Analysis of the hydrological safety of "Belesar" dam using numerical tools: Iber & DualSPHysics

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Introduction

The probability of failure of the exceedance structures (spillways and outlet works) of a dam defines its hydrological safety. This failure can be categorized into two types: structural and performance failures. The former is related to dam breaks and the latter is related to water excess in the impoundment associated to the dam. In this work the hydrological safety of "Belesar" dam is analysed by means of two numerical codes: Iber and DualSPHysics.
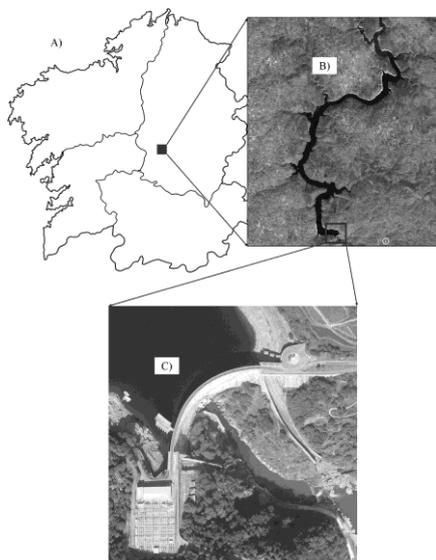

Figure 1: Location of "Belesar" dam (A), impoundment associated to the dam (B) and aerial image of the dam (C).

The "Belesar" dam was built in 1962 with the main purposes of hydroelectric use, basin regulation and control of floods of the "Miño" river. The dam is 127 meters height (from the heel to the crest) and its crest length is equal to 500 meters. The elevation of the top of the dam is equal to 332 m. The impoundment associated to this dam is supplied by the hydrological network of the "Miño" river and it is 50 km long. The main exceedance structures of the dam are two spillways located at both sides of the dam and four low level outlets. Both spillways were designed using scaled models (1:75). According to the technical specifications of the dam the maximum level of the pool is equal to 330 m and the maximum expected flow of the "Miño" river is equal to 4,000 m^3/s. The location of the dam, its impoundment and a detailed aerial image including both spillways are shown in Figure 1.

To analyse the hydrological safety of the dam, first, the water elevation (Figure 2) and the outflow of the spillways associated with the maximum flow of the "Miño" river were obtained using the numerical code Iber. The numerical domain defined for this simulation considers the real geometry of the "Belesar" dam and the whole associated impoundment. The geometry was obtained from raster files. These raster files were downloaded from the IGN website and edited by means of the software QGIS.
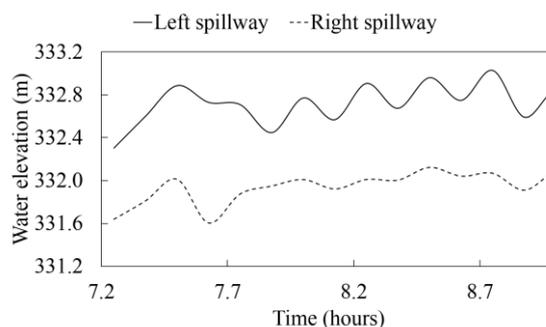

Figure 2: Water elevation close to the dam.

Once the water elevation and the outflow of the spillways were computed, the behaviour of the spillways was analysed using the numerical code DualSPHysics.

Conclusion

The numerical results obtained with Iber and DualSPHysics show that the water elevation near the spillways is constant during the analysed period. Therefore, both spillways have the ability to evacuate the flow originated under the most dangerous situations.