










# Impact of the train-track-bridge system characteristics in the runnability of high-speed trains against crosswinds - Part I: Running safety

P.A. Montenegro <sup>a</sup> , H. Carvalho <sup>b</sup> , M. Ortega <sup>c, d</sup> , F. Millanes <sup>c, d</sup> , J.M. Goicolea <sup>d</sup> , W. Zhai <sup>e</sup> , R. Calçada <sup>a</sup> 

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## Highlights

- Train-track-bridge-wind interaction model to study the running safety.
- Parametric analysis of the train running safety against crosswinds on high-pier viaducts.
- Lateral flexibility of the viaduct does not influence the running safety.
- Track condition has a strong impact in the running safety.
- Lighter trains are more prone to overturning derailments against crosswinds.

## Abstract

This paper studies the influence of different factors related to the structure-track-vehicle coupling system in the train's stability against crosswinds, namely the bridge lateral behaviour, the track condition and the train type. With respect to the former, a parametrization of an existing long viaduct with high piers has been carried out to simulate different lateral

flexibilities. The study concluded that the bridge's lateral behaviour has a negligible impact in wind-induced derailments. Dynamic analyses considering four scenarios of track condition, ranging from ideal to poorer condition, but still within the limits stipulated by the codes, have also been carried out, leading to the conclusion that the track irregularities influence the running safety mainly on the higher train speed levels. This is due to the fact that the Nadal and Prud'homme indexes strongly depend on the wheel-rail lateral impacts, which become more pronounced for higher speeds and under poorer track conditions. Finally, four different trains have been adopted in the study to cover a wide range of vehicles. The results proved the importance of carefully considering the trains used in the analysis, since the train's weight may vary significantly, leading to considerable different results in terms of vehicle's stability against lateral winds.

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## Keywords

Train running safety; Train-track-bridge interaction; High-speed railway bridges; Wind loads; Bridge lateral flexibility; Track condition

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