Urban Intersection Modelling for Signal Coordination and Adaptive Traffic Control
(Case study of Keshar Mahal and Durbar Marg Intersections)
ABSTRACT

Two intersections of the city namely Keshar Mahal and Durbar Marg lie close to each other with a linkage distance of only 225m between them. The currently functioning traffic management system is unable to clear the intersections quickly and causing very long queue lengths. The spillback from one intersection is extending beyond the upstream intersection causing failure of that intersection. Vehicles encounter a cumulative delay at both the intersections with intermittent stops.

The objective of this study is to develop urban intersection models for signal coordination and adaptive traffic control under heterogenous traffic conditions using an advanced lane-based micro-analytical tools the SIDRA INTERSECTION in order to improve operational performance.

Unmanned Aerial Vehicle (Drone) survey along with ground control points from Differential GPS (DGPS) was carried out to collect all relevant geometric details. Videographic survey was conducted for 3 days (24 hrs. in each day) to collect classified directional traffic data in each approach leg. Field survey was done for cruise speed and back of queue (BoQ) in each leg. Drone videography was used to collect data vehicle calibration and movement data like queue space, vehicle length, negotiation distance, negotiation radius, negotiation speed and saturation speed.

The operational performance of the existing study intersections was evaluated from the calibrated and validated SIDRA model. Simulations for different alternatives of phase configuration and cycle timing were run in each study intersection model under isolated condition for pretimed and actuated signalization allocating phases for pedestrians too. The best alternatives were further used for signal coordination under pretimed and actuated signalization. Signal coordination under pretimed signalization and optimal network signal cycle was found to be the best network signalization option.

In the base year, it was found that there would be a total travel time saving of 245 veh-h/h (33.4%). The total control delay in the network would decrease by 229 veh-h/h (48.8%) and average control delay by 52 sec (49.2%). In Keshar Mahal intersection, the 95th percentile BoQ in the worst lane would decrease by 420m (62.1%) while it would decrease by 20.5m
(13.9%) in Durbar Marg intersection. In the forecasted year (10 yrs. later), it was found that there would be a total travel time saving of 24.9 veh-h/h (1.1%). The total control delay in the network would decrease by 37 veh-h/h (2%). In Keshar Mahal intersection, the 95th percentile BoQ in the worst lane would decrease by 753m (50.6%) while it would increase by 70.2m (16.3%) in Durbar Marg intersection.

The analysis shows that signal coordination under pretimed signalization and optimal network signal cycle will clear the intersections quickly minimizing queue length without causing failure of upstream intersection and intermittent stops. Signal coordination would be a better option to improve operational performance which does not require any geometric improvement.
Author’s Information

Nhuja Bajracharya
Masters’ Student
Nepal Engineering College

Civil Engineer
AVIYAAN Consulting Pvt. Ltd.