Proposed Ramp Location Strategies

A Manual To Improve Frontage Road Traffic Flow Through The Planning And Coordination Of Ramp Locations With Anticipated Future Land Development

Prepared for the Texas Department of Transportation
by
The Center for Transportation Training and Research
Texas Southern University

Forward

The Texas Department of Transportation maintains more than 300,000 miles of highways and streets in Texas (TxDOT Pocket Guide, March 15, 2001). Over the next few decades, TxDOT and other officials will be challenged to manage more roadway miles with fewer resources and ever-increasing travel demand. New strategies must be incorporated within TxDOT's standard operating practices to accommodate more with the resources available. This volume offers one method to extend the utility of the highways under TxDOT's jurisdiction.

Acknowledgments

The research team thanks the Texas Department of Transportation's Office of Research and Technology Implementation for providing funding for development of this document and its predecessor *Evaluation of the Effects of Ramp Locations on Land Use and Development (0-1762)*. Maria Burke, P.E., Project Director, and Dr. Khali Persad, P.E.. supported the compilation of the important concepts included in this implementation report. Center for Transportation Training and Research staff Sharon Boxill and Khosro Godazi added to the data assimilation and editing phases of report development. Also, Dr. Jesse Horner prepared several graphics included herein.

Table of Contents

Chapter 1: Introduction and Purpose

1.1 INTRODUCTION

This document provides guidelines to support the recommendations and implementation proposals advanced in TxDOT report 0-1762, Evaluation of the Effects of Ramp Location on Land Use and Development. Case studies reviewing sites throughout the State of Texas contributed the findings and recommendations addressed in this manual. Herein, ideas are offered to assist planners and engineers in planning and designing ramp locations so as to encourage adjacent development in a way that enhances traffic operations and improves safety. By way of this manual, greater focus is suggested on access management strategies that minimize roadway conflict and aid flow from individual properties onto the transportation network.

1.2 PURPOSE

This manual is designed to assist TxDOT planners and engineers in making ramp location and design decisions that consider traffic resulting from adjacent properties and anticipate the type of land use improvements that might occur due to the ramp location. Further, the manual will help in evaluating potential land use and development outcomes of ramp decisions and anticipating how development subsequent to ramp placement may affect traffic flow. The document includes topics to discuss with city officials and developers when deliberating ramp location decisions.

1.2.1 General

This manual is designed to serve as a point of reference for planners and engineers working in the area of ramp location and access management at the Texas Department of Transportation (TxDOT). In particular, the manual:

- Describes how land use responses, can be coordinated to improve the long-term utility of TxDOT's frontage roads and ramps,
- Describes approaches to dialog relative to ramp location planning which includes TxDOT personnel, city officials and planners, developers.
- Defines the potential role of TxDOT personnel involved in the planning and the steps to be followed in maximizing coordination, and
- Delineates the rationale to pose to city officials and developers of adjacent properties relative to coordination.

This manual supplements the provisions of other TxDOT manuals, including, but not limited to "Highway Design Division Operations and Procedures Manual" and the AASHTO "A Policy of Geometric Design of Highways and Streets" (Greenbook).

1.2.2 Specific Problems to be Remedied by this Manual

Currently, there is communication between TxDOT engineers, city planners and developers relative to minimum standards affecting development or redevelopment of parcels. Most discussion centers on the developer perspective that the ramp location plays a large part in facilitating patron access to the property. The TxDOT and city planners are generally trying to accommodate individual developer requests within the bounds of safety, as opposed to determining the optimum design and traffic flow for the entire ramp and intersection area. Often decisions are often made on a parcel by parcel basis, as opposed to with an eye to the overall functioning of the entire ramp area. Further, decisions are made generally based on existing and known elements, as opposed to anticipated total build-out of a ramp area. This manual is written to increase the coordination and planning of developers, city officials and TxDOT engineers.

Stover and Koepke (1988) refer to a "cycle of obsolescence" that results from the construction of a transportation facility, development enticed due to the presence of the facility, traffic or safety problems resulting from the higher level of use, then the need for transportation officials to modify the facililty to accommodate the greater than anticipated use of the facility.

1.2.3 Outcomes From Manual Use

There are many positive outcomes that could accrue to TxDOT and its stakeholders emanating from successful implementation of points in this manual including the following:

- *For TxDOT*

    1. Reduced opportunities for speed discrepancies between through and turning vehicles; reduce the number of accidents
    2. Promote interchange efficiency
    3. Save TxDOT money from ultimate redesign resulting from increased traffic attributable to increased development
    4. Preserve highway capacity
    5. Positive return for relatively little time investment

- *For City or County Government*
    1. Reduced number of accidents
    2. Enhanced economic vitality
    3. Improved Safety

- *For Developer*
    1. Reduced delays exiting site
    2. Better overall use of land and improved site planning due to better location of driveways
    3. Positive return for marginal sacrifice in the way land is utilized

Chapter 2: Related Components in Existing Manuals

2.1 INTRODUCTION

Several of TxDOT's policies on interchange design and access management directly support improved coordination between ramp locations and land use. The key is for TxDOT to exercise extreme caution when granting variances to even "preferred" or "desirable" minimums expressed in existing manuals. There are many design elements that will directly contribute to long term utility of frontage and other roadways as traffic builds. The following sections provide a brief indication of the types of guidelines established and their sources. The reader may consult those documents for details regarding these policies.

