Numerical modelling of thermoset polymers

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Predicting the bonded anchors' response to various loading is very challenging since different material types are involved, i.e. concrete, thermoset polymer and steel. The paper presents the development of a material model utilized to characterize the behaviour of particulate thermoset polymers. The numerical model is based on the lattice discrete particle representation [1] to capture the particle distribution, size and material properties together with the ability to simulate thermosets on the scale of application.

The Lattice Discrete Particle Model (LDPM) simulates the material as a collection of rigid bodies (cells) interacting over the facets defined between them. These facets are assumed to be in the matrix phase between the adjacent cells and are interpreted as potential crack surfaces. The system of polyhedral cells is created based on the grain distribution curve. Note that there are different options utilized for the LDPM internal structure generation, see [1] or [2]. Each cell consists of the aggregate and surrounding matrix phase found between the particles. Contrary to the original LDPM formulation, no mix design is needed for particulate polymers, and only the distribution of filler sizes is assigned.

The following items characterise the constitutive law:

- The compressible generalised Leonov model is utilised to characterise the viscoelastic material behaviour of polymers.
- The volumetric-deviatoric is utilised to capture the Poisson ratio, which is typically above 0.25 for this type of material. Note that the Poisson ratio is restricted to a maximal value of 0.25 for standard LDPM formulation.
- The nonlinear behaviour captured by the proposed numerical model further includes fracturing, material compaction and frictional behaviour.

The numerical model is compared with the standard experimental tests.

Acknowledgement The authors would like to gratefully acknowledge the financial support provided by the GAČR grant No. 21-28525S.

References

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