Exercises: course Hydroelectric power

In this exercise we will focus on the hydraulic aspects of the design of a reservoir hydropower scheme.

Each student receives the input information on the dam height (H) and installed discharge (Q).

H = _____ m

Q = _____ m^3/s

Our design consists of a gravity dam (H meters high) with 4 overspilling sections on the crest, and an intake to the powerhouse. In the powerhouse we plan to have 2 turbines installed.

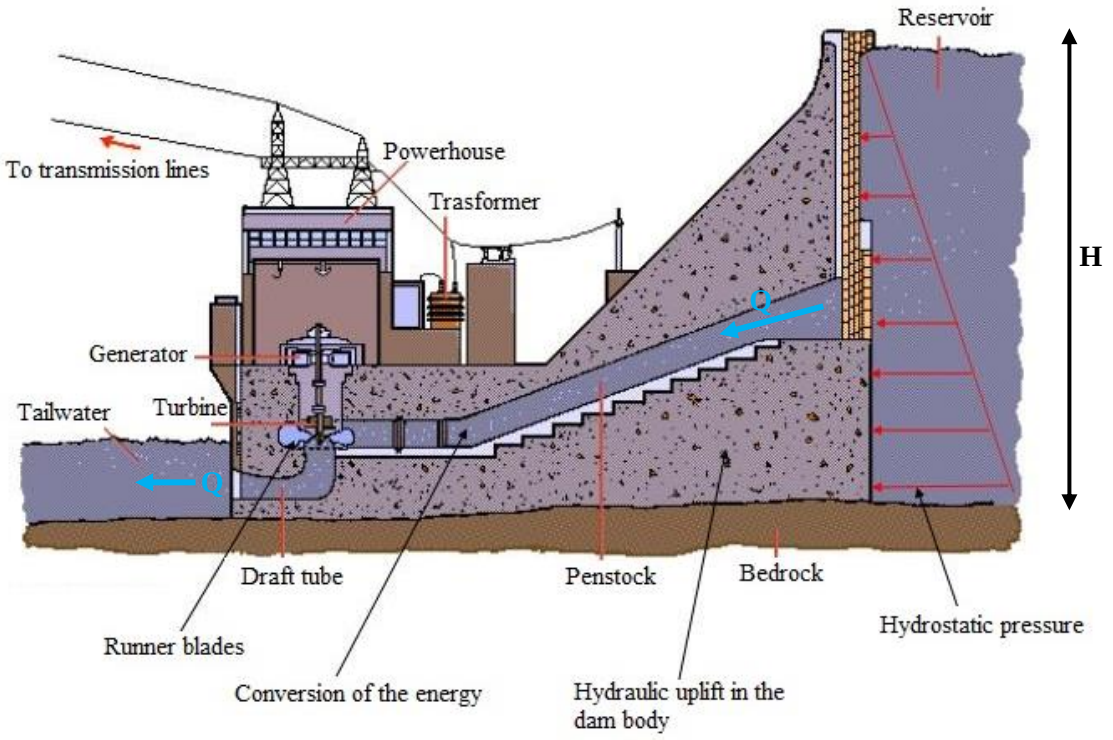

Figure 1: Schematic example of the design case – intake to the powerhouse.

Gravity dams are designed with the respect to the required design safety factors against overturning and sliding. Loads acting on the dam body are: hydrostatic pressure, uplift, silt, ice load, earthquake.

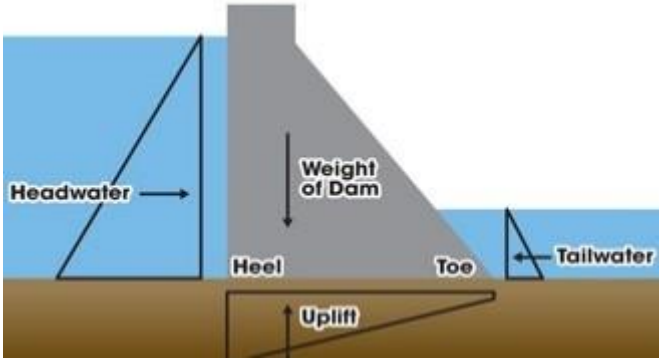

Figure 2: Acting loads for stability analysis of a gravity dam.

Task 1: Determine the design of a gravity dam, height H to satisfy safety factors against sliding and overturning.

The dam body consists of overspilling and non-overspilling sections. Overspilling sections are usually equipped with hydraulic gates, which are maneuvered to evacuate flood water downstream.

Figure 3: Overspilling and non-overspilling part of a gravity dam.

Task 2: Determine the design of spillway section to safely evacuate flood with a 100-year return period downstream.

Q_{100} = _____ m^3/s

During the operation of the powerhouse water enters the dam body at the intake and is guided thorough the penstock to the turbines in the powerhouse. With the draft tube the water is released on to the stilling basin downstream of the dam.

Task 3: Design the intake structure for the powerhouse, route water to the powerhouse and further to the stilling basin downstream of the dam.