Improving Traffic Flow at Transfer Roadways On Collector-Distributor Type Expressways

JOSEPH M. MC DERMOTT and CHARLES H. MC LEAN
Respectively, Graduate Student, Northwestern University, and
District Traffic Engineer, Illinois Division of Highways

•THE Dan Ryan Expressway on Chicago's south side features a 5-mi section of four depressed traveled ways, two in each direction, with a total cross-section of either 12 or 14 traffic lanes. The two inner roadways function as express routes for through traffic; the two outer roadways serve as continuous collector-distributor roads for more localized traffic. Crossover connections from express lanes to local lanes, or vice versa, are provided by 2-lane transfer roadways at three locations for each direction of travel.

Inasmuch as the design feature of continous collector-distributor roadways is a relatively recent development, an analysis of traffic operations at transfer roadways seemed appropriate. An initial operational study at two transfer roadway locations (1) recommended several control measures for improving the efficiency of traffic flow at transfer roadways. This presentation concerns the study of operational characteristics at an express-to-local transfer roadway and compares "before" and "after" pavement markings.

Definitions

Certain terms used throughout this paper are defined as follows:

Transfer roadway—a high-type crossover connection between express lanes and collector-distributor lanes, or vice versa.
Express vehicles—vehicles traveling on the express roadway.
Transfer vehicles—vehicles using a transfer roadway.
Local vehicles—vehicles traveling on the collector-distributor roadway.
63rd St. vehicles—vehicles traveling on the expressway destined for 63rd St.
Through vehicles—vehicles destined for points beyond the Chicago Skyway exit.
Local lanes—collector-distributor lanes.

EXPRESSWAY CHARACTERISTICS

Route Description

The Dan Ryan Expressway links the Eisenhower Expressway (I-90) and the Kennedy Expressway (I-94) with the Chicago Skyway (I-94) and the Calumet Expressway (I-90) (Fig. 1). The north terminal of the Dan Ryan Expressway is the Halsted Street interchange, the junction of Dan Ryan, Kennedy and Eisenhower Expressways, located about 1 mi west of the Chicago downtown area. This interchange accommodates an average daily traffic of approximately 300,000 vehicles. The Dan Ryan Expressway carries I-90 between this interchange and the Calumet Expressway, 11.5 mi south, and is designated both I-90 and I-94 between this interchange and the Chicago Skyway, 8.0 mi south. The latter section was opened to traffic on December 15, 1962, and includes 5 mi of continuous collector-distributor roadways at the southern end.

As shown in Figure 2, the continuous collector-distributor (C-D) roadways are used between 27th St. and 65th St. Although through traffic may use either the express roadways or the C-D roadways, weaving is minimized and flow is expedited for vehicles on the express roadways. At the north end of this section local (C-D) and express road-

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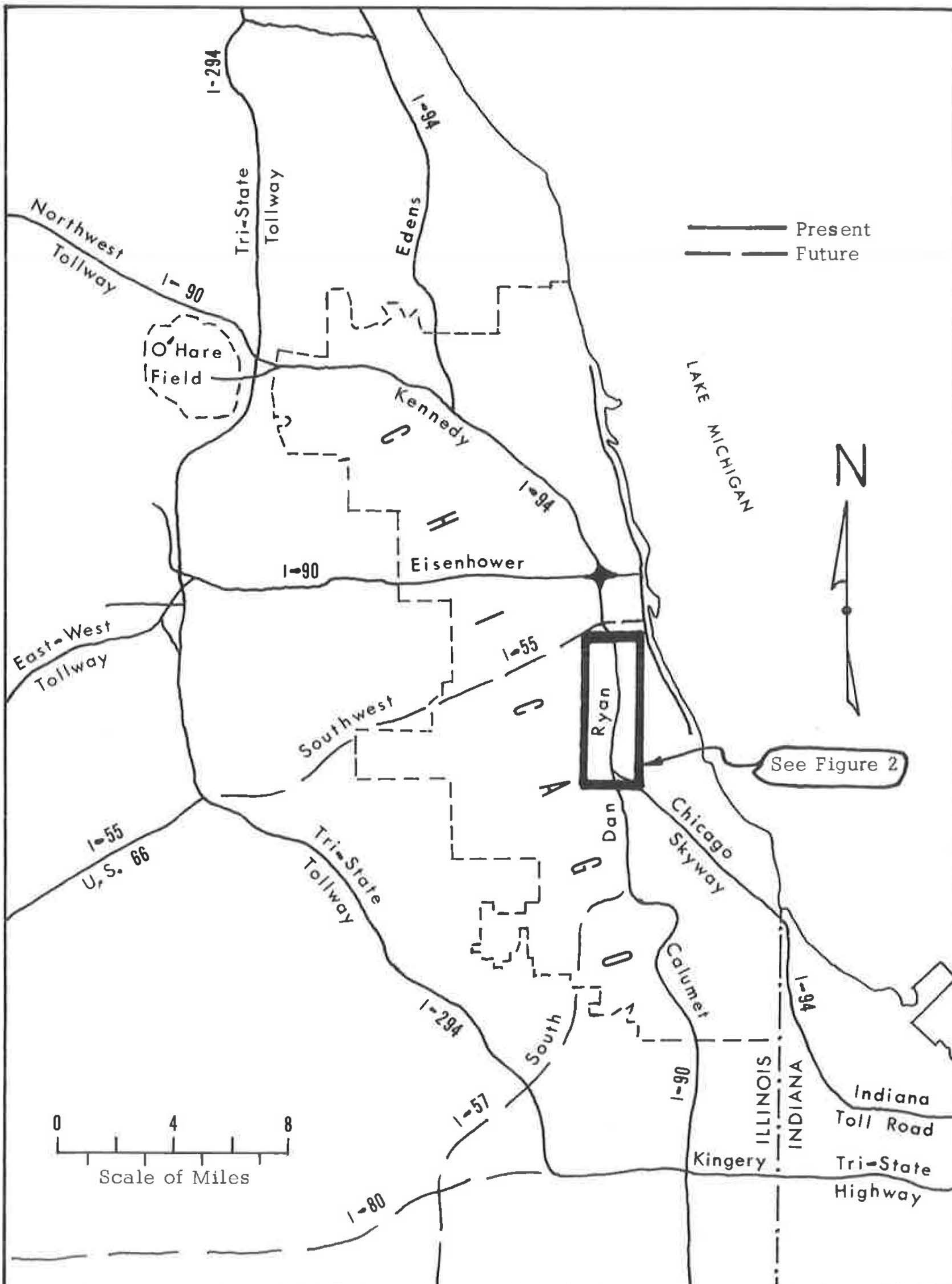


Figure 1. Chicago area expressways.

