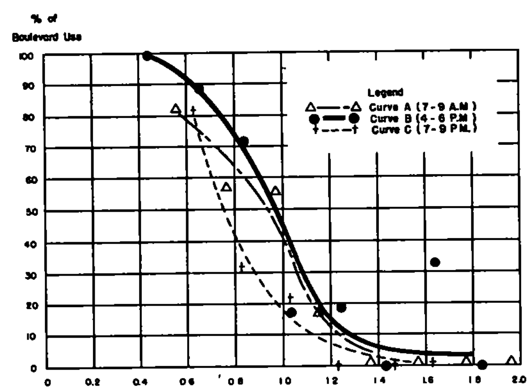

Figure 5. Effect of peak and off-peak periods on boulevard use based on time ratio.

Curves A and C are best for comparison, since they represent trips in the same direction (one during peak hours the other in an off-peak period). These curves indicate that a greater percent of drivers used the boulevard in an effort to gain time, or avoid congestion, or for some other reason during the peak hours than during the off-peak hours. This seems logical, since most people are seeking recreation or pleasure in the evening while they must report to work at a certain time in the morning.

Figure 6 shows the effect of peak and off-peak hours on the use of the boulevard based on distance ratios. These curves also indicate the greatest percent of use in the afternoon (4 to 6 p.m.) and the least use in the evening (7 to 9 p.m.). Here again, comparing peak and off-peak trips in the same direction, a distance saving appeared more valuable during the morning peak (7 to 9 a.m.) than during the evening off-peak hours (7 to 9 p.m.).

Figure 7 shows the effect of trip length on the use of the boulevard, based on time ratios. "Trip length" refers to distance parallel to the boulevard and arterials and does not include any cross-street distances.

From the figure it is evident that more people use the boulevard for trips longer than 2 mi. than for trips of 0.2 mi. Comparing the two curves, when the time ratio is 0.8, 45 percent of the trips with less than 2 mi. of boulevard travel used the boulevard, while approximately 85 percent of the trips over 2 mi. in length used the boulevard. The reason for this is obvious: The longer the trip the greater the time saving via the boulevard. Only one trip over 2 mi. long had a loss of time via the boulevard. Since this was the only trip with a time loss via the boulevard the lower portion of the curve was sketched in.

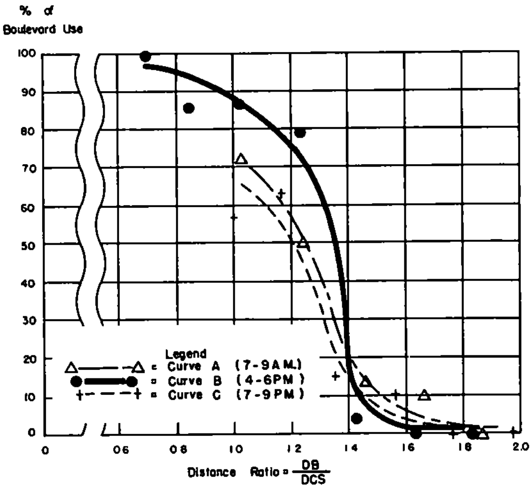

Figure 6. Effect of peak and off-peak periods on boulevard use based on distance ratio.

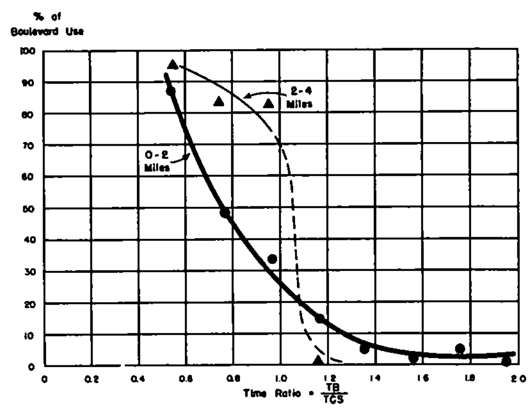

Figure 7. Effect of length of travel parallel to Kanawha Boulevard on boulevard use based on time ratio.

