LABORATOIRE DE CONSTRUCTIONS HYDRAULIQUES

ÉCOLE POLYTECHNIQUE FÉDÉRALE DE LAUSANNE

# *Hydraulic performance of stepped spillway aerators and related downstream flow features*

## *(2012 – 2015)*

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## *Introduction*

Cavitation on chutes and spillways damaged many structures before first bottom aerators were applied. Since these devices are studied in research projects and implemented in practice, no more damages are reported. In parallel, a new spillways type established over the last years with different flow features: stepped chutes. There, the specific discharge load was usually limited compared to classical chutes to avoid cavitation damages, as stepped spillways have presumably a higher damage potential. However, these restrictions are more and more ignored, such that first damages occurred.

However, no systematic studies were so far conducted providing general design guidelines for the application of aerators on stepped spillways. To reduce this gap in knowledge, the chute aeration concept as known from classical chutes is applied on stepped spillways in the herein presented research projects. It thus intends to systematically investigate and optimize related aerators on a physical model to finally give reliable and general applicable design recommendations. All relevant parameters affecting the efficiency of such aerators are known and will be varied systematically during the project.

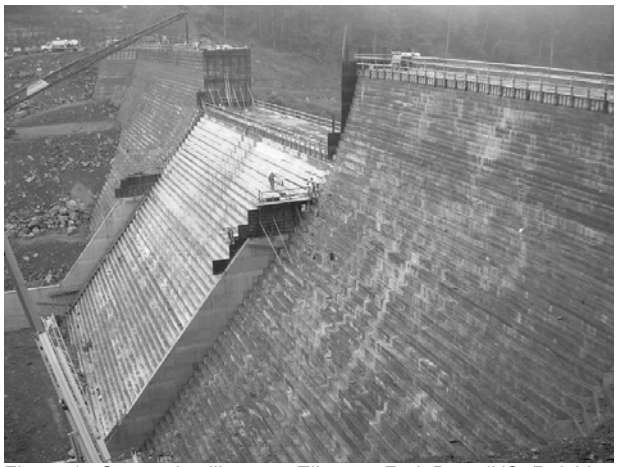

*Figure 1 : Stepped spillway on Elkwater Fork Dam (US, Reichler Engineering)*

## *Research objectives*

For the present research, a physical model of a stepped spillway is used to investigate its performance by systematically varying all relevant parameters:

- the approach flow Froude number $F_o$
- the approach flow depth $h_o$
- the pseudo-bottom (chute) angle $\varphi$
- the step height $s$
- the deflector angle $\alpha$
- the deflector height $t$

The air concentration is measured in the flow depth and along the length of the channel in order to have its distribution. Furthermore, the air entrainment coefficient $\beta$ is derived to design air supply systems avoiding sub-pressures with fluctuations.

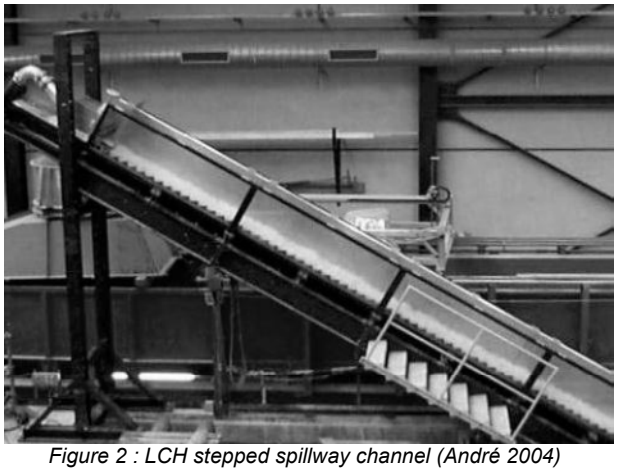

*Figure 2 : LCH stepped spillway channel (André 2004)*

Then, general design recommendations for aerators on stepped chutes can be provided. It is further planned to adapt the results into a numerical model to evaluate its capability to simulate aerated stepped spillway flow.

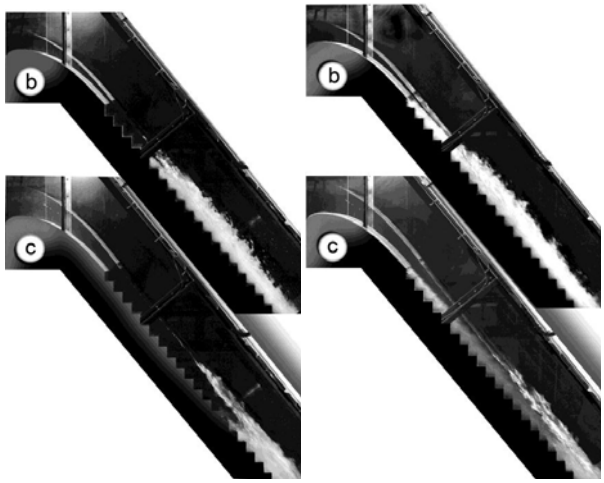


*Figure 3 : Stepped spillway without (left) and with (right) a step aerator (Schiess 2008)*