Symposium in honor of Prof. F. Dias' 60th birthday, Loughborough. U.K., 27-29 October, 2022

Fluid flows around obstacles and boulders

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Abstract

Fluid flows around obstacles constitute a classic problem in fluid dynamics. Such obstacles may be convex-shaped protrusions of the bottom of some flat rigid surface, over which some fluid flows. Steady two-dimensional fluid flows over an obstacle can be solved using complex variable methods. In particular, we study the impact of a flow hitting a vertical wall of finite extent. The fluid overtops the finite vertical wall as shown in Figure 1(a). Here we consider free-surface flows past a semi-infinite step at the bottom of a channel for an inviscid and incompressible fluid; the flow is steady and irrotational. The flows is uniform far upstream with constant velocity and constant depth, while far downstream the flow is also uniform with a different constant velocity and constant depth. The solution of such problems depends on the depth ratios and on the dimensionless upstream and downstream Froude numbers. We will present the numerical procedure with various solutions of the problem, including limiting flows. Relevant pressure and forces will be also addressed with the discussion touching the "boulder" problem.