Project Summary

Texas Department of Transportation

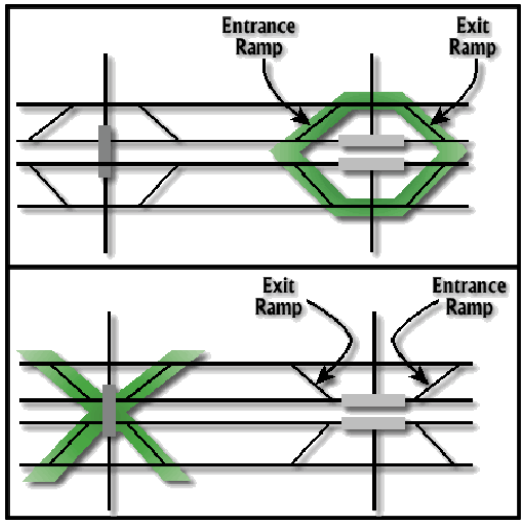
0-5105: Development of Guidelines for Ramp Reversal Projects

Background

Urban growth in Texas has placed tremendous demands on freeway systems. The cost of constructing new facilities or of expanding existing ones has increased at a rate greater than inflation. With main lane expansion becoming an ever-diminishing possibility, many Texas Department of Transportation (TxDOT) districts have modified various freeway elements to maximize efficiency and safety.

Braided Ramps in San Antonio, Texas

As development within freeway corridors increases, several changes to the transportation system occur, including increased traffic congestion and crash potential. In response, TxDOT has implemented improvements such as new ramps, grade-separated ramps, and frontage road U-turn lanes. In addition, TxDOT has modified the ramp configurations via ramp relocations and ramp reversals (ramp reversal is a replacement of an entrance ramp with an exit ramp or vice versa), often for the purpose of reducing vehicle queues at critical locations. The common purpose for each of these improvements is to maximize vehicular movement while minimizing cost.



Conceptual Illustration of X-ramps vs. Diamond Ramp

It is generally accepted that these improvements can be effective in mitigating freeway congestion. However, because of funding and personnel constraints, it is crucial that the various improvement strategies can be easily prioritized according to their expected cost-effectiveness. The general questions motivating this research were:

- When and where should TxDOT consider the use of ramp reversals?
- How should ramp reversal projects be evaluated?
- When and where should TxDOT use an X-ramp pattern as opposed to diamond ramp design for freeway interchanges?

What the Researchers Did

The research team performed a state-of-the-practice literature review that concentrated on ramp reversal, X-ramp interchanges, braided ramps, frontage road operations, weaving analysis, access management, and simulation modeling. Next, researchers surveyed the TxDOT districts to obtain key information on planned and previously implemented projects that involved ramp reversal components.

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Detailed case study evaluations of 15 sites were performed to assess the operational, safety, and basic economic impacts resulting from ramp modification projects. The research team then developed a project evaluation process and framework to serve as a high-level guide for determining whether or not a ramp reversal, X-ramp, or braided ramp project is worthwhile to implement. Finally, researchers formulated guidelines and a checklist to further assist TxDOT engineers in planning and implementation of successful ramp modification projects.

The final product of this research was a guidelines document to assist TxDOT staff in the evaluation and implementation of ramp modification projects. The framework for the guidelines was based on the three themes for the Texas access management program:

- improve safety and mobility,
- provide reasonable access to developments, and
- promote local government partnerships.

Based on this framework, the 21 guidelines for successful implementation were further divided into five categories: educational, encouragement, engineering, enforcement, and evaluation.

What They Found

The research team found that much of the essential guidance on topics such as distance between successive ramps, frontage road operations, and revised freeway access already existed. Eighteen TxDOT districts responded to the survey and provided information on 36 projects throughout the state. X-ramp corridor projects made up approximately half of the total and almost two-thirds of projects were implemented on interstate highway facilities. Safety issues were the most cited rationale for implementation of ramp modification projects (69% of projects). Political and/or developer requests were a rationale for almost half of the projects included in the survey (42% of projects).

Lessons learned from the case study evaluations indicate that operational impacts such as system delay, volumes on the main lanes and frontage road (between ramps and at the cross-street intersections), and queuing, either were positive or had no measurable impact for all of the 15 sites. The one negative operational outcome at the majority of sites was that frontage road volume between ramps significantly increased, sometimes creating capacity issues that were not anticipated or accounted for. When data were available, evaluation of safety impacts (e.g., main lane and frontage road crash rates and removal of queue spillback) revealed safety benefits. (While it is difficult to quantify these benefits in pure numbers, it is inherent that this type of improvement is important to overall public safety). The evaluation of basic economic indicators such as sales tax receipts, property values and business development (e.g., commercial permits and facility expansions) revealed positive trends for the majority of sites.

What This Means

Overall, it appears that the operational, safety, and basic economic impacts of ramp modification projects are primarily positive in nature. The detailed case study evaluation data and anecdotal information from stakeholders of previously implemented projects support further implementation of both ramp reversal and X-ramp corridor projects by TxDOT.

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