Elastic-plastic smoothed particle hydrodynamics method for fluid-structure interaction analysis

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ABSTRACT

Particle methods such as smoothed particle hydrodynamics (SPH) [1] and moving particle semi-implicit (MPS) [2] method are recently applied to fluid dynamics analyses for predictions of damage under natural disasters. The methods have advantage more than the traditional methods that are the mesh based methods such as the FEM, FDM and so on. In fluid-structure interaction analyses, if the structures are subjected to the large deformation, the stress may exceed the yield stress in the structures under the natural disasters or the large scaled earthquakes. The smoothed particle hydrodynamics (SPH) method [3][4] is usually calculated by explicit procedure. The elastic-plastic treatment during deformation for the explicit calculation procedure, that is suitable to the SPH method, is applied to the SPH method in the present paper.

In the present study, the computational elastic-plastic procedure for structural analysis which is appropriate to the SPH method is used for structural analysis. The Marcal method [5] which is explicit method for elastic-plastic algorithm are adopted to the SPH method in the present study. The method is expected to shorten the computational time with the SPH method of the elastic-plastic problems. This method for the SPH method is evaluated on computational precision. It is successful to apply the Marcal method to the SPH method because the sufficient precisions of elastic-plastic problems are obtained. The Marcal method can be applied to fluid-structure interaction analysis of the SPH method.

REFERENCES