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Modeling Operational Performance of Urban Roads With Heterogeneous Traffic Conditions

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Urban areas have seen rapid growth in population during the past few decades. This growth and related demand for travel has had a catalytic effect on traffic congestion, air quality, and safety. Transportation managers and planners have planned for new facilities to cater to the needs of users of alternative modes of transportation (e.g., public transportation, walking, and bicycling) over the next decade. However, there are no widely accepted methods, nor there is enough evidence to justify whether such plans are instrumental in improving mobility and enhancing the safety of the transportation system. Therefore, this project researches and models the operational performance of urban roads with heterogeneous traffic conditions to improve the mobility, reliability, and safety of people and goods.

Research Methods

A 4-mile stretch of the Blue Line light rail transit (LRT) extension, which connects Old Concord Rd and the University of North Carolina at Charlotte's main campus on N Tryon St in Charlotte, North Carolina, was considered for travel time reliability analysis. The influence of crosswalks, sidewalks, trails, greenways, on-street bicycle lanes, bus/LRT routes and stops/stations, and street network characteristics on travel time reliability were comprehensively considered from a multimodal perspective. The average travel time (ATT), planning time (PT), buffer time (BT), buffer time index (BTI), and planning time index (PTI) for selected links on the Blue Line LRT corridor (N Tryon St), the parallel route (I-85), and cross-streets were computed by day-of-the-week and time-of-the-day. They were compared for the network without LRT, the sixth month of LRT operation, the twelfth month of LRT operation, and the eighteenth month of LRT operation scenarios.

A 2.5-mile-long section of the Blue Line LRT extension, which connects University City Blvd and Mallard Creek Church Rd on N Tryon St in Charlotte, North Carolina, was considered for simulation-based operational analysis.

Vissim traffic simulation software was used to compute and compare delay, queue length, and maximum queue length at nine intersections to evaluate the influence of vehicles, LRT, pedestrians, and bicyclists, individually and/or combined.

Travel time reliability analysis not only helps evaluate the performance comprehensively but also helps identify vulnerable links.

Findings

Key findings:

1. The statistical significance of variations in travel time reliability were particularly less in the case of links on N Tryon St with the Blue Line LRT extension.
2. The research showed a decrease in travel time reliability on some links on the parallel route (I-85) and cross-streets. The influence and its magnitude depend on day-of-the-week and time-of-the-day.
3. The research showed a decrease in vehicle delay on northbound and southbound approaches of N Tryon St in most cases after the LRT is in operation.
4. The cross-streets of N Tryon St incurred a relatively higher increase in delay after the LRT is in operation.
5. The pedestrian and bicycling activity increased vehicle delay at some intersections on the Blue Line LRT corridor. However, the current activity levels seemed insignificant to have an overall influence on vehicle delay.

Policy/Practice Recommendations

Assessing the influence of a large-scale transportation project like LRT and related activity on near-vicinity road traffic is difficult because of complex interactions between the moving traffic. The travel time reliability analysis not only helps evaluate the performance comprehensively but also helps identify vulnerable links. The simulation analysis helps evaluate the influence of vehicle, LRT, pedestrians, bicyclists, and geometric design aspects, individually and/or combined, on vehicle delay and queue length on the major street and cross-streets. Overall, the findings from this research can be used to assess the multimodal performance of a transportation facility and identify remedial solutions. Modeling and assessing the influence of heterogeneous conditions on operational performance at intersections on the major street, parallel routes, and cross-streets using traffic simulation software is recommended to identify and address any shortcomings before-hand. Assessing the travel time reliability on the major street, parallel routes, and cross-streets is recommended to identify and address any shortcomings after the implementation of a large-scale transportation project like LRT.

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For more details about the study, download the full report at **transweb.sjsu.edu/research/1802**

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