Introduction

Roundabouts have been increasingly used at intersections in the US over the past 10 years. The benefits of roundabouts include reduced crash severity and improved operations under low to moderate vehicle volumes with balanced demand. Because of these benefits, INDOT policy has been evolving to incorporate roundabouts into its portfolio of options for intersections on state highways. This research project investigated several considerations relevant to agency practice. Various operational analysis tools, including the Highway Capacity Manual methodology and the most commonly used software packages, were compared to see which ones best estimated the actual delay at a real-world roundabout. Gap rejection times were also measured at this roundabout to investigate whether the typical design values for roundabout operational analysis are representative of how traffic actually performs at roundabouts in Indiana. Finally, reviews of peer state practices on roundabout lighting and decisions on intersection treatments were conducted in order to recommend practices for use in Indiana.

Findings

The performance of a real-world roundabout (Spring Mill Road and 106th Street in Carmel, Indiana) was investigated in detail. Several different technologies were deployed at this intersection in order to analyze traffic performance. Bluetooth MAC address sensors were used to measure travel times across the four legs of the intersection, enabling the measurement of delay for each movement. Wireless magnetometers were installed at the approaches and in the circulating roadway of the roundabout in order to measure gaps and the behavior of drivers at the yield lines.

The delay measurements were used to compare several different analysis methodologies for estimating roundabout performance. VISSIM, SIDRA, ARCADY, SimTraffic, and the Highway Capacity Manual (HCM) were the methodologies under comparison. It was found that VISSIM and SIDRA yielded the most reliable results, while ARCADY had a tendency to slightly underestimate the delay, and SimTraffic and the HCM did not yield realistic delay estimates for the peak periods.
Over 45,000 rejected gaps were measured using the wireless magnetometer detector configuration. The observed headways were found to be substantially lower than the suggested values of critical headways that have been observed at a national headway. While these results are based on a single roundabout and a broader set of observations would be needed to make more general conclusions, the results suggest that critical headways are likely reduced as driving populations become more accustomed to roundabouts. For performance analyses intended for 20-year horizons, it is questionable whether longer headways based upon relatively new roundabouts with unfamiliar driving populations are the best representation of how motorists will drive the roundabout throughout its design life.

Fourteen states were identified as having explicitly stated lighting policies for roundabouts available in policy documents that were available online. Of these, nine states required roundabout lighting, four recommended it, and one stated that lighting was “warranted.” Based upon these findings, it is clear that the consensus among peer state agencies is that roundabouts should be lighted.

Finally, a review of peer state practices on site selection for roundabouts was conducted. Based upon a review of the criteria or considerations mentioned in the policy documentation and/or guidelines published by these peer states, a checklist of considerations was developed for use in the state of Indiana. This checklist is set up to identify favorable or unfavorable circumstances for roundabout deployment, and to encourage mitigation of problematic factors as early as possible in the planning process.

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