



Florida Department of Transportation Research

Evaluation of Driver Behavior to Hydroplaning in the State of Florida Using Driving Simulation

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Hydroplaning occurs when a thin layer of water develops between vehicle tires and the road surface, resulting in loss of contact and possible skidding, loss of control, or collision. The potential for hydroplaning is governed by several factors, many of which are beyond a driver's control, but one crucial factor within driver control is vehicle speed. So, how drivers adjust speed for perceived hydroplaning conditions is an important behavioral topic in roadway design.

Florida Gulf Coast University researchers studied patterns of driver behavior during rainfall events. Data were developed for drivers in actual highway settings and in simulated settings, from Florida Department of Transportation databases and participants using a driving simulator, respectively.

For highway settings, data on traffic volume and free-flow speed for six highway segments were drawn from Florida's Statewide 511 Web site and the Florida Department of Transportation STEWARD database. Hourly rainfall data was from the National Oceanic and Atmospheric Administration. Data were classified as to rainfall intensity, traffic conditions, and time of day/week, correlated, and statistically analyzed.

In recent years, the driving simulator has been valuable for study and analysis of driving behavior. In this project, participants of various sex and age groups drove the simulator in a virtual world ranging from suburban to highway routes, with and without rain. Researchers recorded driving speed and conducted a data analysis to correlate driver responses to simulator conditions. The simulator was able to generate five rainfall



Partial views from the driving simulator show a level 3 (left) and a level 4 (right) rainfall event. The reduced visibility caused drivers to strongly alter their speeds.

levels by varying the apparent visibility distance, a thunder/lightning condition, fog density, asphalt friction, and visual rainfall component. The simulated course took drivers through several roadway geometries. In multiple rounds of simulations, participants were trained to use the simulator and provided feedback so that the

simulated experience could be fine-tuned.

Both field and simulator studies demonstrated that drivers tend to reduce speed during rainfall events. Field data showed that traffic volume did not affect free-flow speed during rainfall, but drivers reduced speed by 2 to 8 miles per hour (mph), with greater decreases during night and weekday-peak hours. Importantly, simulator studies agreed closely with field studies, but they gave a more refined view. Simulation drivers did not slow for light rainfall but slowed significantly at higher rain intensity, on average, decreasing by 6 to 12 mph. There was no interaction between rainfall intensity and age group or gender.

A better understanding of driver behavior under conditions conducive to hydroplaning can be an important aid in preventing loss-of-control incidents and collisions. With informed educational efforts and public information campaigns, drivers can be better equipped to respond appropriately to hydroplaning conditions. Also, better on-road warning systems, including variable message signs, can be devised to aid drivers in making real-time judgments.