Hydroplaning Risk Evaluation in High Speed Low Traffic Volume Highways in Developing Countries

Waruna Jayasuriya[1] and Manjriker Gunaratne[2]

Hydroplaning occurs when water pressure builds up in front of and under a moving vehicle tire resulting in an uplift force sufficient to separate the tire from the pavement. The loss of steering and the drag force produced during hydroplaning may then cause the vehicle to lose control, especially when one of the steering tires is subjected to hydroplaning. During high intensity rainfall events, a significantly thick water film builds up on highway surfaces and the risk of vehicle hydroplaning increases with the water film thickness.

It is known that travel speeds which usually exceed 50 mph can drop by ten percent (10%) during rain due to the decreased visibility and the drivers' perception of reduced traction. However, according to the current study, the effects of hydroplaning can be significant even at speeds as low as 45 mph. Vehicle speeds can be excessive in high speed facilities in developing countries due to low traffic volumes and lack of speed limit enforcement. Furthermore, since only a little attention is paid to pavement performance with respect to skid-resistance, there is a higher probability of the occurrence of this safety hazard when more and more high speed facilities are constructed in the developing world. Therefore, it is of utmost importance to incorporate the factors that contribute to hydroplaning in pavement management systems in developing countries.

It is known that the vehicle speed at incipient hydroplaning depends on the water film thickness (WFT), tire pressure, tire tread depth, pavement texture, and several other secondary factors. The effects of the water film thickness in crown and transition sections are the primary factors investigated in this study. The water film conditions are quite different in super-elevation transition sections compared to normal crown sections. The combined effects of lateral and longitudinal slopes in super-elevation transition sections cause a significant increment in WFT. And the magnitude of the maximum WFT increases at super-elevation transitions compared to normal crown conditions while the location of the maximum depth varies with the longitudinal slope. Furthermore, with regard to vehicle safety at super-elevation transitions, it is not clear whether the magnitudes of WFT or changes in WFT in the longitudinal and lateral directions are the more critical variables. All in all, it is realized that hydroplaning can present a severe safety issue at transition sections than at the normal crown sections. In the research described in this paper, a number of field trials were conducted at first to verify the existing correlations developed by previous researchers. Finally due to the relative contributions of a number of different causative factors involved in hydroplaning and the great deal of uncertainty in the initiation of this phenomenon, the hydroplaning risk is evaluated in terms of a probability.

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Authors Details;

1. Graduate Research Student, Department of Civil and Environmental Engineering, University of South Florida, Tampa, FL 33647, USA. waruna@mail.usf.edu
2. Professor, Department of Civil and Environmental Engineering, University of South Florida, Tampa, FL 33647, USA. gunaratn@usf.edu