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Dynamic response comparison between four different structural bridge typologies used in the Spanish High-Speed Rail Network

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Abstract

Over the past decades, clear and sound analysis criteria have been applied to determine the dynamic behaviour of high-speed viaducts, most of them sharing typology and general features. However, lately, bridges for new high-speed rail corridors face new challenges. Therefore, new considerations might need to be considered in regular dynamic analysis.

Keywords: high-speed, viaduct, dynamic analysis, typologies, impact factor, acceleration, torsional effects, vibrating mass, resonance effects, computational requirements.

1 Introduction

During the last 25 years, Spain has experienced a high rate of infrastructure development, especially high-speed railway infrastructures, designed to allow a 350 km/h maximum speed. Many bridges and viaducts have been constructed, most of them sharing typology and general features, with spans ranging between 25 and 50 meters. Pre-stressed concrete box girders, both launched and cast in place using a movable scaffolding system, have been extensively used.

Clear and sound analysis criteria have been applied to determine the dynamic behaviour up to 420 km/h, studying dynamic amplification effects and controlling maximum accelerations under the limit of 0.35·g, to ensure users' comfort. Most bridges have performed properly.

However, new challenges are being faced in bridges for new high-speed rail corridors, involving larger spans and singular typologies. Thus, new variables related with local effects or torsional vibration, usually discarded, may appear and require new factors to be implemented in common dynamic analysis.

Focusing on the special factors to be taken into account for special typology structures, this paper analyses four different built viaduct typologies to highlight their dynamic behaviour.

2 Description of the Viaducts

2.1 Regato del Cuervo Viaduct

Located in the Madrid-Extremadura high-speed rail line, with a maximum design speed of 330 km/h, this 158 m long viaduct is divided in four spans (34m + 2x45m + 34m). The deck is designed as a continuous single concrete box girder, cast in place using conventional formwork. The box is 3.2 m deep, resulting in a span to depth ratio of 14. Its width varies in cross-section from 14.0 m at the top slab, matching the standard platform width, to 5m at the bottom. The bridge is longitudinally fixed at one of its abutments, being allowed to move lengthwise over all the other

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