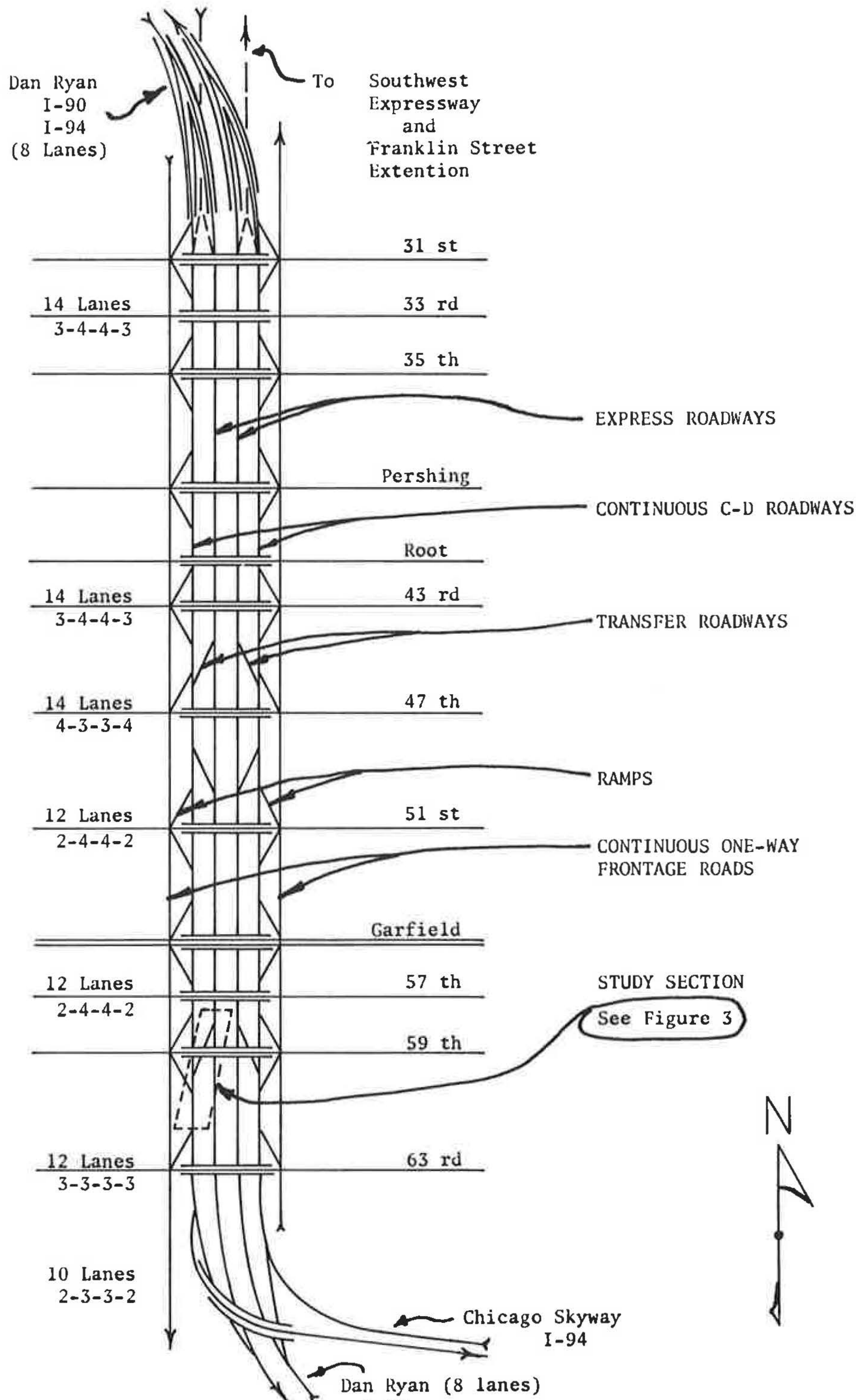


Figure 2. Continuous collector-distributor section, Dan Ryan Expressway.

ways combine on an 8-lane elevated structure. Connection to the future Southwest Expressway and the Franklin Street Extension is provided near 31st St. At the south end of the 5-mi route connection to the Chicago Skyway is provided near 65th St., beyond which local and express lanes combine to form an 8-lane cross-section with only one traveled way for each direction. Thus, the 5-mi continuous C-D roadway section has either 14 or 12 through traffic lanes and connects 8-lane sections at each end.

Route Geometrics

High-type design standards were applied throughout the construction of the four depressed roadways of the Dan Ryan Expressway. Continuous one-way frontage roads feed and collect ramp traffic to and from the continuous C-D roadways at diamond interchanges spaced approximately at 0.5-mi intervals. Continuity prevails along the route because all ramps adjoin the right-hand side of the C-D roadways. A common acceleration-deceleration lane is used where adjacent ramps handle entering and exiting C-D traffic. The only diverging and merging movements on the expressway not requiring right-hand operations occur at the six transfer roadways, which either leave or enter the local roadway on the left side.

Transfer roadways are located for both directions of travel near 45th St., 49th St. and 59th St. All six sites differ either in lane configuration or type of transfer. Figure 2 shows that the cross-section lane configuration changes at each transfer point, inasmuch as one traffic lane is physically "transferred" between roadways. The second lane of a transfer roadway permits optional use of an additional express or local lane at each terminal. An exception occurs at 49th St., however, where the normal cross-section changes from 14 lanes on the north to 12 lanes on the south via the transfer roadways.

All traffic lanes are 12 ft wide and are constructed of continuously reinforced concrete pavement. Contrasting shoulders of bituminous material, generally 8 to 10 ft wide, are furnished on both sides of each roadway. A combination gutter and mountable curb separates shoulders from through pavements. Because most of the route has been designated to accommodate a future mass transit median facility, an unusually wide center median, protected by guardrail along both edges, separates directional flow along the route. Express and local roadways are separated by a 20-ft shoulder-median bisected by continuous, double-faced, steel, barrier-type guardrail. Throughout the whole expressway, mercury vapor luminaires are provided and directional signs are externally illuminated.

Operational Controls

Soon after the Dan Ryan Expressway was opened to traffic, operational problems resulted in the imposition of commercial vehicle lane-use restrictions. Trucks are confined to the collector-distributor roadways, where speed limits are 45 mph for cars and buses and 40 mph for trucks. Passenger vehicles on the express roadways are limited to 50 mph, with a posted minimum of 40 mph.

STUDY PROCEDURE

Although the initial operational study (1) was conducted for both transfer roadways at 59th St., pavement marking improvements were fully installed only at the southbound site. This presentation, therefore, contains "before" and "after" findings for the southbound express-to-local transfer roadway at 59th St.

Study Section Details

Figure 3 shows the study area, located approximately 7 mi south of downtown Chicago and 1 mi north of the Chicago Skyway connection. The total cross-section at this site is 12 through traffic lanes and the average daily traffic flow is approximately 180,000 vehicles. This transfer roadway "transfers" one lane of pavement from the express roadway to the local roadway. Thus, the express roadway is reduced from 4 lanes to 3 lanes and the local roadway is increased from 2 lanes to 3 lanes. Vehicles approach-

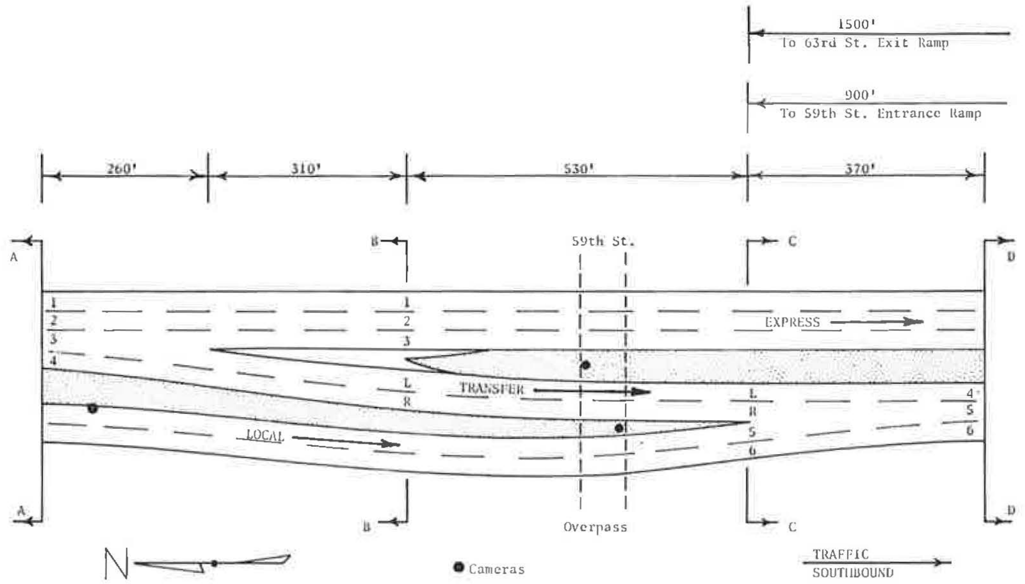


Figure 3. Study section, southbound express-to-local transfer roadway at 59th St.

ing in the right express lane, therefore, are required to transfer; vehicles approaching in the adjacent express lane (second from the right) may either transfer or remain on the express roadway.

The 1,470-ft study section begins at a normal 48-ft express pavement width and ends at a normal 36-ft local cross-section. Observation was confined within these extremes for transfer vehicles (Secs. A-A and D-D); express and local traffic were studied in the diverging (Secs. A-A and B-B) and merging (Secs. C-C and D-D) areas terminating at

Figure 4. Diverging Terminal of study section with "after" pavement markings.

the nose and commencing at the merging end, respectively. Data were obtained from time-lapse films taken simultaneously from both sides of the 59th St. overpass, as shown in Figure 3. Figures 4 and 5 show typical camera views from the overpass positions.

For notation purposes, lanes were numbered from left to right at the four check points (A-A, B-B, C-C, and D-D) indicated in Figure 3. L and R denote left or right lane of the transfer roadway. All vehicles were counted in and out of the study section. Examples of typical vehicle traces through the study limits for express, transfer, and local vehicles are 3-2, 4-R-R-5, and 5-6, respectively.

Individual transfer vehicles were checked outside the study section to determine if they exited at 63rd St. Such a maneuver requires a left-to-right weave within 1,500 ft across local traffic. Although this particular maneuver is not illegal, advance signing advises use of the 45th St. transfer roadway for express traffic desiring to exit at the 63rd St. ramp.

Signing on the express roadway for the study section directs only "CHICAGO SKYWAY (I-94 EAST)" traffic into the transfer roadway from express lane 4 and optionally from express lane 3. "THRU TRAFFIC (I-90 EAST)" is advised to remain on the express roadway in express lanes 1, 2, or 3, although transfer to the C-D roadway also allows through travel. Overhead directional signing is provided at the nose, and 0.5 mi and 1.8 mi in advance of the nose. Although the study site is situated in a level tangent location, a slight shift due to extra pavement and median introduces some horizontal curvature.

