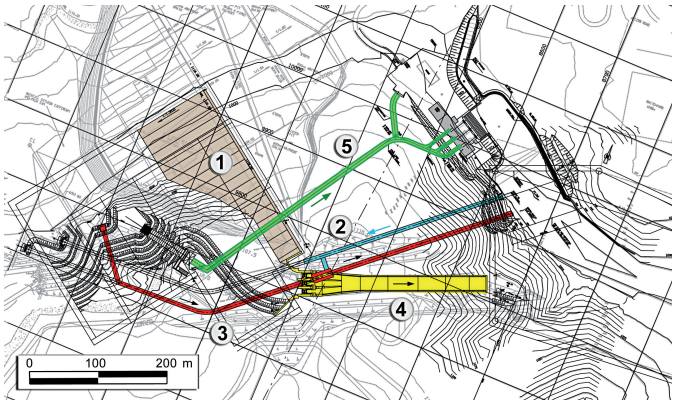
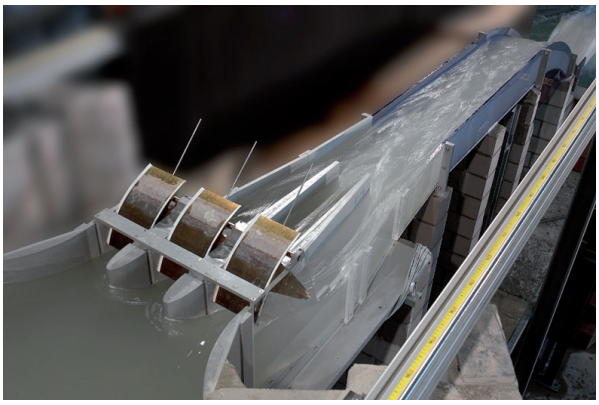
Model Investigations of the Gojeb Spillway (Ethiopia) (2002)

The Hydropower Project (HPP) Gojeb in Ethiopia consists of a 130 m high concrete faced rockfill dam (CFRD), a powerhouse with an installed power of 150 MW and a gated, open spillway on the right hand side.

A curved approach channel leads to an ogee weir with three radial gates, followed by a transition section contracting the channel width, an open chute (20 m wide and some 176.6 m long) and a flip bucket.



HPP Gojeb: 1. Concrete Faced Rockfill Dam (CFRD), 2. Air Supply for the Bottom Outlet, 3. Bottom Outlet, 4. Spillway, 5. Water Supply for the Powerhouse Tunnel.



Shockwave pattern for PMF outflow of 3500 m3/s, all gates opened.

The performance of the spillway had to be verified. Therefore, a physical model with a scale of 1:55 was built. For steady state conditions, the flow conditions in the approach channel, the discharge characteristics including the velocities of the spillway and corresponding pressures were assessed. Furthermore, qualitative aspects, such as shockwaves in the chute and the hydraulic jump in the adjoining flip bucket were investigated. Finally, scouring in the adjacent tailwater reach was documented and conclusions for adequate measures were drawn.

Only the gated outflow of small discharges (e.g. 359 m^3/s) over the weir structure leads to pressures close to zero. Pressures close to vapor pressure were not observed in the hydraulic model. The absence of the danger of cavitation erosion at the ogee weir and in the chute is typical for all investigated cases. Maximum measured velocities at the end of the steep part were of 31 m/s with corresponding cavitation indices of approximately 0.3. Therefore, provision of aerators does not seem to be necessary.

The overall performance of the flip bucket is satisfactory. Issuing from the flip bucket, trajectories of floods higher than 1184 m^3/s do not hit the original terrain. Jets hitting the actual river bed result in scour hole depths close to those estimated. The biggest hole occuring during the highest investigated discharge of 1725 m^3/s is 31.6 m deep. Secondary currents, developing as rollers on each side of the jet's impact area, cause additional scouring, and measures should be considered to protect the left valley flank against sliding.

Keywords:	Cavitation, flip bucket, scour
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