Fall velocity of cluster of spherical particles in Quiescent fluids

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Abstract. The interplay between the resultant of the hydrodynamic forces on a falling particle and of its weight represents the physical mechanism of sediment motion in streams. Transport of sediment occurs because of interaction of fluids with loose material of confined boundaries, which create a very complex set of conditions. The loose boundaries deform due to erosion and deposition. Moreover, the case most frequently encountered in analysis and prediction on sediment transport is one where more than a discrete particle falls through a fluid.

Hubbell, D.W., et al.(l956) showed that cobbles and gravel play a significant role in problems of local scour and resistance to flow of natural streams. Theorectical and experimental information about settling of cluster of particles available is very meagre. Settling velocity of cluster of model sediments was investigated in the department of Civil engineering, Institute of Technology, B.H.U., India. The experiments were conducted in a fall column square in x-section of 30 cm x 30 cm size and 2.3m high. Spheres made of steel, copper and glass were dropped simultaneously in a group of 2, 3 and 4 respectively and their fall velocity and other parameters were compared with that of a discrete falling spheres.

Nomograms for fall velocity were also developed. The range of Reynolds number investigated was from l000 to 40000. It was found that the drag coefficient of group of 2,3 and 4 particles, when dropped simultaneously increased from 6.5% to 25% respectively as compared to that of discrete particles for various values of Reynolds number. Fall velocity of group of spheres decreased from 2.ll% to 7.23%when the number of spheres dropped together increased from 2 to 4, as a functionof Force number. As already shown by McNown and Lin (l952), there is a net retarding effect on the fall velocity of particles, when these particles are uniformly distributed, as in the case of sediment suspensions.