Operational and Geometric Evaluation of Exclusive Truck Facilities

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Traffic growth in Texas has resulted in the need to investigate the feasibility of exclusive truck facilities (ETF) in the median area of existing Interstate highways. In this paper, operational and geometric considerations used to identify candidate sections of a selected corridor are described. Several ETF cross sections were developed for typical median widths used in Texas. Volume-to-capacity ratios with and without trucks were calculated to evaluate the alternative median cross sections. The paper also describes the development of a moving-analysis computer program that identifies candidate sections of highway that warrant the addition of exclusive truck facilities. The I-35 corridor from Dallas to San Antonio was used as a case study to illustrate the use of the program. Present and future traffic conditions were considered in the evaluation of the effect of separating trucks from the mainstream of traffic.

Traffic growth on the Texas highway system has prompted the State Department of Highways and Public Transportation (SDHPT) to examine various techniques of handling the simultaneous increase in truck traffic demands. The Texas SDHPT decided to evaluate special truck lane needs along the I-35 corridor between Dallas-Ft. Worth and San Antonio. The objectives of this study were to identify areas of high truck volumes, to establish operational and design procedures to deal with truck traffic, and to evaluate the corridor and system-wide effects of the proposed recommendations.

One alternative of particular interest was the feasibility of using existing median rights-of-way for an exclusive truck facility (ETF). The analysis procedure involved two distinct phases. The first phase involved the review of current geometric design policy to determine applicability to ETFs *(1)*. Major elements of the overall study included geometrics, right-of-way availability, operations, safety, pavement requirements, and costs of the potential improvements. Roadway geometry was the critical element in the first phase. The second phase, which is the subject of this paper, resulted in a computer program to evaluate the feasibility of providing separate truck lanes in the median area of Interstate highways.

The computer program calculates the level of service (LOS) of each half-mile segment of a selected highway, with and without trucks. The quality of total traffic flow (cars plus trucks) and the change in this quality after trucks are removed are expressed in terms of volume-to-capacity (V/C) ratios as computed by techniques published in the *Highway Capacity Manual (2)*.

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ACCOMMODATING EXCLUSIVE TRUCK LANES

Typical Exclusive Truck Lane Cross Sections

The median portion of I-35 was selected as the portion of the cross section to accommodate trucks. Because the available median width varied throughout the selected corridor, several options were reviewed. Other strategies, such as a parallel alignment on separate right-of-way or truck lanes between the mainlanes and frontage roads, were investigated in another study *(3)*.

Figure 1 shows typical truck lane cross sections. All except Cross Section M-2 place trucks in the median area. The development of these cross sections considers typical Texas SDHPT median widths of 36, 44, 48, 60, and 76 ft. The first, designated M-1A, exhibits minimum widths, whereas the second, M-1B, shows desirable widths. These two configurations do not physically separate trucks from other traffic by positive barriers. Special lane designations, unique raised pavement markers, and regulatory signing such as "Trucks Only" could be used to define the authorized lane. Option M-4 shows an existing 76-ft median that can accommodate an additional lane in each direction using a depressed median. This same median width is sufficient for three truck lanes, providing for passing maneuvers alternating back and forth by direction, as shown in Cross Section M-5.

Cross Sections M-2 (the outside truck lane), M-5, and M-6 are particularly relevant to urban areas. This is because M-2 and M-5 can practically eliminate weaving across mainlanes; M-6 is advantageous where right-of-way and available median widths are at a premium.

Where positive barriers are needed to separate directional flows of trucks or to separate trucks from other vehicles, a substantially taller barrier is needed such as that developed by Hirsch et al. *(4)*. Barrier height is an important safety issue because of possible restrictions in sight distances caused by the aforementioned taller barrier of 7.5 ft in the reference cited. Current truck driver eye heights are typically in the range of 7.5 to 8.0 ft.

The minimum effective median width is one of the most important considerations when evaluating truck lane feasibility. The effective median width is the available clear width of median measured from the nearest edge of each inside travel lane. Any obstructions such as piers for overhead structures reduce the clear width. The width of a positive barrier such as the concrete safety shape also limits the total available median width. Figure 2 shows the determination of available effective median width.

ETFs for Median Widths of 36 to 48 ft: M-1A, M-1B, and M-2

To accommodate the continuous through-truck nature of traffic along rural segments, Cross Sections M-1A and M-1B are feasible. M-1A should be considered as a minimum cross section with 12-ft travel lanes and shoulders of approximately 5 ft. M-1B depicts a more desirable cross section, using 12-ft travel lanes with 20 to 24 ft available for the inside shoulders and barrier. For those cross sections, roadside barriers need to withstand the impact of large vehicles.

Cross Section M-2 is suitable for either urban or rural applications. An operational advantage occurs in urban areas in that trucks are not required to weave across two or more lanes of heavy traffic to enter or exit the truck lanes as in M-1A and M-1B. In this case, the median itself is not used for trucks, but autos are shifted toward the median so that trucks can be accommodated in the outside lanes.

An advantage of Cross Sections M-1A, M-1B, and M-2 is their application in narrow medians. Further, for M-1A and M-1B the pavement structure can be specifically designed for the anticipated truck traffic. As such, the existing travel lanes would experience a longer service life due to the reduced heavy

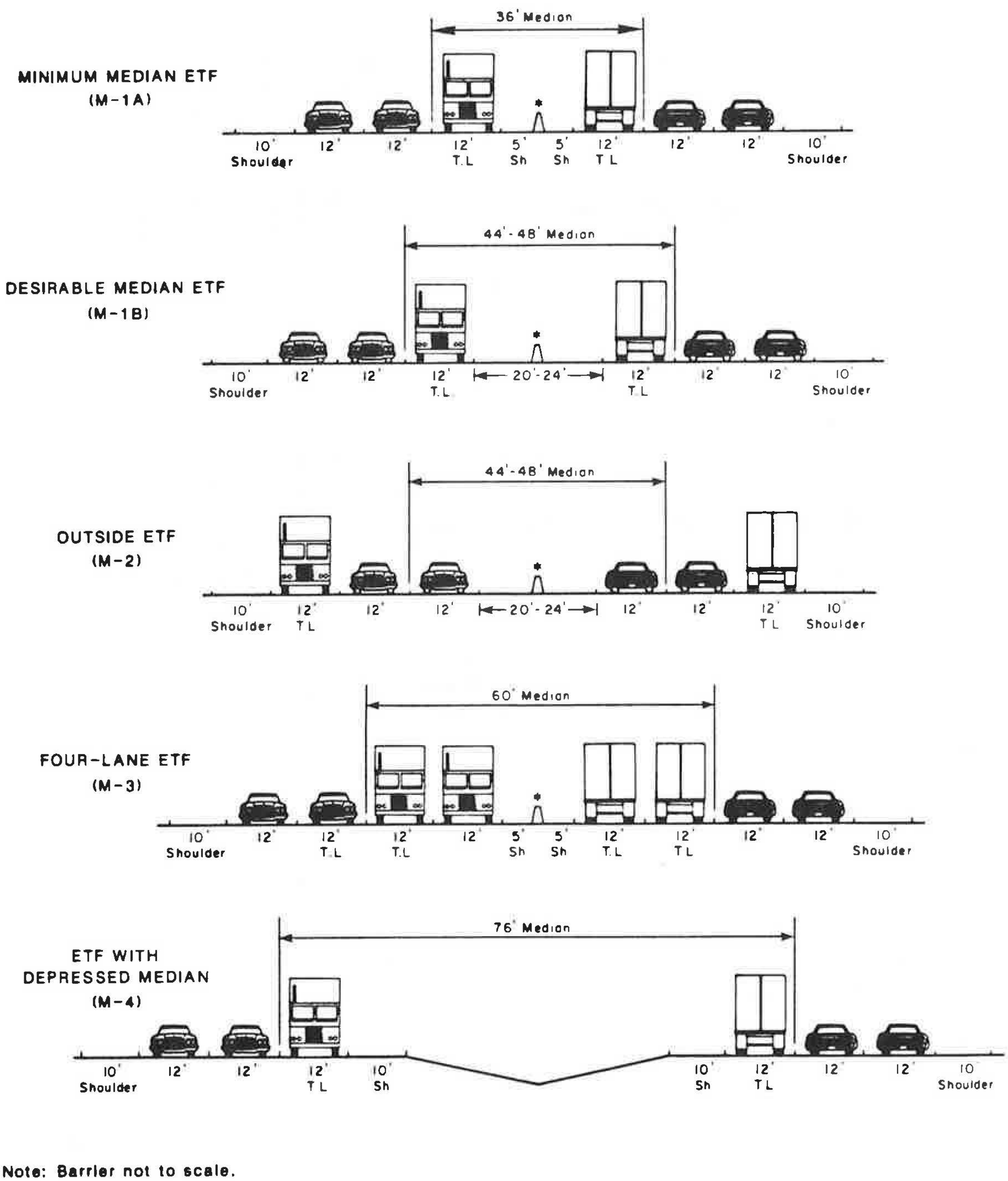


FIGURE 1 Typical ETF cross sections.