2.2 TXDOT HIGHWAY DESIGN DIVISION OPERATIONS AND PROCEDURES MANUAL[1]

2.2.1 . Access control through deed restriction is provided as one option

2.2.2 Construction of frontage roads is the second option for access control. It is this second option that is the focus of this manual. In many areas in Texas, frontage roads are not merely an access to major highways, but rather are viewed as a transportation improvement in themselves that attract substantial additional development.

2.2.3 Deed restrictions may be used when right-of-way is purchased from abutting land owners.

2.2.4 The state cannot completely deny access to a property with compensation.

2.3 REGULATIONS FOR ACCESS DRIVEWAYS TO STATE HIGHWAYS[2]

2.3.1 The regulations for "access driveways" document guides the number, location and design of driveways. Those wishing to construct or revise a driveway to a state highway must secure a permit from TxDOT that stipulates the terms and conditions based on the driveway regulations.

2.3.2 The purpose of the guidelines is to provide both reasonable safety and access for property owners.

2.3.3 It is considered desirable to restrict access in the vicinity of the ramp gore area to assure maximum safety to the traveling public. The manual requires that access be denied for 300 feet for exit ramps (50 feet before and 250 feet after the junction

[1] TxDOT Highway Design Manual, pages 4-83 through 4-87.

[2] TxDOT, Regulations for Access Driveways to State Highways, Adopted September 1993, Revised August 1996, pages 6 through 9.

of the ramp with the frontage road). For entrance ramps the requirement is 100 feet before the ramp and 50 feet after the junction.

2.3.4 The length of frontage of an individual property determines design criteria such as minimum and maximum curb return radii, minimum island width, desirable and maximum driveway width, and driveway angles.

2.3.5 The location of ramps is controlled by limits on the maximum number of driveways based on length of frontage and by minimum and desirable corner clearance.

2.3.6 Minimum and desired separation distances between the ramp and the cross street is also specified.

2.4 ROADWAY DESIGN MANUAL[3]

2.4.1 The roadway design manual is to be utilized as a base for all TxDOT road projects. The manual notes that no document can cover every highway design situation, thus the guidelines may require modification for local conditions.

2.4.2 Section 2 of the manual addresses "design exceptions, design waivers, and design variances.

2.4.3 The manual requires significant deviations from the manual be documented and based on an objective engineering analysis.

2.5 OTHER RELATED TXDOT RESEARCH STUDIES

Several TxDOT research studies may prove interesting as engineers and planners deliberate about driveway access and potential traffic flow responses include, but are not limited to the following:

a. Project 0-1847; Identify Legal Issues and Regulatory Requirements Needed to Establish an Access Management Plan for Texas.
b. 0-1873 Investigation of the Impact of Frontage as an Element of Controlled Access Facilities.

2.6 SUMMARY COMMENT ON DESIGN DEVIATIONS

2.6.1 Strict adherence to "desirable" guidelines in the various highway manuals would prevent many of the traffic conflicts and problems identified in the case studies leading to development of this manual (documented in 0-1762, Evaluation of the Effects of Ramp Location on Land Use and Development).