The analysis of the study section was based on the hypothesis that all vehicles in the express roadway, on entering the study section, should be located in the proper lane for executing the desired movements. All transfer vehicles should originate only from express lanes 3 and 4 and terminate only in local lanes 4 and 5. No through express traffic should enter in express lane 4 and no local traffic should encroach on local lane 4. It was further assumed that any violation of the neutral approach nose pavement area constituted a hazardous maneuver, reflecting the quality of traffic operations at the diverging terminal.

Figure 5. Merging terminal of study section with "after" pavement markings.

Field Methods

Two time-lapse cameras equipped with 16-mm color film were used for data collection at the study site. Approximately 65 min of continuous observation per roll of film was produced by exposing one frame per second. Power for the initial study was supplied by a 110-v AC inverter connected to a standard 12-v automobile battery. The expressway lighting circuit was tapped for the "after" study power supply.

Before actual filming operations, reference lines were whitewashed at 50-ft intervals along the shoulder nearest the transfer roadway at the diverging and merging areas of the study section, thus delineating the extremes of the study site and providing intermediate speed traps. A radar speed meter was also used to check speeds in the "after" study.

For the initial study, data films were taken on Wednesday, May 1, 1963, for three complete hours of traffic—1:55-2:55 PM; 3:15-4:15 PM, and 4:30-5:30 PM. For the "after" study, data films were taken on Tuesday, September 10, 1963, for two complete hours of traffic —1:55-2:55 PM and 4:30-5:30 PM. Weather conditions were ideal and traffic conditions were normal throughout all study periods.

Film Analysis

Ten films covering 5 hr of traffic were analyzed for the study section. All laboratory work was performed with a modified commercial projector featuring variable controls and a daylight screen.

Each matching pair of films was coordinated by identifying every transfer vehicle and tracing its path through the four check points of the study section: lane of entry (Sec. A-A); lane at nose (Sec. B-B); lane at merging end (Sec. C-C); and lane of exit (Sec. D-D). Each transfer vehicle was also classified as a "63rd" vehicle if the 63rd St. exit ramp was used.

Both matching films were then analyzed for each 5-min interval; lane volume counts were made of all vehicles at the nose and merging end check stations. These lane volume figures were combined with lane change movements in the terminal areas to produce lane volumes at the extremes of the study section. Using this method, flow values for all movements within the study section were determined for all coverage periods.

Vehicle types were classified only at the 2-lane C-D section located at the merging end (Sec. C-C). Truck volumes were negligible on express and transfer roadways due to the prohibition of such operations. Vehicles having more than four tires were considered heavy trucks; four-tired single-unit trucks of the panel and pickup variety were classified as light trucks.

Hazardous maneuvers were summarized for each hour of data based on violation of the neutral approach nose pavement at the diverging terminal. Two degrees of severity were recorded: crossing the neutral zone with all wheels and straddling this area with either side of wheels.

In the initial study, speeds were checked through a 500-ft trap terminating at the nose and a 400-ft trap commencing at the merging end. Because present traffic demands seldom produce congestion during normal peak flows through the study section, speeds usually are quite uniform. Thus, instead of checking every vehicle, individual speed samples were obtained from each lane throughout each initial study period. The radar speed meter used in the "after" study provided comparable data.

INITIAL OPERATIONAL STUDY

The initial study findings at the express-to-local transfer roadway are based on worn pavement markings, which were limited to painted lane lines that had been applied as a minimum control to allow use of the expressway immediately following pavement construction. Although similar in color and texture to the traveled way, the neutral approach nose pavement lacked delineation other than visible construction joints along the edges of contiguous traffic lanes. Therefore, the "before" markings could not be considered as an effective traffic control measure because of their deteriorated condition.

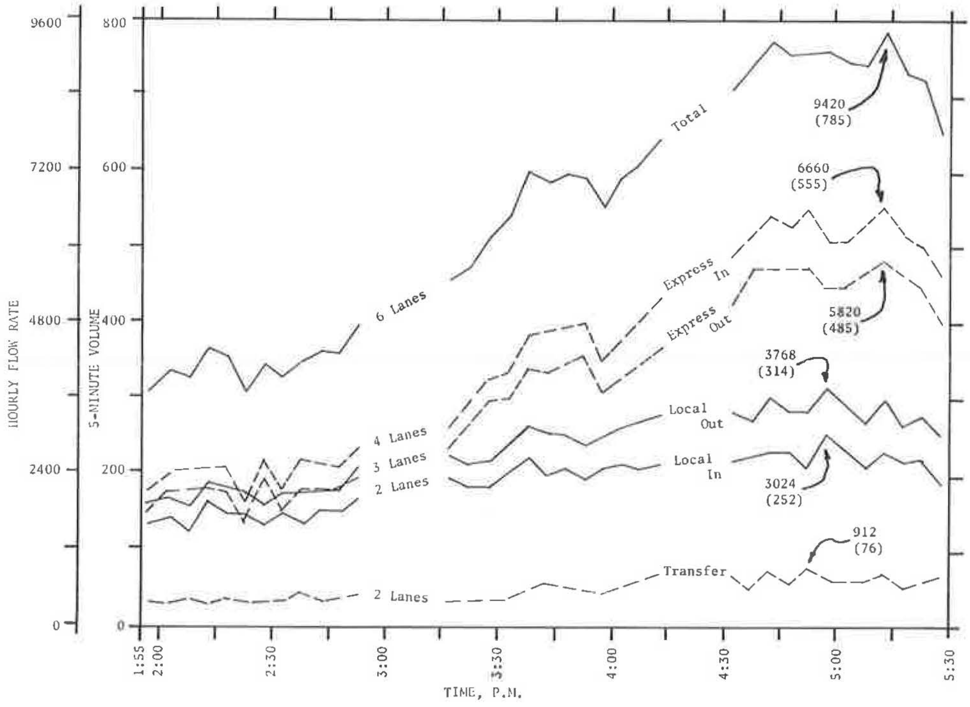


Figure 6. Traffic pattern in study section.

TABLE 1

AVERAGE SPEED BY LANE AND PERIOD

Lane	Average Speed (mph)		
	Off-Peak 1:55-2:55 PM	Transition 3:15-4:15 PM	Peak 4:30-5:30 PM
	(a) Section B-B, Approach Nose		
1	52	54	48
2	51	53	47
3	49	53	48
L	48	51	48
R	48	51	47
(Sample size)	(44)	(53)	(57)
	(b) Section C-C, Merging End		
L	50	50	48
R	48	46	44
5	45	44	42
6	41	42	40
(Sample size)	(44)	(55)	(72)

Traffic Pattern

Figure 6 shows actual 5-min roadway volumes plotted against clock time for the three initial coverage periods. The peak 5-min flow rates are also depicted; the peak 5-min lane volume of 180 (2,160 vph) occurred in express lane 1.

From the total trend displayed, the hour periods are classified as: off-peak (1:55-2:55 PM); transition (3:15-4:15 PM); and peak (4:30-5:30 PM). Roadway volumes at the various check points indicate that the bulk of the volume increase occurs in the express lanes, whereas transfer traffic values are relatively low.

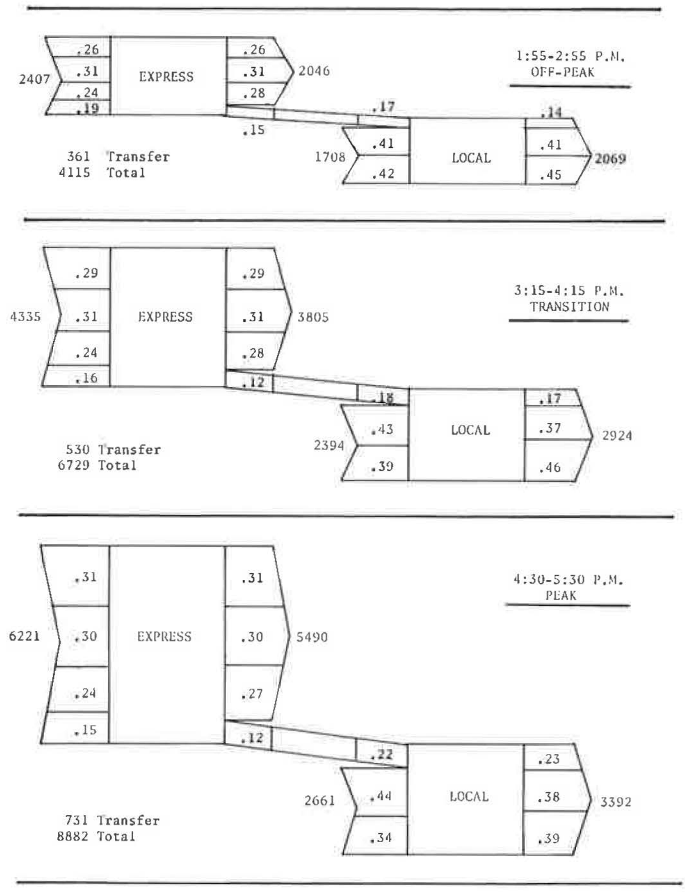


Figure 7. Roadway volumes and lane distributions, by period.

