Deformations in Railway Ballast due to Contact Induced Damage – A DEM Study

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ABSTRACT

The load transferring mechanism in railway ballast is contact between the stones. If the contact conditions change due to damage, movements could occur in the ballast. This work aims at predicting this contact induced damage and the possible deformations in the ballast by using DEM simulations.

In a first step, the contact induced damage mechanisms are quantified by the Finite Element Method (FEM). The stone material is modelled by a combined plasticity – damage model [1-2] accounting for damage in both tension and compression. By using the experimental values in [3], the possible damage mechanisms at stone-to-stone contact are found and quantified. Two different mechanisms are found, local contact damage leading to creation of fine particles and the creation of large median cracks that could split the stones.

In a second step, a DEM-model is created of the railway ballast which is loaded with representative force data pertinent to a passing train. The DEM model is implemented in an in-house DEM code where particle fracture is taken into account [4]. In the DEM simulations, stone fracture is introduced with a normal force fracture criterion and a fractured stone is modelled by changing its stiffness depending on the fracture plane. The effect of fine creation is modelled by reducing the stone-to-stone friction coefficient depending on the cyclic energy dissipation of the contact.

The outcome of the DEM simulations is the elastic and plastic strains in the railway ballast when a train is passing over the ballast. The effect of different stone quality and cyclic deformations on the deformations will be discussed.

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