Interaction between track and simply-supported bridges on high-speed railway frame pier

Bin YAN
Lecturer
Central South University
Changsha, China
Binyan1984@gmail.com

Bin Yan, born 1984, received his engineering PHD degree from Central South University. And now he worked for Central South University, China. His main area of research is related to track-structure interaction.

Summary

In order to study the interaction between high-speed railway bridge and track on the frame pier, the beam-rail-frame pier-pile foundation finite element model of the high-speed railway bridge was established by both using the beam element with rigid arms to simulate the bridge and using the nonlinear spring to simulate longitudinal resistance of the line. Taking a (3×32) m simply-supported beam of the frame pier using steel-concrete combination on the Hefei-Fuzhou line as a case, the transfer rule of CWR (continuously welded rail) longitudinal force on the frame pier was analysed, and it was discussed that the design parameters of the longitudinal resistance model, live load model, beam-column joint stiffness, stiffness of pile foundation, temperature increase range, wind pressure and so on made the impact on the longitudinal force. They will be of reference value to the design of the high-speed railway frame pier in the future.

Keywords: high-speed railway; frame pier; continuously welded rail; beam-track interaction; longitudinal force.

1. Introduction

With the rapid development of high-speed railway in China, transportation networks were criss-cross. When the new high-speed railway intersected other transportation lines, the frame pier structure was usually used to span them. Although scholars made extensive studies on the bridge-track interaction [1]-[6], plane models were adopted in most of existing studies and the model processing was oversimplified. The impact of the frame pier, this special substructure, on bridge-track interaction was not still clear.

The high-speed railway simply-supported bridge model, considering the impact of frame pier and pile foundation as well as spatial location of the track, was established by using a proven bridge-track contact simulation. Taking a completed 3×32m simply-supported T-section bridge on the Hefei-Fuzhou Railway as the study case, the track longitudinal force distribution of simply-supported bridge on frame pier was studied.

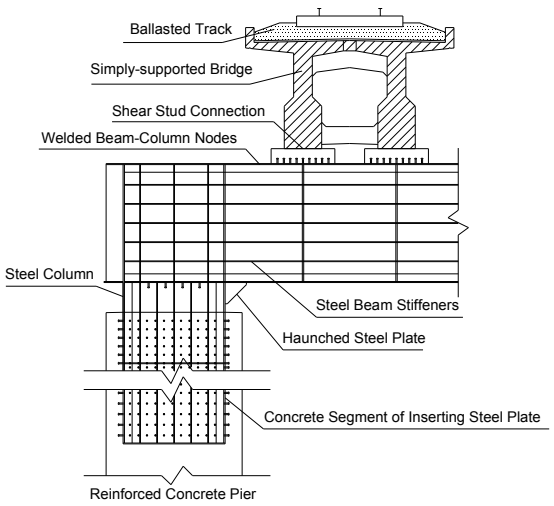

Fig. 1 Node structure diagram of frame pier

2. Track-bridge interaction model considering frame pier

Assuming relative displacement between track and bridge did not occur horizontally and vertically, beam element with rigid elements was used to simulate bridge, nonlinear spring was used to simulate line resistance, and the track on certain length of the embankment was established outside bridge [6] to reduce the impact of boundary conditions [5].

The example in this paper was located at

https://doi.org/10.2749/222137814814028232