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DEVELOPMENT OF OPERATIONAL PERFORMANCE MODELS FOR BUS LANE PREFERENTIAL TREATMENTS

PROBLEM STATEMENT

Increasing concern for improving the efficiency of roadways in moving people rather than just vehicles has led to the promotion of giving preferential treatments to buses. Bus-only and high-occupancy vehicle (HOV) lanes are two types of lane preferential treatments available for buses. The use of preferential lanes is generally justified on the grounds that buses can potentially carry more passengers than automobiles. However, when a lane is taken away from the general-purpose traffic and designated as a bus-only or HOV lane, it can create congestion in other lanes, causing protests by motorists. Thus, to maintain the long-term success of preferential facilities, better guidance on conditions that justify bus-only or HOV lanes is needed. Such guidance requires that the expected operational performance of each design alternative be known.

OBJECTIVES

This study aims to develop operational performance and decision models that can be applied by transit planners and traffic engineers to help determine the appropriate preferential treatment and design for bus lanes on freeways and arterial streets.

FINDINGS AND CONCLUSIONS

The operational performance of bus facilities may be measured by travel time, speed, capacity, etc. It is affected by a number of factors, including bus headway, vehicle volumes, vehicle mix, free-flow speed, dwell time, bus stop capacity, bus stop location (near-side, mid-block, or far-side), bus stop type (on-line vs. off-line), bus stop spacing, signal control parameters, number of lanes, etc. The CORSIM simulation model was used to estimate the bus and non-bus travel speeds under different conditions of these contributing factors. The simulated data were then used as a substitute for field data in an empirical modeling of relationships between travel speeds and their contributing factors. The estimated speeds then provided input to a decision model for the computation of expected person travel times under a specific set of conditions. The design alternative that provides the lower total average person travel time becomes the recommended design alternative.

For the freeway models the new HOV modeling capability that comes with CORSIM version 5.0 was applied for scenario modeling. Non-linear regression models were developed for predicting the average speeds of HOV lane, mixed lanes adjacent to HOV lane, and mixed-only lanes. The models consider traffic compositions (carpools, vanpools, buses, trucks, and passenger cars),

number of lanes, and free-flow speeds. A limited model evaluation was performed by comparing results from a mixed-traffic speed model with those of the Highway Capacity Manual (HCM) and the Bureau of Public Roads (BPR) volume-delay equation. The results are found to be relatively consistent.

For the arterial models, a corrected version of CORSIM version 5.0 was used for scenario modeling. Mixed linear and non-linear regression models were developed for average bus and non-bus speeds for bus lane, non-bus lanes, and mixed traffic lanes. The models consider a number of variables, including bus volume, non-bus volume, right-turn volume, bus stop location, bus stop density, use of bus bay, number of bus berths, mean dwell time, green ratio, cycle length, signal offset, and number of lanes. The regression models for arterial bus lanes were evaluated by comparing the results with those reported in HCM 2000 and the TCRP Report 26. The results were found to be surprisingly close.

This research represents the only known effort to develop quantitative models for justifying bus-lane design alternatives based on the average person travel time for all road users. It lays the groundwork necessary to perform additional studies that incorporate the impact of different signal priority strategies, including queue jumper, that are gaining increasing interest in both the traffic and transit communities. Although the models developed are strictly based on the operational efficiency of design alternatives, other important factors such as safety experience must eventually be considered in practice. Studies that look into the safety of various preferential facilities would be beneficial.

BENEFITS

The models developed in this research allow for the evaluation of a proposed bus lane before implementation or for the re-evaluation of an existing bus lane for possible improvements. Also, the models allow for the objective evaluation of a bus lane should it become controversial. Because such models include a number of design variables, they can be used as a tool to evaluate the effectiveness of design alternatives—for example, the location (near side, far side, or mid-block) of bus stops under prevailing conditions.

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