In-Service Evaluation of Major Urban Arterials With Landscaped Medians — Conditions as of 2004

Background

The Context Sensitive Design (CSD) philosophy aims to develop projects that are sensitive to the specific conditions within the project area. CSD is influenced by the local culture and desires, and develops projects with input from highway users, local communities, and designers. Past research indicates a minimum “clear zone” is needed to protect travelers from striking fixed objects such as trees. Much of the research for fixed object collision frequency and severity is based on data from the rural highway context. WSDOT desires to evaluate the effects of clear zone design guideline deviations within an urban context, and to develop innovative design solutions.

The CSD approach is not license to lower the level of safety standards used in highway design, simply to achieve the desired aesthetic qualities — regardless of the needs and context of the facility. On the other hand, at times context-sensitive designs implement non-standard design solutions based on optimizing the tradeoffs. These solutions are developed by investigating the varied needs of the users and stakeholders, and objectively balancing these needs. Focusing exclusively on one user group or design objective (such as livability or mobility) will inevitably lead to designs that are not optimal.

The Problem

This research evaluates the safety performance of landscaped medians and other streetscape improvements on high speed urban principle arterials, including State Route (SR) 99 in Washington State. Findings contained in the first edition of this report are based on a before-and-after in-service evaluation of streetscape improvements made in SeaTac, Washington. Due to concerns for the safety of the traveling public, and in an effort to increase the attractiveness of the local communities, cities along arterials like SR 99 have proposed and are implementing streetscape redevelopment plans.

SeaTac was the first city to propose this type of streetscape redevelopment in Washington State. Of specific interest is whether the aesthetically pleasing landscaped designs change the accident rates and characteristics of these arterials.

What We Did

The Washington State Department of Transportation (WSDOT) adopted an in-service evaluation process to evaluate a broad range of collision, environmental, operational, and maintenance situations in the high-speed urban highway context. WSDOT formed agreements with cities including SeaTac, Des Moines, Federal Way, Kent, Shoreline, Mukilteo, and Kenmore to evaluate their innovative designs. This evaluation is intended to help WSDOT and its partner cities understand the overall impacts and benefits of these context-sensitive designs. The research findings will inform policy makers by illustrating both quantitative and qualitative measures of design tradeoff impacts within the urban context.

Purpose: To evaluate various median landscaping plans in order to better define safe and attractive streetscape options on high-speed urban highways.

What We Found

The research findings inform policy makers by illustrating both quantitative and qualitative measures of design tradeoff impacts within the urban context.

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Research notes

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What We Found

The research findings inform policy makers by illustrating both quantitative and qualitative measures of design tradeoff impacts within the urban context.
Arterials such as SR 99 are typically characterized by an unattractive streetscape with high accident rates and severities. The cross section through SeaTac consisted of five lanes with a center two-way left-turn lane (TWLTL). There were wide, paved shoulders without sidewalks, minimal access control, transit stops with few crosswalks, and unsightly overhead utility lines. The posted speed limit is 40-45 mph, with average daily traffic volumes between 27,000 and 49,000 within the 2-mile project section.

**After: Redevelopment Projects**

The redevelopment projects incorporate changes in the roadway geometry, access control, and signalization. Specific features in SeaTac include:
- Five through lanes with a business access and transit (BAT) lane in the southbound direction
- Sidewalks and street trees
- Landscaped medians with turn pockets
- Signal improvements for vehicles and pedestrians
- Underground utilities
- Driveway definition and consolidation

**Tradeoffs in the Urban Context**

Some of the elements in these projects may be viewed as presenting drawbacks. For example, medians reduce opportunities for mid-block movements, which may increase the number of accidents at intersections and concentrate other conflicts at mid-block left turn lanes. The potential safety impacts of placing trees within the Design Clear Zone include an increase in the likelihood of severe injuries involving tree collisions given the speed of the facility. Effects that trees may have on pedestrian crossing behavior, involving tree collisions given the speed of the facility, the Zone include an increase in the likelihood of severe injuries and the lack of trees at these locations.

**What We Learned**

Findings from the first two phases of SeaTac’s redevelopment project analyses are shown and indicate no statistically significant change in frequency or severity of crashes. Crashes in the combined study area increased slightly, while SeaTac Phase 1 showed a slight decrease.

**Analysis Plan**

The research for this project is occurring in two distinct qualitative forms: 1) the analytical process of comparing crash frequencies and severities and determining significant differences, and 2) the development of multi-variate statistical models to demonstrate the factors that contribute to the frequency or severity of crashes. The data consist of accident reports from three years prior to construction and following project completion. Detailed geometric and traffic data were also collected for before and after conditions. An additional measure of safety investigated is the landscape maintenance reports from the City of SeaTac. These data illustrate different aspects of tree collision frequency and severity than the accident data are able to capture.

**Multi-Variate Models**

The multi-variate models developed follow the Poisson and multinomial logit forms. Negative binomial models were also investigated, but the data were not found to be overdispersed. One set of models included all of the data along the project sections. The second set of models excluded the accidents occurring at intersections. These accidents were excluded because it was believed that they might skew the data given the high proportion of accidents occurring at intersections and the lack of trees at these locations.

**Tradeoffs**

- Medians
  - Eliminate conflicts in TWLTL
  - May deter pedestrian mid-block crossings or serve as a "refuge"
  - Reduce opportunities to access businesses adjacent to the road
- U-turn/left-turn pockets
  - Provide access to businesses
  - Introduce new movements into the traffic stream
- Trees in medians and along sidewalks
  - Aesthetic definition of the streetscape
  - Introduce fixed objects within the Design Clear Zone
  - May reduce visibility
  - Require maintenance

**Severity Model**

Crash injury severity models were developed using the multinomial logit (MNL) method. The injury severities were split into three discrete choice/outcome categories: property damage only (PDO), injury crashes (evident, disabling, and fatal injuries), and possible injuries. One of the limitations in the data that lead to this structure is the low frequency of fatal and disabling injury crashes. By combining all injury levels there are sufficient data to estimate coefficients. The most significant model results are shown below.

- When a pedestrian or bicyclist is involved, there is an increased probability of injury, typically to the non-motorized traveler
- The lane separation variable tends to reduce injury accidents Before, but contributes to a higher probability of injuries After
- Fixed objects associated with increased injuries Before, and reduced possible injuries After
- The variable for trees along the west side is associated with increased property-damage accidents

**Tree Maintenance and Collisions**

SeaTac supplied supplementary maintenance information about median intrusions and tree maintenance activities. The frequency of tree incidents offers qualitative insights into the potential future impacts of median and roadside trees once they have reached maturity.

- The City of SeaTac provided maintenance records for median trees between 1997 and 2003.
- Within the 3-year analysis timeframe, 36 trees were replaced, ~90% due to vehicle strikes
- A total of 8 trees were related to collisions reported to the police, and only one resulted in an injury. This maintenance data indicates that approximately 24 additional trees were impacted during unreported collisions. These incidents represent interactions between vehicles and trees, even if they did not result in sufficient damage to the vehicle or occupant to warrant being reported to the police as a collision.