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Think Jersey DOT

Tech Brief

Safety Comparison of Roadway Design Elements on Urban Collectors with Access

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BACKGROUND

- Motor vehicle crashes are among the leading causes of death and disability in the United States. In 2006, Fatal Analysis Reporting System of the U.S. Department of Transportation in the National Highway Traffic Safety Administration (NHTSA, <http://www.nhtsa.dot.gov>) division reports that 42,642 people died in motor vehicle crashes, while 2,575,000 people were injured in these crashes. Among these crashes, urban areas accounted for 45 percent of the fatal crashes and 44 percent of the fatalities. Moreover, in 2006, 63 percent of all urban crashes occurred on roadways where the posted speed limit was 50 mph or less.
- Ever increasing congestion of our roadway system has also caused a rapid increase in the number vehicular crashes increases. As a direct result of this alarming safety statistics, there has also been a welcomed increasing interest in enhancing roadway safety through safety research and safety conscious design, which are both mainly concerned *“with reducing the number of consequences of vehicle crashes”*.

WHAT'S THE PROBLEM?

- According to recent NCHRP and AASHTO reports, the safety effectiveness of many of the strategies in the guides has not yet been rigorously evaluated. It is clear that more research is needed to evaluate the effectiveness of various safety treatments. Research is also needed to better understand *“the safety record or history of different types of geometric features that have been constructed to improve the safety of arterial roads in New Jersey”*.
- The common way to evaluate the effectiveness of any safety improvement is to conduct before-and-after studies using the data collected before and after the safety treatments. To conduct this kind of comparative before-and-after safety evaluation study, first data should be collected from at sites *“where selected safety strategies have been implemented”*. Then, results of this evaluation study will be summarized to assist practitioners in selecting the appropriate strategy for

a number of candidate locations for future safety improvements in New Jersey. An important point in conducting these comparative before-and-after evaluation studies is the use of statistically robust evaluation methodology that will produce reliable results that minimize the bias in recommendations.

HERE'S THE SOLUTION

- The main goal of this study identified by NJDOT can be defined as “the quantification of the effects of management treatments on roadway operations and safety on urban collectors with access”.
- Since, urban collector road runs through highly diversified areas, various factors have to be considered when before-and-after comparisons of improvements in terms of safety are conducted in this study. For 25-40 mph urban collectors with access, these are:
 1. Increase in lane widths (10' or 11' to 12'),
 2. Construction of 4,6,8, or 10 foot shoulders,
 3. Removal of trees in median and border areas,
 4. Installation of guide rails, and vertical & horizontal geometry changes to improve sight distances.
- The following steps are conducted while performing before and after analysis for these countermeasures:
 - o Step 1: Before and after analysis via naïve approach
 - o Step 2: Before and after analysis via control groups
 - o Step 3: Before and after analysis via Empirical and Full Bayes approaches
 - o Step 4: Estimation Crash Reduction Factors (CRF) and Accident Modification Factors (AMF)
 - o Step 5: Analysis and interpretation of the results and recommendations.

THESE ARE THE OBJECTIVES...

The four major scopes of our study can thus be summarized as follows:

- Development of a statistically robust evaluation methodology that will produce reliable before and after analysis results.
- Development of CRF and AMF values that can be used to select candidate sites.
- Development of a report that compares the effectiveness of various safety improvement strategies and technologies based on the empirical study coupled with the review of the literature.
- Provide recommendations to understand the safety improvements to different kind of urban collectors with access.

HERE IS WHAT WE DID...

- Rutgers University research team first conducted a detailed literature review regarding the impacts of different safety improvements on the road safety. Then, several different road sections were selected from New Jersey and other states (California and Ohio) where safety improvements have been implemented. For each of these individual sites before and after crash data were collected in addition to geometry and traffic data.
- Using the information obtained regarding the treatment sites statistically robust evaluation techniques were developed to determine the impacts of safety improvements on urban collectors. Before and after analysis for these countermeasures was conducted via several approaches, including naïve approach, analysis via control groups, analysis via Empirical Bayes approach, and analysis via Full Bayes approach.
- After conducting before-and-after analysis, CRF and AMF values were estimated for each countermeasure. The individual CRF values and their relative order among different countermeasures are similar to each other. In particular, improvements in vertical and horizontal alignment results in highest reduction in the accident rate, followed by adding shoulders, median barrier installation, lane width increase, and guide rail installation.
- The total benefit of implementing a countermeasure includes the costs saved resulting from the number of crashes or crash severity reductions; and the total cost of implementing a countermeasure includes construction and possibly maintenance costs. The determination of benefits from countermeasures depends on projected crash reductions, which is calculated as the expected number of crashes without the countermeasures multiplied by a CRF. Thus, CRF is simply a quantitative statement of the percentage of crashes that a countermeasure is expected to reduce.

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