Speeds

Table 1 gives the general range of lane speeds for each hour of analysis, merely verifying operations as "free-flowing." These values seem reasonable in view of the differential speed limits. Only a few individual vehicles deviated greatly from these averages, usually for maneuvers requiring speed reductions.

Flow Diagrams

Figure 7 summarizes the data of Figure 6 into hourly roadway volumes and also presents lane volume distributions. Figures 8, 9 and 10 show volumes for all movements observed in the 3 hr of initial analysis, as well as vehicle classifications.

These four figures indicate that express lanes 1 and 2 are not apparently influenced by transfer operations and express lane 4 feeds many non-transfer vehicles into the diverging terminal. Optional transfers from express lane 3 are minor; transfers from express lanes 1 and 2 are relatively insignificant. The movement of vehicles avoiding compulsory transfer from express lane 4 imposes weaving conditions with optional transfers and merging conditions with through express vehicles.

At the merging end, a substantial number of local vehicles shift into local lane 4 and many transfer vehicles leave the study section via local lane 6. These weaves were performed despite local traffic of high truck concentration.

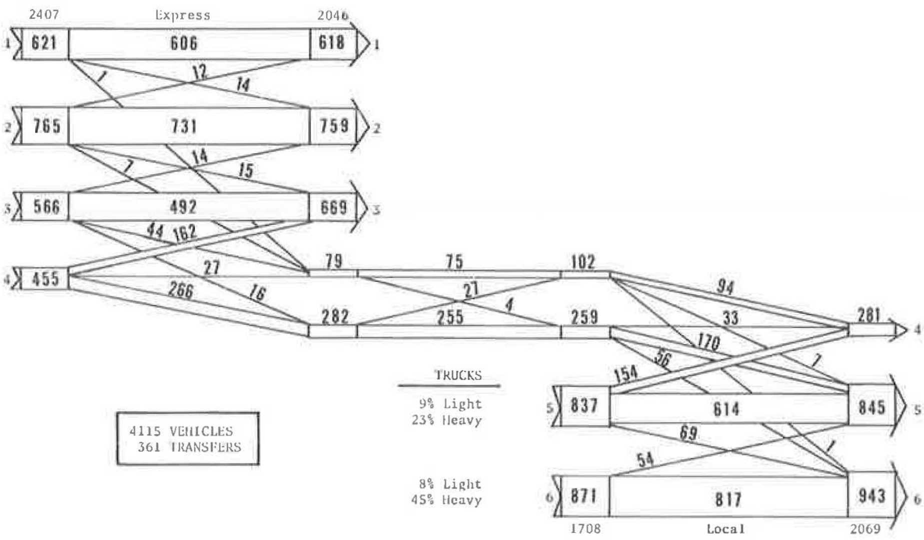


Figure 8. Flow diagram for off-peak hour, 1:55-2:55 PM.

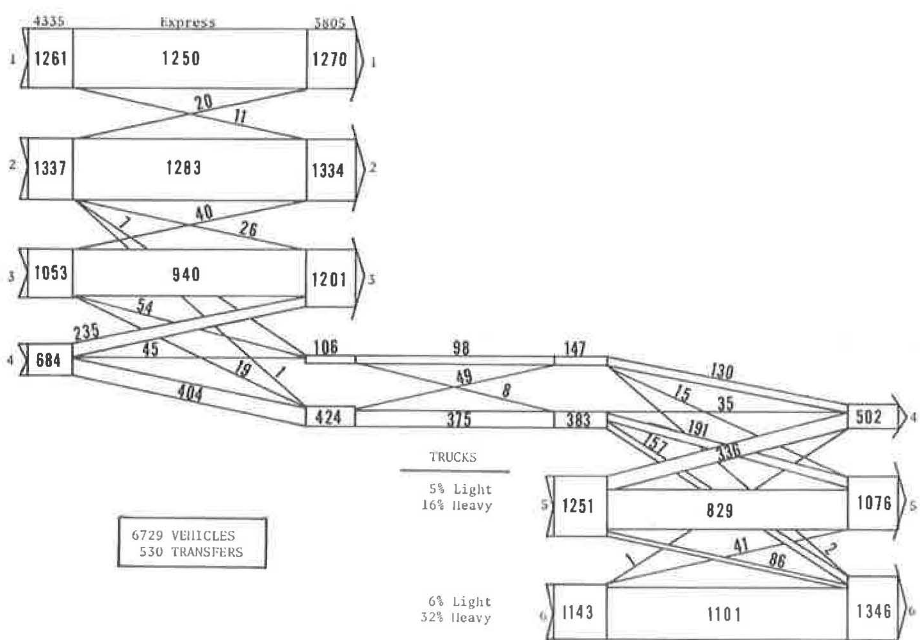


Figure 9. Flow diagram for transitional hour, 3:15-4:15 PM.

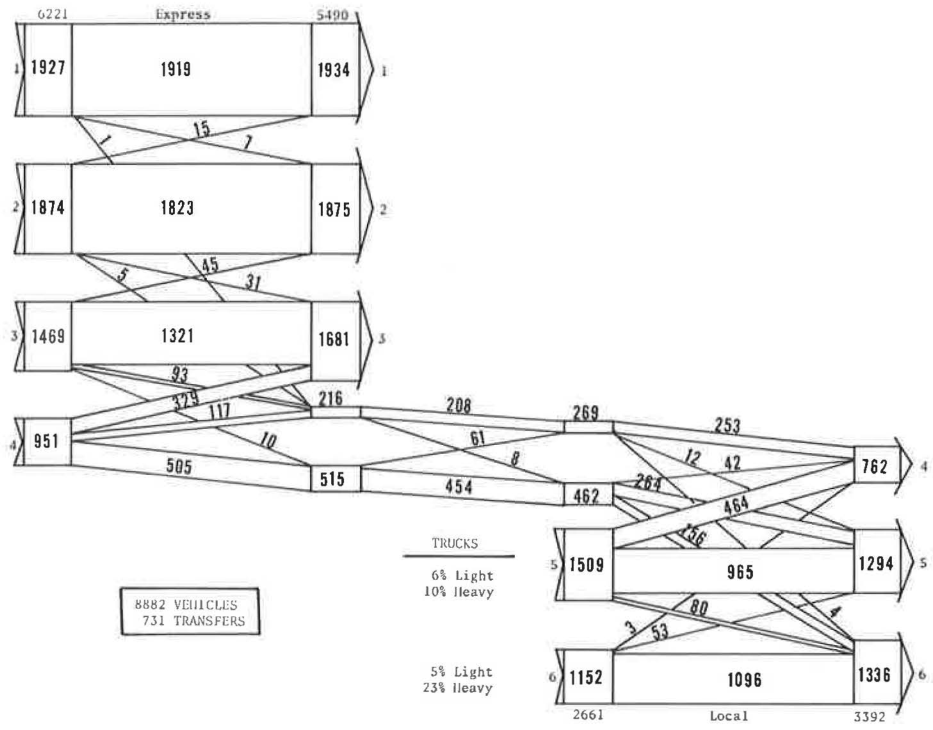


Figure 10. Flow diagram for peak hour, 4:30-5:30 PM.

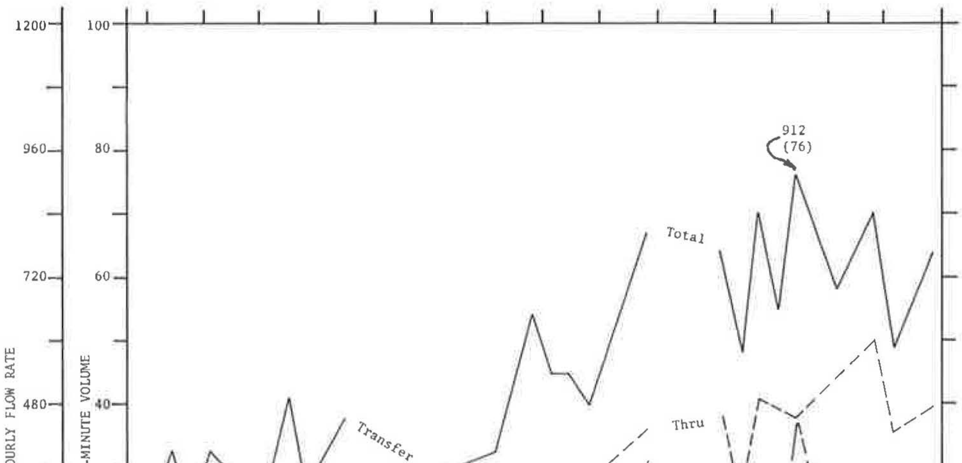


Figure 11. Transfer traffic pattern.

