Dez Dam rehabilitation project, Iran - reservoir sedimentation by turbidity currents (2008)

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Introduction and objectives

The Dez Dam was constructed in 1963 on the Dez River in southern Iran (Khuzestan) with the purpose of power generation, irrigation, water supply and flood control. It is a double curvature concrete arch dam with a height of 203 m and the created reservoir has an initial storage capacity of 3'315x10^6 m^3.

Fig. 1: Downstream view of the Dez Dam

Dez Reservoir is one of the many reservoirs in Iran which suffer from sedimentation. In its operational period, a sedimentation rate of 15 to 20x10^6 m^3/year has caused the sediment level behind the dam to raise close to the power intakes level (with a rate of approximately 1.2 m/year) and the delta front of coarse grained material has progressed 0.5 to 1 km/year towards the dam. Currently, the major issue which threatens the Dez Dam is the continual accumulation of silt in the reservoir near the dam endangering the operation of the entire hydraulic scheme.

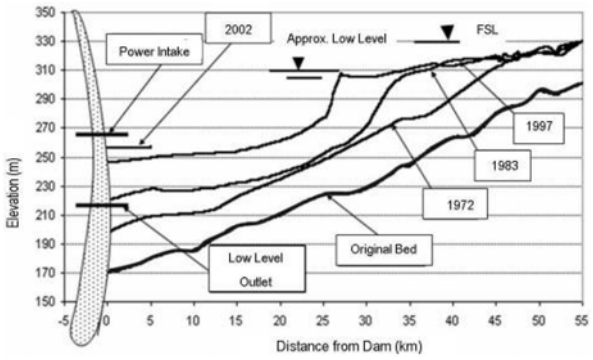

Fig. 2: Longitudinal profiles over time of the Dez Reservoir bottom showing the filling-up of the reservoir by sediment, delta and turbidity currents (source: Emamgholizadeh and Samadi, 2008, Journal of Applied Sciences in Environmental Sanitation)

The aim of the study is to assess the plunging and the behaviour of a turbidity current event in the gorge part in the Dez Reservoir using a 2D CFD model. An observed flood event with measured turbidity current in the reservoir was used as bases for the simulation.

The conditions for the possible formation of turbidity currents are a significant density difference (high suspended sediment concentrations), a large reservoir depth at the flow entrance and a low flow velocity in the reservoir.

Numerical model simulation

The simulations of the turbidity current were performed using the software FLOW-3D® in its version 9.3 (performed within the frame of advanced Master student work).

The simulations reveal the behaviour of a turbidity current along its descending path in Dez Reservoir, including its local hydraulic characteristics. The simulations have been performed non-stationary, with at its initial stage, the reservoir filled only with clear water and no movement and the upstream silt laden discharge entering the reservoir.

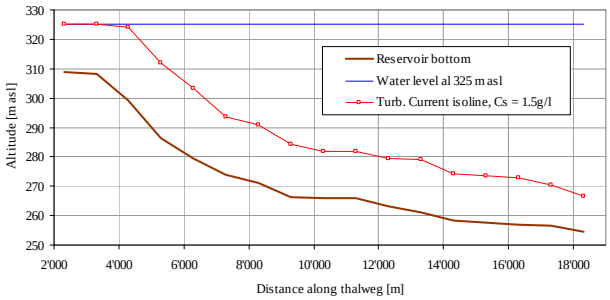

Fig. 3: Simulated 2D turbidity current in Dez Reservoir form its plunge point downwards showing the upper limit of the current at C_s =1.5 g/l

Immediately after the start of the computation, after plunging, an advancing turbidity current with its characteristic head and following body forms.

The current has an almost constant height, it does not dilute and increase in height, nor does it increase its concentration and accelerates in the narrow part of the reservoir. These parameters indicate a stable, conservative turbidity current.

Conclusion and outlook

The performed study confirms that turbidity currents occur in Dez Reservoir. These currents can be assumed to be almost conservative in the gorge part of the reservoir, therefore transporting its suspended load (with eventual additional re-suspended material for larger flood events) all the way down the wide part of the reservoir. The field observations showed that these currents reach the dam.

A solution for venting these turbidity currents would therefore evacuate significant amounts of sediment downstream the dam. Turbidity current venting is the most efficient solution which can considerably attenuate the sedimentation in Dez Reservoir. Therefore it can be considered as a sustainable solution.

The behaviour inside the enlargement of the Dez Reservoir and the subsequent narrowing towards the dam site has not been evaluated in this study, as the model is only 2D. In order to assess the transport potential of turbidity current all the way down to the dam, only a fully 3D simulation will allow doing so. This is planned to be performed early in the next project stage.