Congress Street Expressway
Traffic Characteristics

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- EXPRESSWAY FACILITIES reach volumes far beyond design requirements soon after they are built. Their level of service for most hours of the day is exceptionally high, however, during peak hours when the public critically expects a high level of service, volumes build up and intolerable congestion prevails. These periods of congestion bring strong public criticisms against costly expressways. This study was designed to isolate those elements of expressway performance which affect traffic flow.

CONGRESS STREET EXPRESSWAY

This facility is approximately parallel to and five blocks south of the east-west street number base line of Chicago. It is generally a depressed section 16 miles long and utilizes four lanes in each direction between the Main Post Office, the Eastern Terminus, and Austin Avenue (6000 W) a distance of 7.5 miles and three lanes in each direction from Austin to the Tri-State Tollway—a distance of 8.2 miles.

The first section of Congress Street Expressway, 1st Avenue to Mannheim Road was opened to traffic in December 1954 and five subsequent sections. The last one (Central to Desplaines) which was put into operation in October 1960 completed this central portion of the comprehensive expressway system.

There are 18 on-ramps and 24 off-ramps westbound and 24 on-ramps and 19 off-ramps eastbound, a total of 85 ramps included in this study, an average spacing of $\frac{1}{2}$ to $\frac{3}{4}$ miles (see Fig. 1).

The maximum recently observed 24 hr totals were approximately 105,000 in the six-lane section and 165,000 in the eight-lane section.

Further, the maximum observed lane usage was 2,240 vehicles at Kedzie Avenue eastbound inside or curb lane AM peak hour.

Truck traffic in the AM peak eastbound averaged 7.2 percent for all on-ramps, the range extending to 32 percent. Westbound ramp truck traffic averaged 7.1 percent for all on-ramps, ranging up to 18 percent.

The prevailing ramp design is commonly described as diamond type except that in the west section both 25th Avenue and Mannheim Road are a cloverleaf type.

The ramp width is 16 ft and the ramp terminal length is 400 ft long, and where an additional weaving lane is provided it is 600 ft long and 12 ft wide.

The angles of intersection of the ramp centerlines with the freeway lanes is an average of $5^\circ$ ranging between $4^\circ$ and $14\frac{1}{2}^\circ$. Ramp grades vary from 2.25 to 4 percent.

With the exception of the Austin Avenue and Harlem Avenue interchanges the ramp exists and entrances are located on the right-hand side, except for two on the left-hand side.

A significant feature of the Congress Street Expressway is the presence of mass transit facilities in the median. This service was opened in June 1958. This mass transit service includes 14 stops which serve 22 cross-street loading points. In 1959, 35,000 passengers per day were transported, and in 1960, contrary to general trends 40,000 passengers were transported. These are 24-hr volumes. This expressway assuming a 1.5-person per vehicle car occupancy and including mass transit usage produces 350,000 person-trips per day.

SURVEY STRUCTURE

The field portion of this study was held on March 15 and 16, 1961, westbound outbound from the CBD on the 15th, and eastbound towards the CBD on the 16th. This study
was designed around the distribution and collection of pre-punched IBM cards distributed and collected at all 85 on- and off-ramps of the 16-mi expressway.

Card accumulation (normal card color for passenger cars and red for trucks) was in 15-min increments. Westbound and eastbound cards were distributed and collected between 7 AM and 1 PM. Adverse light conditions prevented a PM peak study. In the two 6-hr sections of trip study 95,000 cards were collected. This accumulation of data resulted in 70 separate analysis which will be contained in the final report. To conduct this study 112 men were required on each of the two days.

RAMP VOLUMES

Pouring into the expressway via 18 on-ramps during the first day of the survey Wednesday, March 15, between 7 AM and 1 PM were 44,000 vehicles westbound, 85 percent of which were autos. The actual average hourly volume was 7,300 vehicles per hour with the peak rate (based on the highest 15-min period) of 11,100 vehicles per hour. The lanes east of the post office, the east end of the study section supplied 30 percent of the 6-hr volume and 24 percent of the peak volume.

Entering trucks accounted for 7.1 percent of the westbound AM peak hour. The westbound volume of 44,000 vehicles produced 202,000 vehicle-miles in the 7 AM to 1 PM period.

During the same 6-hr period on the following day, an eastbound volume of 44,000 vehicles produced 202,000 vehicle-miles in the 7 AM to 1 PM period.

During the same 6-hr period on the following day, an eastbound volume of 50,000 vehicles (88 percent automobiles) produced 291,000 vehicle-miles. For this direction of travel, 8,400 vehicles was the average hourly rate with a peak hourly rate again based on the maximum 15-min flow of 11,900 vehicles per hour. Twenty-four entrance ramps produced these flows with the west terminal (Roosevelt Road) contributing 12 percent of the 6-hr total and 14 percent of the peak hour volume. The eastbound truckflow during the AM peak was 7.2 percent of the total peak hour. It was found that the eastbound traffic exceeded that of the westbound during the 6 hours by 12 percent and during the peak hour by 7 percent. A significant fact, however, is that the eastbound vehicle-miles of travel exceeded the westbound by 45 percent.
Expressway volumes were determined by the successive net accumulation of vehicles just downstream of each ramp. It was found that for the eastbound portion of the study about \( \frac{1}{2} \) the total expressway was operating above an assumed capacity of 1,500 vehicles per hour per lane. In spite of this, reasonable average speeds were experienced.

**RAMP USAGE CHARACTERISTICS**

**AM Peak Hour, Westbound**

Reading from right to left the direction of travel, Figure 2 shows entrance and exit ramp volumes. A relatively small percentage of the total trips are destined to the western terminus of the expressway (Roosevelt Road). The bulk of the trips leave this facility (Congress Street) within the limits of Chicago (Austin Avenue).

