Undular hydraulic jumps

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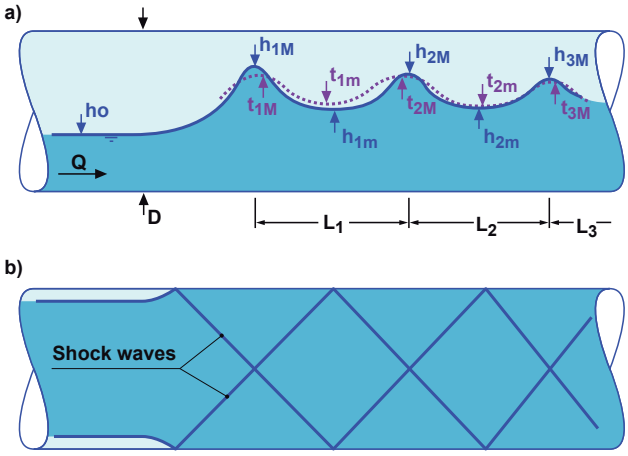
In the past years, several studies were conducted on weak hydraulic jumps that are also referred to as undular. Their upstream Froude number is typically between 1 and 2, and their energy dissipation is extremely small when compared with direct hydraulic jumps. Studies extended to jumps in both the rectangular, and the circular profiles, with results relating mainly to the various appearances of jumps, their specific features, and design relations for hydraulic engineering.



Definition plot for undular hydraulic jump in circular conduit (a) streamwise section, (b) plan.

Non-breaking undular hydraulic jump

The differences between the undular jump and the undular surge are described. Further, the limit approach depth and the channel width are defined for undular jumps governed by the Froude similarity law. Based on previous and present observations, the main flow characteristics of undular jumps are established. These include the characteristics along the axis and the walls of the rectangular channel. Also, generalized surface profiles are presented. Finally, the formation of shocks is physically explained as a breakdown of the supercritical approach flow.

Undular hydraulic jumps in circular conduits

Undular hydraulic jumps in circular conduits are considered with an experimental approach. Based on previous findings in rectangular channels, this research indicates differences in terms of shape effects. All present results depend on the filling ratio of the upstream conduit flow in addition to the upstream Froude number. The results include information on the wave crests and troughs, wave lengths, and generalized axial surface profiles. The wall surface profile is shown to be similar to the axial wave profile, but with smaller wave extrema and a wave shift. The design of conduits containing undular jumps should be avoided because of flow instability. It is also demonstrated that conduits may choke in the presence of undular jumps, with a previously established choking number relating to a design limit. For flows with ckoking numbers in excess of 1, choking occurs associated with a transition from the free surface to the pressurized conduit flow.

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