Closure to "Negative Surges in Open Channels: Physical and Numerical Modeling" by Martina Reichstetter and Hubert Chanson

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The authors thank the discussers for their pertinent comment. Indeed, a negative surge is observed in the upstream reservoir during a dam break wave, and there is an abundant literature on the topic. The complete solution of dam break wave is commonly treated in modern textbooks (Henderson 1966; Montes 1998; Sturm 2001; Chanson 2004a, b). The analytical solution of dam break wave advancing over some water was first solved by Barré de Saint-Venant (1871) for a rising tide in a channel with initial water depth. Relevant experimental evidences included Bazin (1865, pp. 536–553) [see also Darcy and Bazin (1865), Schoklitsch (1917), Cavaillé (1965), and Estrade (1967)]. Interestingly, Bazin (1865) repeated experiments in a large canal with different initial conditions to check his findings, whereas Cavaillé (1965) repeated identical experiments on smooth and rough inverts for three initial water depth-to-reservoir height ratios. Hager and Chervet (1996) reviewed the historical developments.

Experimental studies of negative surges included the free-surface measurements of Favre (1935) and the unsteady velocity data of Reichstetter and Chanson (2013) and Leng and Chanson (2013). Numerical studies of negative surges are more numerous (Tan and Chu 2009; Reichstetter and Chanson 2013), albeit restricted by the limited amount of detailed validation data sets.

In relation to the original data at $x = 10.8$ m [Fig. 4 in Reichstetter and Chanson (2013)], the water depth data were recorded 0.35 m upstream of the tainter gate, itself located 0.85 m of a free overfall (Fig. 1). Fig. 1 presents an undistorted dimensioned sketch of the channel downstream end. The longitudinal flow profile was substantially determined by the hydraulic control mechanism operating within the system (Henderson 1966; Chanson 2004b). Prior to gate opening, the channel flow was controlled by the undershoot tainter gate. The flow was subcritical upstream of the gate and supercritical between the tainter gate and free overfall (Fig. 1, solid line). During the rapid complete gate opening, a transient flow took place during which the channel flow was controlled briefly by critical flow conditions at the gate location. This was followed by a gradually varied flow motion in the flume, which became controlled by the critical flow conditions at the overfall (Fig. 1, dashed line). The channel flow experienced a shift in downstream control location that was responsible for a slight increase in water depth at $x = 10.8$ m beyond a certain time, as recorded by the acoustic displacement meter [Fig. 4 in Reichstetter and Chanson (2013)] and observed with video camera and digital photography.

Notation

The following symbols are used in this paper:

d = water depth (m) measured above the invert;

h = initial undershoot gate opening (m);

x = longitudinal distance (m) positive downstream, with $x =$ 0 at test section upstream end; and

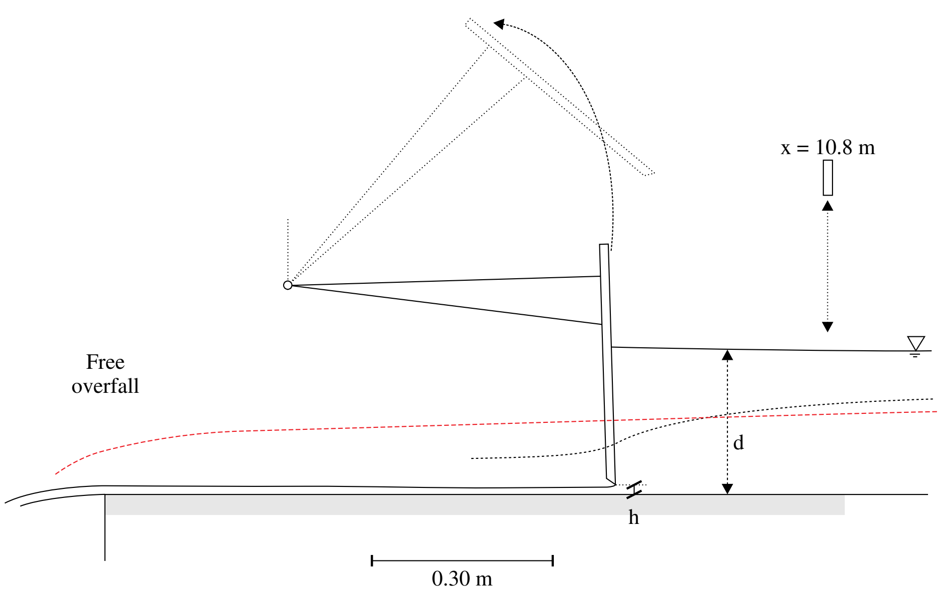

Fig. 1. Sketch of the negative surge generated by the rapid tainter gate opening

x_{Gate} = longitudinal coordinate (m) of the tainter gate ($x_{Gate} = 11.15$ m herein).

Subscripts

Gate = flow properties at tainter gate; and

x = longitudinal direction positive downstream.

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