Suitability of EN 1317 crash test parameters for determining accidental loads on bridges

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Abstract

In Europe the EN 1317 defines testing and certification procedures for vehicle restraint systems depending on the containment level. The monitoring data obtained in these tests can be used to determine the accidental loads for bridges in case of vehicle impact. The present study investigates which quantile of real-life vehicle impacts the respective test conditions correspond to. Based on fundamental mechanical principles a ratio between the results obtained with the parameters of the crash test and the statistical parameters for real-life events with different vehicle mass, velocity or angle of impact can be calculated. The distribution function of this factor is determined in parallel by the orthogonal array and Latin hypercube sampling methods, using the Kolmogorov–Smirnov and chi-squared goodness of fit tests. Thus, the quantile corresponding to a given containment level, as well as a multiplicator required to reach a chosen level of safety can be determined.

Keywords: vehicle restraint system; roadway departure accident; impact load; accidental action; vehicle mass; angle of collision; impact velocity; orthogonal array sampling, latin hypercube sampling.

1 Introduction

In Europe the EN 1317-1 [1] and EN 1317-2 [2] standards define testing and certification procedures for road restraint systems. For each containment level the test conditions are specified, including the vehicle type, mass, its velocity, and angle of impact. In Germany the results of the tests and the accompanying measurements are also used to determine the accidental loads for bridges due to vehicle impact. In this case the question arises, if the test conditions specified in the standard may be considered as representative for vehicle impact in general. The present study aims to answer this question, more specifically to determine which quantile of real-life vehicle impacts the test conditions correspond to.

2 Background

2.1 Vehicle Restraint Systems

The purpose of vehicle restraint systems (VRS) is to minimise the consequences of accidents. On the one hand, they are intended to protect uninvolved persons or areas in need of protection next to the road as well as oncoming traffic on two-lane roads. On the other hand, they also serve to protect vehicle occupants from the serious consequences of a roadway departure.

In Europe, VRS are regulated by the EN 1317 series of standards. In EN 1317-2 [2], performance levels are specified for the following three key vehicle restraint criteria: