Toolbox to Evaluate the Impacts of Roundabouts

tech transfer summary

The toolbox provides information to assist transportation agencies in considering and integrating roundabouts within corridors or roadway networks.

Objectives

The "Toolbox to Evaluate the System Impacts of Roundabouts on a Corridor or Roadway Network" was developed to assist transportation agencies with assessing the impacts of roundabouts on a corridor or system in terms of transportation planning, corridor and network mobility, land use, flow conditions, access management, and other planning considerations (i.e., pedestrians, emissions). The toolbox will allow agencies to consider the "big picture" rather than assess the safety and/or operational impacts of isolated roundabouts.

Background and Problem Statement

Intersections introduce conflict. Each time a new intersection is planned and constructed, new vulnerability has been incorporated into the roadway network. Conflict not only introduces the potential for crashes, it also initiates delay when turning vehicles impede traffic. Traffic signals and stop signs are common treatments used to assign right-of-way at intersections and are proven to be compatible with each other within a roadway network. Alternatively, modern roundabouts provide a self-regulating intersection strategy whereby drivers chose their own gaps in the traffic stream. However, questions remain about the compatibility of signalized intersections and roundabouts along the same corridor.

Roundabouts are typically considered individually to address operational and/or safety needs at an isolated intersection or along a section of a roadway. More often than not, at the project level, little consideration is given to how a roundabout may impact an overall roadway corridor or

Roundabout

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RESEARCH PROJECT TITLE
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network. As a result, a roundabout at one intersection may solve safety and operational problems or address other needs, but it may also adversely affect the corridor performance if adjacent intersection traffic control is not also evaluated. Signal timings, phasing, and coordination with other signals may be compromised, as platoons dissipate at a roundabout.

Research Description

The information in the toolbox was developed by summarizing available information and conducting several evaluations. Common concerns and strategies are presented in the report. Case studies are used to illustrate how other agencies have successfully addressed challenges. The toolbox discusses how roundabouts can be incorporated in comprehensive planning so that they can be considered early in the planning process. The impacts of incorporating a single or series of roundabouts within a corridor are described.

The research team evaluated the impacts of incorporating a roundabout within two signalized corridors using traffic simulation. The impacts on travel time and delay were evaluated. The toolbox includes discussion of the following issues:

- Use of roundabouts in various land-use settings
- Impact of roundabouts on system-wide mobility
- Experience of several agencies in Wisconsin, Oregon, and Colorado
- Use of roundabouts in a corridor as part of access management
- Impact of roundabouts on other planning considerations, including a summary of available information about the air-quality impacts of roundabouts as well as pedestrian and bicyclist needs
- Performance of roundabouts in situations where unbalanced flows exist.

Unbalanced flow at roundabout

Since little information is available, the team conducted a case study. Various balanced and unbalanced volumes were evaluated and compared to determine the impact of unbalanced flows on travel time and delay.

Key Findings

Delays at the roundabout were considerably less than those at the signalized intersection, regardless of whether the volumes were balanced or unbalanced. The scenarios with balanced flows had similar delays and queues, but an intersection does not often have completely balanced flows.

The unbalanced flows at the roundabout resulted in average delays for all the approaches, within four seconds of each other. The smaller, minor approach volumes at the roundabout did not have a great impact on the major approaches for an intersection with 10% and 25% left turns (both with 10% right turns). The signalized intersections showed a much higher variability in delay between approaches and scenarios.

As was shown by this sensitivity analysis, the roundabout performed substantially better than the optimized signal during the peak hour at this isolated intersection with 10% and 25% left turns.

Recommendations

Roundabouts should not be ruled out as a viable alternative at an intersection with unbalanced flows. Intersections should be evaluated to consider all solutions, including roundabouts, when addressing safety and operations for both existing and new intersections.

This analysis did not address the potential delay to traffic on the major or minor routes during off-peak periods due to the roundabout (i.e., all traffic having to reduce speeds at the intersection). However, it is known that the safety implications of roundabouts (i.e., near elimination of right-angle, high-speed crashes) should be a part of the balanced intersection analysis for all hours of the day.

Additionally, the analysis could not consider effects such as platooning, as it was evaluated in isolation. However, the results suggest that roundabouts can be effectively used in situations where unbalanced flow exists and a signal would have been the alternative traffic control.

The analysis also did not address the situation where a roundabout would replace 2-way stop control. In all cases, each potential alternative should be evaluated for the existing situation before selecting the best alternative.