Influence of Bridge Vehicle Interaction on the bridge's subsystems considering road roughness

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Summary

The evident advances of computational power of digital computers and their use in structural engineering enable advanced modelling and analysis of structures. Modelling demands compatible representation of the different subsystems and their interaction, such subsystems are the loading, the superstructure, the substructure and the bearings in bridge engineering. Therefore, models of the dynamic interaction between heavy vehicles and highway bridges taking into account the road roughness are of interest. The influence of this interaction (coupling) on the bridge's subsystems is under study. Such topic is of necessity to the bridge required maintenance and determination of appropriate load models corresponding to the effects of the dynamics of the bridge-vehicle interaction.

This paper describes the bridge-vehicle interaction modeling and its effect on the bridge superstructure and substructure. The study is carried out by the assessment of the dynamic amplification factors calculated from different measures, deflection, strain and stress and the assessment of loading history of the bridge's piers.

Keywords: Bridge vehicle interaction, beam bridges, bridge bearings, road roughness

1. Introduction

The dynamic effects in the structural behavior of bridges due to the passage of vehicles may rise due to the bridge-vehicle interaction and the excitation of the vehicle from the road irregularities.
These dynamic effects are influenced by a wide variety of random factors, such as the characteristics of the bridge and road roughness, the stiffness and damping of the suspension systems and wheels as well as the characteristic of the traffic flow. Such effects can be evaluated either experimentally (Nowak 1994; Paultre 1995; Baily 1996, among others) or numerically (Fafard 1998; Karoumi 1998, among others). The former involves the development and implementation of an appropriate dynamic measurement system. The later requires the development and application of a computational model to simulate the dynamic bridge-vehicle dynamic response, but the reliability of the corresponding results is always in question and depends on the appropriate experimental calibration and validation of the numerical modeling [1].

Studying the dynamic effects numerically or experimentally, the dynamic amplification factor (DAF) is often used to quantify the dynamic effects of the bridge-vehicle interaction. DAF has been an important parameter in the design of highway bridges and yet no worldwide agreement so far to its

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