SELECTION OF TYPE OF DAMS AND RESERVOIRS

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Summary

In order to maximize a reservoir's usage of a river, it is essential to make an all-embracing plan that considers long-term prospects and proceeds with the project as planned. The selection of dam type should be based on full consideration of all topographical and geological conditions, hydrological features, availability of construction materials, safety, environmental issues, and economic evaluation. Dams have sustained human lives for more than three thousand years, and the selection of dam type has altered over time, depending on what was feasible and most useful at the time. A selection of modern types of dam are described.

1. Introduction

In order to maximize a reservoir's usage of a river, it is essential to draw up a total plan that considers all aspects as well as long-term prospects. Once approved it is necessary to proceed with the project strictly as planned. The site for the dam must be determined by investigating all possible locations, making case studies on single or multiple cases and at various scales, and comparing their advantages and disadvantages very carefully so that maximum benefit can be achieved at minimum cost, and minimum risk, in accordance with the total project plan. Problems before, during and after construction may go beyond mere technical ones, and extend to those relating to local communities, the economy, the natural environment and, in some cases, political issues.

It is natural that the way of thinking about the selection of dam sites differs according to the purpose of the project. If the dam is intended for flood control, water supply and irrigation, it is preferable that a site is sought as close as possible to the place that will benefit, i.e. in the middle or lower reaches of the river, from the perspective of ensuring a stable effect. On the other hand, if the dam is intended for electric power generation, attention is focused on the upper reaches, in situations with a large water head, even if it is a long way from the place of demand.

Once dams are constructed, they have a great economic effect on the surrounding region, according to their intended purposes. No matter how ideal a proposed dam site is, if they affect any large-scale or important farmlands, other land of value, villages, railroads, mines, power stations, forests, fishers, sightseeing areas or cultural assets, reconsideration may be unavoidable. Also, since dams are designed to control rivers artificially, they must be concerned with users who have vested rights. Therefore, the selection of a dam site requires full consideration of its potential impact on the complex social economy of the entire river basin.

When a dam site has been selected, it should be recognized that a dam is a very large artificial structures, and due attention must be given not only to its position but also to harmony with the natural environment, particularly as regards dam height and dam type. The natural environment is to be conserved, of course, but the main purpose of construction is to contribute to human development. Thus, it is important that a dam site is selected such that maximum harmony with nature can be achieved, nature must be conserved where possible, and the desired results still be obtained. In fact, it is compulsory in most countries to assess the impact on the environment according to the scale of the dam and the site conditions.

Most reservoirs are water storage bodies, retained by a dam and with natural inflow. Some, however, are pumped storage reservoirs for hydropower projects.

2. Factors to be examined in selection of dam type

The following main factors are examined at the stage of selection of dam type:

- Topography and geological conditions of the proposed dam site,
- Availability of suitable materials for the dam,
- The feasibility of spillway construction, and
- The need to be able to cope with conditions of extreme flood or earthquake.

3. Classificatory criterion of dam type

Generally dam type is classified according to the main material of dam-body, to design feature, and to execution of work.

4. Embankment Dams

This is one of the oldest types of dam. This type is usually selected on the basis of local geological conditions, particularly when foundation conditions are unsound. The location of the spillway is most important factor with this type of dam, because overtopping during flood can be a fatal factor in such dams.

4.1. Homogeneous earth dam

This type dam is embanked with homogeneous impervious soil material. So such dams are necessarily fairly small. Ancient dams are almost all of this type.

