Optimal Size of Roundabout for Safety Considerations

Sewa Ram[a], Amal Jose[b]

[a,]Professor, School of Planning and Architecture, New Delhi,
[b]PhD Scholar, School of Planning and Architecture, New Delhi

Abstract

Recently, Indian roundabouts caused hundreds of fatal accidents due to their poor geometrical designs and unconventional driving behaviour. This study addresses safety concerns in roundabouts by analyzing different roundabout in India with varying sizes and traffic conditions. Study also identifies 240 roundabouts in India and 13 roundabouts of varied traffic conditions and vehicular composition are selected. We have investigated all conflict points of variable severities and locations on a roundabout. Research put forward solutions to reduce vehicular conflicts through optimization of sizes. This approach benefitted in reducing 32 conflicts points to 8 on roundabouts in such a way that all fatal conflicts are eliminated.

Background, Method, Results and Conclusions

The roundabout functions on the principle of yielding for the circulating flow by the entry vehicles. This behavior, however, is not observed in Indian context. Ideally, the design of roundabout should facilitate in conversion of major crossing conflict angle into minor crossing conflict angle (Crown, 1998). It is also observed that size and design of roundabout has a greater influence upon the severity of impact (HCM, 2000). The increasing popularity of roundabouts in India and other countries owes to their safety and operational benefits. Yet, urban roundabouts in India aren't safe due to concerns over geometrical design and driving behaviour.

Researchers, in the past decades, have made an effort to relate the capacity of roundabout with the size of roundabout, however the safety aspect has been generally neglected in finding the capacity of roundabout. The conflicting movement becomes even more severe with heterogeneous traffic operations. Smaller roundabouts have less speed but high degree of crossing conflict. This makes the roundabout vulnerable to safety concerns. On the other hand, larger roundabouts have relatively acute crossing conflict angle but higher operating speeds, again increasing the severity of conflicts. Further, for larger roundabouts, the crossing conflict points are far more scattered along the weaving length.

The study majorly focused on the geometrical design of roundabouts of difference sizes and traffic conditions. This research makes an effort to find out the optimal size of roundabout having safe and less severe conflicts for design vehicle. The objective of the research is to find out the optimal size of roundabout for varying flow condition and design vehicle with an intent of reduced conflict intensity. But, the safety issues and accidents due to driving behaviour is not addressed in this research.

Around 13 roundabouts were selected out of 240 roundabouts which were identified through web – survey. These 13 roundabouts were selected based upon varying size and geometrics. Further, it was also observed that the selected roundabouts varied in terms of traffic conditions and vehicular composition. To carry out the conflict analysis, path of vehicles was traced to locate the conflicts. This provided the crossing conflict angle and distribution of such crossing points across the weaving length. Impact of conflict was determined through spatial analysis and hotspot aggregation of conflicts. Change in momentum for single vehicle momentum differential across the vehicle was used to quantify the impact of crossing conflict. The expected outcome of the research study is to identify the relation between sizes of roundabout with the safe throughput handled by roundabout for design vehicle.

Findings of this research has a high significance of safety concerns in Indian roundabouts. Optimal size of a roundabout w.r.t. flow and design vehicle is very crucial in reducing the intensity of vehicular conflicts. Using this approach, the fatal accidents are either converted to minor ones or nullified, hence increasing the safety standards of roundabouts.

References

HCM (2010), Highway Capacity Manual. Washington, D.C. :Transportation Research Board.

Crown, B. (1998), An Introduction to Some Basic Principles of U.K. Roundabouts Design." Presented at the ITE District 6 Conference on Roundabouts, Loveland, Colorado.