Creep-like settlement of railway ballast under cyclic loading

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Abstract

The settlement of the railway ballast that occurs on high-speed train tracks is a major challenge for maintenance as it requires frequent costly tamping operations to restore the initial ballast track. By means of realistic numerical modeling, using the Contact Dynamics method and based on the field data and advanced analytical methods, we investigate the settlement of a portion of the railways ballast bed under cyclic loading. The granular bed is composed of ballast grains in a deformable box and a sleeper over which a harmonic stress signal, representing the load exerted by train circulation, is applied. By varying the loading amplitude, frequency and the ballast grains bed width, we show that the settlement follows a creep-like logarithmic settlement law whose parameters change with stress amplitude and frequency. The settlement is found to decrease with track width. We also consider the effect of the investigated parameters on the microstructure in terms of coordination numbers and friction mobilization.

Keywords: discrete element modelling, cyclic loading, settlement, contact dynamics, creep, like behavior

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