2.6.2 A key point is that deviations from design standards are likely to compromise future roadway traffic flow.

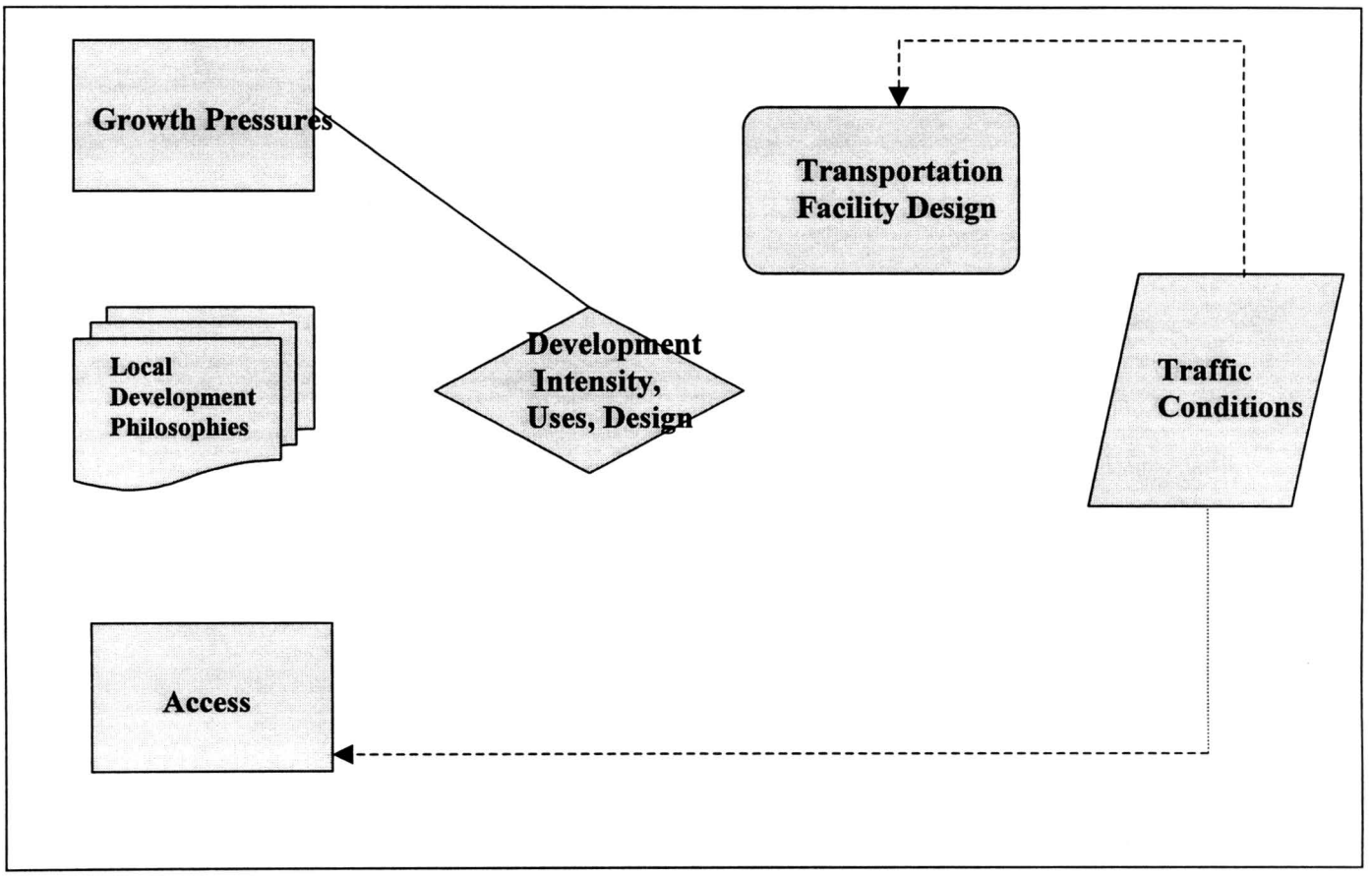
[3] TxDOT Roadway Design Manual (TxDOT on-line manuals).

Chapter 3: Strategies Designed to Increase Proactive Liaisons With Developers and City Officials

3.1 THE ISSUE

Freeway ramps are known to contribute to land use changes and serve as one of many stimuli for development. When this occurs, traffic increases may result in unanticipated circulation patterns and volumes that exceed design. Figure 3.1 shows the interactive nature of transportation improvements, resultant land development and then subsequent traffic outcomes.

Figure 3.1 Interactive Relationships Between Transportation and Land Development



3.2 STRATEGIES TO WORK WITH CITY AND COUNTY OFFICIALS AND DEVELOPERS

The specific steps and strategies delineated below for discussions with city and county officials and developers will aid TxDOT in assessing the future potential land use and the likely impact on traffic. The steps are not sequential; further, all steps may not be necessary for every case.

3.2.1 Recognize the benefits of coordinating ramp location with current and anticipated adjacent land uses. Although these steps are not sequential, a primary first is that local TxDOT engineers and planners recognize the benefits of coordinating land use and ramp locations and advocate for a high level of order between the ramps and anticipated adjacent land use.

3.2.2 Recognize and be prepared to discuss the residual and interactive effects of roadway, existing development and resulting induced development. In order to adequately prepare for the land development and ramp interface cycle, TxDOT planners and engineers need proactive liaisons with local officials. This will enable TxDOT to be apprised of land use and zoning designations, as well as upcoming plans for key locations in a community. The discussions should incorporate the nature of the ramp and its potential to attract development that may have otherwise occurred elsewhere. An important component of the dialog is for TxDOT to express the importance of land development requirements that mesh with the capacity of the adjacent roadway. Another important component of the dialog is alternate methods of accommodating increased volumes (See section 4.1 of this manual).

