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Experimental validation of the FE model for dynamic analysis of a composite railway viaduct's deck slab

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Abstract

The experimental validation of FE numerical models, performed through the comparison between measured and calculated responses, presents an important step in further detailed calculations or simulation of future scenarios. Several parameters to be taken into account in numerical analyses, such as the cut-off frequency, train speed or damping coefficients, might have a preponderant effect in the success of that validation. Therefore, this paper discusses and evaluates the effect of these parameters in the numerical analyses to be carried out on a FE model of the Alcácer do Sal railway viaduct, under the passage of an Alfa Pendular train with a speed equal to 220 km/h. The dynamic behaviour of the deck slab is evaluated, through a methodology that considers train-bridge interaction, taking into account frequency limits equal to 15, 20 and 30 Hz, small variations in the train speed and two different scenarios of damping coefficients.

Keywords: railway bridge; reinforced concrete slab; dynamic tests; experimental validation; dynamic behaviour; parametric analyses.

1. Introduction

In the last years, structures composed by longitudinal girders and an upper reinforced concrete (RC) slab have been widely used in the construction of railway bridge decks. RC deck slabs in railway bridges and viaducts are structures subjected to high intensity moving loads, where the dynamic effects can reach significant values. Due to higher train speeds, higher axle loads and the existence of track irregularities or wheel defects, particular attention has been given to these dynamic effects, since they can lead to excessive bridge vibrations, passenger discomfort, increasing applied stresses or fatigue damage.

In railway bridges, this dynamic amplification depends on several factors, which may be directly related to the structure, track or train. The influence of several parameters on the dynamic response, such as structural damping [1], track irregularities [2] or train speed [3] has been studied. The effect of these parameters should be carefully evaluated as well as how they should be taken into account in the numerical analyses to be developed. This allows, on one hand, the correct validation of the numerical models and, on the other hand, to obtain more realistic results in later calculations or simulation of future scenarios.

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