



# Study on the Influence of Bridge Expansion Joints on Vehicle-Track-Bridge System

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## Abstract

Bridge expansion joints (BEJs) are equipped at the girder end of long-span railway bridges to ensure the reliable transition of the track. The track structure of BEJs is more complex than that of bridge, so the BEJs should have suitable dynamic stiffness to ensure the safety and stability of vehicle. Taking a high-speed railway bridge equipped with densely arranged BEJs as an example, a vehicle-track-bridge coupled model was established to analyse the influence of vertical stiffness of BEJs on the dynamic response of whole system. Base on the established model, the study shows that the deformation of the BEJs will cause the short-wave irregularity of the rail and high-frequency impact on the vehicle. The unreasonable stiffness of BEJs will greatly increase the derail risk of the vehicle, so the influence of the stiffness of BEJs on the dynamic response of vehicle should be considered adequately in the design of the BEJs. According to the research results, it is recommended to use a larger stiffness of cushion plate. The results have been applied to the design of the BEJs on the studied railway lines, which are in good service condition at present.

**Keywords:** BEJs; railway bridge; vehicle-track-bridge coupling model; dynamic response.

## 1 Introduction

With the rapid development of railway industry and the increasing of bridge span, BEJs have become a vital device for long-span railway bridges. It not only needs to match the deformation of the girder end, but also needs to have good strength and stiffness to bear the dynamic load brought by the vehicle. Since the track structure of BEJs is more complex than that of the bridge, BEJs are regarded as the weak parts of the railway and has attracted extensive interest of researchers.

The performance of BEJs, including the deformation and joint force, in service condition have been studied [1-4], and plenty work has been

done on the failure mechanism of BEJs [5, 6]. Although BEJs have been widely studied, the impact of BEJs on vehicle is not clear enough. According to the detection results of the railway department, the dynamic response of vehicle on BEJs is significantly greater than that on other areas. The dynamic stiffness of BEJs is the main factor affecting the dynamic response of vehicle. Therefore, this study built the vehicle-track-bridge coupled model to investigate the influence of the vertical stiffness of BEJs on the dynamic response of vehicle.

Taking a high-speed railway line in China as a case to study. In order to reduce the seismic response of the structure, hyperboloid bearings are used as