

# Research Report Summary



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## Operational and Safety-Based Analyses of Varied Toll Lane

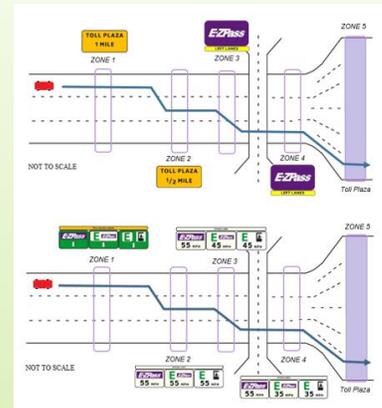
Over the past decades, fatal crashes and severe injuries have been observed to increase in highway facilities. This has created a big concern among different transportation agencies and other organizations such as State Departments of Transportation (DOT) and the World Health Organization (WHO). One of the most important components of highway operations that are affected by the increase of crashes are toll road systems.

This research presents the first mobile driving simulator in Puerto Rico used to address safety issues related to driver behavior and toll plaza design, which is located in the Transportation Laboratory of the University of Puerto Rico at Mayaguez (UPRM). The purpose of this research is to evaluate the effectiveness of two different signage configurations of Caguas Sur Toll Plaza using a virtual simulation environment. The first

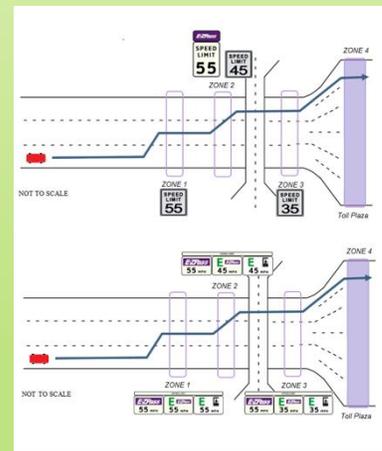


Figure 1. Simulated Caguas Sur Toll Plaza

### Data Collection Area



Locator References or the Standard Deviation of Roadway Position Variable



Locator References or the Acceleration Noise and Average Speed Variable

configuration contained roadside signage that corresponded to the existing sign conditions while the second configuration consisted of the proposed overhead signage. Both signage configurations provided information regarding the speed limits and lane purpose before approaching

with the proposed conditions had a statistically significant reduction of acceleration noise, which was used as a surrogate measure of safety. This was a result of the reduction in lane changing patterns. It was found that subject drivers of scenarios containing overhead signage changed lanes smoothly and reduced vehicle

41.67%, 50% and 50% of the scenarios.

The average speed decreases 27% in the toll plaza in scenario 8 specifically. The Acceleration Noise variable, a surrogate measure for crash frequency showed a significant difference in the toll plaza locator reference. Scenarios 3, 10 and 11 resulted in significant differences of 75.2%, 71.7% and 71.2%, respectively.

*“The proposed safety countermeasure has the potential to reduce the expected crash frequency up to 70% including both day and nighttime scenarios.”*

the toll plaza. A sample of subject drivers was selected to drive through different scenarios to evaluate the effectiveness of both signage configurations. The variables used for analysis were

velocity with anticipation when approaching the toll plaza. Significant difference was found between both signage configurations when analyzing acceleration noise in the toll plaza locator reference.

In conclusion, this study provides strong evidence that driving simulators can be used as an effective and low-cost technology to identify alternative signage configurations at toll plazas without exposing drivers to dangerous situations. These

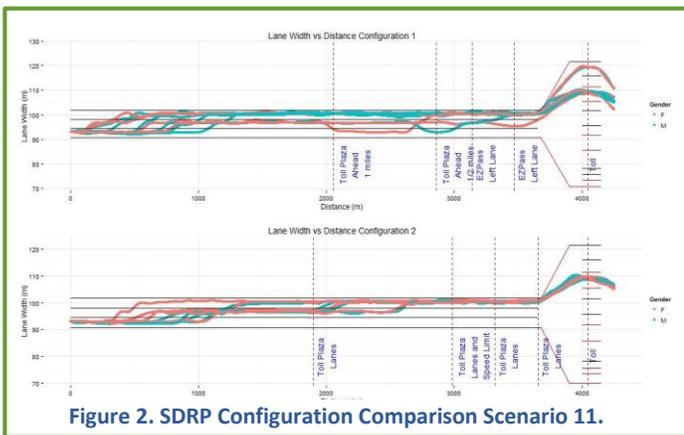


Figure 2. SDRP Configuration Comparison Scenario 11.

standard deviation of roadway position (SDRP), average speed and acceleration noise, which were calculated in different locator references prior to the toll plaza.

The outcome of the research indicated that the configuration

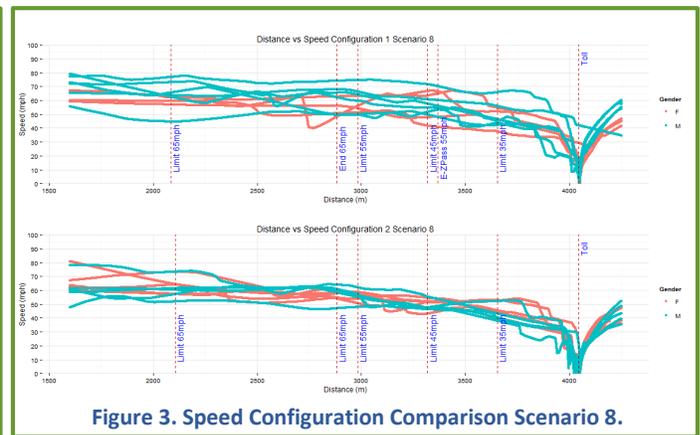


Figure 3. Speed Configuration Comparison Scenario 8.

Scenario 11 contained the most significant difference for SDRP variables, having significant difference in 4 out of the 5 areas studied. In addition, the third, fourth, and toll plaza locator references resulted in a significant difference in

results are expected to contribute both to the understanding of driving behavior and safety of new features used in the operation of toll facilities around the world.