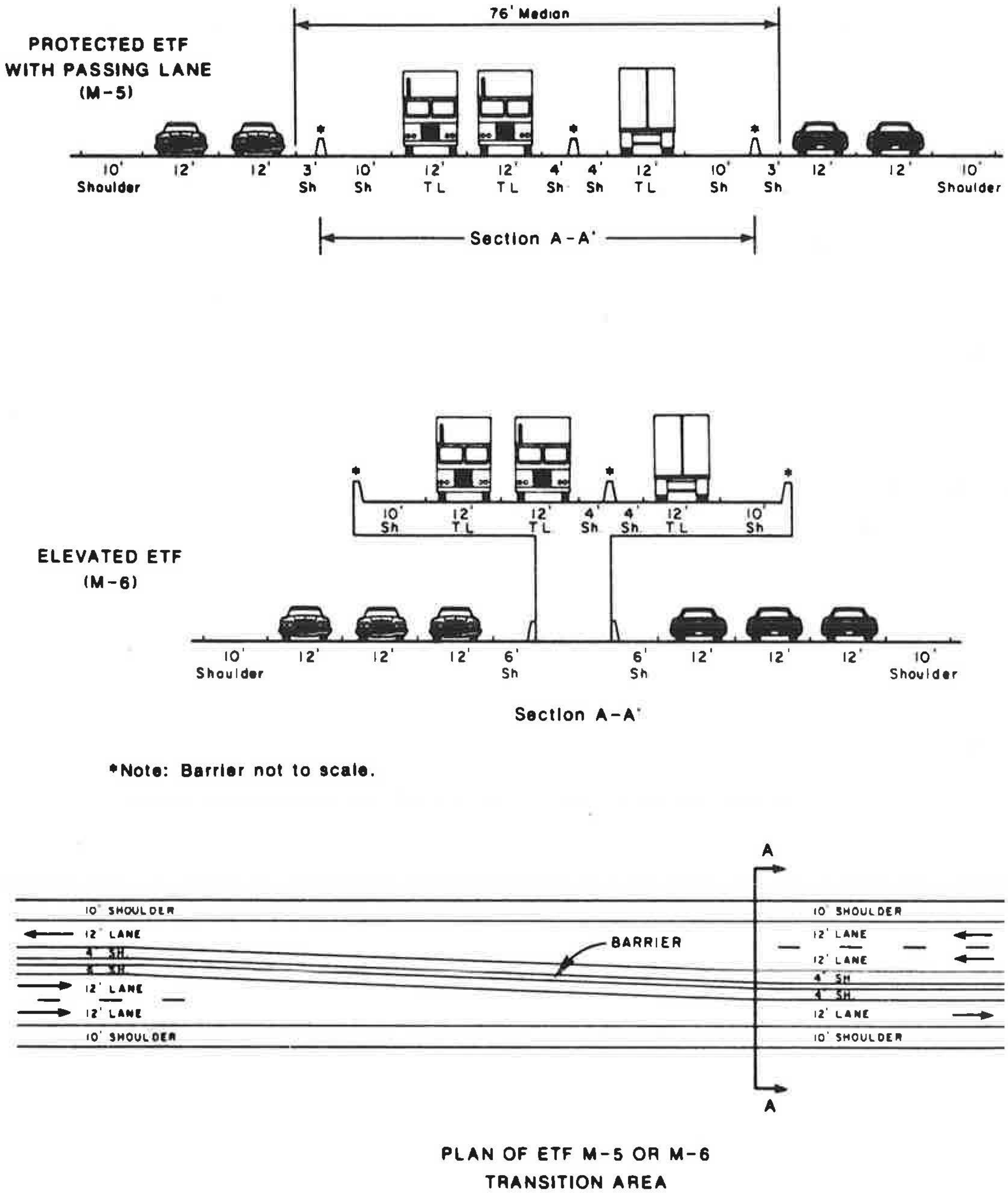


FIGURE 1 continued

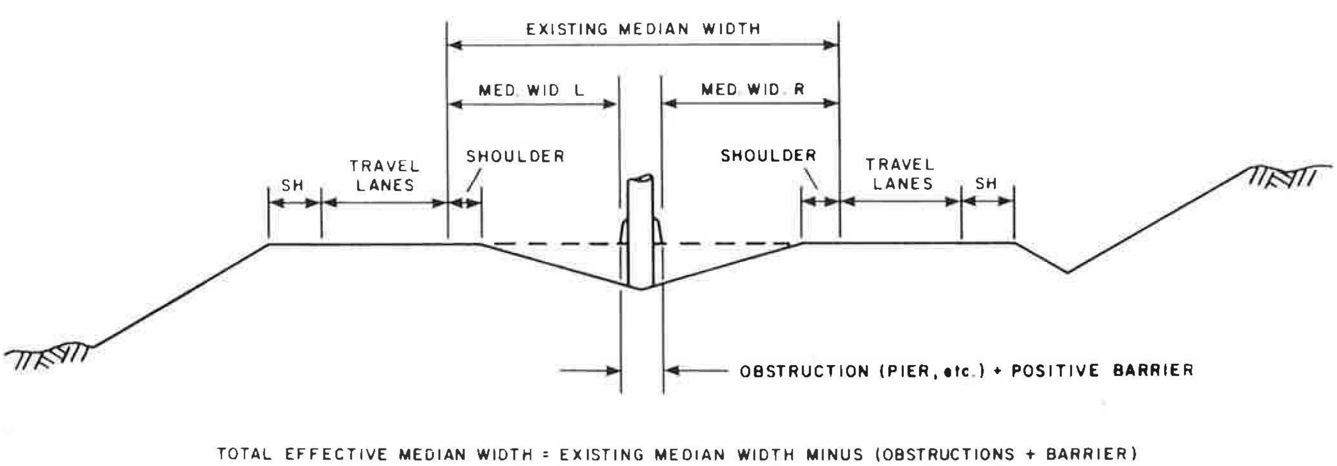


FIGURE 2 Effective median width.

axle load repetitions. This option is the most economical in comparison with the other alternative schemes. For M-2, other advantages are that traffic operation is smoother with slower vehicles to the right, overall weaving is minimized, median barrier is the smaller version designed for automobiles, and wide loads can be accommodated without special provisions.

Disadvantages of Cross Sections M-1A and M-1B include limited control of entering and exiting maneuvers, no provision for truck-passing maneuvers except by other traffic lanes, insufficient inside shoulder for a stalled truck (M-1A), and long weaving distances necessary near interchanges. Disadvantages of the outside truck lane in Cross Section M-2 include existing pavement design may be insufficient for total truck loading, lack of capacity may occur near interchange ramps for all trucks plus entering and exiting traffic, and generally a small incremental improvement in operations is provided.

ETF for Median Width of 60 ft: M-3

Cross Section M-3 is similar to Cross Sections M-1A and M-1B. The difference is that the additional median width allows construction of a second lane in each direction of travel. This second lane can be designated as a passing lane for trucks only, thus improving the operation of the ETF.

The advantages of Cross Section M-3 are that pavement is designed exclusively for trucks and improved operations due to the passing lane. Disadvantages of M-3 include limited control of entering and exiting maneuvers, insufficient inside shoulders for stalled trucks, and long weaving distances necessary near interchanges.

ETF for Median Width of 76 ft: M-4 and M-5

For very wide medians, a single lane might be added for trucks as shown by Cross Section M-4. Because opposing directions of traffic are still sufficiently separated, a positive barrier is not needed. Traffic operations are the same as for Cross Sections M-1A and M-1B.

Advantages of Cross Section M-4 are low cost because no barrier is needed, and the pavement is designed specifically for trucks. Disadvantages include limited control of entering and exiting maneuvers, no provision for truck-passing maneuvers except by other traffic lanes, and long weaving distances necessary near interchanges.

Separation of trucks from smaller vehicles is achieved by positive barriers on each side of the ETF as shown by Cross Section M-5 in Figure 1. Minimum travel lanes and outside shoulders are 12 and 10 ft wide, respectively. Provision for passing is accomplished by a second truck lane that goes from one side to the other. The plan view of this traffic scheme is shown in Figure 1. At any location except in transition areas, one direction of traffic will have two 12-ft travel lanes, while the other has only one. After a sufficient distance has been provided for passing in a particular direction, the passing lane can be shifted to the opposite side.

