

Project Title

Discrete Element Modelling of Railway Ballast

Institution:

The University of Nottingham



The University of Nottingham

Researcher:

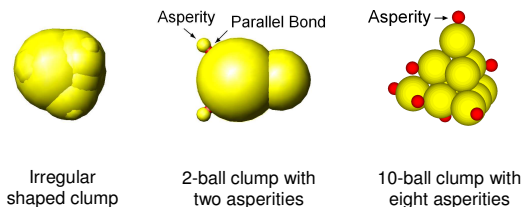
Mingfei Lu

Background:

Ballast particle shape and strength play important roles in both determining the stiffness of the trackbed and the accumulation of the permanent strain.

The permanent deformation arises from particle breakage (and the rearrangement of particles). Most of the degradation of ballast particles under cyclic loading is due to abrasion rather than bulk fracture.

The discrete element method (DEM) is suitable for analysing and simulating the mechanical behaviour of ballast.



Progress:

Irregular shaped clumps are used in the box test simulations to investigate the effect of particle shape.

A simple 2-ball clump is used with two additional small balls (asperities) bonded at the surface to represent each single ballast particle in the box test simulations to investigate the behaviour under cyclic loading and the effect of particle breakage on the accumulated permanent deformation.

A series of monotonic triaxial test simulations using 10-ball clumps with eight asperities have also been carried out to determine the resulting macro behaviour.

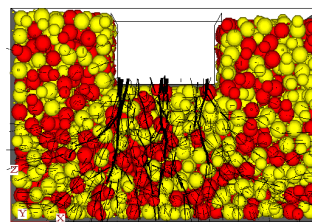
Novel Aspects:

Modelling particle shape

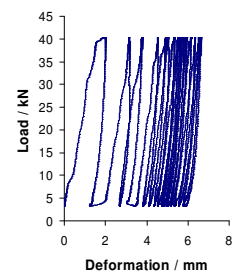
Particle shape strongly influences the behaviour of the ballast assembly. Different shaped clumps are used to represent each single ballast particle in order to simulate the mechanical behaviour of ballast. A clump is a single entity of overlapping balls in PFC3D and internal overlapping contacts are ignored in calculations.

Modelling particle breakage

Instead of using the crushable agglomerate (formed by bonding spheres together), which makes the calculations time-consuming when modelling a large number of agglomerates, small balls are bonded at the surface of the rigid clumps in order to provide a mechanism for abrasion.



Box test simulation using 2-ball clumps with two asperities



Load against deformation for the box test on 2-ball clumps with two asperities

Future work:

Box tests and cyclic triaxial triaxial tests are modelled using appropriate particle model to investigate the micro mechanical behaviour of the ballast and the influence of clump geometry on macro response.

Contact:

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