Figure 8 shows the effect of length of travel on the boulevard based on time saved in minutes. Here again the longer the trip the greater the percent of trips via the boulevard. More information is needed on the effect of length of travel on superior facility use, especially where the long trips have nearly the same time by either facility.

Figure 9 shows the effect of excess distance to the boulevard on the use of the boulevard. "Excess distance to the boulevard" is the distance from the points of choice to the boulevard in excess of the distance from the points of choice to an arterial.

This figure indicates that as the excess distance to the boulevard increased in relation to the distance traveled on the boulevard the percentage of use of the boulevard decreased. When there was no excess distance to

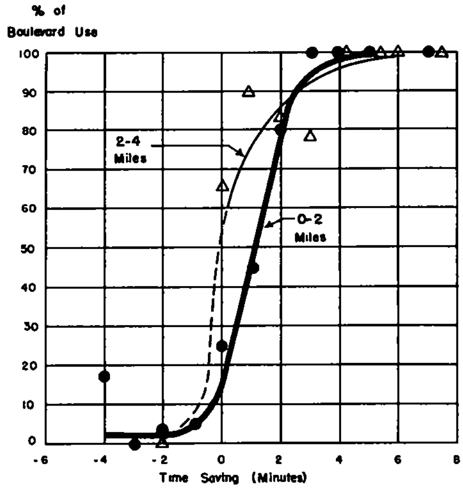

Figure 8. Effect of length of travel parallel to Kanawha Boulevard on boulevard use based on time saving.

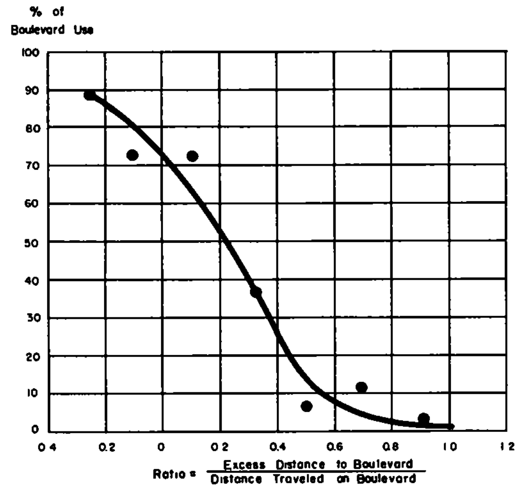

Figure 9. Percent of boulevard use for ratios of excess distance to the boulevard to distance traveled on the boulevard,

the boulevard, about 72 percent used the boulevard. However, when the excess distance to the boulevard was 0.9 of the distance traveled on the boulevard, not one trip was made via the boulevard. Thus, few people, if any, will travel an excess distance equal to the distance traveled on a superior facility in order to use it.

Conclusions

As a result of the foregoing study the following conclusions have been made:

1. As travel time via a superior facility increased in relation to travel time via other city arterials the use of the superior facility decreased.

2. Not everybody will use a superior facility in order to save a minute or two.

3. As the ratio of distance traveled via a superior facility to distance via city streets increases, the percentage use of the superior facility decreases.

4. The use of a superior facility differs during peak and off-peak hours. The greatest use occurs during peak hours.

5. There is a significant difference in the percent of use of a superior facility for trips of different lengths. The longer the trip parallel to or on a superior facility the greater the use of the superior facility.

6. When the distances from the point of choice to the superior facility or to a city arterial are equal, about 72 percent of the trips are via the superior facility. However, when the distance from the points of choice to the superior facility minus the distance from the points of choice to the city arterial is equal to the distance traveled on the superior facility few people will use the superior route.

It is evident that more studies of driver preference are needed in order to give engineers a clearer picture of traffic diversion as it actually exists. These studies can then be used as a basis for estimating traffic diversion to new or improved routes.