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Turbulent Flow Over a Sphere – An Approach to Erosion

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Abstract

The study here presented is devoted to the study of the shear flow over a sphere for high Reynolds numbers as a way of analyzing the erosion process.

Theoretically it can be shown that the Shields criteria (Shields, 1936) can be expressed as a function of the velocity fluctuation (Durst, 2002):

$$\tau_c = f(u^+).$$

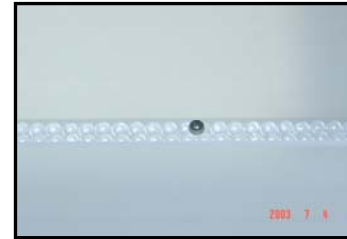


Fig. 1: Detail of the model

The experimental model used was a loose particle placed over a bed of fixed particles, as shown in Figure 1. Measurements were made for 4 Reynolds numbers (10000, 20000, 30000, 40000), and LDA, mounted in a forward-scatter configuration was used to characterize the flow over the sphere (Figure 1). Some of the results obtained for the u component for the Reynolds numbers 10000 and 40000, along the centerline of the channel are shown in Figure 2.

The obtained data allowed the analysis of the flow around the sphere and its influence in the downstream flow. These data was also used to verify if the onset of particle lift out of the sediment bed occurs when the turbulent fluctuations reach a limiting value proportional to the weight of the particle.

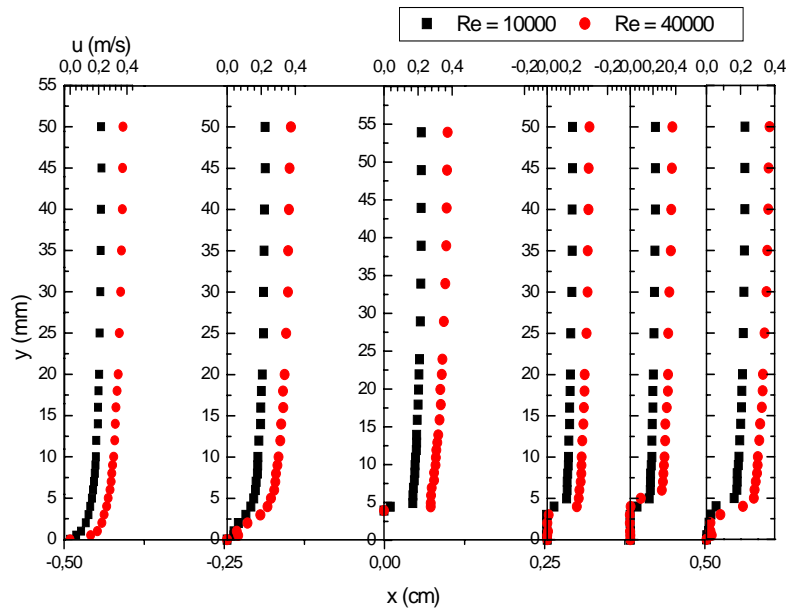


Fig. 2: Detail of the u component at the sphere vicinity

References

Durst, F., Contribution for an Annex of a FCT Research Project Proposal, 2002.

Shields, A., Anwendung der Aenlichkeitsmechanik und der Turbulenzforschung auf die Geschiebbewegung, Mitteilungen der Preussischen Versuchsanstal fur Wasserbau und Schiffbau, Berlin, 1936.