Proceedings of the 9th International Conference On Civil Structural and Transportation Engineering (ICCSTE 2024)
Chestnut Conference Centre - University of Toronto, Toronto, Canada – June 13-15, 2024
DOI: 10.11159/iccste24.003

Probabilistic, Safety-Explicit, Reliability-Based Road Design

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Abstract

Reliability analysis has been widely applied in many civil engineering fields. Current design standards in structural and geotechnical engineering applications are based on reliability analysis to reflect the design' probability of failure. Several applications have been researched in transportation engineering including road design. However, road design guides have not adopted such applications. Rather, current design practices in road design are typically based on assuming near-worst conditions for most design parameters. For example, in calculating stopping sight distance, conservative values are assumed for the perception-reaction time, deceleration rate, and speed. When the stopping sight distance model is applied or vertical curve design for example, conservative values are also assumed for driver eye height and object height. In addition, while design guidelines are derived to ensure safe vehicle operation, safety is considered only implicitly. For example, the design formula for minimum horizontal curve radius is derived based on the forces acting on a vehicle during cornering to ensure that the vehicle will not skid off the road. However, the final design criteria do not provide designers with tools to assess the consequences of deviation from the design assumptions. As a result, current road design guidelines are generally considered deterministic and safety implicit.

A probabilistic, safety-explicit, reliability-based road design is an alternative approach where the full distribution of each design parameter is considered designers can assess the design safety impacts using explicit safety measures. Several researchers have adopted reliability analysis to examine road design criteria methods in road design applications such as stopping sight distance, passing sight distance, intersection sight distance, horizontal curve design, and length of speed change lanes. This presentation will discuss the main reliability analysis methods, proposed safety measures, and existing research utilizing reliability analysis in road design.