Koman Dam Albania - Numerical simulation for spillways & plunge pool *(2010 - 2011)*

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Introduction and objectives

Koman dam (Figure 1) is located in the Northern part of Albania and is one of the existing dams of the Drin River cascade. It is a concrete face rockfill dam which was constructed between 1980 and 1988. The powerhouse has an installed capacity of 600 MW.

A 3D numerical study was carried out in order to determine the hydraulic behavior of the dam and the plunge pool in the framework of the Koman dam rehabilitation project. Physical model tests have been performed at LCH, EPFL in 2008. Numerical simulations were carried out to evaluate the effect and hydraulic solicitation on the downstream toe of the dam as well as on the banks of the plunge pool.

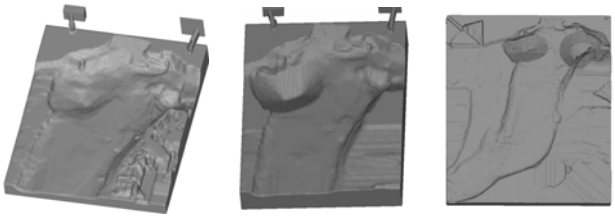
Figure 1 : View of the downstream face of the Koman dam with eroded dam toe and the outlet works

Numerical simulations

Three scenarios were defined to be simulated numerically. The first scenario simulates the actual state of plunge pool with its topography before the flood events in December 2010. The second scenario models the plunge pool with an assessed ultimate scour hole below spillway N°4. The last one simulates the plunge pool with two estimated ultimate scour holes below spillways N°3 and N°4. The assumed most harmful situation is the operation of both spillways together at 100% of their capacity. Therefore, both spillways are simulated functioning simultaneous with maximum discharge for all the scenarios. The objectives of the numerical simulations were as below:

- *Evaluation of the jet trajectory and impact zone,*
- *Assessment of water levels in the plunge pool,*
- *Study of the flow circulation inside the plunge pool, especially in front of the dam toe and along the banks where the tailrace channel is situated.*

The simulations were performed at prototype scale. At an initial stage, the current geometry is simulated in order to validate the numerical approach. This simulation was first performed at the physical model scale, where precise measurements were available and upgraded to prototype scale. The numerical simulations were performed using the software FLOW-3D, version 9.4.2 from Flow Science Inc. in New Mexico, USA. FLOW-3D numerically solves the continuity and momentum equations using finite volume approximation. Tailored plunge pool geometries for scenarios two and three were created based on 2D longitudinal estimation and extended laterally based on rock quality assessment.



Scenario n°1 *Scenario n°2* *Scenario n°3*

Figure 2 : Plunge pool state for the simulated scenarios

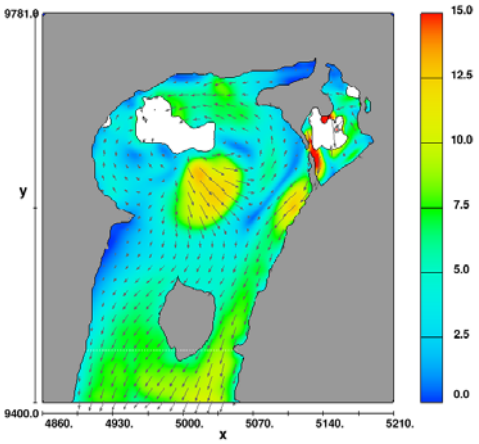


Figure 3 : XY plane, velocity magnitude in the plunge pool for the first scenario (n°1)

Test results

The results are relevant for design of dam toe and river bank stabilization. Furthermore, the wave impact measurements on physical model should be taken into account. The simulated flow velocities can be used as one of the influential elements for the design of the protection measures.

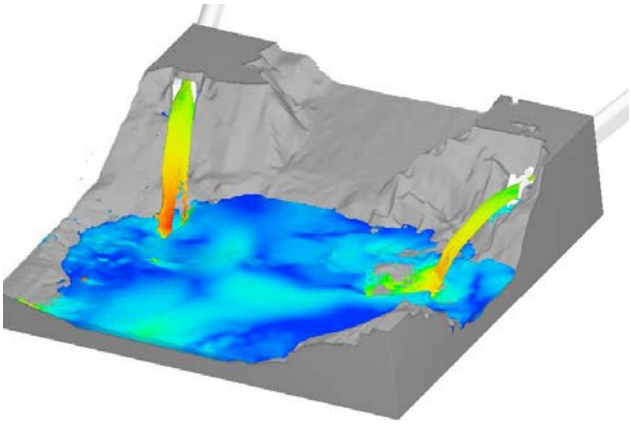


Figure 4 : 3D snapshot of the plunge pool with the tunnel spillways