Research Notes

Agreement No. 31867 Work Order No. 6 | Mar. 24, 2024

TRUCK ACCESS INTO ROUNDABOUTS

Background

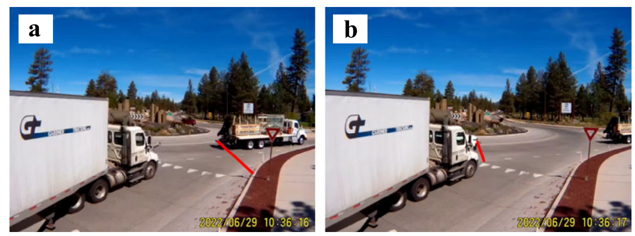
Heavy trucks can be described as featuring a gross-vehicle weight of over 26,000 pounds. These vehicles also have a longer footprint, larger turning radii, and greater required distances to achieve desired acceleration and deceleration. These innate characteristics influence the ways heavy trucks enter and traverse the circulatory roadway of a roundabout. Roundabouts have the potential to provide both safety and operational improvements, and are often designed to accommodate heavy trucks, but under congested conditions the entrance requirements are confounded by fewer available gaps on the circulatory roadway.

Study objectives included the assessment of three experiments to understand the accessibility of heavy trucks at roundabouts, develop recommendations for micro-simulation modeling, and to evaluate improvement potential through design and traffic control devices.

Study Outline

Task 1: Field Observations

A dataset of 2,626 heavy truck observations at roundabouts across OR and WA was developed. Six roundabouts were identified that met pre-established site selection criteria. Transcription of heavy truck classifications followed AASHTO and included observations of WB-40, WB-50, WB-62, WB-67, WB-67D, and WB-92D in the field. The WB-67 was the most common classification. Of the 2,626 observations, a total of 400 represented a heavy truck that rejected at least one gap before entering the circulatory roadway. Timing of accepted/rejected gap lengths permitted the development of critical gap curves using Raff's Method, where 50% of vehicles will accept a gap, while 50% will reject a gap of a specified length. The image below describes when a gap in circulating traffic was defined as (a) open and (b) closed.

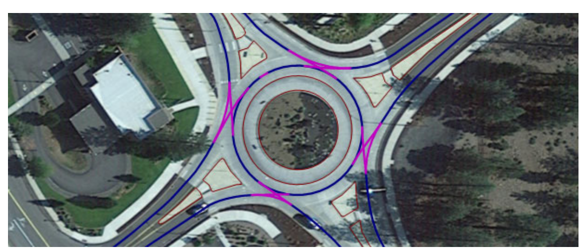


Gap Opens **Gap Closes**

Critical gap lengths were evaluated per-vehicle classification. Results showed a direct relationship between heavy truck size and critical gap, where an increase in size was correlated with a larger critical gap. The critical gap spanned a range of 1.0 sec, where smaller vehicles (WB-40) were associated with a critical gap length of 5.4 sec while larger vehicles (WB-92D) were associated with a critical gap length of 6.4 sec.

Task 2: VISSIM Simulation

Base VISSIM roundabout models were developed in reference to a field site in Sisters, OR using the 2011 ODOT Protocol for VISSIM Simulation.



Roundabout VISSIM Model

Four base models were developed for analysis, with two elements identified for additional consideration: (i) Heavy truck fleet and (ii) Method of unsignalized control. A total of 80 scenarios were modeled producing 800 simulation runs and accompanying analytics.

Two heavy truck fleet compositions were compared: The first fleet was the North American default VISSIM fleet, and the second was generated based on field observations from Study 1. The default fleet was comprised of smaller heavy trucks, and underrepresented the larger classes observed in the field. As such, models using field observations were a better representation of heavy truck behavior. Priority rules were found to be the preferred method of unsignalized control as compared to conflict areas in terms of gap acceptance modeling but required more data, time, and computing power to achieve the improved results.

Task 3: Heavy Vehicle Driving Simulator

A heavy vehicle driving simulator study was conducted with 41 CDL drivers to understand how implementation of geometric modifications, or the inclusion of traffic control devices (TCDs) can be used as a solution to address challenges. An example of the environment with gap lengths is shown in the image below.

Example Gap Length in Simulation

Three different roundabout geometries were modeled, (i) Traditional, (ii) Tapered, and (iii) Elliptical. The addition of roundabout metering was also investigated at either a near (115-ft) or far (230-ft) distance from the roundabout entrance.

Performance measures revealed that roundabout geometry influences heavy vehicle driver behavior, and that the choice of preferred modifications are dependent on desired project goals for specific locations. The elliptical design was associated with decreased stress for drivers but may not be suitable at locations where higher speeds are a concern. Placement of the roundabout meter was found to influence driver's velocity, with the far meter resulting in greater variations in acceleration and deceleration profiles as compared to the near meter position. Manipulation of roundabout geometry and the inclusion of TCDs can improve accessibility and driver consistency, which may ease negotiations with other road users and result in safer outcomes.

Research Recommendations

This three-phase study concluded that:

- WB-67 was the most common heavy truck observed and its use as a design vehicle is warranted.
- Generating heavy truck fleets by location produces the best model in VISSIM.
- If time and resources permit, the Priority rule is the preferred method for gap acceptance modeling in VISSIM.
- Critical gaps of 5.4s - 6.4s should be considered when modeling heavy trucks in simulation.
- Modifying the geometry of roundabouts can lead to enhancements for heavy trucks. However, project context should be the primary consideration.
- Roundabout metering affects heavy truck speed, metering devices are most influential if placed 115 to 230-ft in advance of the yield markings.

Research Benefits

This research provides insight into the accessibility of heavy trucks at roundabouts. The findings highlight considerations for roundabout planning and implementation along roadways with high heavy truck volumes and various classifications.

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To read the full research report go to:

[link to report if chose to publish]

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