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Validation of hydraulic design of the Ritom compensation basin

Jakob Siedersleben[1], Samuel Vorlet[1], Giovanni De Cesare[1], Nicola Tatti[2], Graziano Sangalli[2], Urs Mueller[2]
[1]Platform of Hydraulic Constructions (PL-LCH), Ecole Polytechnique Fédérale de Lausanne (EPFL)
[2] CRT/IM Ingegneria Maggia SA, Ritom SA

Context

Based on the Water Protection Act of 2013, severe issues caused by the rapid change of water discharge (hydropeaking) must be reduced by operators of hydroelectric power plants in Switzerland. Therefore, a new generation of regulating basins is under construction. In Tesin, the Ritom hydroelectric power plant, constructed in 1921, will be modernized. The project includes a new powerhouse with three machine groups. A compensation basin with a volume of 100'000 m^3 is planned in order to minimize the effects of hydropeaking. The discharge exiting the basin to the Ticino will be controlled by a regulating structure. Due to the new compensation basin, the route of the Foss river needs to be modified and new weirs have to be installed to prevent the overflow of the Foss river into the compensation basin. Figure 1 shows the planned basin and the physical model boundaries.

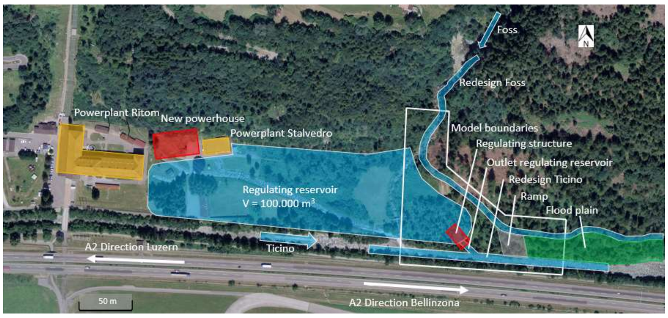

***Figure 1:** Planned basin and physical model*

Objectives

The Platform of Hydraulic Constructions (PL-LCH) was mandated to carry out physical modelling of the basin and the regulating structure in four phases with the following objectives:

- Concept validation of the planned geometry of the Ticino, the regulating structure and the Foss
- The investigation of the influence of the regulating structure on the Ticino
- The verification of the behaviour of the system under extreme flooding event
- The analysis of floating debris and debris flow in the Ticino and the Foss

Methods

The modelled area is 215.2 m long in flow direction of the Ticino and 181.2 m wide perpendicular to the flow direction. The modelled area is illustrated in Fig. 1. The model was constructed with a scale of 1:40 according to the Froude similitude. Water height is measured at eight locations with ultrasound sensors. The height of the riverbed is measured with a red laser on a grid of twenty-five points. The flow velocities are measured with a current meter at three different points.

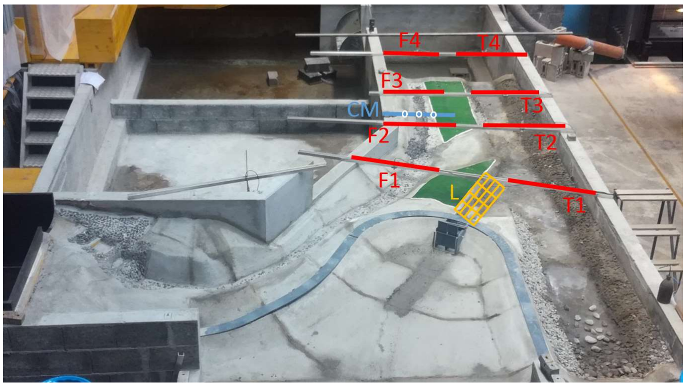

***Figure 2:** Physical model, ultrasound sensors (red), current meter locations (blue) and laser locations (yellow)*

Results

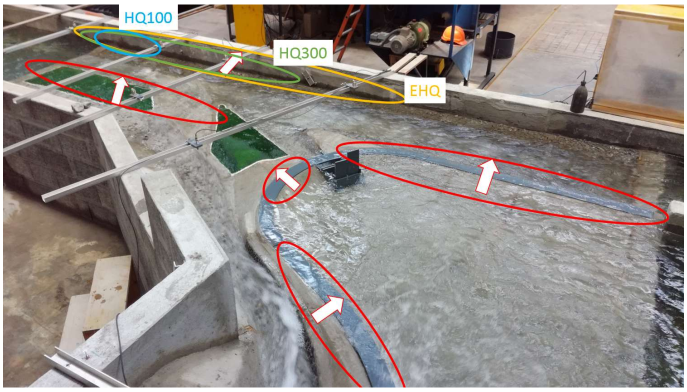

***Figure 3:** Overflow areas for tested configurations*

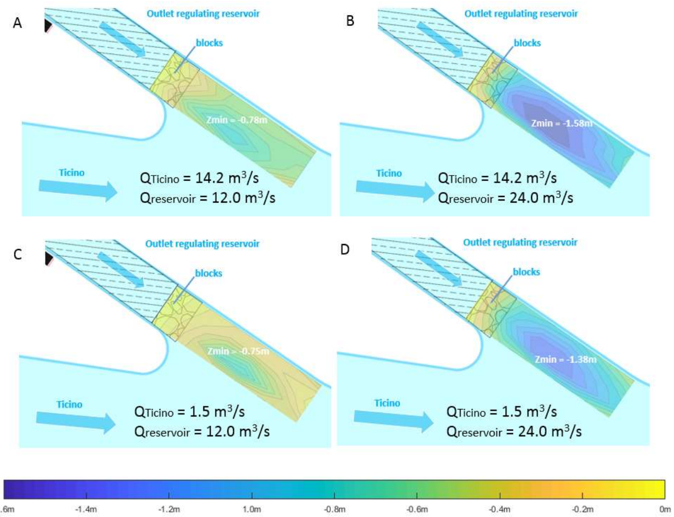

***Figure 4:** Depth and location of the scour hole*

Conclusions

The results confirm the proper functioning of the initial hydraulic design of the compensation basin and the regulating structure under the tested conditions. The tests carried out during Phase I and Phase II show that the influence of the regulating structure on the downstream water depth is low. The overflow tests performed on the Foss show that without intervention, overflows are possible over the dike of the demodulation basin. Therefore, the setting up of weirs and the increase of bottom roughness make it possible to redirect the flow in a more favorable direction and thus reduce the risk of overflow of the Foss.

The flood analysis carried out during Phase III shows the proper functioning of the structure according to the tested conditions. The tests performed during Phase IV show that in case of debris flow in the Foss and in case of overflow over the dike of the demodulation basin, a majority of the debris flow is transferred to the demodulation basin.

References

[1] Bassin de démodulation des rejets d'une centrale hydroélectrique : Barrage de Ritom ; Cédric Egolf ; 2019

[2] Erneuerung des Wasserkraftwerkes Ritom; Hydraulische Modellversuche; PL-LCH Offerte 11/2017; 31.08.2017

[3] Auslaufbauwerk Demodulationsbecken – Verlegung Fossbach – Pflichtenheft für physikalische Modellversuche; Ritom SA (Bauherr); 02.08.2017

[4] Wasserkraftanlage Ritom; 28.06.2019; Retrieved from https://www.aet.ch/DE/Impianto-idroelettrico-del-Ritom-ba89fd00#.XRXZFuszZaQ