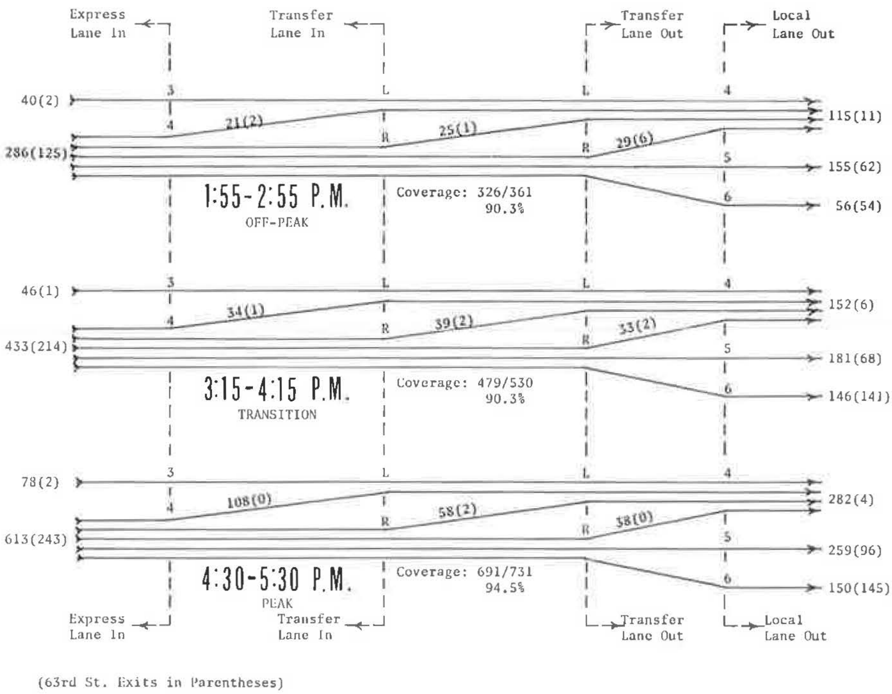


Figure 12. Transfer paths.

Transfer Traffic

Figure 11 shows the traffic pattern of transfer vehicles during the initial study. A large number of transfer vehicles do not conform to the advisory signing, but exiting for 63rd St. via this transfer roadway. For the three periods 63rd St. exits accounted for 39, 45 and 36 percent of all transfer vehicles as total volumes increased. The maximum flow rate for total transfer traffic during a 5-min period was 912 vph. Only three heavy trucks were observed on the transfer roadway during three hours of study.

Figure 12 presents volumes for vehicle paths through the transfer roadway. The coverage figures indicate the proportion of total transfer vehicles represented by paths of at least 20 vph, as shown. Although express lane 4 originates most of the transfer traffic, many vehicles shift to the left lane of the transfer roadway, particularly in the peak hour, so as to enter local lane 4 freely. Vehicles destined for 63rd St. generally keep to the right, thus accounting for nearly all shifts from the transfer roadway into local lane 6.

Hazardous Maneuvers

Figure 13 summarizes the hazardous maneuvers observed at the diverging terminal, as based on the criterion of neutral approach nose pavement violation. Although hazardous maneuvers increase with increasing total volumes, the percentage of these undesirable movements decreases. The magnitude of hazardous maneuvers, mostly of the more severe type in which all wheels cross the neutral zone, reflects the major problem of vehicles not transferring from express lane 4. Total violations for this movement comprised a nearly constant 35 percent of all express lane 4 traffic for the whole initial study period. On the other hand, fewer than 5 percent of all transfer vehicles executed hazardous maneuvers at the diverging terminal in each hour. An average of only 12 percent of the transfer hazardous maneuvers were destined for 63rd Street.

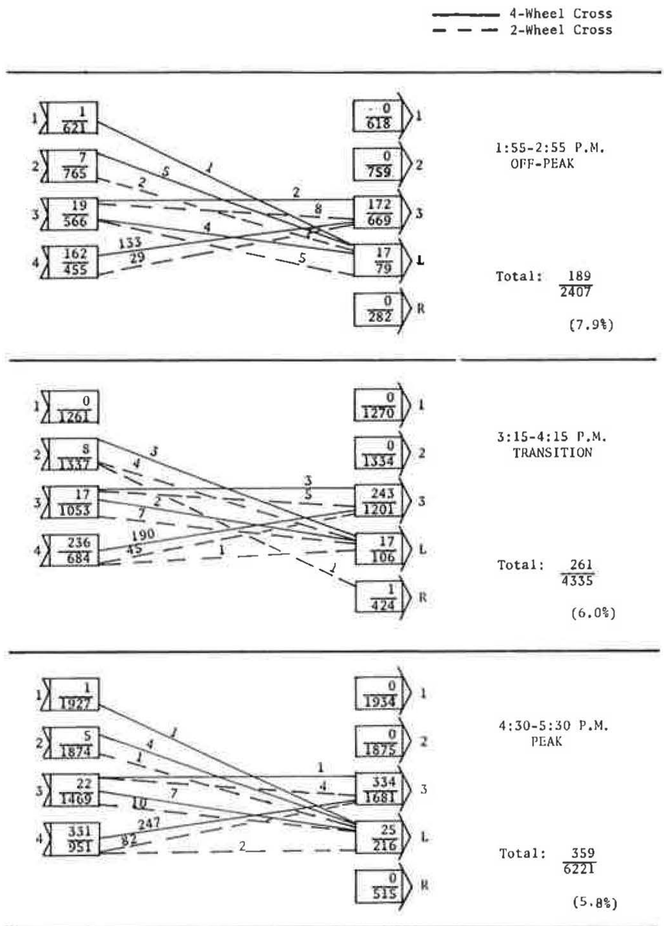


Figure 13. Hazardous maneuvers at diverging terminal.

Many hazardous maneuvers from express lane 4 into express lane 3 required forced entry into normally unacceptable gaps, especially during peak flow. Lane 3 vehicles affected by these movements usually shifted to lane 2 or reduced speed. These events occurred beyond the study limits in the area contiguous to the elongated recovery taper and did not affect more than one or two individual vehicles at a time. Hence, these "merges" did not cause speed reductions and lane changes within the actual study boundaries.

DISCUSSION OF INITIAL FINDINGS

The initial operational study of the southbound express-to-local transfer roadway at 59th St. indicated that a satisfactory level of service was provided for all lanes for the range of volumes normally encountered. Closer study of other factors, however, suggested that the efficiency of traffic operations could be improved by eliminating certain undesirable lane changes at each transfer roadway terminal. Although accident records do not reflect particular problems at transfer roadway locations, the observed maneuvers reveal a definite accident potential.

The movements of major concern, as shown in Figure 14, are discussed hereafter: transfer vehicles shifting into local lane 6 and local vehicles encroaching into local lane 4 at the merging end; and non-transfer vehicles originating from express lane 4

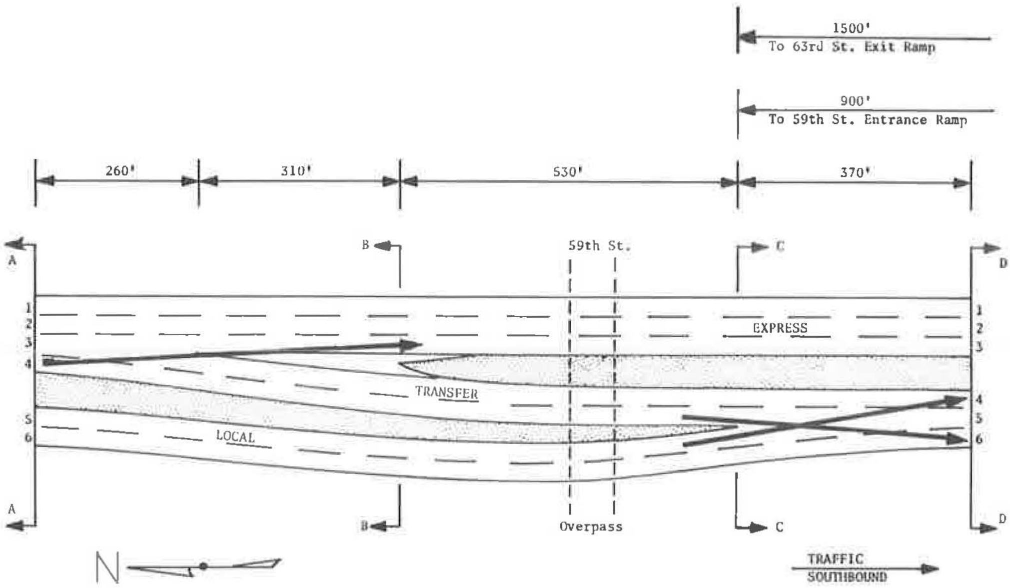


Figure 14. Operational problems at study area.

in the diverging area. It is highly conceivable that these particular maneuvers would have a greater influence on the level of service if the expressway demand were increased at this location.

