Dynamic behaviour of under-deck cable-stayed bridges under the action of moving loads

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Summary

Under-deck cable-stayed bridges are innovative bridge configurations in which stays are located underneath the deck. This bridge typology can lead to highly efficient and slender decks, resulting in a large reduction of the amount of materials employed. Nevertheless, if very slender decks are designed, vibration problems can arise potentially compromising the comfort of bridge users. The dynamic response of an under-deck cable-stayed bridge with a steel-concrete composite deck under the action of moving loads is studied. After an initial modal analysis, the contribution of each mode is identified. Loads applied eccentrically on the cross-section of the deck are found to increase accelerations substantially. Amplification and cancellation speeds are observed to govern the maximum accelerations registered on the deck. A parametric analysis reveals the maximum slendernesses that can be achieved to satisfy different comfort criteria.

Keywords: bridges; cable-stayed; under-deck; innovative structural systems; dynamic; moving loads; parametric.

1. Introduction

Since the late 1970s, a new type of cable-stayed bridge has been designed and built: under-deck cable-stayed bridges (UDCSBs) [1]. In UDCSBs, the stay cables follow non-conventional layouts in comparison with those of conventional cable-stayed bridges [2], the stays being located underneath the deck (Fig. 1). The pretensioned stays, which are self-anchored in the deck, provide elastic supports to the deck by means of the struts, reducing the bending moments acting on the bridge as a consequence. UDCSBs have been reported to present several advantages in comparison with conventional bridges without stays for medium spans [1]: (1) highly efficient structural behaviour by reducing the flexural demand on the deck and enhancing the axial response; (2)

https://doi.org/10.2749/222137814814068021