Advantages of Cross Section M-5 include total control of entering and exiting movements, provision for passing maneuvers, and compatibility with the separate truck intersection or interchange and with the elevated truck lane shown in Cross Section M-6. Disadvantages of M-5 include greater required median width and less clear width for some wide loads.

Elevated Median Truck Lane, M-6

In urban areas with minimum median width, Cross Section M-6 is an option. Cost-effectiveness is the primary consideration. However, the facility could also be used by line-haul transit or by express bus from outlying park-and-ride lots. Buses generally have operating characteristics that are similar to those of large trucks. Special consideration must be given to pavement drainage, lighting, vertical clearance for vehicles at ground level, and icing during winter months. A combination of Cross Sections M-6 and M-5 is appropriate near the urban fringe.

Advantages of Cross Section M-6 are minimum required median width, passing maneuvers provided, control of access by large vehicles, potential use by transit vehicles, and compatibility with Cross Section M-5. Disadvantages of Cross Section M-6 are high cost, difficulty in future expansion, icing in winter months, less clearance for wide loads, and potential noise problems near environmentally sensitive areas.

Table 1 is a summary of advantages and disadvantages of the various exclusive truck facilities noted. The focus of this comparison is operational and geometric evaluation of the various alternatives; it is not intended to be totally comprehensive.

ACCESS TO ETFs

Most interchanges in Texas incorporate frontage roads. The exchange of traffic from a typical Interstate highway to a secondary cross road therefore occurs in a hierarchical movement pattern. A typical pattern in Texas is Interstate mainlane to ramp to frontage road to at-grade intersection. These frontage roads also act as collector-distributor roads.

Existing Ramps

Accessibility to ETFs depends on the type of ETF involved as well as the existing interchange configuration. In the lowest order of access to the ETF, little or no change to existing ramps or other access features occurs. Trucks enter the freeway on ramps designated for both cars and trucks and then move to the appropriate lanes designated for trucks only. Adequate advance signing and decision sight distance are necessary for successful operation. The plan and profile of a typical interchange of this type are shown in Figure 3.

Frontage Roads

The next level of control gives trucks access to exclusive truck lanes from the frontage roads. Trucks must still interface with other traffic on the cross-street intersections near the trunk ramp terminals. This situation may be a shortcoming of this scheme because of its adverse effects on intersection capacity. The plan and profile of a typical interchange of this type is shown in Figure 4.

TABLE 1 COMPARISON OF ETF CROSS SECTIONS

Cross Sections	Minimum Median Width	Minimum Weaving	Requires Taller Barrier	Wide Loads	Passing Maneuvers	Access Control	Area for Stalled Truck	Pavement Design for Trucks
M-1A	+	-	-	+	+	-	-	+
M-1B	-	-	-	+	+	-	+	+
M-2	-	+	+	+	+	-	+	-
M-3	-	-	-	+	+	-	-	+
M-4	-	-	+	+	+	-	+	+
M-5	-	+	-	-	+	+	+	+
M-6	+	+	-	-	+	+	+	+

Legend

(+) Advantage of the Cross-Section
(-) Disadvantage of the Cross-Section

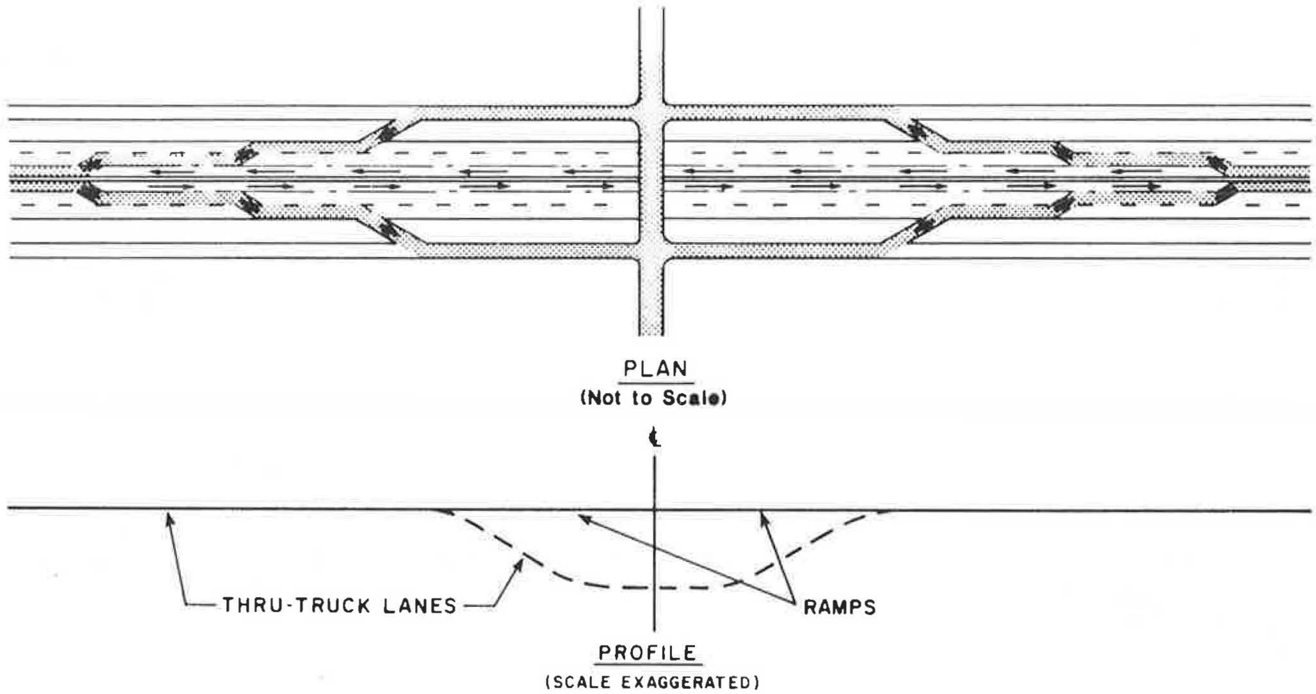


FIGURE 3 Truck access to an ETF by existing ramps.

Typical on-ramp and off-ramp schemes for Cross Section M-6 using the frontage roads for exit and entry are shown in Figures 5 and 6. These diagrams represent conceptual layouts that require adequate geometry for efficient operations. Ramp widths in Figures 5 and 6 assume AASHTO Traffic Condition C of sufficient bus and combination-type vehicles to govern design, Case II (one-lane, one-way operation with provision for passing a stalled vehicle), in Table X-3 of the 1984 AASHTO Greenbook *(5)*. Maximum grade is limited to 5 percent with horizontal and vertical curvature consistent with the selected design speed.

Exclusive Truck Routes

The third scenario represents the highest level of access control. In this situation, large vehicles must enter or exit at an interchange or intersection specifically designed for trucks or other large vehicles. This is advantageous in providing direct access to specific truck traffic generators such as large industrial complexes and in avoiding congested areas. Figures 7 and 8 show the schematic for this concept.

STUDY PROCEDURE

The overall study procedure is shown in Figure 9. The primary components included the selection of the corridor, preparation of a strip map, development of a moving analysis computer program, level of service (LOS) computations, traffic projections, and evaluation of the results.