The Merging Terminal

The effect of the 63rd St. exit ramp on traffic operations is reflected by the magnitude of transfer vehicles weaving for this destination. Disregard for advisory signing suggests that familiar drivers probably perform this maneuver, which is often characterized by an urgent shift immediately from the transfer roadway into local lane 6, despite relatively high volumes of heavy truck composition on the local lanes. The AASHO Urban Policy (2) recommends for this type of design: "Weaving distances... should be 2,000 ft or more and not less than 1,500 ft." The physical weaving distance at this location is 1,500 ft, merging end to nose, but this length includes merging, weaving, and ramp diverging areas, as well as auxiliary weaving pavement shared by the 63rd St. exit ramp as a common acceleration-deceleration lane with the 59th St. entrance ramp.

Evidence exists to warrant prohibition of 63rd St. exits by vehicles using the transfer roadway at 59th St. Although such enforcement would help to minimize conflicts at the merging terminal of the transfer roadway, transfer volumes would decrease at the study site and increase at the 45th St. express-to-local transfer roadway. Further research would be needed at upstream transfer roadways and C-D sections to assure no problems occur from shifting all 63rd express vehicles into the C-D roadway at 45th St.

Due to the lane balance problem at each terminal from physically "transferring" one complete traffic lane, the low transfer demand imposes correspondingly low volumes in the "free" lane at each extreme of the transfer roadway. This relatively empty lane attracts traffic from adjacent lanes at each terminal, particularly at the merging end where local vehicles seek relief from heavy truck concentrations by shifting into local lane 4. Restricting transfer exit to one lane at this terminal would alter the encroaching movement to a normal lane change beyond the study section and eliminate the merging operations now present. Obviously one-lane channelization would increase the difficulty of transfer vehicles exiting at 63rd St. and could not be safely justified without the prohibition of this weave.

The Diverging Terminal

The "attraction theory" also explains in part why many non-transfer vehicles enter the study area in express lane 4. The magnitude of this movement indicates a definite need to emphatically forewarn drivers of mandatory transfer from that particular lane. The flexibility of design at the nose of the transfer roadway permits, or perhaps even encourages, many hazardous maneuvers. Undoubtedly contributing to the number performed by express lane 4 vehicles is the fear of "exit." Signing advises "CHICAGO SKYWAY" traffic to transfer and "THRU TRAFFIC" to remain on the express roadway. Thus the diverging terminal appears to be an exit, although transfer to the C-D roadway allows through traffic to continue on the expressway via the local lanes.

It is quite likely that the increase of right-to-left lane shifts within the transfer roadway in the peak hour can be attributed to familiar drivers utilizing the relatively vacant transfer roadway for through travel. Most vehicles performing this operation remained in local lane 4 for a considerable distance beyond the study section; Chicago Skyway and 63rd St. traffic must perform a left-to-right weave to exit from the expressway. Although actual counts were unobtainable from the films, very little weaving was noticed for transfer vehicles suspected as through traffic.

If some express traffic were encouraged by signing to transfer from express lane 4 to local lane 4 as through vehicles, transfer roadway volumes would increase and undesirable movements at the nose would decrease. Under heavy express flows it might be feasible to relieve the pressure of four lanes reducing to three lanes by using the transfer roadway and local lane 4 for express travel (3). Although this scheme of through access via the transfer roadway would improve traffic operations in the vicinity of the transfer facility, further research would be needed at downstream locations to determine the ability of the C-D roadway to handle increased volumes, especially in the 2-lane section just beyond the Chicago Skyway direct exit.

PAVEMENT MARKING STUDY

Because the lack of sufficient pavement markings obviously contributed to the undesirable movements in the transfer roadway diverging area, new pavement markings were installed and the transfer roadway was restudied to evaluate the effectiveness of the markings as a traffic control measure.

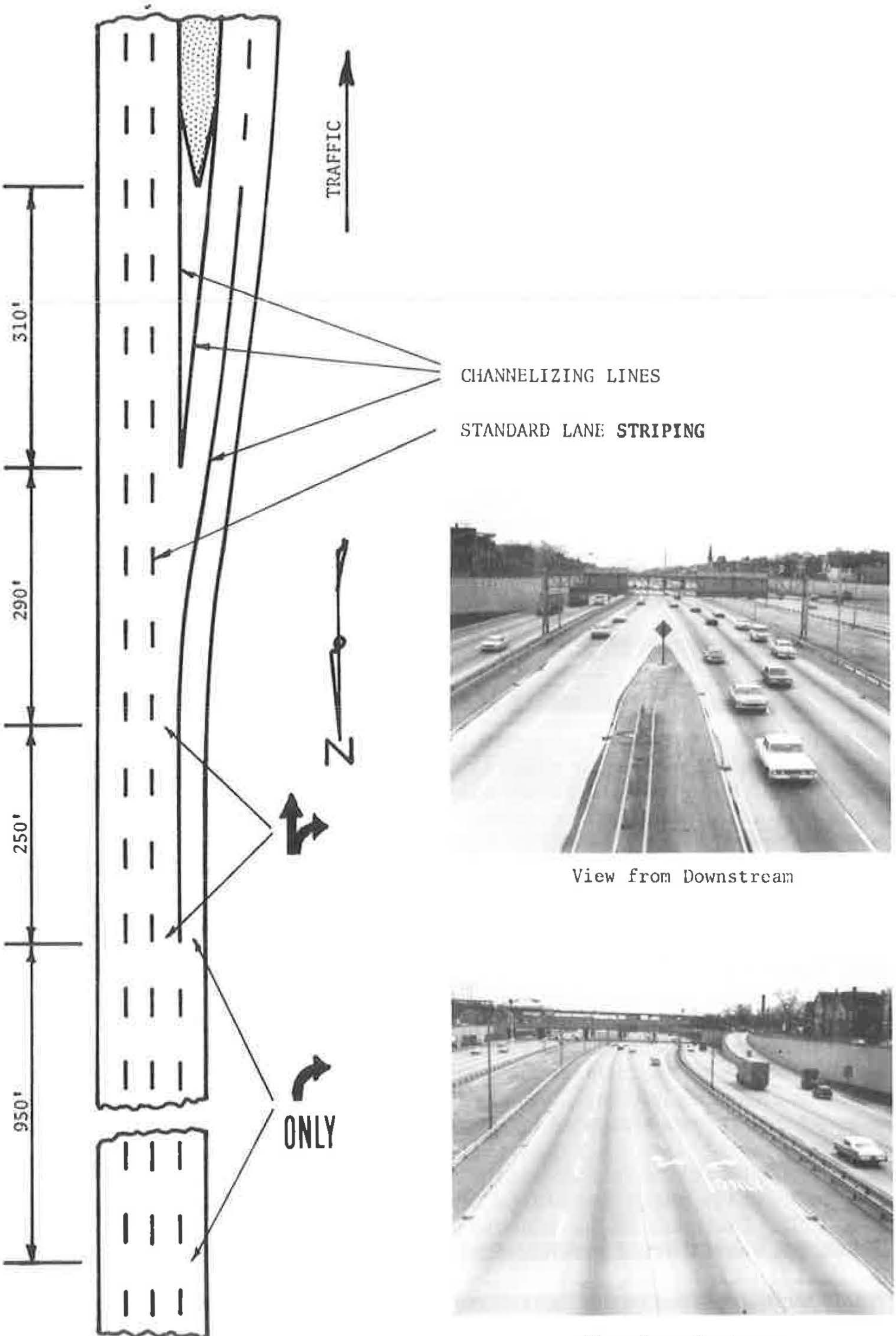
Figure 15 shows the locations of thermoplastic pavement marking improvements in the diverging area. As part of the standard State of Illinois expressway striping program (4), traffic lanes were delineated by broken, white, 5-in. lane lines having 15-ft line segments and 25-ft gaps. In addition, an 8-in. solid, white, channelizing line was installed to isolate the neutral approach nose pavement. These standard markings can be seen in Figures 4 and 5.

Based on the initial operational findings, special markings were applied to further improve operations in the diverging area. A solid, white, 5-in. channelizing line was placed to indicate compulsory transfer from express lane 4. Advance warning in this lane was provided by white, right-arrows elongated to 8 ft and accompanied by "ONLY" legends in 8-ft elongated letters. Express lane 3 was furnished with white, straight-through-and-right-arrows elongated to 8 ft, thus showing optional movements permitted from this lane.