3.2.3 Try to get your local officials and developers on board with the concept ahead of time. Prior to a specific property and ramp location discussion, establish on-going dialog and relationship with city planners and engineers about the desire to better coordinate and manage traffic on frontage roads. Through formal and informal discussions with local officials and developers, speak positively of the benefits of internal circulation to the developer as coordinated driveway entrances allow higher overall capacity and improve safety with traffic flowing to and from the property better. Patrons to the development can experience a higher level of safety; further in the most congested conditions, queue time on frontage and access roads can be reduced and travel time improved. Additionally in some cases, shared access will allow customers patronizing several properties along the frontage road to travel from one to another without returning to the frontage road, thus decreasing the volumes on the frontage road.

3.2.4. Prepare to express disbenefits of the lack of coordination. The lack of coordination can increase conflicts on the frontage road, decrease roadway safety and advance the time when the roadway will reach

congestion, particularly in the ramp vicinity. Combine this discussion with a display of the interactive traffic responses of alternative circulation plans relative to ramp locations (See section 3.2.7 and Appendix A). Relate the alternate circulation options to safety ramifications, especially for city traffic officials.

3.2.5 Encourage developers of large parcels with multiple driveways to direct patrons to exits. TxDOT planners can take advantage of dialogs regarding proactive management of areas near ramps by encouraging developers to utilize interior signage to direct patrons to lower volume exits and those exits that would cause fewer conflicts on the frontage roads.

3.2.6 Review land use and zoning documents and comprehensive plans before making driveway and access decisions. Based on these documents, conduct analysis and assess potential traffic and circulation effects from land use and ramp location interactions based on the maximum and highest land utilization. Inquire about ultimate build-out options and the number of driveways that would be anticipated.

3.2.7 Utilize traffic simulation graphics to show conflicts and advantages of internal circulation. TxDOT can utilize simulation technologies to show local planners and developers the advantages of various strategies to accommodate interior traffic and improved management of driveway and ramp location interfaces.

3.2.8 Anticipate win-win solution is possible and look for advantages for the city and developer. If the TxDOT planner or engineer anticipates that the ultimate plans and development will be triggered or advanced due to improved access and the ramp location, diligently work to maintain the "desirable" level shown in the TxDOT Design Manual, resisting moving to the "preferred minimum" or "minimum" levels.

3.2.9 Consider pedestrians and non-motorized transportation. When preparing for new construction or modifications, explore designs that allow for pedestrian and non-motorized transportation, particularly in key urban areas. Despite the vehicular orientation of ramps and land development interaction, many developments draw bus patrons, patrons on bicycles and pedestrians. Persons traveling by these modes must be properly prepared for during the planning and design phases to ensure their safe operation and to handle the interface between these modes and vehicles.

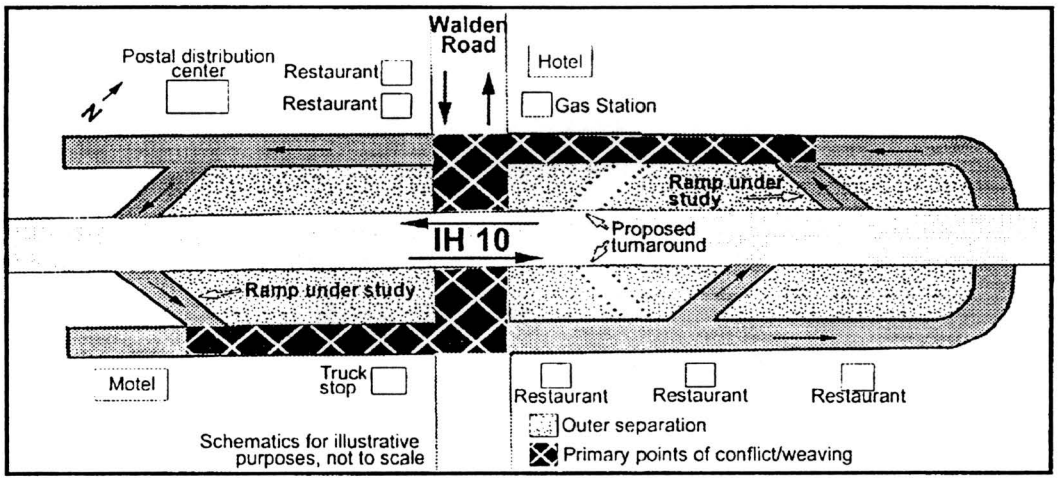
3.3. POTENTIAL TRAFFIC CONFLICTS FROM DRIVEWAY LOCATION DECISIONS [4]

There are several traffic flow issues that result from too many driveway locations near a freeway ramp. Conflicts also may occur when the driveway locations are placed so as to allow traffic to cross several lanes to enter a driveway causing an

[4] Information displayed in the table reflects the traffic flow issues identified from TxDOT Research 0-1762.

unsafe maneuver (Figure 3.2). Beyond the traffic issues highlighted in Figure 3.2, Appendix A describes the type of additional potential conflicts that can be avoided with more coordination between transportation professionals, planners and developers.

