Experimental study on the influence of gust-wind on a high-speed railway train-viaduct system

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Abstract

As the high-speed railway emerges in Eurasia, a comprehensive understanding of the aerodynamic problems – particularly extreme wind events – is vital to the success of the safety, operational efficiency, and transportation industry. Such knowledge of the effect of extreme wind on the train and bridge system has been hindered by a lack of available field test data. In light of limited field measured data to arrive at a consensus on quantifying key parameters characterizing the non-stationarity winds, accuracy associated with wind velocities is carried out using wind tunnel experimental approaches in this study. Compared with atmospheric boundary layer winds, which are customarily treated as stationary, winds associated with gust-fronts originating from a thunderstorm/downburst/tornado exhibit rapid changes during a short period which changes in direction may accompany. To realistically capture the characteristics of gust-front winds and their attendant load effect, a new gust-wind generator was presented, built in the CSU wind tunnel. Under a condition of the combined operation between a gust-wind generator and wind tunnel, the gust-front wind characteristics and effects on the train-bridge system were analyzed.

Keywords: high-speed railway; train-viaduct system; gust wind; wind tunnel test; aerodynamics

1 Introduction

Over the past 20 years, China's high-speed railways have grown from 0 to more than 40,000 kilometers[1]. A high-speed expansion of railway construction in and around cities has made this development trend even more evident in recent years. The geography and climate are vital environmental factors that must be considered for the intensive exploitation of railway transport, and the developing trend puts a high demand on design and research in the railway field. Especially climate change poses multiple threats to the railway, one of the effects of climate change the worldwide is that there will be more extreme weather. In addition, the expanding railway network is a consequence of the need to pursue speed and convenience; therefore, train shuttles through various terrain scenes have become widespread. Hence, the main issue is the environmental effects of extreme climate and geography on railway aerodynamic behavior. These increases in extremes are significant from the perspective of the train–bridge system because of the complexity have to face. First, the viaducts have majorities in both the railway and transportation network, and the situation has been particularly noticeable in China. It means the risk of a train running on the

https://doi.org/10.2749/nanjing.2022.1927
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