These pavement marking improvements were the only physical changes made in the study area between the initial operational analysis in May 1963 and the "after" study in September 1963. Inasmuch as the improved pavement markings were installed in August 1963, the short time of service which the new markings experienced prior to the "after" study adds further impact to the results obtained. The procedures of the initial study were repeated in the "after" study for the same off-peak and peak time periods.

Traffic Pattern

Traffic volumes in the "before" and "after" study periods are fairly comparable (Fig. 16). The rate of vehicle entry into the study section, however, is slightly higher during the "before" peak hour, due to higher express roadway inputs.



View from Downstream

View from Upstream

Figure 15. Pavement markings at transfer roadway approach and diverging terminal.

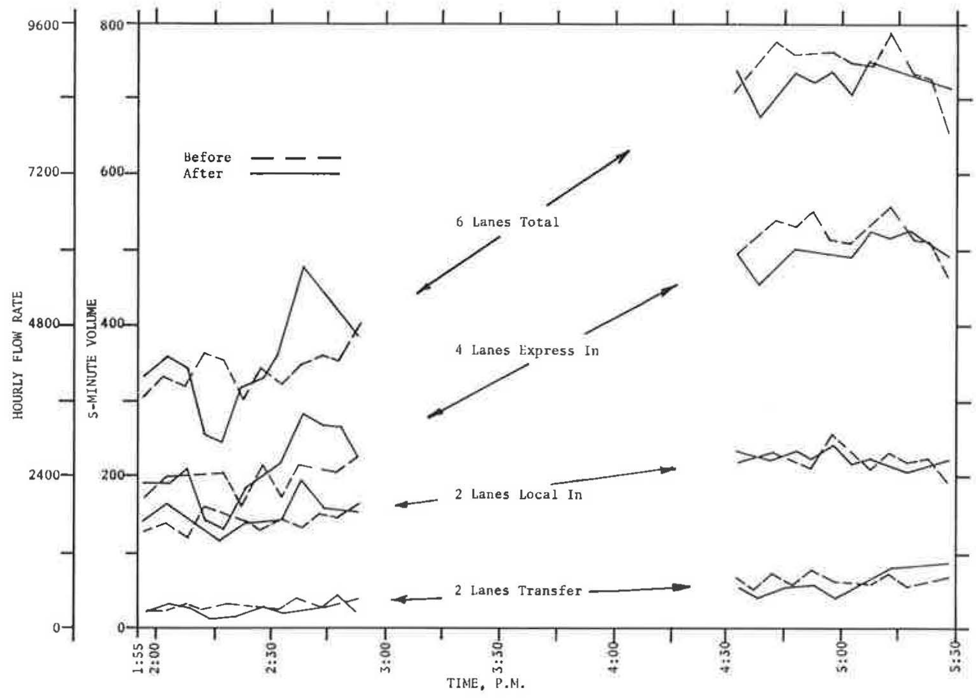


Figure 16. Comparative before and after traffic patterns.

Speeds

In general, the radar speed meter indicated that speeds approximated the "before" averages. There was a decrease in average speeds in the express lanes after 5:00 PM, but the average speeds for each hour remained over 40 mph for all lanes.

Flow Diagrams

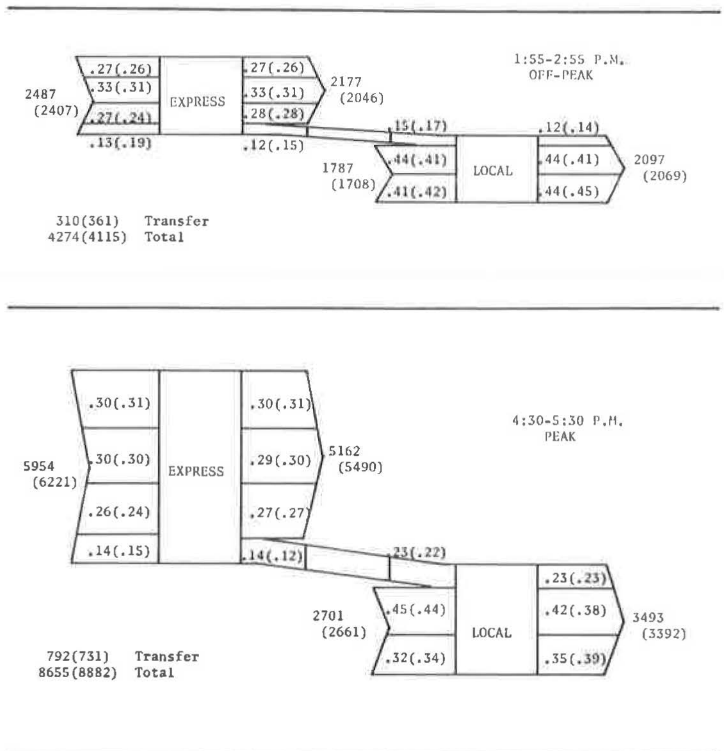
Figure 17 shows hourly roadway volumes and lane volume distributions, with "before" results indicated in parentheses. Figures 18 and 19 display "after" movements and vehicle classifications for the off-peak and peak hours, respectively. Significant changes between data in these three figures and the "before" findings are summarized in Table 2.

The operational movements in the "after" periods were basically comparable with the "before" movements except for the two right express lanes affected by the improved pavement markings. Another obvious difference was the over-all reduction in lane changes at both transfer roadway terminals.

Table 2 indicates that the combined inputs of express lanes 3 and 4 were practically identical "before" and "after" for both time periods. Essentially, express lane 4 approach volumes were decreased and express lane 3 volumes increased an equivalent amount.

For the off-peak period the 46 percent reduction (162 to 88) of express lane 4 vehicles avoiding transfer can be attributed mostly to vehicles shifting to the through roadway in advance of the study section. The decrease in transfer roadway volume with an increase in express roadway input, however, suggests that some transfer traffic may have been similarly shifted to the through express lanes. Perhaps the "before" transfer volume included some unfamiliar motorists who desired through travel but became trapped on the transfer roadway under the former transfer approach pattern.

For the peak period, the 56 percent reduction (329 to 144) of express lane 4 vehicles avoiding transfer can be attributed partly to vehicles shifting to the through express



("Before" data in parentheses)

Figure 17. Comparative after and before roadway volumes and lane distributions.

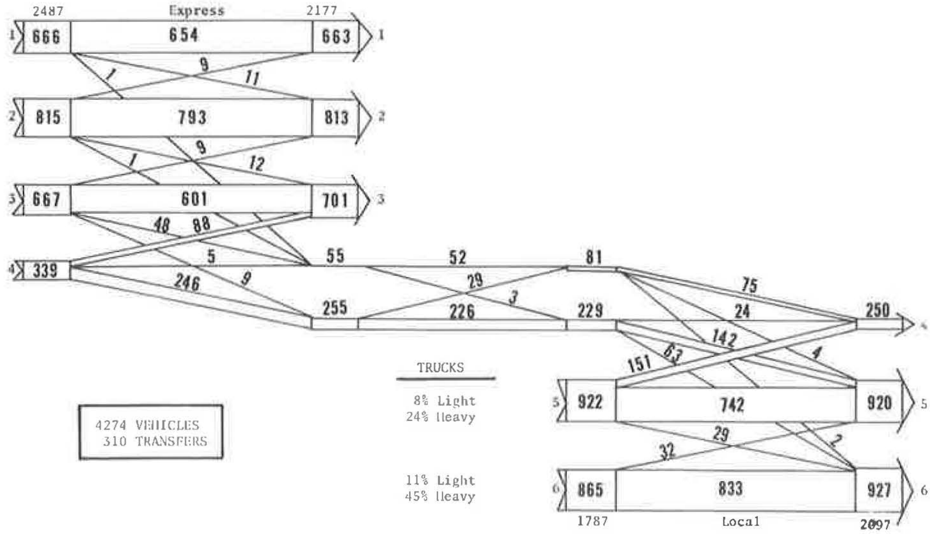


Figure 18. "After" flow diagram for off-peak hour, 1:55-2:55 PM.

