

DAM ENGINEERING

ORAL EXAM

Questions

Part 1 – General topics + Concrete Dams

- 1) Which are the types of dams and which are the main criteria for selecting the dam type?
- 2) What makes the construction of large dams so particular, and what are the implications in terms of construction methods (for concrete and fill dams)?
- 3) How does the shape of a gravity dam influence its design (in terms of stability and resistance of materials to failure)?
- 4) Which conditions must a dam site meet to make it eligible for an arch dam? Cite methods for ground-quality investigations and criteria for assessment of the results.
- 5) Explain the role of uplift pressures for gravity dams. Describe means to measure and limit uplift pressures.
- 6) Explain the safety of a gravity dam against sliding. Present and discuss possible improvements.
- 7) How is the effective behaviour of a gravity dam in the event of an earthquake as compared with the simplifications made for pseudo-static analysis? Present and discuss the 'Response Spectra procedure' to assess dam behaviour in case of earthquake.
- 8) Describe the effect of temperature on a gravity dam and measures to be taken to ensure adequate concrete cooling and hardening.
- 9) Describe the vertical and horizontal stresses in a gravity dam and the consequences on cement use.
- 10) Describe the stability concept of buttress dams. Compare it with that of gravity dams.
- 11) Describe the stress distribution of a buttress head and optimisation measures to eliminate tensile stresses.
- 12) Describe the main assumptions & calculations made across the various stages of development of an arch dam project.

- 13) Stability and behaviour of arch dam and comparison with gravity and buttress dams.
- 14) Water acting on an arch dam. Distribution between cantilevers (walls) and arches.
- 15) Explain the process for definition of the initial shape of an arch dam and indicate the approximate rules.
- 16) What are the permissible stresses in an arch dam. Justify the permissible tensile value.
- 17) Describe the main steps of the trial-load method used for the preliminary design of arch dams.
- 18) Where and why are injections used in arch dams? Describe the methods and products used.
- 19) What quality controls are carried out during the execution of a concrete dam?
- 20) Compare the different possibilities for heightening a gravity dam. Describe the current limitations for the use of post-stressing.
- 21) Explain the safety concept for dams in Switzerland. Indicate the main requirements to ensure safety in the event of floods and earthquakes.
- 22) What are the means of monitoring a concrete dam? Indicate reasons for monitoring.

Part 2 – General issues + Embankment dams (fill dams)

- 23) Propose a comprehensive program for dam site investigations. Highlight those activities that are specific for embankment dams.
- 24) Analyze different possibilities for creating a low permeability element for embankment dams and list the advantages and disadvantages.
- 25) Justify the presence and importance of the different parts in zoned dams with center core.
- 26) Cite some specific problems with embankment dams on non-rock or permeable foundations? Justify the solutions adopted to prevent such problems.
- 27) Pore pressures: evolution during and after construction. Demonstrate their importance to the stability of the embankment dam.
- 28) Explain the role of the water content of cohesive materials during the construction and operation of the embankment dam.
- 29) Explain the importance and consequences of percolation through a zoned embankment dam with full reservoir supply and when performing a fast draw lowering of the reservoir.
- 30) What are the means to characterize an earthquake and its effect on structures?
- 31) Concrete-face rockfill dams. Choice and arrangement of materials. Security Considerations.
- 32) Which data are needed to carry out a stability analysis of an embankment dam. Describe the currently used methods. Present and discuss the safety factor values (against sliding).

- 33) Describe the design criteria for the protection of the upstream face of a zoned dams with inclined core.
- 34) Present the pseudo-static analysis of a zoned dam in the event of an earthquake. How is the potential increase in pore pressures assessed and what could be its consequences?
- 35) What are the two main types of settlement observed on embankment dams? Distinction between cohesive and non-cohesive materials.
- 36) Describe the load cases for the stability analysis of a zoned embankment dams. Explain the criteria for selecting the safety factors.
- 37) Explain how embankment dams behave after construction. Highlight the main differences between upstream face dam and zoned dam (with core).
- 38) Describe the means of controlling percolation through an embankment dam and its foundation.
- 39) Describe the compaction process for cohesive and non-cohesive materials. How is compaction controlled during construction?
- 40) Define the freeboard for an embankment dam. How is it quantified (select one example)?
- 41) What are the most common failure modes of embankment dams? Explain/illustrate.
- 42) Illustrate the type of analysis required to assess the foundation stability of any dam during dam design. How can monitoring assist in similar assessments during the dam's operational lifetime?
- 43) What geological investigations would you propose for the reservoir area?
- 44) Describe the main steps of the Maksidi & Seed (1968) procedure for the assessment of the seismic safety of Class II and III embankment dams, recommended in the Swiss Dam Safety Directives C3 (2016). Compare it to the Newmark 1978 procedure.