Diverging diamond interchanges (DDIs) and Displaced left-turn intersections (DLTs) are designed to enhance the operational performance of conventional intersections that are congested due to heavy left-turn traffic volumes. Since drivers are not familiar with these types of intersections, there is a need to evaluate their safety performance to validate their effect, and to estimate reliable and representative Crash Modification Factors (CMFs). The safety evaluation was conducted based on three common safety assessment methods, which are before-and-after study with comparison group, Empirical Bayes before-and-after method, and cross-sectional analysis. Furthermore, since DLTs showed poor safety performance, the study also investigated the operational performance of DLTs using a general linear model describing the relationship between traffic delay and other operational and geometric characteristics based on high-resolution traffic data. The analysis results indicated that converting conventional diamond interchanges to diverging diamond interchanges could significantly decrease the total, fatal-and-injury, rear-end and angle/left-turn crashes by 26%, 49%, 18%, and 68%, respectively. On the other hand, converting conventional intersections to displaced left-turn intersections could significantly increase the total number of crashes as well injury crashes and some other crash types (i.e., single vehicle, angle). However, the operational analysis implied that they have the potential to reduce the delay at intersections by 3.567 sec/veh. Consequently, the study quantified the costs and benefits associated with implementing DLTs. The results showed that this alternative design could provide much benefits in terms of its operational performance. However, its poor safety performance could result in losses much higher than its benefits. The study concludes that DDIs could significantly decrease crash frequency, while DLTs could not provide safety benefits. However, DLTs might be more efficient for operational performance. It is recommended that appropriate safety countermeasures should be developed and implemented to enhance traffic safety at DLTs.

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Approved for distribution by Mohamed Abdel-Aty, Committee Chair, on June 9, 2020.

The public is welcome to attend.