Numerical simulation of wave propagation and failure phenomena by using MPS method

Junichi Takekawa[1]; Yasuhiro Yamada[2]; Hitoshi Mikada[3]; Yuzuru Ashida[4]

[1] Civil and Earth Resources, Kyoto Univ.; [2] Civ. Earth Res. Eng., Kyoto Univ.; [3] Kyoto Univ.; [4] Dept. Civil & Earth Res. Eng, Kyoto Univ.

This study provides coupled simulations of elastic wave propagation and failure phenomena by using MPS (Moving Particle Semi-implicit) method which is one of particle methods. It is easy to model analysis objects because a mesh or lattice structure is not needed in particle methods. Additionally, the absence of mesh or lattice structure makes easy to simulate large deformation and failure phenomena. Before failure simulation, the validation of MPS code developed in this study was conducted relating to elastic wave propagation by comparing with FDM (Finite Difference Method). The results were in good agreement with FDM results with respect to reproducibility of P and S wave. It is examined that numerical stability was dominated by velocity of media, grid spacing and time interval.

We focus attention on Hopkinson's effect as a failure phenomenon induced by wave propagation, and applied MPS method to that. The specimen was modeled as a long bar. Stress wave was generated by applying the pressure on one edge. Compressive wave propagation interior of the specimen induced by incident external pressure was observed clearly, and the dynamic spalling of the bar was reproduced numerically. And a broken piece of the bar was formed and fell away from the main body. Consequently, these results showed that MPS method can reproduce wave propagation and failure phenomena by a common standard, and it is very effective to treat these phenomena at a time.