

JOINT TRANSPORTATION RESEARCH PROGRAM

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Evaluation of Alternative Intersections and Interchanges

Volume I—Roundabout Capacity and Rollover Analysis for Heavy Vehicles

Introduction

There is a recent trend of building roundabouts on high-speed roads, often with the considerable presence of heavy vehicles. With the increased presence of trucks on roundabouts, the issue of overturning has become a concern. Although some geometric, vehicle, and loading factors have been connected to rollover, the safety performance of roundabouts built on high-speed roads is not well understood. This study compared the heavy vehicle rollover risk for roundabouts on low- and high-speed roads, while also examining roundabout circulatory superelevation, aggressive driver behavior, roundabout readability, and nighttime conditions in the context of rollover. Moreover, the critical and follow-up headways were estimated for trucks and other vehicles at roundabouts located on the low- and high-speed roads and during daytime and nighttime conditions.

Findings

This research developed a methodology which was used to examine truck overturning at roundabouts. A generalized rollover model suitable for application to heavy vehicles was applied to field-observed semi-trailer speeds and paths to estimate their proximity to rollover at newly built Indiana roundabouts. This was done by introducing Δv , the difference between the critical rollover speed determined from the model and the actual speed.

The research detected no excessive rollover risk on the studied roundabout built on the high-speed road. The benefit of an inward-sloped circulatory roadway was too small to justify its introduction to design

practice. High speeds in advance of a roundabout, associated with aggressive driver behavior, did not result in a considerable increase in the rollover propensity at the roundabout. Although a larger deceleration rate on the roundabout approach was associated with a slightly higher rollover risk, a large safety margin was still preserved. Night conditions did not bring any increase in the propensity for rollover. Driver behavior tended to be more cautious under night conditions than during the day. A wider circulatory roadway may be associated with a lower rollover propensity by allowing drivers to compensate for higher speeds with a flatter path. An examination of literature and crash reports found that a cautious design of the truck apron is warranted. It should be easily mountable and marked conspicuously with texture and color different from the pavement.

This report revealed that heavy vehicles increased the critical headway and, in turn, reduced the entry capacity of roundabouts. Drivers of heavy vehicles, on average, accepted a 1.1 sec longer critical headway than drivers of passenger cars. The effects of nighttime/twilight conditions indicated additional capacity reduction caused by a 0.6 sec longer critical headway compared to daylight conditions. Likewise, drivers on dual-lane roundabouts in rural areas accepted a 0.6 sec longer critical headway than drivers on single-lane roundabouts in urban areas. It was determined that the gap-acceptance parameters for a single-lane roundabout on a low-speed state road were shorter than the national values, on average resulting in 30% higher capacity for Indiana conditions. In contrast, the estimated critical headway was larger for dual-lane roundabouts on high-speed state roads, resulting in 15% reduced capacity for Indiana conditions.

The findings of this report are based on low and medium traffic volumes presently observed on high-speed rural and suburban roads. Heavy traffic flow may affect driver behavior; therefore, studying such roundabouts in heavier traffic conditions might improve the results.

Implementation

The propensity for rollover at the studied roundabouts during the observation period was low. No considerable difference in the rollover propensity between the studied roundabouts on low- and high-speed roads was found. This finding does not provide a basis for recommending changes in the current design policy for roundabouts. It should be noted, though, that Indiana is in the early phase of introducing roundabouts on high-speed roads.

The estimated critical and follow-up headways may be used instead of the default national values in capacity and LOS evaluation by INDOT designers and traffic engineers.

The limited number of roundabouts available in this study prompts for a similar study in the future.

Recommended Citation for Report

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