PLANNING AND OPERATIONAL MODELS FOR ROUNDABOUTS

A Dissertation Presented

by

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ABSTRACT

This dissertation focuses on public acceptance and operational modeling of roundabouts. First, the issue of roundabout implementation in Maine, New Hampshire, and Vermont is addressed. Locations of roundabouts built between 1995 and 2010 were collected. More importantly, locations of not-built but technically feasible roundabouts were also included. These locations, which would not usually be cataloged, allowed for a more complete analysis of the factors associated with roundabout implementation. The goal of this research is to advance the knowledge and understanding of roundabout opposition. Results suggest that demographics, built-environment, exposure, and proximity to other roundabouts impact the likelihood of a technically feasible roundabout proposal being implemented. The findings reinforce that unique challenges exist when proposing a roundabout in northern New England.

Second, this dissertation focuses on operational modeling of single-lane roundabouts by collecting innovative data on entering driver behavior using new video-based methods. Entry behavior at a roundabout is generally modeled using gap-acceptance methods; this assumes that a driver enters the roundabout only when there is a sufficient gap in the circulating traffic. However, this is widely discussed as not always being the case. Traffic interactions at roundabouts are dynamic and complex because of the non-compulsory nature of yield-at-entry. Adding to this complexity is the temporal variability of a single driver, heterogeneities between drivers, and the characteristics of varying complex interactions that can lead to very diverse driver behavior and priority reversal. Findings from real-world video collected at five roundabouts in Maine, New Hampshire, Vermont, and New York suggest that non-compliant types of behavior (i.e., priority taking, abstaining, and surrendering) occur frequently and should be considered in modeling methodologies. Further, the data allow for robust documentation that priority taking and priority abstaining occur at all volume levels and that as the conflicting volume increases so does the relative frequency of each behavior type.

Finally, this dissertation presents the development and application of a new cellular automata model of traffic operations at roundabouts that explicitly accounts for non-conforming types of entering driver behavior identified from real-world data. This research addresses the deficiencies in current roundabout simulation models by allowing for transfers in and reversal of priority between traffic streams. Model results show that variations in conflicting traffic volume (i.e., arrival rate and turning movement balance) affect observed levels of priority taking and abstaining behavior. In addition, driver familiarity (i.e., reductions in priority abstaining behavior) has significant impacts on delay and queue lengths in certain traffic volume ranges.

Overall, this dissertation advances the state-of-the-art in understanding driver behavior at roundabouts as well as the methods used to model traffic operations. The results have profound implications for roundabout analysis and motivates larger-scale studies on driver behavior at roundabout entries. The spatial analysis of built and not-built roundabout locations confirms challenges for roundabout implementation and should be expanded as a method to study trends at the national level.
CITATIONS

Material from this dissertation has been submitted for publication to *Transportation Research Record* on August 1, 2013 in the following form: