

Renewal of the Hagneck run of river hydroelectric plant, numerical model study on the influence of the old weir structure (04/2013)

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Study entrusted by: BKW Energy Ltd, Berne, Switzerland

INTRODUCTION

The Hagneck hydropower plant is located in Switzerland in the Seeland region. The existing barrage has been built during the first Jura water correction and put in operation in 1898. The hydropower scheme is operated by the electric power company of Lake Biel (BIK), owned by the city of Bienne and the company BKW Energy Ltd as equal partners.

In order to better exploit the energy potential of the Hagneck canal and to meet the new flood safety requirements, the construction of a new barrage and powerhouse is planned.

OBJECTIVES

With the objective of avoiding the total demolition of the old weir sill, a numerical study allowed evaluating the effect of the existing sill on the flow field by varying its maximum elevation. A three-dimensional numerical model was built using Flow-3D. Several different scenarios were studied, starting by the present situation where the highest part of the sill is at an elevation of 432.04 m asl. In order to take a decision, many features of the flow were checked (e.g. Froude number, velocities). The old weir levels that were respectively tested are: 431.64, 431.24, 430.79, and 430.44 m asl.

RESULTS

In the presence of the actual weir sill (at 432.04 m asl), the results have shown local lowering of the water level upstream of the new dam. The difference between the highest and lowest water levels around the old structure was more than 80 cm and the Froude number reached 0.8 in this region (shown in Figure 1) which is not acceptable inside a reservoir. The maximum level of the old weir is then progressively lowered by more or less 40 cm until reaching a hydraulically acceptable situation. The considered flood discharge is 1800 m³/s and the reservoir level is at 436.75 m asl. The effect of this lowering on the flow in terms of Froude number is shown in figure 2 below.

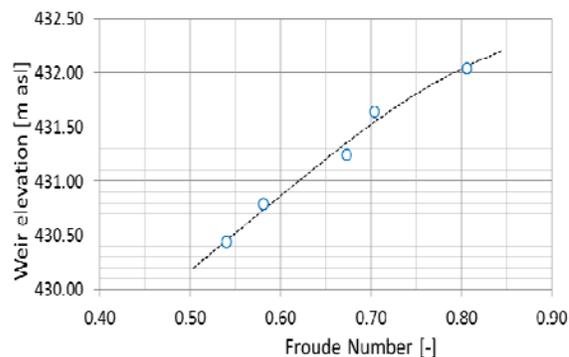


Figure 2: Graph showing the effect of weir elevation on Froude numbers

Results showed satisfying improvement when the sill level reached 430.79 m asl. The local Froude number fell below 0.60 and the water level differences passed from 80 cm to 25 cm. These conditions are less disturbing for the new dam and therefore acceptable. The decision on lowering the old weir sill has been taken. Results were beneficial and helped in avoiding the total and costly destruction of the old weir sill.

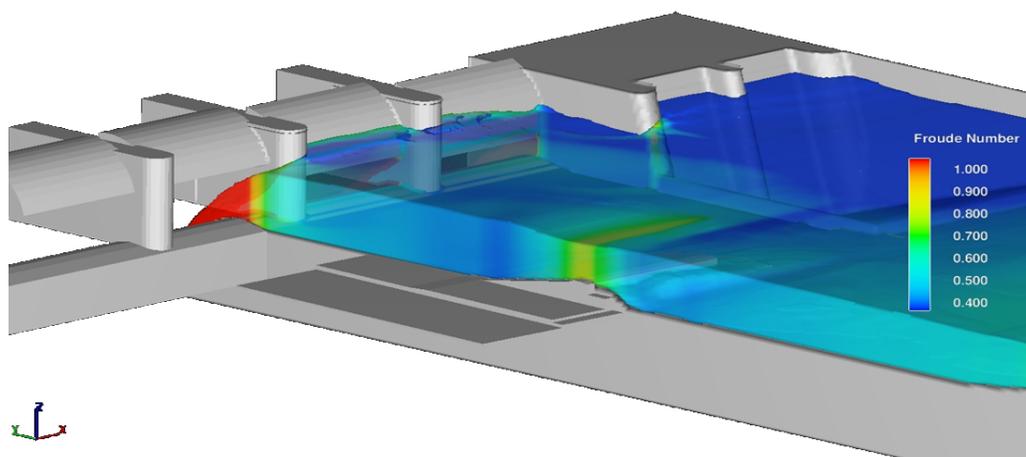


Figure 1: View of the numerical model showing the old weir sill imposing high Froude numbers close to the new dam