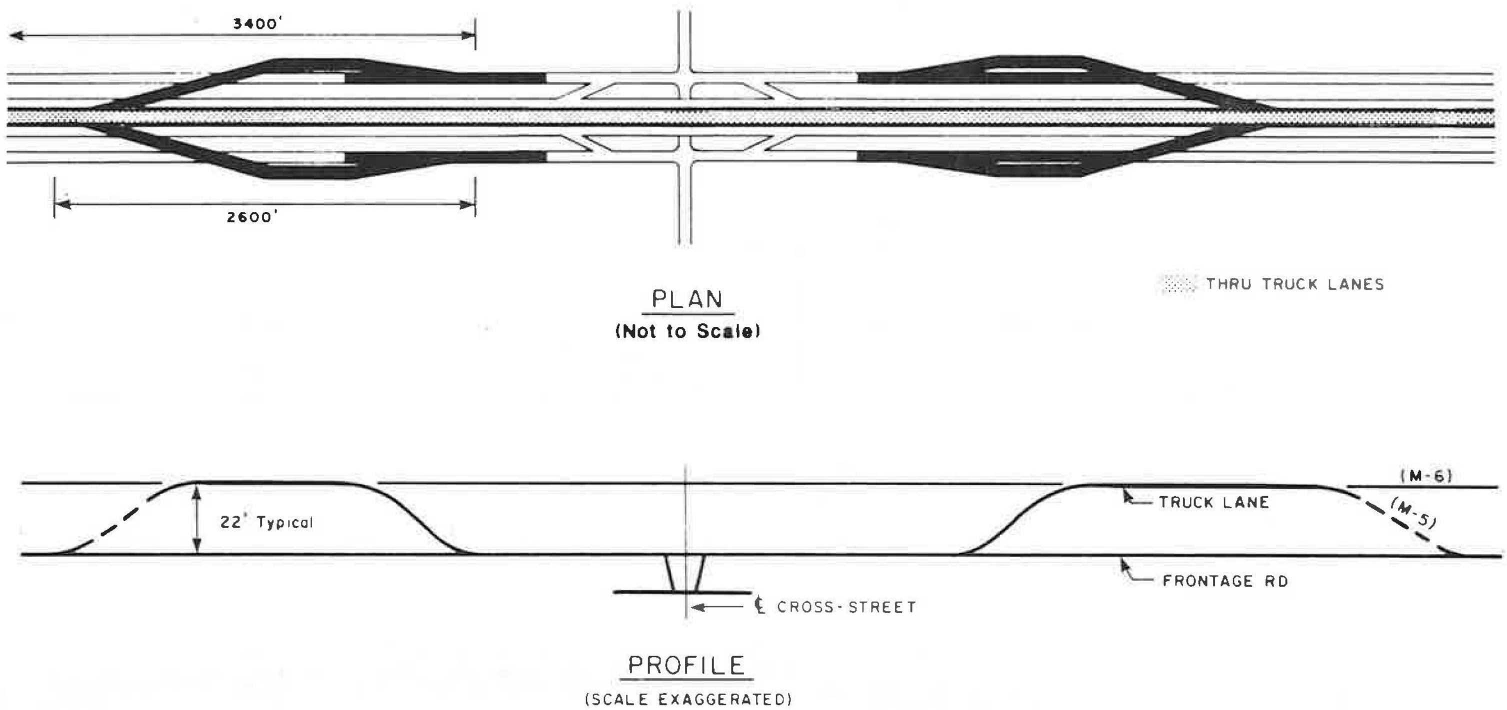
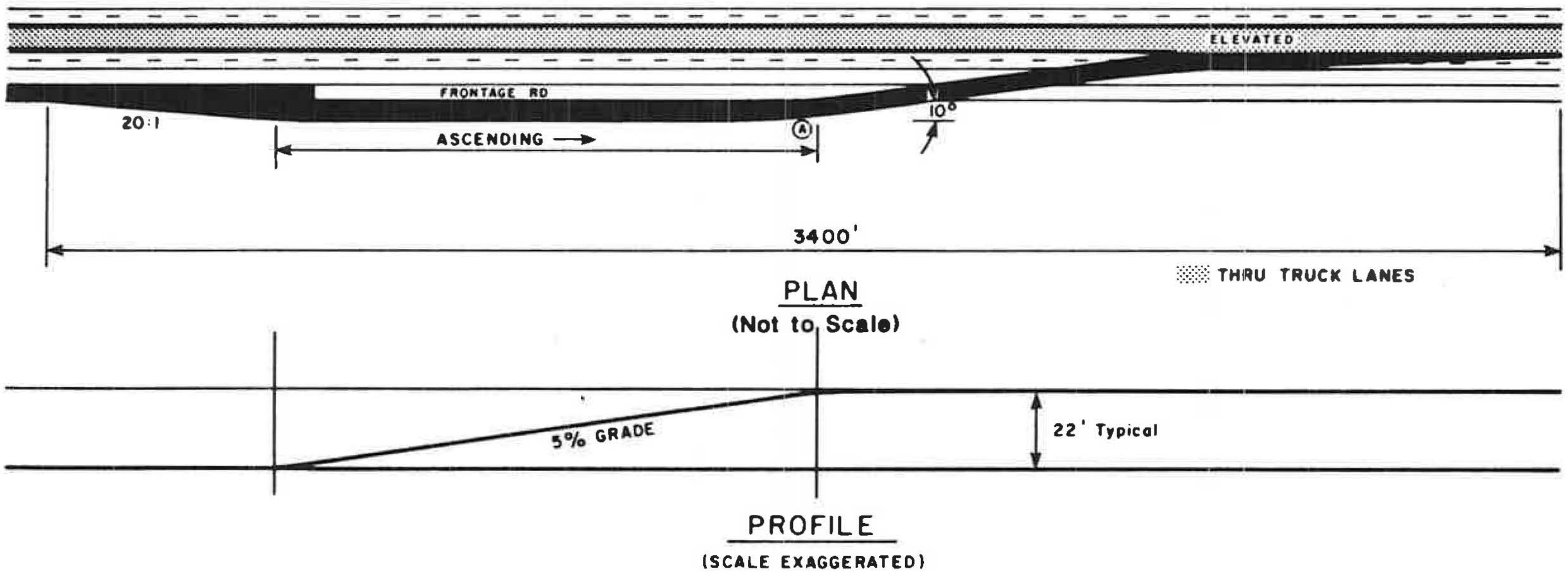


FIGURE 4 Truck access to an ETF by frontage roads.



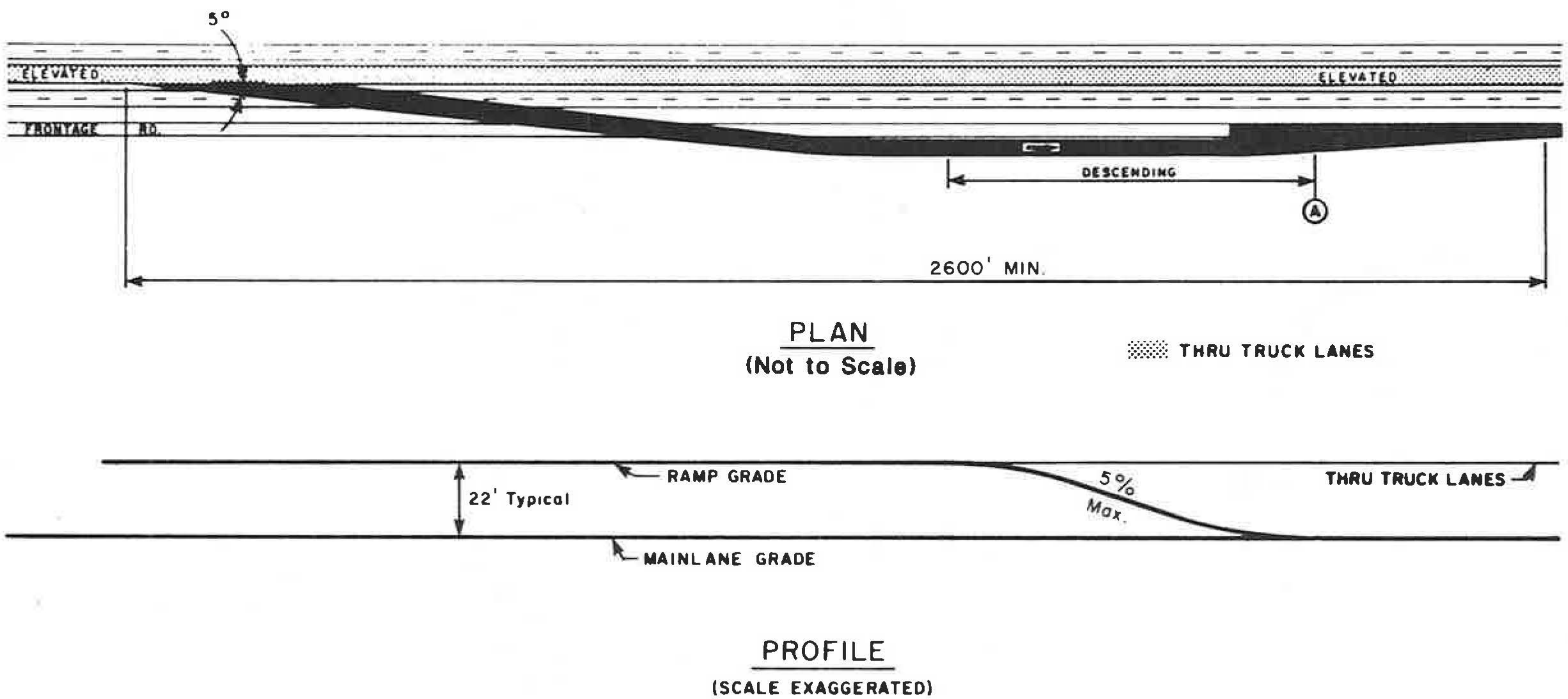
NOTES:

(1) Assume design speed of ETF 70 mph.