Figure 3.2 Potential Conflicts From Too Many Driveway Entrances



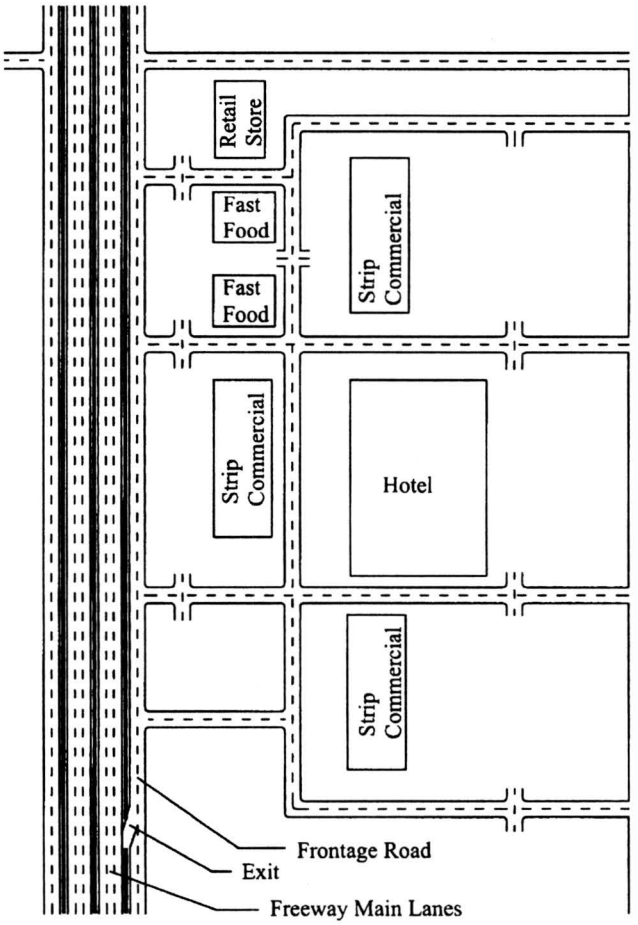
Chapter 4: INTERNAL CIRCULATION – REDIRECTING PATRONS TO SAFER EXITS

4.1 OPTIONS TO GRANTING ADDITIONAL DRIVEWAYS NEAR RAMP LOCATIONS

The typical property owner desires a driveway so that each parcel or business may have access to frontage roads near ramp locations. The objective is to provide patrons easy acess to the various establishments. It is known, however, that too many driveways near ramps impede traffic flow and increase conflict. The objective of this section is to show options that will provide the same or better access to each parcel, while maintaining the "desired" levels of flow and safety per the TxDOT regulations for driveway access. Two kwy methods are available to maintain high levels of access to patrons, while managing the number and locations of driveways near ramps.

4.1.1 Increase attention to internal circulation. Shifting the traffic flow to occur on properties instead of along frontage roads offers several advantages. First, interior circulation relocates sorting of directional vehicles to on-site where speeds arelower and volumes less. Second, interior circulation facilitates the locating of driveways strategically to optimize flow along the frontage road and allows TxDOT and local traffic engineers to identify the most appropriate point for turning and merge movements. Also, the perception of visitors and patrons relative to traffic management and ease of circulating once on the property, as well as perceptions about accessing and exiting the property can be improved (Figure 4.1).

