



The Relationship Between Design Consistency And Safety On Combined Horizontal And Vertical Curves Of Two-Lane Rural Highways

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Abstract

Each year a large amount of traffic accidents occurs on two-lane rural highways specially on curved sections due to lack of geometric design consistency. Design consistency is one of the most significant methods in highway safety evaluation. An effective criteria to consider design consistency is through operating speed prediction and speed profile presentation.

This paper develops operating speed models for combined horizontal and vertical curves on two-lane rural highways. Two types of combinations were considered: a horizontal curve combined with a sag vertical curve and a horizontal curve combined with a crest vertical curve.

Regression analysis were used to develop operating speed models based on data collected on 10 combined curves in "Karaj-Chalus" rural highway. Validation results is presented and speed profiles were drawn for three one-kilometer road segments.

In order to consider the relationship between safety and design consistency, collision crash rate models in both cases were presented using accident data in 14 combined curves.

The results show that the most significant predictors for operating speed are radius of horizontal curve, horizontal distance between the point of horizontal intersection and the point of vertical intersection, length of vertical curve (rate of curvature), gradients and algebraic difference in grades and for collisions are operating speed differential in successive sections, degree of curve and roadway width.

Keywords: combined horizontal and vertical curves, design consistency, regression analysis, speed profile.

1. INTRODUCTION

The impact of road collisions on various aspects of society including economical and social has forced transportation engineers and government officials to put this issue at the high priority in their plans.

The role of highway transportation in Iran due to other undeveloped transportation systems causes a huge amount of fatalities, injuries and property damages in highways.

The portion of rural highways in these collisions is about 61% in Iran [1], which the main part is estimated to taken place on curved sections [2].

One of the main reasons for accident occurrence is lack of geometric design consistency, defined as the degree to which highway systems are designed to avoid critical driving maneuvers and to ensure safe traffic operation.

The combination of horizontal and vertical alignments as an example of highway 3D nature, is an obvious case in which the safety of road is jeopardized due to lack of geometric design consistency.

Although a large body of research work has been conducted on the effects of combined horizontal and vertical alignments on driver perception, operating speed, visual demand, sight distance, vehicle stability and aesthetics that may contribute to its safety, fewer efforts, were made to evaluate and quantify the safety effects of 3D alignments and their interaction with the above parameters.

The purpose of the present paper is to provide 85 percentile speed models on combined horizontal and vertical curves on two-lane rural highways as a main factor of highway design consistency and to evaluate its effect on the rate of curve collisions in the term of 85 percentile speed differential in successive alignments of 3 one kilometer segments through using speed profile. The following section is a review of previous operating speed and accident prediction models in 3D alignments.

The most complete speed models in combined alignments was presented by G.M Gibreel, S.M Easa and I.A El-Dimeery [3] which was established at 5 points along the 3D combinations (sag and crest combinations).