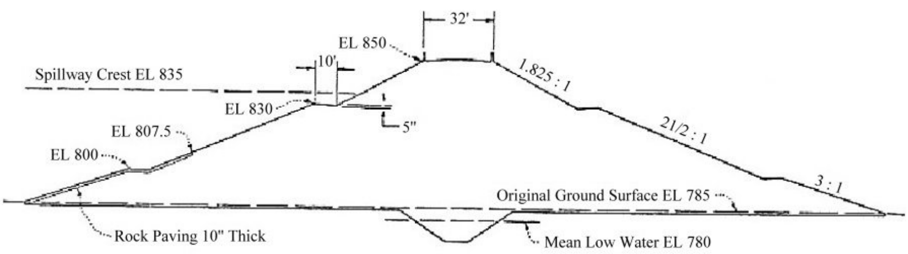


Figure 1. Homogeneous earth dam

4.2. Zone type rockfill dam

This type is composed generally of three zones: a central core of impervious material, usually clay, a filter zone of sand, and an outer zone of rock. Modern embankment dams are mostly of this type. They can be constructed on a large scale, e.g. more than 100m high.

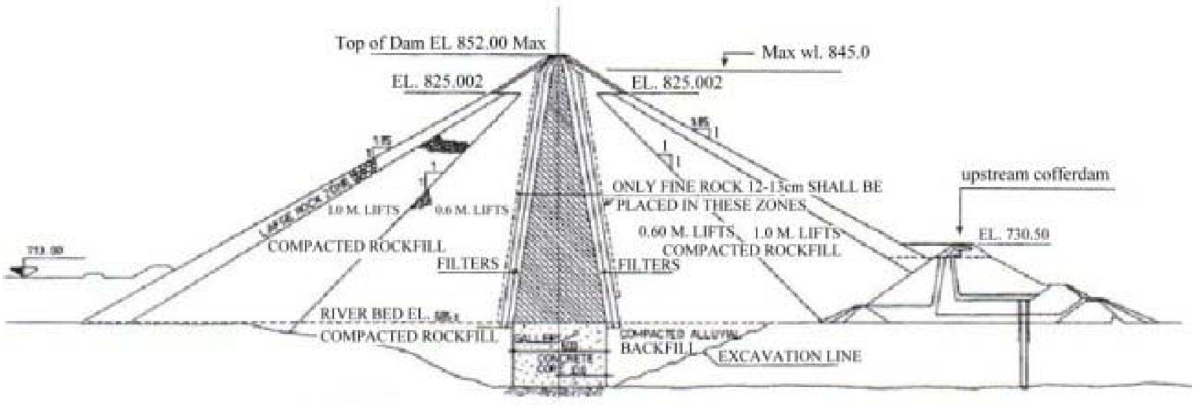
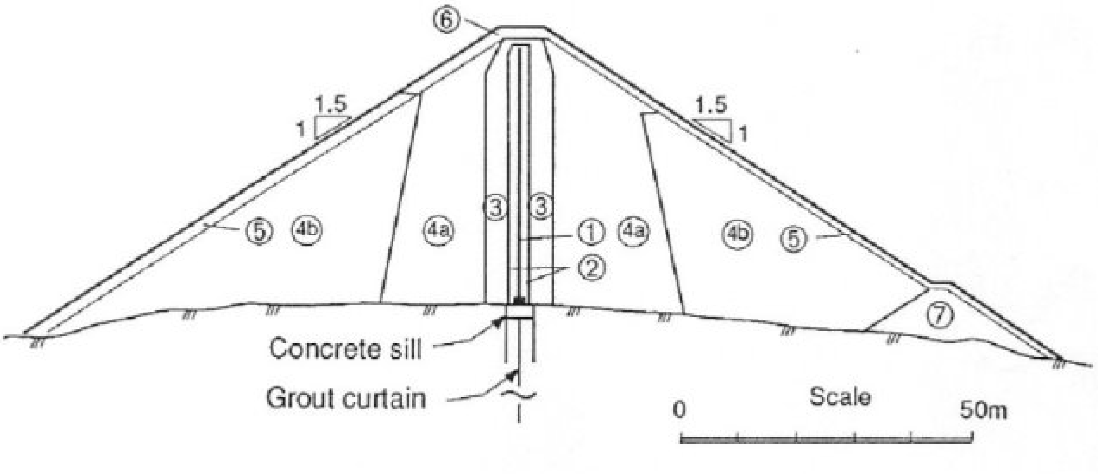


Figure 2. Zone type rockfill dam

Recently this type has been modified so that there is an impervious thin wall of concrete or an asphalt concrete diaphragm instead of a clay core.