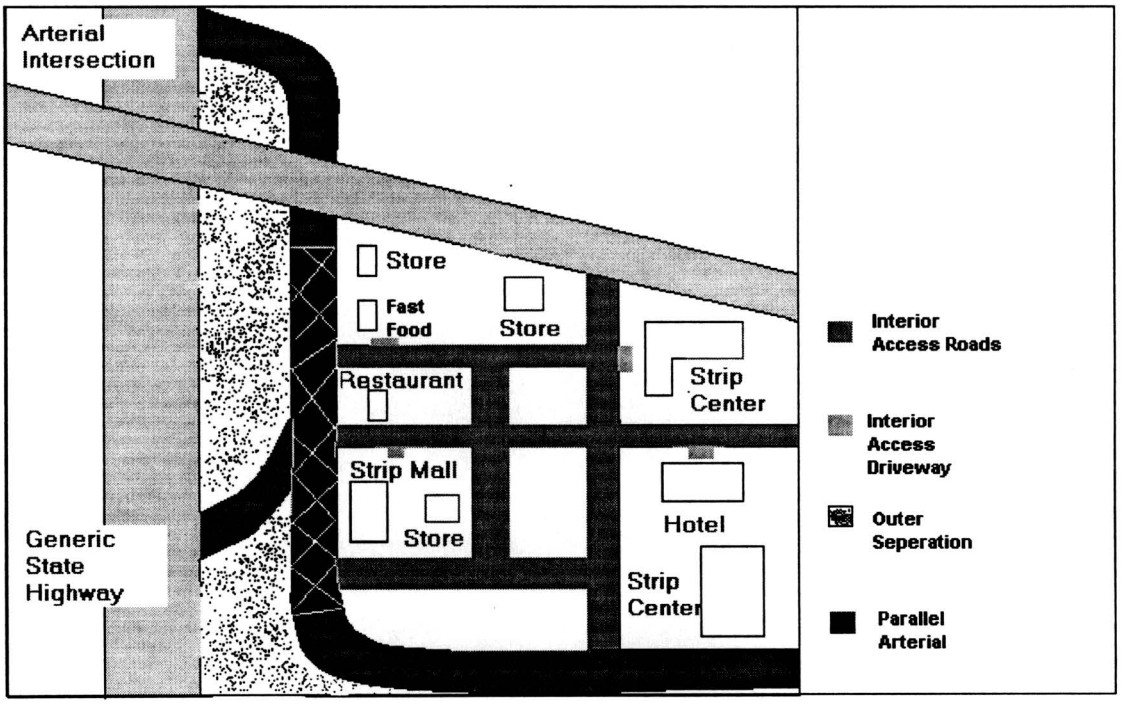
Figure 4.1 Internal Circulation Option



4.2 ENCOURAGING PARALLEL ARTERIALS

Provision of parallel arterials increases the opportunities for patrons to enter and exit the property. This type of street option also reduces the volume of traffic exiting along the primary frontage road near freeway ramps where volumes and speeds are high.. The dispersion of traffic over a broader area allows modulated and more disaggregated merging into major arterials and frontage roads and freeways. While either the internal circulation option or the parallel arterial option could be implemented independently, the benefit would be maximized if the used in combination to improve the traffic flow from developments in the vicinity of ramps (Figure 4.2).

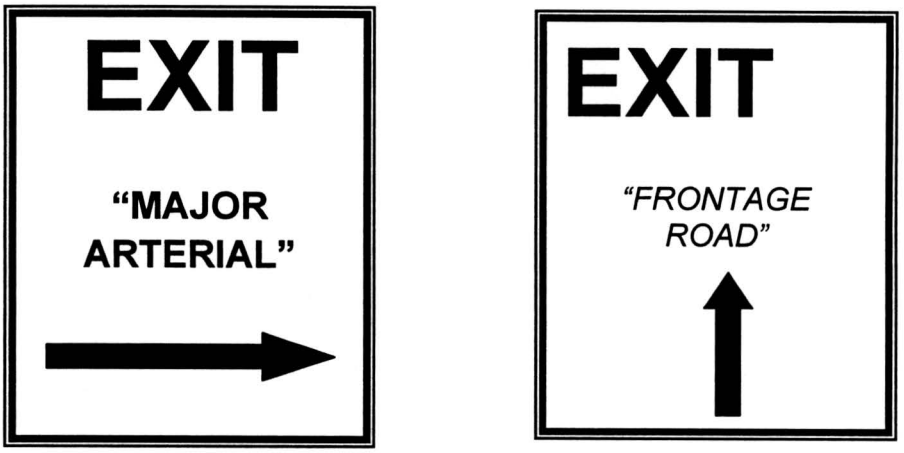
Figure 4.2 Combination Internal Circulation and Parallel Arterial Option



4.3 UTILIZING SIGNAGE TO REDIRECT PATRONS

Local officials and TxDOT planners and engineers should encourage developers to utilize signage on their properties to aid patrons to key egress locations. The signage should be devised to facilitate the patrons travel, by focusing on less congested and lower conflict exits (Figure 4.3).

Figure 4.3 Example Signage Directing Patrons to Alternative Property Exits



Chapter 5 Strategies For Improved Information To Motorists

5.1 ROADWAY SIGNS

Safety and traffic flow can be improved if travelers make more informed decisions in accessing properties near ramp locations. Section 6.1.1 recommends striping or physical separation to prohibit unsafe maneuvers by travelers as they egress certain ramp locations. Travelers should be provided information designed to facilitate their access to certain properties. In addition to permanent signs, dynamic message signs may also provide this information as a safety improvement measure. Figures 5.1 and 5.2 illustrate the type of information that can be conveyed on the dynamic message signs to alert motorists to make more informed egress decisions. TxDOT does provide these traveler message signs in many locations as a public information item; the thinking should be broadened to utilize the messages as a safety measure.

Figure 5.1 Message Alerting Travelers of Upcoming Establishments

Figure 5.2 Message Alerting Travelers of Upcoming Governmental Service

5.2 WEB BASED INFORMATION

Local officials and TxDOT should encourage merchants and public services to include directions on web sites that direct patrons to exit freeways at locations that improve traffic flow and minimize conflict with traffic exiting nearby ramps.

