Interaction Study for Continuous Slab Track and Multi-Span Simple Beam Bridges

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Abstract

Since the mechanical properties of the continuous slab track (CST) structure and bridges are extremely different compared with other track-bridge systems, a fine finite-element model considering the rail, CST structure, multi-span simply-supported beams (span is 32m), and piers was established in this paper to study the system's mechanism. The stresses and deformations of the CST structure and simple beams under the braking forces of the train, temperature loads, and live loads were calculated. The track-bridge effect was also compared when different slab track. The calculation results show that the rail additional stress is minimal if the continuous slab track is used on the bridges. In addition, the influence of friction coefficient of the sliding layer was discussed. When the friction coefficient increases from 0.2 to 1.0, the tensile and compressive stress in the base plate of the CST structure under the braking forces have increased 27% and 15.6%, respectively; and the rail stress has increased 250% under the temperature change of beams. In summary, the CST structure can reduce the track-bridge effect obviously, and the stress in this slab track can be reduced further by reducing the friction coefficient of the sliding layer.

Keywords: continuous slab track, beam bridges, track-bridge interaction, new design, FEM analysis

1 Introduction

Slab track including the CRTS (China Railway Track System) I type slab track, CRTS II type slab track, and CRTS III type slab track has been widely used in high-speed rail in China. The CRTS II type slab track that was improved on the basis of Borg slab track from Germany and is also called Continuous Slab Track (CST). The most obvious characteristic of CST different from other slab tracks is that this unballstted track is continuous on the bridges [1]. So it means that this slab track can be constructed continuously even at the beam ends. In order to reduce rail additional stresses due to the changes in bridge temperature, the bridge and the CST structure is separated by the "sliding layer" which is composed of two layers of geotechnical fabric and a layer of polyethylene film. Therewith, the unballasted track and beams are connected together only at the fixed support of the bridges.

As of 2014, the application mileage of continuous slab track in Chinese high-speed rail has reached 4415 km [2]. The interaction law between continuous slab track and bridge is different from the interaction law between ballast track and discrete slab track. The biggest difference

https://doi.org/10.2749/222137817821232496