**AM Peak Hour, Eastbound**

By far the greatest bulk of trips during the Eastbound AM peak entered the expressway in the west portion (from Roosevelt to Mannheim Road). The preponderance of exiting traffic eastbound AM peak occurred between Racine Avenue and the post office. This can be seen by the bars at the extreme right-hand side in Figure 3.

![Figure 2. Ramp usage characteristics, westbound, AM peak hour.](image1)

![Figure 3. Ramp usage characteristics, eastbound, AM peak hour.](image2)
EXPRESSWAY VOLUMES

Normally highway volumes are stated as 24-hr two-way totals crossing a line. Traffic movements before or after such a counting line are obviously not included. In this study all ramp volumes were totaled. Based on this approach, the "expressway usage" volume would be 240,000 vehicles in 24 hr for Congress Street Expressway.

This "expressway usage" total reflects all on and off movements occurring over the entire expressway rather than across one line.

Figure 4 shows the eastbound volumes (in black) in large part exceed 1,500 vehicles per hour per lane. The density chart (Fig. 10) shows that this high volume alone, does not necessarily create congestion. Many of the high-volume sections were found to be operating at reasonably high speeds.

TRIP LENGTHS

Figure 5 shows the time required to make trips of various lengths at speeds of 25, 45, and 60 mph which correspond to arterial highway speeds, expressway speeds at peak hour, and expressway speeds at noon peak hours where posted speeds can be realized. The impact from this figure does not come from the relative time differentials (which are constant) but from the absolute time differentials; that is, a two-mile trip at 60 mph which requires 2 min, requires only slightly over 4 min at 25 mph.

On the other hand, a saving of 18 min can be realized on a trip of 16 mi (the length of this expressway) using the same speed values for the trip of 25 and 60 mph—25 mph being the criterion on arterial systems and 60 mph on expressways at non-peak hours. It is evident from this that the real value of a costly highway facility is to provide for maximum trip lengths of 10 miles or greater.

![Figure 4. Vehicular accumulation, AM peak hour.](image-url)
Figure 5. Expressway and arterial travel times related to trip length.

Figure 6. Westbound AM peak volumes and trip lengths, by entrance ramps.
Westbound Volumes and Trip Lengths

Figure 6 shows the volumes and trip lengths originating from each of the westbound on-ramps during the Wednesday AM peak hour. A sizeable portion of the total trips is less than 2 miles. These trips are easily discernible as they are shown in black. In general it is desirable to discourage these short trips from using the expressway.

The trips portrayed by the white portion of the bar graphs are from 2 to 5 miles in length and make up the greatest bulk of the westbound trips.

Eastbound Volumes and Trip Lengths

Figure 7 shows a marked difference in the number of short trips (0 to 2 miles) particularly at the west terminus. Of the trips entering at the west terminus almost \( \frac{1}{2} \) traveled 10 miles or more on the expressway. This type of trip length is most desirable.

These expressways like any other express service are intended to serve relatively long trips. It is, therefore, quite apparent that the elimination of short trips would be conducive towards increasing the efficiency and vehicle-mile productivity of an expressway facility.
Vehicle-Miles

Figure 8 shows that a substantial portion of the expressway vehicle-miles can be accounted for by relatively short trips. For example, about 15 percent of the westbound vehicle-miles are produced by trips of 3 miles or less. From this it follows that a change in design for a new facility or a ramp control on an existing facility will result in an increased average trip length and consequently the lessening of congestion.

Trip Lengths vs Exit Opportunities

Up to this point in the report, trip lengths have been considered in terms of absolute length. However, ramp spacings are of primary significance. Figure 9 shows that...
about 10 percent of the drivers left the expressway at their first or second opportunity to do so and 50 percent had left by the time the seventh opportunity presented itself. From this it is further emphasized that greater ramp spacings will tend to produce more nearly expressway-like trips, thereby reducing undesirable turbulence.

DENSITIES

Figure 10 shows the relationship between speed (dotted line) and density (solid line). When the density in vehicles per mile per lane exceeds the speed in miles per hour, congestion tends to develop. This cross-over occurs at a speed of 40 mph per lane.

There were only two sections on the expressway where this condition was found to exist. The more pronounced of the two was in the area of the two "center" interchanges. It was felt that these center ramps might very well be contributory to the congestion which was found. A further study of these ramps is indicated.

Figure 10. Density and speed characteristics, eastbound, AM peak hour.

SUMMARY

Expressways, most of which are operating at or above design capacity, are being choked up by sizeable numbers of short trips. This congestion is reflected in both the additional trips on the expressway as well as the added turbulence of the many interchanges. It does not appear sound economically to design for trips under 2 miles. Although a study such as this can point to better ramp spacings for future design, some sort of ramp control is needed to improve operating conditions on existing facilities.

The Cook County Highway Department is developing a simulation program to test various ramp controls. This program is based on the data gathered in this study. Testing various other hypotheses, such as the effect of eliminating all trucks from the expressway during the peak hours, will also be possible. Such a simulation technique is clearly desirable to augment the benefits from any proposed controls.
Ultimately, the economics of building and maintaining an expressway, and the economic gain realized by the users are the prime considerations. The economic gains are increased when the vehicle-miles of travel on the facility are at a maximum. The author is confident from the experience in this study that ramp spacings must be increased if this maximum is to be reached. The goal as designers and operators should be the highest productivity possible. When the output reaches the maximum level of vehicle-miles per hour, then that goal is reached.