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Performance Analysis of the Dowling Multi-lane Roundabouts in Anchorage, Alaska

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The first multi-lane roundabouts in Alaska were constructed in 2004 at the ramps of the Dowling Road/Seward Highway interchange in Anchorage. These serve as junctions for commuters accessing the Seward Highway. As vehicle traffic in Anchorage continues to grow, however, use of the Dowling roundabouts also increases. The roundabouts are currently operating at or near capacity, with long vehicle queues at their entrances during peak traffic hours. This research project examined the performance of multi-lane roundabouts and how drivers use them. Analysis showed that extended queues were due to unbalanced flow patterns at the roundabouts, causing high circulating flow in front of one roundabout. This high circulating flow resulted in low-capacity, high-delay queue values. Researchers also found that accident rates and danger to pedestrians had increased in the past two years. Modeling traffic flow patterns for several possible alternatives suggested that reducing the eastbound flow rate "upstream" of the roundabout by 70% of the original flow could result in an acceptable level of delay and queue length at the eastbound approach of the west roundabout.

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SUMMARY

The first multi-lane roundabouts in Alaska were constructed in 2004 at the ramp terminals of the Dowling/New Seward Highway interchange in Anchorage. The Dowling roundabouts are currently operating at capacity for a short period of time during the evening peak hours. The Dowling Road roundabouts offer a unique opportunity for traffic engineers to study the operating capacity of multi-lane roundabouts in the US. In addition, the safety performance of these multi-lane roundabouts has not been examined either. This study was designed to measure the operating performance and safety performance of the multi-lane roundabouts. We studied the operation of the roundabouts in both summer and winter operating conditions.

The data collection effort was initiated in the winter of 2008. The winter roundabout operation was video-taped on Wednesday, Dec. 17th, Thursday, Dec. 18th, and Friday, Dec. 19th in 2008. Data collection for the summer evening peak hours was completed on Tuesday, May 12th; Wednesday, May 13th; and Thursday, May 14th in 2009.

After data collection, turning movements as well as queue length and delay at the roundabouts during both the winter and summer peak hours were counted from the video records. The turning movement data were analyzed using software RODEL and SIDRA. The field-measured delay and queue length were compared to the numbers predicted by the two software packages and other available roundabout design guides.

Based on the data extracted from the video records, we found that the extended queue on the EB approach of the west roundabout was a result of the unbalanced flow pattern at the roundabouts, in which the EB entering flow rate was substantially higher than the other three entrance approaches. The unbalanced flow pattern also created a high circulating flow in front of the NB approach of the east roundabout. The high circulating flow for the NB approach explains why this approach of the east roundabout had low capacity and high delay and queue values.

After comparing our field data with those from roundabouts in the UK, Germany, and Australia, we found that the performance of the Dowling roundabout in terms of entry flow and circulating flow are slightly lower than those in the UK and Australia. But, the Dowling numbers are slightly higher than those from Germany. In the future, applying the Dowling data using the Germany models may be tested to see if the model produce better results than those used in the UK and Australia.

We then analyzed the data with RODEL and SIDRA. It is noted that our RODEL and SIDRA models were un-calibrated. The purpose of the analysis is to investigate how well RODEL and SIDRA can predict, in the project planning stage, the eventual field conditions. The results of our analysis show that the un-calibrated RODEL and SIDRA models both overestimate the capacities for the queued approaches. RODEL's capacity estimates are closer to the field measurements than SIDRA's.

For queue length and delay estimation, version 1.0 of RODEL can not model the queue length and delay of roundabouts in presence of right-turn channels. When only the delay and queue caused by the entering flow (without the right turn movements) are considered, RODEL overestimated delays and queue lengths for most approaches. SIDRA's estimation of queue length and delay appears to be more reasonable than RODEL's. However, when compared with field values, SIDRA underestimates the delay and queue length for the two roundabouts.

To find out potential measures for the reduction of the queue and delay at the EB approach of the west roundabout, we designed a series of VISSIM simulation runs to study how much reduction in vehicle flow on the EB entrance approach will result in an acceptable level of delay and queue on this approach. The simulation results show that a reduction of the EB upstream flow at 70% of the original flow can result in an acceptable level of delay and queue length at the EB approach of the west roundabout.

We also simulated the effect of No Turn On Red (NTOR) from the NB Old Seward Highway to EB Dowling Road. The results of the simulation show that NTOR does not appear to be an effective measure to reduce the queue length and delay at the EB approach of the west roundabout. The minimal amount of delay reduction can not justify for the large amount of increase in delay that the NB right turn movement at the Old Seward/Dowling would suffer, if turning on red from this approach were to be prohibited.

A separate investigation effort intended for the analysis of drivers' yielding behavior (i.e., yielding to pedestrians) was also carried out. Drivers' responses to investigators acting as pedestrians at the crosswalks of the Dowling multi-lane roundabouts during summer evening peak hours were video-taped. Although we carried out the plan as intended, the traffic condition was different from what we expected. Our investigation ended after involving in a near collision.

Based on our experience in the field, we found that the high traffic volume combined with long vehicle queue and delays at the entrance created realistic risk for pedestrians crossing the roundabouts during the peak traffic conditions (i.e., 15 to 20 minutes during the evening peak hour). We found that drivers would slow down for pedestrians who had already on the crosswalk in motion. But, very rarely would drivers react to pedestrians who stood still by the side of the road. We recommend that an emphasis be placed on designing exit lanes to facilitate active yielding for pedestrians in the design of roundabouts in the future.

Finally, vehicular accident records before and after the roundabout installation at the study site were retrieved for analysis. Based on the crash statistics of the SB terminal and the NB terminal from 1998 to 2007, we found that there were more events in every crash category (i.e., Property damage only, minor injury, and major injury) after the roundabouts were in operation. But, we also found that the crash rates had been decreasing every year after 2004, suggesting that drivers were learning to safely negotiate the roundabouts. Because we have only three years of data after the roundabout operation, we need to wait for a few more years before a fair assessment of roundabout crash rate in comparison with traffic signals can be made.