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Evaluation of the Performance Measures of Two-Lane Roundabout and Turbo Roundabout with Varying Truck Percentages

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Abstract : The economy of any country is dependent on its ability to accommodate the movement and delivery of goods. The demand for goods movement and services increases truck traffic on highways and inside the cities. The livability of most cities is directly affected by the congestion and environmental impacts of trucks, which are the backbone of the urban freight system. Better operation of heavy vehicles on highways and arterials could lead to the network's efficiency and reliability. In many cases, roundabouts can respond better than at-level intersections to enable traffic operations with increased safety for both cars and heavy vehicles. Recently emerged, the concept of turbo-roundabout is a viable alternative to the two-lane roundabout aiming to improve traffic efficiency. The primary objective of this study is to evaluate the operation and performance level of an at-grade intersection, a conventional two-lane roundabout, and a basic turbo roundabout for freight movements. To analyze and evaluate the performances of the signalized intersections and the roundabouts, micro simulation models were developed PTV VISSIM. The networks chosen for this analysis in this study are to experiment and evaluate changes in the performance of the movement of vehicles with different geometric and flow scenarios. There are several scenarios that were examined when attempting to assess the impacts of various geometric designs on vehicle movements. The overall traffic efficiency depends on the geometric layout of the intersections, which consists of traffic congestion rate, hourly volume, frequency of heavy vehicles, type of road, and the ratio of major-street versus side-street traffic. The traffic performance was determined by evaluating the delay time, number of stops, and queue length of each intersection for varying truck percentages. The results indicate that turbo-roundabouts can replace signalized intersections and two-lane roundabouts only when the traffic demand is low, even with high truck volume. More specifically, it is clear that two-lane roundabouts are seen to have shorter queue lengths compared to signalized intersections and turbo-roundabouts. For instance, considering the scenario where the volume is highest, and the truck movement and left turn movement are maximum, the signalized intersection has 3 times, and the turbo-roundabout has 5 times longer queue length than a two-lane roundabout in major roads. Similarly, on minor roads, signalized intersections and turbo-roundabouts have 11 times longer queue lengths than two-lane roundabouts for the same scenario. As explained from all the developed scenarios, while the traffic demand lowers, the queue lengths of turbo-roundabouts shorten. This proves that turbo roundabouts perform well for low and medium traffic demand. The results indicate that turbo-roundabouts can replace signalized intersections and two-lane roundabouts only when the traffic demand is low, even with high truck volume. Finally, this study provides recommendations on the conditions under which different intersections perform better than each other.

Keywords : At-grade intersection, simulation, turbo-roundabout, two-lane roundabout
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