4.3. Impervious Core type rockfill dams

This is a modification of the impervious core type. Instead of a clay core, a thin impervious membrane (wall) of concrete, asphaltic concrete or other impervious materials, is used. In recent years almost all embankment dams have been constructed to this design.



①: impervious core. ②③: transition zone. ④⑤: outer zone. ⑥: surface zone. ⑦: coffer dam

Figure 3. Impervious core type rockfill dam

4.4. Facing type rockfill dam

This type has an impervious concrete or asphaltic concrete plate supported by backfill embankments of rock materials. This type is becoming popular due to its relatively low cost.

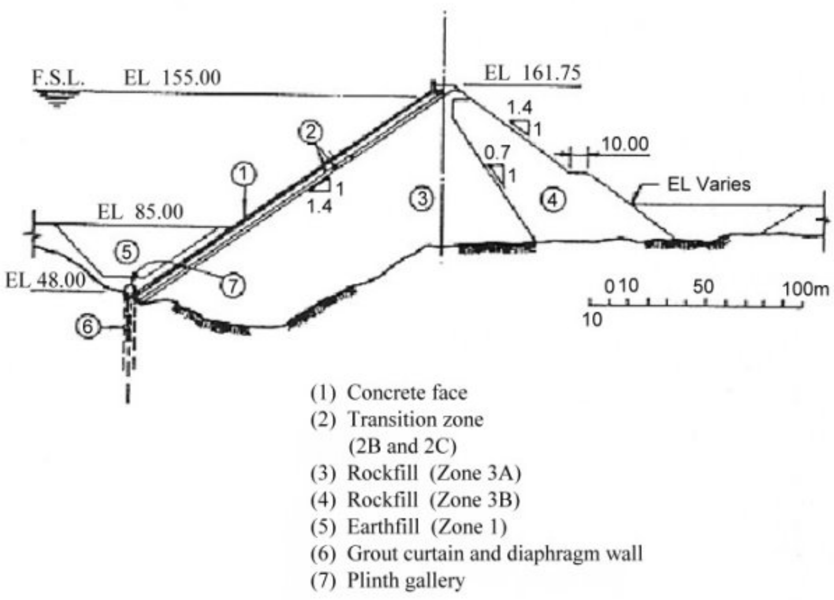


Figure 4. Facing type rockfill dam

4.5. RCC embankment dam

This type is embanked with roller compacted concrete (RCC). It was developed as a fast and economic method for construction of embankment dams, using a wide range qualities of rocks and gravels.

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Biographical Sketches

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Doctor of Engineering. Member of Concrete Committee for Dams and a former member of the Environment Committee of ICOLD. Vice President of Konoike Construction Co., Ltd. Former chief of Miyagase Dam Construction office which is the biggest concrete gravity dam made by the RCD method in Japan, and Sagae Dam Construction office which is a 112-meter high centre core type rockfill dam.

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Doctor of Engineering. Honorary member of the Japan Society of Civil Engineers, former Vice-Minister of the Ministry of Construction, former President of the Japan Commission on Large Dams and President of the Ecology and Civil Engineering Society. He is the top leader of dam engineering in Japan. He has experienced every stage of dam engineering such as design, construction, and operation for river management and also environmental countermeasures for reservoirs by biotechnological concepts. He originally proposed the Roller Compacted Dam (RCD) method and applied it to actual projects. He also established the Ecology and Civil Engineering Society, aiming at close cooperation between civil engineering and ecology. It is organized by civil engineers and biologists from all fields such as algae, fishes, plants, animals and birds. He is now becoming active in these fields.