Rail-Structure-Interaction Parameters at Ballasted Viaduct in Rohtak - Gohana Elevated Stretch: Instrumentation, Measurements and Interpretation

Nupur Saxena[*], Chandan Kumar[*], Pameer Arora[**] and Samit Ray-Chaudhuri[*]

[*]*Department of Civil Engineering, Indian Institute of Technology, Kanpur, UP, India*

[**]*Northern Railways, Delhi, India*

Abstract. This work deals with *India's first elevated multi-span* (about a kilometer long) *Bridge* along the Rohtak-Gohana stretch *having Continuous Welded Rail (CWR) with a ballasted deck*. The work focuses on instrumentation involving various sensors for real-time measurement of responses for evaluation of the effects due to rail-structure-interaction (RSI). For this study, three spans were selected with varying attributes such as stiffness, span length, height of piers and type of deck. Parameters such as total relative displacement of the rail with respect to the deck, vertical displacement of the deck at the ends, and horizontal support reaction generated at the supports under normal train running conditions, were recorded using data acquisition system for a period of several days. The results of this work show that, while the limits prescribed in the codes are reasonable, further research is needed to better understand the interaction effects.

Introduction

CWR are long-length jointed rail tracks formed by welding many short rails together to form several kilometers long rails. Owing to their long lengths and the resistance offered by ballast and rail fasteners, such rails cannot expand or contract freely in the central portion. A bridge deck is however able to move to some extent due to thermal and traffic loads while the CWRs over on the bridge are usually restrained. This leads to relative displacement between the rail and the bridge, which in turn induces additional stresses in the rail. Also, an extra horizontal support reaction is developed due to this phenomenon. Relative displacement of rail with respect to the bridge is an important parameter as it causes RSI effects. If these parameters exceed the permissible limits, then the track's safety may get hampered due to the loosening of ballast. The increase in tensile and compressive stresses beyond the permissible value could lead to fractures and buckling issues in the rail. Therefore, it is immensely vital to ensure that these parameters are within the prescribed limits as mentioned by UIC 774-3R and RDSO (Indian Railways) codes. Simoes et al. observed that stiffness of the abutment and foundation greatly influences the axial forces in the track. Somaschini et.al. concluded that the high-order resonances up to 30 Hz between the deck and the passing train local vibration modes possess a major influence on the extreme acceleration. In general, the overall RSI effects are of nonlinear nature primarily owing to ballast and rail fastening mechanism, which are difficult to model in absence of actual measurement data. Measured data are thus not only useful for checking the adequacy of the code provisions but also to update analytical model for further predictions.

Figure 1: Continuous Welded rail track at Rohtak.

Results and Discussion

The result of this work shows that the absolute horizontal displacement of the deck, relative longitudinal displacement of rail with respect to the deck under tractive/braking forces, and the bending effects due to vertical loads are reasonable considering the code prescribed limit. However, further research is needed to better understand the interaction effects. It is also found that the span under the tallest piers has the greatest relative displacement and mid-span displacement. Also, it can be observed that a higher horizontal support reaction is generated on the abutment side, which can be related to larger stiffness on the abutment side.

References

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