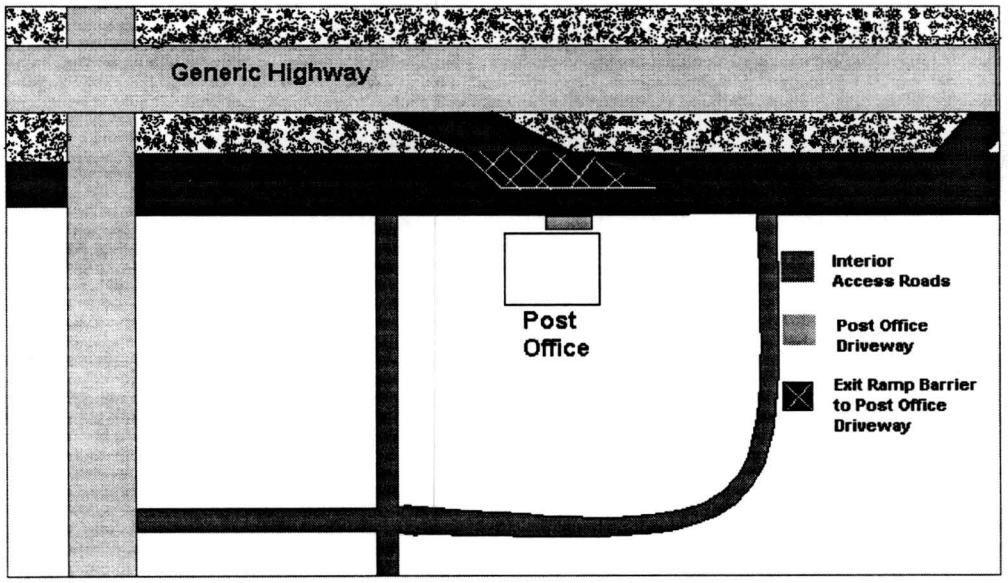
Chapter 6 Focus on Redesign and Ramp Modifications

6.1 RAMP REDESIGN AND MODIFICATION

In cases where TxDOT reverses ramps or redesigns a facility so that the original traffic patterns are altered, the revised traffic flow must be examined for new areas of impedance. This is particularly the case when the modification results in a more difficult access circumstance for driveways adjacent to frontage roads.

6.1.1 When desirable design standards no longer apply subsequent to ramp redesign and modification, TxDOT should examine its options to improve safety, such as signage or striping prohibiting turns or physically precluding undesirable traffic maneuvers. (See Figure 6.1)

Figure 6.1 Double Stripe or Physically Prohibiting Turn



6.1.2 When constructing a diamond interchange, locate the on-ramp as far from the interchange as practical and appropriate, given design standards and geographic parameters. This will allow a longer time for traffic entering the freeway to transition and merge onto the ramp.

6.2 TRAFFIC ENFORCEMENT

6.2.1 Support from law officers is periodically needed to enforce the signage and striping prohibiting unsafe traffic movements.

Chapter 7 Future Considerations

7.1 PROTECTIVE RIGHT OF WAY PURCHASE

Consider carefully anticipated future travel volumes on the facility when buying right-of way. Draw control of access line so as to maximize the traffic flow and protect the integrity of safety on the frontage road. This may require defining the "need for the roadway" broadly enough to purchase property allowing TxDOT to better manage the number of driveways to the frontage road. The result will be to limit the number of driveways to the frontage roads, requiring shared access between businesses in order to improve mobility and extend the useful life and utility of the frontage road.

7.2 "TRUCK ZONES"

When planning new roadways work with local officials to designate an intersection or area as a desired truck zone. Zoning or a comprehensive area plan are examples of tools that can be applied to encourage this concept. The purpose is to concentrate overnight and other major activities of through trucks in desired locations in order to increase convenience for truckers and reduce mixing with local traffic. These "truck zones" could include hotels, heavy truck fueling capabilities, eateries, as well as Intelligent Transportation System (ITS) weighing and tracking.

7.3 CONSIDERATIONS FOR PEDESTRIANS AND NON-MOTORIZED TRANSPORTATION

When preparing for new construction or modifications, explore designs that allow for pedestrian and non-motorized transportation, particularly in key urban areas. Despite the vehicular orientation of ramps and land development interaction, many developments draw bus patrons, patrons on bicycles and pedestrians. Persons traveling by these modes must be properly prepared for during the planning and design phases to ensure their safe operation and to handle the interface between these modes and vehicles.

Bibliography

Stover, V.G. and Koepke, F. J., Transportation and Land Development. Institute of Transportation Engineers, N.J. Prentice Hall, 1988.

TxDOT Highway Design Manual, pages 4-83 through 4-87.

TxDOT Pocket Guide, March 15, 2001, Texas Department of Transportation web page.

TxDOT, Regulations for Access Driveways to State Highways, Adopted September 1993, Revised August 1996, pages 6 through 9.

TxDOT Roadway Design Manual (TxDOT on-line manuals).

