

TWO-PHASE FLOW SIMULATION OF BED-LOAD TRANSPORT IN THREE DIMENSION WITH MBS-3D MODEL

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A two-phase flow model, namely MBS-3D, is presented for the simulation of bed-load transport in three-dimensional coordinates with focusing on characteristics of movable bed layer. The model is constructed on the basis of Euler-Lagrange coupling of the governing equation of fluid and sediment phases, respectively. The flow phase is computed as unidirectional flow condition with assuming a logarithmic velocity distribution over flow depth; while, the turbulent component intensities in three dimensions have been considered. The sediment transport is described as the motion of a granular media under the action of a steady flow, based on the Distinct Element Method (DEM) of Cundall and Strack (1979), with accounting for interparticle collision of the moving bed particles. Fig.1 shows, a spring-dashpot system should be activated in both normal and tangential directions of the local coordinate, between each contacting particles to describe numerically the interparticle collision in bed-load layer.

The characteristics of mean-flow velocity and concentration of bed-load are discussed, at different rate from low to high bed shear stress, by the present model. In addition, the characteristics of mean velocity as well as concentration profiles of sediment phase is studied and discussed in light of the interphase momentum transfer. Finally, the transport rate resulted from the model has been compared with both the result of a two-dimensional model of Gotoh and Sakai (1997) and the Meyer-peter Muller formula (1948) for bed-load transport.

Fig.2 shows the comparison of the results obtained in this study, namely from MBS-3D model, and those of the two-dimensional model with the conventional formula of bed-load transport at different bed shear stress. It can be clearly concluded that the MBS-3D model provides a better agreement with the conventional bed-load formula, especially at higher bed shear stresses.

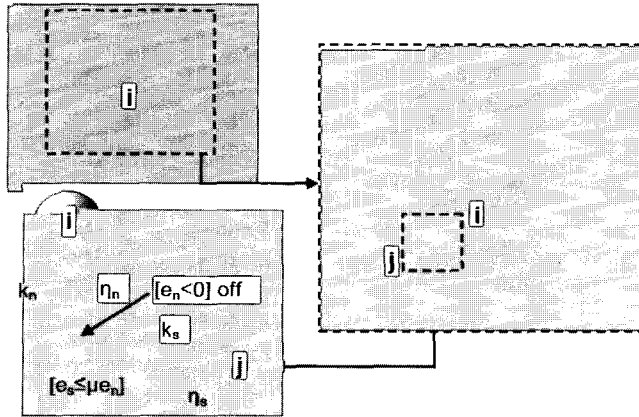


Fig. 1 Interaction system between contacting particles in bed-load transport layer.

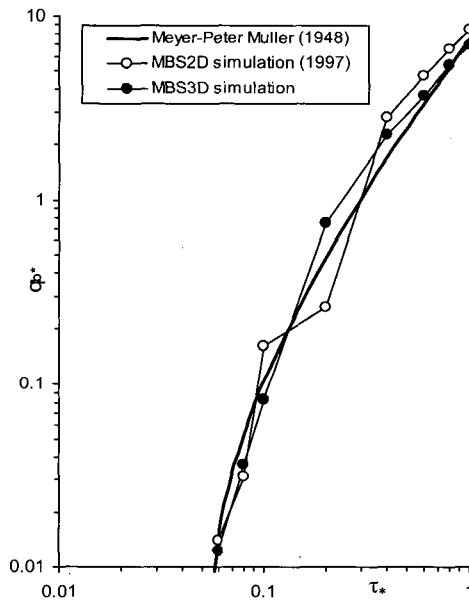


Fig. 2 Bulk nondimensional sediment transport rate.

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