(2) Ramp width 27 ft. (22 ft. pavement, 5 ft. shoulder).

(3) Assume speed at Ⓐ 20 mph.

FIGURE 5 Typical truck lane on-ramp for Cross Sections M-5 or M-6.



NOTES:

(1) Assume frontage road design speed 50 mph; speed @ Ⓐ 30 mph.

(2) Assume design speed of ETF 70 mph.

(3) Ramp horizontal curve radius (40 mph) is 500 ft.

(4) Ramp width 27 ft. (22 ft. pavement, 5 ft. shoulder).

FIGURE 6 Typical truck lane off-ramp for Cross Sections M-5 or M-6.

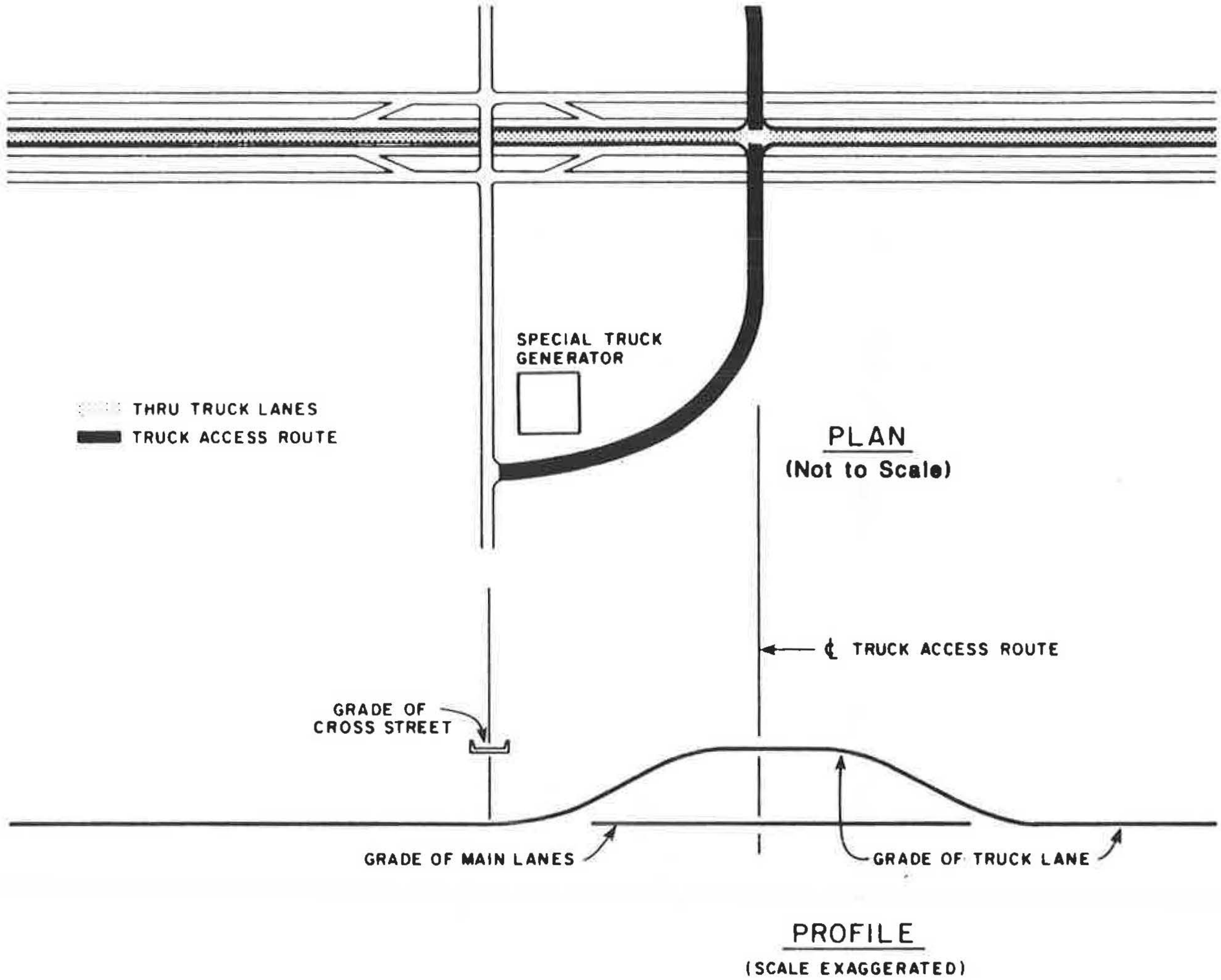


FIGURE 7 Truck access to an ETF by elevated intersection.

Corridor Selection

Corridor selection criteria included average daily traffic (ADT), number of trucks, percent of trucks, existing and predicted population growth along the corridor, size of urban areas along the corridor, and horizontal and vertical alignment of the highway. The length of the I-35 segment was approximately 250 mi.

Corridor Description

The major urban areas within the study limits included Austin, Temple, Waco, and portions of San Antonio and Dallas. Terrain was flat to gently rolling. Specific individual grades were used in the LOS calculations. Most of the corridor, 228 mi, had two lanes in each direction; 19 mi of urban freeway had three or more lanes in each direction.

Daily traffic volume along rural areas of the corridor ranged from 15,000 to 25,000 vehicles per day (vpd). Urban area traffic volumes were as follows: San Antonio, 71,000 vpd near the project terminus; Austin, 70,000 to 130,000 vpd; Temple, 40,000 vpd; Waco, 50,000 vpd; and Dallas, 44,000 vpd south of the I-20 interchange, and 51,000 vpd just north of this interchange *(6)*.

Additional traffic classification counts were made at strategic locations to supplement the 1983 traffic count information available from the Texas SDHPT. Manual counts were conducted for approximately 18 hr at eight locations with counts tallied by 60-min intervals. From the manual counts, percentages of trucks were determined and peak-hour and 24-hr volume percentages were computed. These percentages were then used in LOS calculations.

Strip Map

A strip map was prepared showing a sketch plan view of the roadway at a scale of 1 in. = 1 mi. Figure 10 shows the general concept. Additional information included mileposts at 10-mi increments, bridges, overpasses, interchanges and their ramp configurations, median obstructions, county lines, city limits, rivers, and other pertinent geographic features. This information was positioned on the top one-third of the strip map.

Information contained on the lower two-thirds of the map was plotted to a pictorial scale such that problem areas could be spotted at a glance: average daily traffic (ADT), number of trucks, percent trucks, median width, median obstructions,