Appendix
Examples of Traffic Issues from Case Study Analysis

The case study analysis that identified issues arising from ramp locations and subsequent development led to the recommendations outlined in this manual. The first example below shows internal circulation; local planners and engineers' report that benefits have been realized at this location due to advanced planning. The next two contrast examples illustrate the types of traffic conflicts this manual is designed to alleviate and why coordination is advantageous to TxDOT, local officials and developers. The last example shows the opportunities available to address the interactive nature of ramp location and development.

Example A

Example A displays a ramp location with attention to internal circulation and coordinated driveways. The traffic volume at this location is high. While some traffic conflict still remains, the interfaces have been mitigated via the coordination and shared driveway arrangements.

Figure A.1

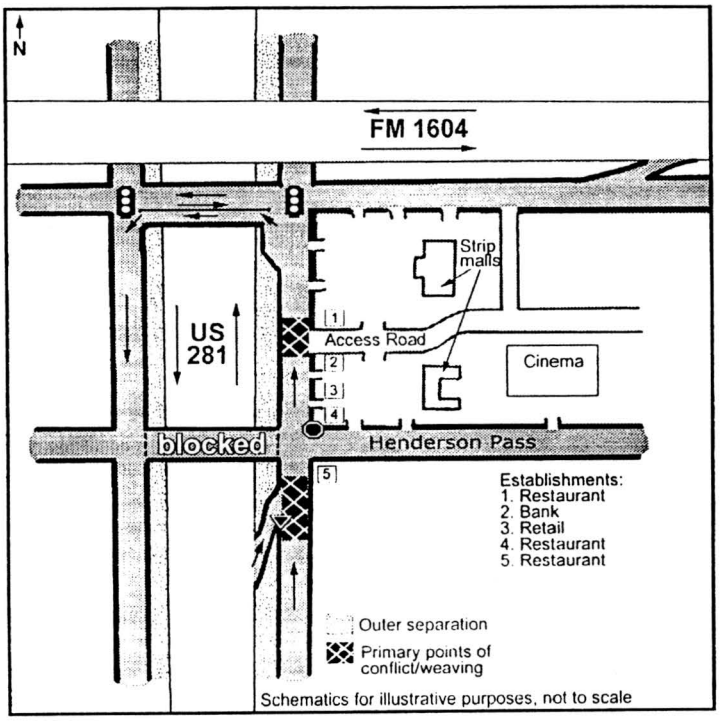
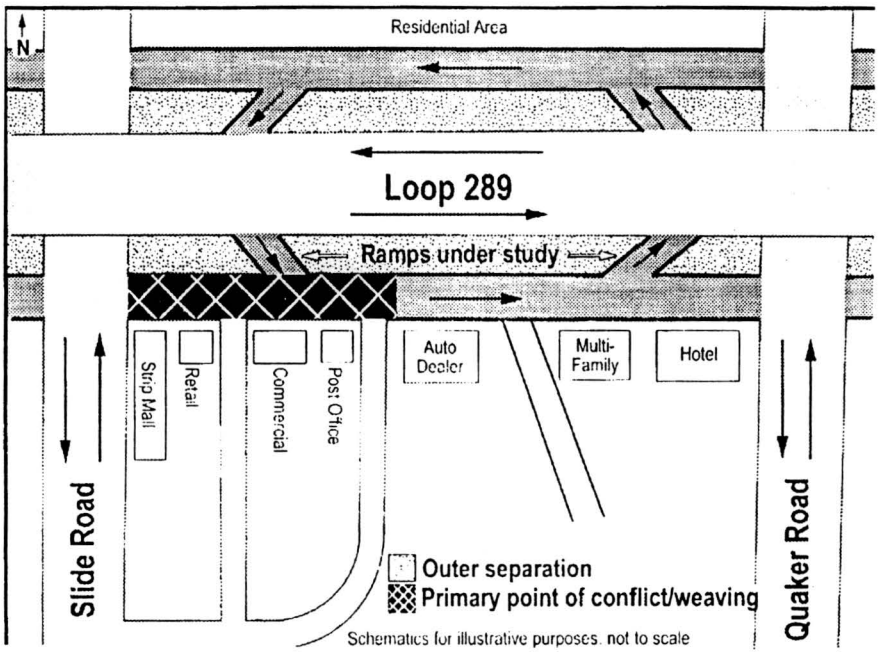


Figure 23. San Antonio Case Study Schematic

Example B

This example shows the safety issues arising from travelers that exit the freeway, then make an unsafe turn into the Post Office. During some periods, vehicles stop on the freeway off-ramp, waiting for traffic to clear in order to make the right turn into the Post Office.

Figure A.2



Example C

Example C exemplifies two issues. The first is the traffic condition arising from lack of internal circulation or alternative exits from the retail/commercial development. Patrons properly exiting the complex onto the frontage road cannot access the freeway on-ramp. Internal circulation with a driveway at a strategic point along the frontage road would enable patrons to enter the freeway, as would an exit to the adjacent arterial. The traffic conditions are exacerbated at this location as a major truck stop attracts a high volume of heavy trucks.

Figure A.3