EXPERIMENTAL AND NUMERICAL INVESTIGATION OF THE INTERACTION OF A STRESS WAVE WITH A CHAIN OF PHOTOELASTIC DISKS

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Abstract

The dynamics of stress waves propagation in granular media is of great interest in different fields of both science and engineering. From rock and soil mechanics through powders compaction and structures protection the importance of the contact mechanism as the main load transfer mechanism is well known.

The dynamics of stress waves propagation in a single straight chain of disks was analyzed both experimentally and numerically. The shape and velocity change of the waves as they moved through the chain of disks under a dynamic stepwise pressure load were recorded and numerically simulated. The effects of the stress wave reflection from the chain boundaries, the influence of the disk's diameter, density, stiffness, the role of pre-stress, and the loading pulse duration, were examined numerically. In the experimental part, the pre-stress influence on the dynamics of the stress wave propagation was investigated using the photo-elastic method. The numerical investigation was conducted using the commercial code ABAQUS, which uses the finite element method. The numerical model consists of deformable disks and the definition of the contact between them includes mechanisms of contact stiffness and damping. The validity of the numerical model was verified by comparing the simulated contact force and strain history with those obtained in the experimental study conducted by Glam (2004). Fairly good agreement between the simulations and most of the experimental findings was obtained

This successful investigation of the influence of different parameters on the wave propagation in the granular medium, demonstrate the basic capability of the numerical model to be used for further research of such characteristics for different applications of granular materials such as structures protection.