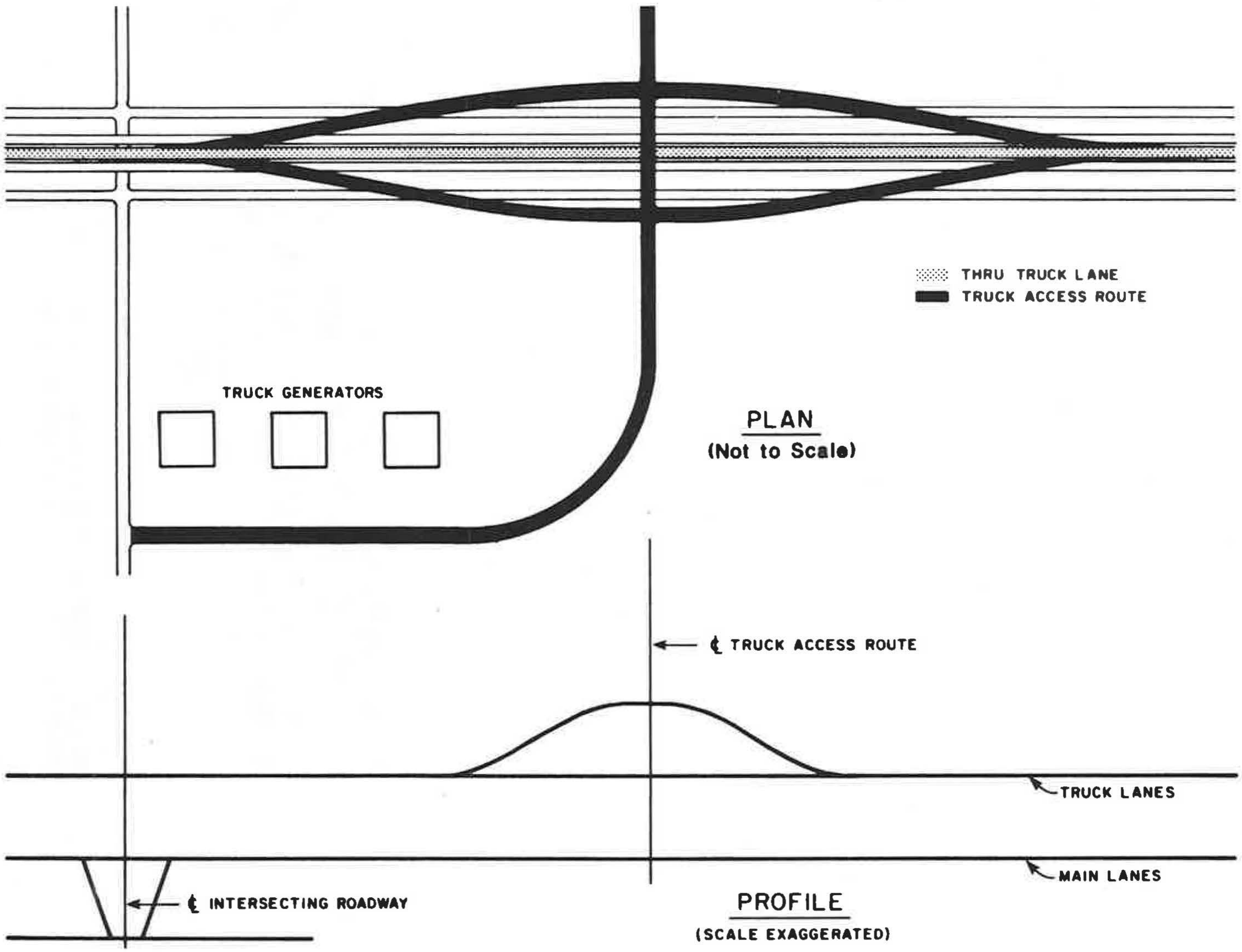


FIGURE 8 Truck access to an ETF by elevated interchange.

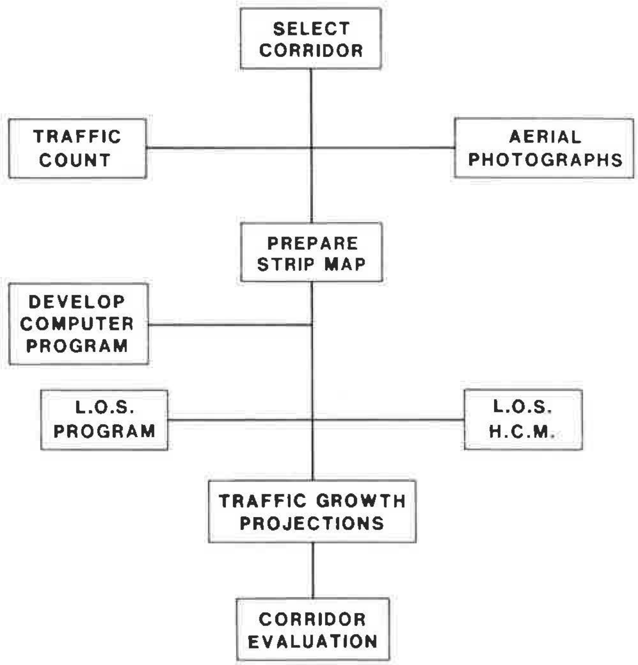


FIGURE 9 Flowchart of study procedure.

grade, number of lanes, shoulder width, vertical clearance, right-of-way, and LOS. The thickness of the black bands is an indicator of the severity of each of the aforementioned 11 items. Most physical information came directly from the design and as-built drawings.

Alignment and land use information were verified by aerial photographs of the entire study corridor of scale 1 in. = 200 ft. The aerials were helpful in determining changes made since the original construction of the corridor.

Because the strip map provided a means of visually evaluating many factors along a selected highway corridor, it was decided that the concept of pictorial evaluation should be maintained. A more efficient method was needed, however, to expedite the process. The capability of evaluating selected criteria on a preselected, incremental-length basis was needed so that individual grades or sections of narrow pavement could be evaluated. Evaluation by computer was the answer.

Development of the Computer Program

A computer program was developed as the next step in the truck lane evaluation process. Data input in half-mile segments are milepost, peak-hour volume, number or percent of trucks,

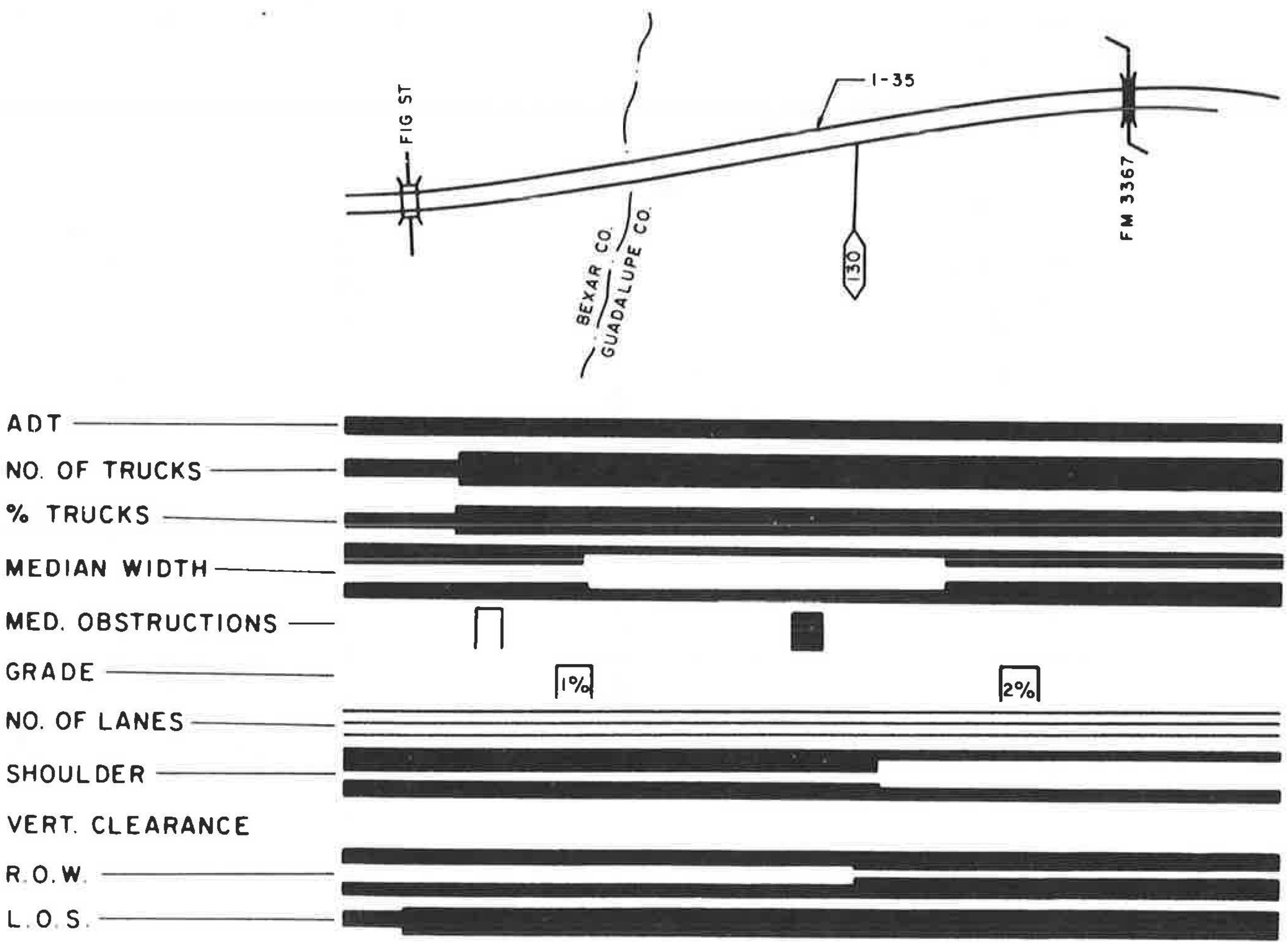


FIGURE 10 Strip map.

percent grade, grade length, terrain factor, number of lanes, distance to lateral obstructions, total median width, and effective median width. The computer evaluates each half-mile segment independently and calculates V/C ratios. Two V/C ratios were computed by the Highway Capacity Manual *(3)* method: V/C with total traffic and V/C without trucks. This comparison was used to determine the impact of removing trucks from the mainstream of traffic. Two key parameters are determined by the program: effective median width (Figure 6), and improvement in V/C ratio by removing trucks. The computer program is described in detail elsewhere *(7)*.

