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Summary

Since long time the dynamical actions of moving vehicles on bridge decks have been present in structural engineering concerns. In the last few decades the scientific community has started a continuous effort on the study of the dynamical effects on bridge superstructures due to the vehicle traffic on irregular pavement surfaces. In design practice, most of the technical recommendations use a dynamical load factor applied to the vehicle static effects to take into account all the dynamical actions. One presents now the results of a study to verify the extension of the dynamical effects, displacement and stresses, on highway bridge decks, due to vehicles crossing on the rough pavement surface defined by a probabilistic model.

Keywords: bridge structural dynamics, highway bridges, bridge pavement roughness.

Abstract

Since the late 80's, many efforts have been taken to study the dynamical effects on highway bridge decks due to the interaction of the vehicle suspension flexibility with the irregular pavement surface. Several studies have made evident that such effects are much more important than those for a smooth vehicle movement on the bridge [1,2,3,4].

In design practice, the displacements and stresses of the dynamic actions are taken in account, in general, by means of a dynamical load factor (DLF) applied to the static effects of the moving vehicles. In most of the countries, including in Brazil, the code recommendations propose formulas to evaluate the DLF based only on the bridge span length.

In addition to these points, field reports say that some bridges have been submitted to excitation levels, under usual traffic conditions, which have deteriorated their service conditions and structure durability; this can be an indication of under conservative DLF. So, it is desirable to have the problem parameters quantitatively evaluated to better estimate their participation in the structure disruption and to review quantitatively the definition of the DLF for lower quality pavement surfaces.

This ensemble of papers that have been published since then made evident that the dynamic effects produced by the oscillation of the vehicle vs. rough pavement interaction force is a main factor in establishing the DLF value [4,5,6,7,8,9].

In this work one considers a probabilistic definition for the pavement irregular profile and a mathematical structural model which includes the interaction between the dynamical properties of the vehicle with those of the bridge. The moving load is formed by an infinite train of similar vehicles regularly spaced and running at constant speed, in such way to obtain steady-state mean maximum response quantities of the bridge deck, which are necessary to a fatigue analysis of the deck material; one also considers the generation of a number of pavement surface profiles sufficiently large to sustain a statistical treatment of the results [4,5,8,9].

This analysis methodology is applied to reinforced concrete beam decks, continuos on several supports, with overhangs and with constant box cross section and one observes the node displacements and member stresses where the maxima occurs. A parametric study is developed and one concludes proposing a review on the evaluation of the DLF and on qualitative and quantitative aspects of the problem and the attitudes concerned with bridge design and maintenance.

The main point in this work is the magnitude of dynamical effects relatively to the static values. The roughness of an excellent pavement surface produces response quantities, displacements and stresses to as the bridge deck, that can reach magnitudes to the same order of those due to the static effect of a train of vehicles long enough to load all the bridge. These magnitudes are many times greater than that due to the load mobility alone [10].

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