Summary of Final Report, BD015-01
April 2003

OPERATIONAL PERFORMANCE MODELS FOR FREEWAY TRUCK-LANE RESTRICTIONS

PROBLEM STATEMENT

Highways are designed to facilitate the flow of various modes of traffic, including passenger cars, trucks, buses, and recreational vehicles. The fact that the impacts of these different vehicle types are not uniform, however, creates problems relating to highway operations and safety. Passenger car volume has increased over the last decade, as have truck operations, both in terms of volume and dimension. Consequently, highway planners must address a number of distinct issues in order to enhance the safety of our highways. A common approach to reducing the impacts of truck traffic on freeways has been to restrict trucks to certain lane(s) to minimize the interaction between trucks and other vehicles and to compensate for their differences in operational characteristics.

Many possible design alternatives for truck-lane restrictions exist. Some use one restricted lane while others use two or more; some restrict trucks to the rightmost lane(s) while others restrict them to the leftmost lane(s). The performance of these different truck-lane restriction alternatives differs under different traffic and geometric conditions. Thus, an effective estimate of the operational performance of different truck-lane restriction alternatives under prevailing conditions is needed to help make informed decisions regarding truck-lane restriction alternatives.

OBJECTIVES

The objective of this project is to develop operational performance models that can be applied to help identify the most operationally efficient truck-lane restriction alternative on a freeway under prevailing conditions. The operational performance measures examined include average speed, throughput, speed differentials, and lane changes. Prevailing conditions include number of lanes, interchange density, free-flow speeds, volumes, truck percentages, and ramp volumes.

The developed performance models will provide the information needed to determine such issues as the levels of truck and non-truck volumes needed to justify the implementation of a specific truck-lane restriction alternative and the expected travel speeds and throughput for a corridor before and after the implementation of a truck restriction method.

FINDINGS AND CONCLUSIONS

The analysis of simulated data resulted in the following findings and conclusions:

1. In general, truck restriction alternatives increase the average speed under conditions of low interchange density, low truck volume, and low ramp volume. When a freeway corridor is congested with densely spaced interchanges, high truck percentages, or high ramp volumes, truck-lane restrictions reduce the average speed. However, the speed reduction is negligible,

except when a large number of restricted lanes is used (e.g., when three of four total lanes are restricted). This finding suggests that restricting an appropriate number of lanes to truck traffic is generally beneficial since it may improve traffic safety without worsening the efficiency of moving traffic.

2. A large number of the restricted lanes resulted in a higher rate of throughput under low truck percentages with sparsely spaced interchanges. A relatively low number of restricted lanes (e.g., one out of three lanes or one or two out of four or five lanes) generally provides a higher capacity than the non-restriction alternative for truck percentages up to 25%.

3. Statistical analysis shows that the speed differentials between restricted and non-restricted lane groups are significant, and that the magnitude increases as the number of interchanges, ramp volumes, truck percentages, and free-flow speed increases.

4. Truck-lane restrictions significantly reduce the number of lane changes by separating slower vehicles from faster vehicles, which, in turn, reduces the necessity of vehicles overtaking one another. Since lane changes are a major cause of crashes, a reduction in lane changes through truck-lane restrictions can potentially improve freeway traffic safety.

5. One-lane truck restriction is suitable for three-, four- and five-lane freeways, while two-lane truck restriction is more suitable for four- and five-lane freeway corridors, except when the interchange density is high and the truck percentage is larger than average.

BENEFITS

Performance models provide a variety of benefits: (a) the ability to evaluate a proposed truck restriction method before implementation, (b) the ability to re-evaluate an existing method for possible improvements, and (c) the ability to objectively review a method should it become controversial. As such models improve the decision-making process and the effective implementation of lane restrictions, a corresponding improvement to the operational efficiency of highways may reasonably be expected—a key benefit of which is increased safety to the traveling public.

This research was conducted by Albert Gan, Ph.D., at Lehman Center for Transportation Research, located at Florida International University. For more information, contact Gina Bonyani, Project Manager, at (850) 414-4707, gina.bonyani@dot.state.fl.us.