THE COMPUTER PROGRAM

It was decided that a moving-analysis computer program could most effectively evaluate each individual segment and print the results in an easily interpreted format. Such a technique required an iterative, multistep type of development to identify the pertinent variables, to develop the analysis model, and to present the results in a meaningful manner.

Traffic V/C ratio calculated according to the Highway Capacity Manual (HCM) *(3)* proved to be the most meaningful method of analysis. Interpretation of the end results could also be done using traditional LOS comparisons. For each half-mile segment, the program calculated V/C ratios with and without trucks on the segment, using the procedures outlined in the HCM for basic freeway segments.

Upon starting each run of the program, the passenger-car equivalent from Table 3-6 of the HCM *(3)* for heavy trucks (≥ 300 lb/hp) was read into a four-subscript array. After data for a single half-mile segment were read, the computer located the appropriate table value based on number of lanes in a single direction, percent trucks, grade percent, and grade length. The array was then entered at the proper location to obtain the relevant value of E_T, passenger car equivalents. Next, the number of trucks was subtracted from total traffic to give the number of passenger cars. The proportion of trucks (P_T) was then determined; the proportions of recreational vehicles and buses were not separately considered. If 24-hr traffic volume had been input, the program calculated peak hourly volume V by multiplying the ADT by a recommended K value, the ratio of peak-hour traffic volume to average daily traffic, that had been entered in the RUNDATA file.

Service flow rate SF was calculated for existing traffic with and without trucks by dividing the respective peak-hour volumes by the peak-hour factor PHF in RUNDATA: $SF = V/PHF$. The V/C ratios were determined using the rearranged Formula 3–3 from the HCM *(3)*:

$$V/C = SF/[c_j \times N \times f_w \times f_{HV} \times f_p] \quad (1)$$

where

V/C = ratio of demand volume to roadway capacity,
SF = service flow rate,
c_j = capacity under ideal conditions (e.g., 2,000 passenger cars per hour per lane for 60 and 70 mph design),
N = number of freeway lanes in one direction,
f_w = factor to adjust for restricted lane widths and lateral clearances from Table 3–2 or the HCM *(3)* or input in RUNDATA,
f_{HV} = factor to adjust for heavy vehicles, and
f_p = factor to adjust for the effect of driver population input from RUNDATA. A value of 1.0 was used.

Each grade could be individually evaluated by the program, or a general terrain factor could be entered for each half-mile segment. If there were no grade data entered, the program used Table 3–3, "Passenger-Car Equivalents on Extended General Freeway Segments," of the HCM *(3)*, instead of the values in Table 3–6 for specific grades. An effective median width (the width between mainlanes less shoulders and obstructions) as described earlier and shown in Figure 2 was then computed and plotted for a particular half-mile segment. The computer output was verified by comparison with selected manually calculated V/C ratios and median widths; these gave identical results.

Base-Year Traffic

A portion of the computer program output for I-35 is shown in Figure 11. This information represents the base-year (1985) traffic demand. The section begins at Milepost 230.0 and ends at Milepost 243.0. Input variables printed with the associated output are Milepost (*MP*), peak-hour volume (*PHV*), number of trucks (*TRUCKS*) or percent trucks (*%T*), percent grade (*%GRADE*), grade length (*L*), terrain factor (*T*), number of lanes in each direction (*N*), and distance to lateral obstructions (*LAT*). The actual computer-generated evaluation criteria are shoulder-to-shoulder median width (*MEDW*), effective median width (*TW*), volume-to-capacity ratio for all traffic (V/C), volume-to-capacity ratio for traffic without trucks (*V/CA*), improvement in V/C (%V/C), and level of service at 70-mph design (LOS70), each printed out by half-mile segment.

The effective median width is evaluated according to the following categories: less than 36 ft, between 36 and 52 ft, and more than 52 ft. Exclusive truck facilities can be built at grade if the effective median width is at least 36 ft (see Figure 1). If the width is less than 36 ft and if other messages are not called, a message is printed out under the heading "IMPROVEMENT IN V/C," which overrides the actual plot of change in V/C. A good example is the section from milepost 230.0 to 231.5.

Future Traffic

Another feature of the computer program is its ability to evaluate future traffic growth scenarios. Within each county, the half-mile segment with the smallest base-year V/C ratio was selected for evaluation. Projections were made assuming an annual compounding of traffic volume within each county, using estimated growth rate factors.

The resulting output is very similar in format to the base-year tabulation. For each section of roadway, the current roadway geometry (number of lanes, etc.) is held constant. As the traffic volumes increase over time, the V/C ratios increase,

TTI TRUCKLANE ANALYSIS PROGRAM OUTPUT

ANALYSIS OF FULL ADT DATA: I-35

MP	PHV	TRUCKS	%T	%GRADE	L	T	N	LAT	MEDW	TW:	-36	36-52	52+	V/C	V/CA	%V/C	LOS70	IMPROVEMENT IN V/C 0% 50% 100% 150% 200%	OBS	COMMENTS
230.0	2160	173	8	5	1100	0	3	6	20	19	•			0.56	0.39	43	C:B	MEDIAN TOO NARROW	0	4MID
230.5	2160	173	8	-3	1500	0	3	6	20	25	•			0.56	0.39	43	C:B	MEDIAN TOO NARROW	0	
231.0	2160	173	8	0	0	0	3	6	20	25	•			0.45	0.39	15	B:B	MEDIAN TOO NARROW	0	WILLIAMSON CR
231.5	2160	173	8	0	0	0	3	6	20	25	•			0.45	0.39	15	B:B	MEDIAN TOO NARROW	0	
232.0	4360	349	8	4	1500	0	3	6	20	19	•			1.13	0.79	43	F:D	#### LOS = F ####	0	4MID
232.5	4360	349	8	0	0	0	3	6	20	25	•			0.90	0.79	15	D:D	MEDIAN TOO NARROW	0	
233.0	4360	349	8	5	1100	0	3	6	20	17	•			1.13	0.79	43	F:D	#### LOS = F ####	0	NO PLANS?
233.5	4360	349	8	5	1000	0	3	6	20	17	•			1.13	0.79	43	F:D	#### LOS = F ####	0	
234.0	4360	349	8	0	0	0	3	6	20	17	•			0.90	0.79	15	D:D	MEDIAN TOO NARROW	0	NO PLANS?
234.5	4360	349	8	-4	1584	0	3	6	20	17	•			1.13	0.79	43	F:D	#### LOS = F ####	0	
235.0	4360	349	8	6	1000	0	3	6	20	17	•			1.13	0.79	43	F:D	#### LOS = F ####	0	NO MED./NO E.H.
235.5	4360	349	8	0	0	0	3	6	20	17	•			0.90	0.79	15	D:D	MEDIAN TOO NARROW	0	
236.0	4360	349	8	4	1600	0	3	6	20	11	•			1.13	0.79	43	F:D	#### LOS = F ####	0	4MID
236.5	4360	349	8	-5	2600	0	3	6	20	17	•			1.20	0.79	52	F:D	#### LOS = F ####	0	NO PLANS?
237.0	4360	349	8	0	0	0	3	6	20	17	•			0.90	0.79	15	D:D	MEDIAN TOO NARROW	0	
237.5	4360	349	8	0	0	0	3	6	20	17	•			0.90	0.79	15	D:D	MEDIAN TOO NARROW	0	
238.0	4360	349	8	0	0	0	3	6	20	17	•			0.90	0.79	15	D:D	MEDIAN TOO NARROW	0	
238.5	4360	349	8	0	0	0	3	6	20	17	•			0.90	0.79	15	D:D	MEDIAN TOO NARROW	0	
239.0	4360	349	8	0	0	0	3	6	32	37		•		0.90	0.79	15	D:D	• I	0	
239.5	3760	301	8	3	2300	0	8	6	32	31	•			0.36	0.25	43	B:A	MEDIAN TOO NARROW	0	3MID
240.0	2800	224	8	0	0	0	8	6	32	37		•		0.22	0.19	15	A:A	- - - -I- - - -	0	
240.5	2800	224	8	-2	3000	0	8	6	32	37		•		0.27	0.19	43	A:A	- - - -I- - - -	0	
241.0	2800	224	8	0	0	0	8	6	32	37		•		0.22	0.19	15	A:A	- - - -I- - - -	0	
241.5	2800	224	8	-2	2700	0	8	6	32	37		•		0.27	0.19	43	A:A	- - - -I- - - -	0	
242.0	2800	224	8	0	0	0	3	6	54	59			•	0.58	0.51	15	C:B	• I	0	
242.5	2800	224	8	0	0	0	3	6	54	59			•	0.58	0.51	15	C:B	• I	0	
243.0	2800	224	8	0	0	0	3	6	54	53			•	0.58	0.51	15	C:B	• I	0	4MID

FIGURE 11 Computer program output for I-35—base year.

