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Final Report

Project Title:

Roundabout Design and Elderly Drivers

Project Number:	**Project End Date:**	**Submission Date:**
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Main Study: Background and Objective

Many drivers are apprehensive to accept a roundabout as a viable form of intersection, but their safety and mobility benefits are increasing their popularity among designers. This thesis is an in-depth study of a specific approach at a roundabout in Bangor, Maine. The location was previously two separate "T" intersections, one of which was a high crash location. The reduction in reported crashes at this location after installation of the roundabout warrants a performance evaluation that not only looks at all the drivers using the intersection as a whole, but also focuses on different groups of users to determine, if there is a problem, where it may lie within the population.

Methodology of Main Study

The performance evaluation conducted in this thesis began by looking at the critical gap value for a specific approach to the roundabout, a value at which 50% of the users would accept a gap in the conflicting traffic stream. This was done for the following groups: Drivers aged <20, 20-29, 30-39, 40-49, 50-59, 60-69, 70+, males only, females only, and whether or not a cell phone was in use while negotiating the merge into the circulating flow.

These critical gap times were then used to calculate an average delay that drivers utilizing the roundabout experience, which was in turn used to determine the level of service for that approach.

Results and Conclusions from Main Study

It was found that the <20, 70+, and cell phone groups had a higher critical gap value, leading (through delay equations) to a lower level of service. However, these findings are not validated because not enough data was collected within each of these groups. The reason for this is the location of the roundabout, which is in a somewhat industrial area that does not see many drivers that are on the extreme ends of the data spectrum and the number of drivers using a cell phone were a small proportion of all the drivers observed. In total, 2,366 observations were made with only 26 being under the age of 20, 64 being 70 years old or older, and 162 using a cell phone.

The average actual delay times experienced by drivers was also measured and compared to three methods for estimating delay to evaluate the accuracy of the estimation methods. Two of the three methods are new equations offered by the 2010 edition of the Highway Capacity Manual (HCM 2010). It was found that the HCM 2010 overestimates the delay times, which has the potential to give an engineer or city planner the incorrect impression that a roundabout is not a viable option when it may very well be.

As an aside, the drivers using cell phones were categorized into the aforementioned groups to see which groups used cell phones the most while negotiating the roundabout. It was discovered that females used cell phones more than men at this intersection.

Fuel Consumption Study

The purpose of this study was to use field measurements to compare the fuel consumption of vehicles going through a typical roundabout in the United States to that of a nearby signalized intersection. Fuel consumption was measured with a fuel-gauge equipped vehicle passing

through the intersections multiple times. Each measurement started and ended with the vehicle being driven at the speed limit, 25 mph, and using a 'normal' non-aggressive driving style. The experiments lasted for 0.2 miles; 0.1 miles on either side of the midpoint of the intersections. According to these observations, a driver going straight through a roundabout would, on average, use 30.9 mL of gasoline as opposed to 45.4 mL of gasoline going straight through the signal, a savings of 14.5 mL. The savings for left turns would be even greater, or 15.6 mL; whereas right-turning drivers would save only 5.2 mL. A driver who goes straight through ten roundabouts of this type on a daily basis would use 29.8 gallons of fuel per year (over the 0.2 miles studied). If they instead went through ten signalized intersections, of the type studied here, they would consume 43.8 gallons a year. The savings of going through roundabouts rather than signals would amount to 14 gallons per person per year, a savings of 32% compared to the signal. If every licensed driver in the US were faced with this situation, though sometimes turning, the savings would amount to around 2.7 billion gallons per year or 1.5% of current fuel consumption.

Documentation

There are two papers and one Master's thesis that have resulted from this project:

T. Olaf Johnson and Per Gårder, "An Evaluation of the Effects of Different Driver Groups on Control Delay at a Low-Volume Roundabout Approach in Bangor, Maine. **Submitted** Aug 2011 to *Transportation Research Record*—the Journal of the Transportation Research Board

Per Gårder, "Fuel Consumption at a Modern Roundabout vs. a Signalized Intersection: A case study comparing two similar intersections in Bangor, Maine. **Submitted** Aug 2011 to *Transportation Research Record*—the Journal of the Transportation Research Board

"A Microscopic Evaluation of A Low Volume Approach at a Roundabout in Bangor, Maine," by Torey Olaf Johnson

Electronic copies of the papers and the thesis can be obtained from Per Garder by contacting him by e-mail at Garder@Maine.edu