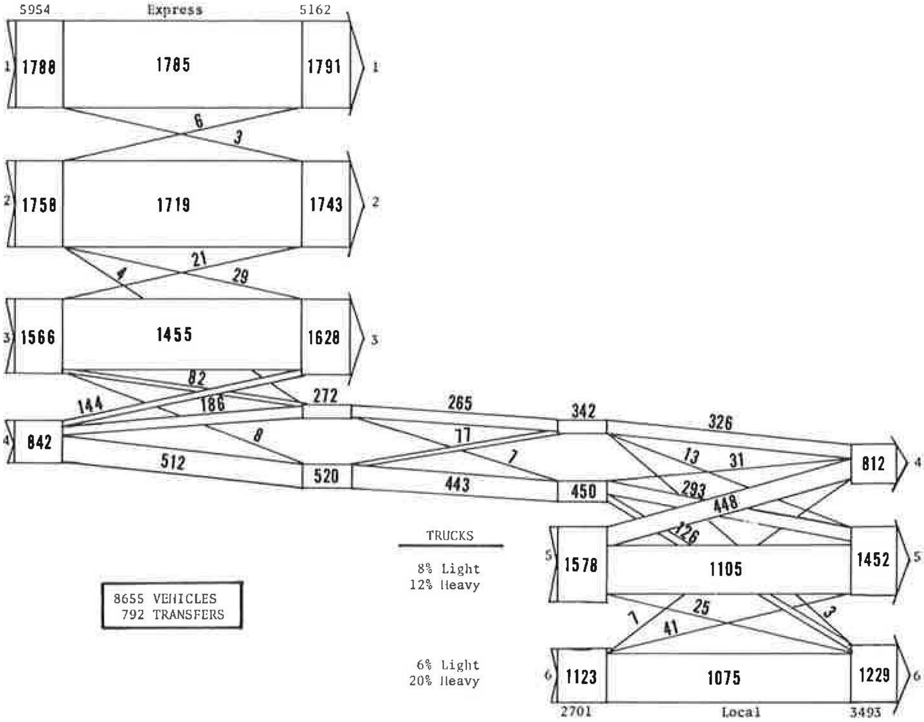


Figure 19. "After" flow diagram for peak hour, 4:30-5:30 PM.

TABLE 2

LANE TRAFFIC VOLUME COMPARISONS

Lanes	Off-Peak, 1:55-2:55 PM			Off-Peak, 4:30-5:30 PM		
	Before	After	Change	Before	After	Change
6-Lane total	4115	4274	+159	8882	8655	- 227
Express in	2407	2487	+ 80	6221	5954	- 267
3 and 4 in	1021	1006	- 15	2420	2408	- 12
3 In	566	667	+101	1469	1566	+ 97
4 In	455	339	- 116	951	842	- 109
Transfer	361	310	- 51	731	792	+ 61
4 In 3 out	162	88	- 74	329	144	- 185

(Traffic Volume (vph))

roadway in advance of the study section and partly to vehicles shifting to the transfer roadway as through traffic. This latter movement, probably performed by familiar users, is suspected because transfer roadway volumes increased, although the express roadway input decreased.

Transfer Traffic

Figure 20 depicts the pattern of "before" and "after" transfer traffic volumes for off-peak and peak periods. The higher maximum 5-min flow rate of the "after" data (1,080 vph) is probably due to an increase in transfer roadway use for through travel by familiar drivers. The transfer volume increase occurred after 5:00 PM and coincides with average speed decreases on the express roadway. Thus it is likely that many through vehicles were attracted to the faster moving collector-distributor roadway via the transfer roadway.

Observations in both study periods revealed continued motorist lack of response to the advisory signing which designates the express-to-local transfer roadway at 45th St. for traffic exiting from the expressway at 63rd St. The posted regulation restricting commercial vehicles to the local lanes was again well observed, as only four trucks were express roadway travelers in the two "after" hours.

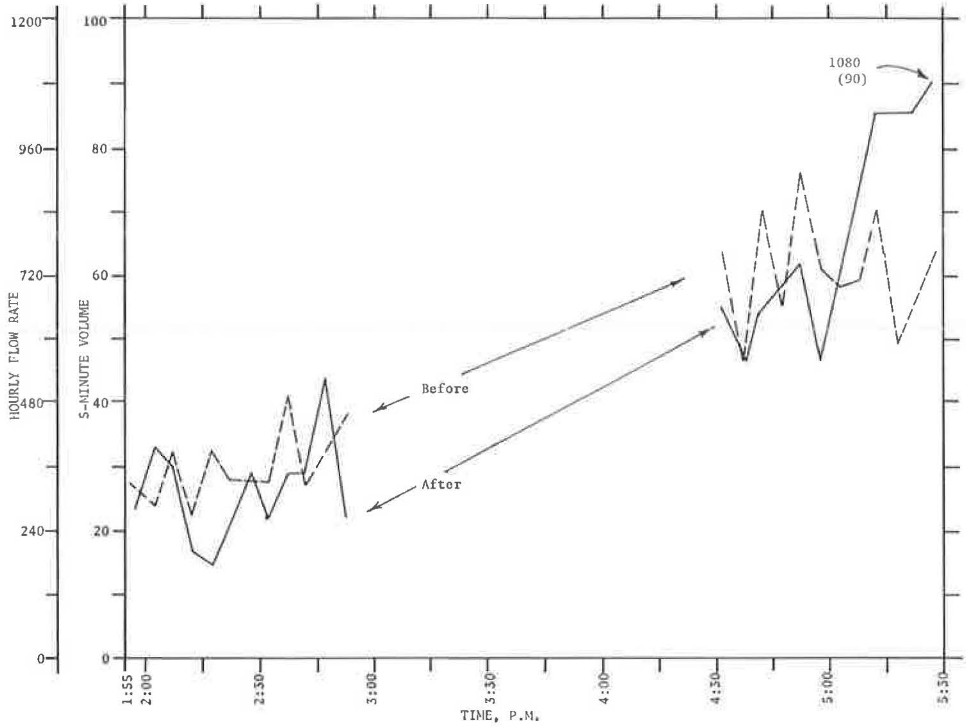


Figure 20. "After" transfer traffic pattern.

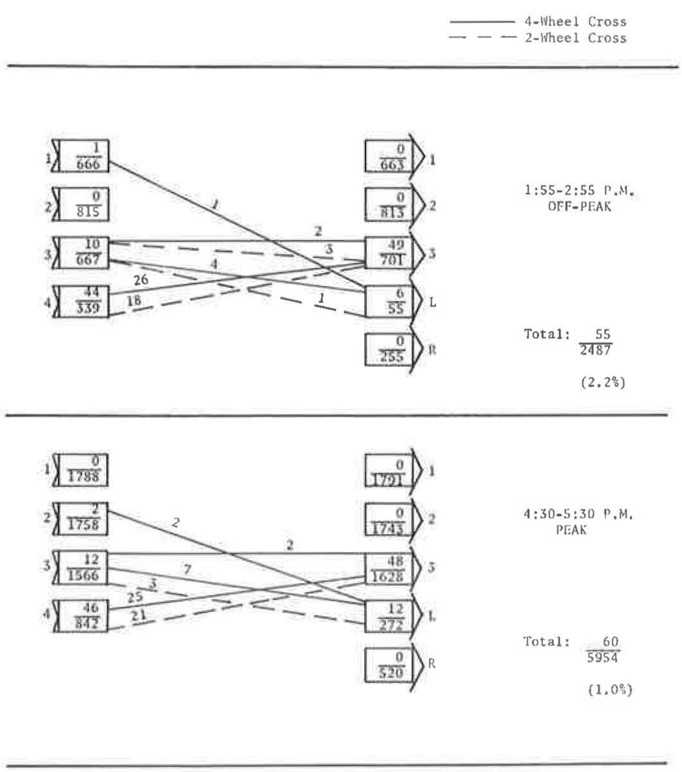


Figure 21. "After" hazardous maneuvers, diverging terminal.

Hazardous Maneuvers

The considerable reduction in hazardous maneuvers at the diverging terminal is shown in Figure 21. The neutral approach nose pavement encroachments were reduced 71 percent (189 to 55) in the off-peak hour and 83 percent (359 to 60) in the peak hour. Hazardous maneuvers of the more severe type, in which all wheels cross the neutral zone, were reduced 77 percent (145 to 33) in the off-peak hour and 86 percent (260 to 36) in the peak hour. Once again the movement from express lane 4 to express lane 3 across the neutral approach nose pavement accounted for the majority of the hazardous maneuvers in the diverging area.

CONCLUSIONS

The operational studies at the express-to-local transfer roadway pointed out various possibilities for improving the efficiency and safety of traffic flow by the elimination or reduction of certain undesirable movements at the merging and diverging terminals.

The effect of pavement markings in reducing hazardous lane changes in the transfer roadway diverging area demonstrated the usefulness of this type of traffic control measure.

Other possibilities for further improving the quality of traffic operations at this transfer roadway location warrant investigation. These include:

1. Geometric changes to allow one-lane operations on the transfer roadway.
2. Advance warning signs for vehicles approaching in the compulsory transfer lane.
3. Signing to inform express traffic of through access via the transfer roadway.
4. Methods to eliminate or reduce weaving at the merging terminal by transfer vehicles exiting at the next downstream ramp.

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