TTI TRUCKLANE ANALYSIS PROGRAM OUTPUT

ANALYSIS OF I-35 GROWTH: ADT * K AT MILEPOST 250.0   GROWTH FACTORS USED: 7.15% 1985 - 1989; 7.36% 1990 +

WILLIAMSON COUNTY: CRITICAL (HIGHEST) V/C PHV OCCURS BETWEEN MP 250.0 & MP 250.5

YEAR	PHV	TRUCKS	%T	%GRADE	L	T	N	LAT	MEDW	TW:	-36	36-52	52+	V/C	V/CA	%V/C	LOS70	IMPROVEMENT IN V/C 0% 50% 100% 150% 200%	OBS	COMMENTS
1985	1680	134	8	2	5000	0	2	4	54	53	: .	.	* :	0.70	0.46	52	C:B	: * I . :	0	2MID
1986	1800	144	8	2	5000	0	2	4	54	53	: .	.	* :	0.71	0.49	43	C:B	: *. I . :	0	2MID
1987	1929	154	8	2	5000	0	2	4	54	53	: .	.	* :	0.80	0.53	52	D:B	: * I . :	0	2MID
1988	2067	165	8	2	5000	0	2	4	54	53	: .	.	* :	0.86	0.57	52	D:C	: * I . :	0	2MID
1989	2215	177	8	2	5000	0	2	4	54	53	: .	.	* :	0.92	0.61	52	D:C	: * I . :	0	2MID
1990	2373	190	8	2	5000	0	2	4	54	53	: .	.	* :	0.93	0.65	43	D:C	: *. I . :	0	2MID
1991	2548	204	8	2	5000	0	2	4	54	53	: .	.	* :	1.00	0.70	43	E:C	: *. I . :	0	2MID
1992	2736	219	8	2	5000	0	2	4	54	53	: .	.	* :	1.07	0.75	43	F:C	: #### LOS = F #### :	0	2MID
1993	2937	235	8	2	5000	0	2	4	54	53	: .	.	* :	1.15	0.80	43	F:D	: #### LOS = F #### :	0	2MID
1994	3153	252	8	2	5000	0	2	4	54	53	: .	.	* :	1.31	0.86	52	F:D	: #### LOS = F #### :	0	2MID
1995	3385	271	8	2	5000	0	2	4	54	53	: .	.	* :	1.33	0.93	43	F:D	: #### LOS = F #### :	0	2MID
1996	3634	291	8	2	5000	0	2	4	54	53	: .	.	* :	1.43	0.99	43	F:E	: #### LOS = F #### :	0	2MID
1997	3901	312	8	2	5000	0	2	4	54	53	: .	.	* :	1.62	1.07	52	F:F	: #### LOS = F #### :	0	2MID
1998	4188	335	8	2	5000	0	2	4	54	53	: .	.	* :	1.74	1.14	52	F:F	: #### LOS = F #### :	0	2MID
1999	4496	360	8	2	5000	0	2	4	54	53	: .	.	* :	1.76	1.23	43	F:F	: #### LOS = F #### :	0	2MID
2000	4827	386	8	2	5000	0	2	4	54	53	: .	.	* :	2.01	1.32	52	F:F	: #### LOS = F #### :	0	2MID
2001	5182	414	8	2	5000	0	2	4	54	53	: .	.	* :	2.16	1.42	52	F:F	: #### LOS = F #### :	0	2MID
2002	5563	444	8	2	5000	0	2	4	54	53	: .	.	* :	2.31	1.52	52	F:F	: #### LOS = F #### :	0	2MID
2003	5972	477	8	2	5000	0	2	4	54	53	: .	.	* :	2.48	1.63	52	F:F	: #### LOS = F #### :	0	2MID
2004	6412	512	8	2	5000	0	2	4	54	53	: .	.	* :	2.67	1.75	52	F:F	: #### LOS = F #### :	0	2MID
2005	6884	550	8	2	5000	0	2	4	54	53	: .	.	* :	2.86	1.88	52	F:F	: #### LOS = F #### :	0	2MID
2006	7391	590	8	2	5000	0	2	4	54	53	: .	.	* :	3.07	2.02	52	F:F	: #### LOS = F #### :	0	2MID
2007	7935	633	8	2	5000	0	2	4	54	53	: .	.	* :	3.30	2.17	52	F:F	: #### LOS = F #### :	0	2MID
2008	8519	680	8	2	5000	0	2	4	54	53	: .	.	* :	3.54	2.33	52	F:F	: #### LOS = F #### :	0	2MID
2009	9146	730	8	2	5000	0	2	4	54	53	: .	.	* :	3.80	2.50	52	F:F	: #### LOS = F #### :	0	2MID
2010	9819	784	8	2	5000	0	2	4	54	53	: .	.	* :	4.08	2.68	52	F:F	: #### LOS = F #### :	0	2MID

FIGURE 12 Computer program output for I-35—future years.

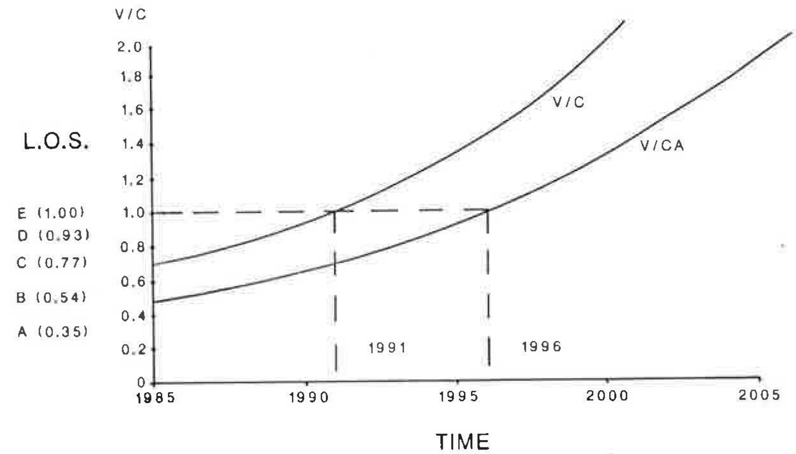


FIGURE 13 Plot of V/C projections for Milepost 250.0.

indicating a need for expanded roadway capacity. Other values held constant over the projection period were percent trucks, driver population characteristics, and truck operating characteristics. A portion of the computer output is included in Figure 12.

Figure 13 is a plot of anticipated V/C ratios with and without trucks at milepost 250.0 from Figure 11 values. Given the assumed growth factors, percent trucks, and driver population characteristics, the roadway capacity at LOS E will be reached in 1991 with mixed traffic, and in 1996 if trucks are removed. Other traffic growth scenarios can be evaluated in a similar manner.

FINDINGS

Two evaluations are possible from the analysis procedure described:

1. A comparison of changes in LOS on the existing facility with and without trucks.
2. A comparison of the length of time until traffic conditions reach undesirable levels.

Analysis of the I-35 corridor between San Antonio and Dallas revealed that the addition of exclusive truck facilities to remove trucks from the mainlanes of traffic would not be feasible for most of the study corridor if only existing traffic is considered. Approximately 90 percent of this section operates at LOS A or B; only 3 percent (7.5 mi) of the entire length of 247 mi operates at LOS D or worse. These congested segments of the freeway were all in or near urban areas where available median width for truck lanes is insufficient for desirable at-grade truck lane cross sections. Therefore, the only option in many of these critical sections is the elevated truck lane of Cross Section M-6 shown in Figure 1.

Figure 12 shows the utility of the program for evaluating future traffic projections. The growth rate for the county represented is expected to be very high—more than 7 percent per year. The length of time remaining until capacity is reached on the mainlanes will be 6 years with trucks, and 11 years without trucks. Fortunately, on this particular section of I-35, sufficient median width remains for truck facilities.

SUMMARY

This research has resulted in several accomplishments:

1. Establishment of critical geometric design elements for ETFs *(1)*.
2. Identification of typical cross sections to accommodate truck lanes within an existing median area.
3. Preparation of alternative access control configurations to serve ETFs.
4. Development of a moving-analysis computer program to evaluate geometric constraints and operational performance along a specific corridor.

The study procedure can be adapted to other locations where truck traffic poses unique demands on the system. Additionally, candidate sections of roadway can be readily identified using the computer program to examine alternative traffic scenarios.

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