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UNIVERSITY
OF ARCHITECTURE
CIVIL ENGINEERING
AND GEODESY

Winter School at UACEG

Topic: Hydraulic structures. Dams and reservoirs

Task for Students #1:

Site assessment and selection of type of dam

Explanations and Example

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PLANNING OF DAM PROJECTS

PHYSICAL FACTORS

Except for flood control projects, availability of sufficient water is essential for all types of water resource projects. In flood control projects, the sudden excess of water is the problem. The source of water is the surface runoff resulting from weather phenomena which are understood only in a general way. Weather conditions can be predicted only as seasonal probabilities. Weather predictions for shorter periods (a few hours or days) can, however, be made with more reliability. Historical measurements of stream flows and rainfall are considered the best available means for forecasting stream flow supplies for water resource projects.

At sites where no measurements or only a few measurements have been made, reliable correlation methods are used to estimate streamflow statistics. There is always some risk involved in building a project either too large or too small at sites of meagre stream flow measurements. In such situations, alternatives of staged development or other means of adjusting the project size and scope may have to be considered.

A flood occurring once in 100 years or less may cause enormous damage. Therefore, stream gauging records of 10, 20 or 30 years, though useful to some extent, are inadequate for flood control projects and spillway design for large dams. Besides, actual measurement of peak flood flows is difficult even if the stream is being gauged. Some other methods of estimating the magnitude of peak floods are invariably used for the planning of such works. Computation of the stream flow based on high water marks and flood channel dimensions is one such method. Alternatively, stream flow (or runoff) estimation can be based on actual measurements of amount and duration of high rainfall at rain gauge stations in the catchment area upstream of the dam site. The latter method considers factors such as principles of precipitation as affected by stream characteristics in the region, and the catchment characteristics (location, shape, vegetative cover, and geological structure). Extremely large floods are also extremely infrequent floods. Hence, the planner's judgement is crucial in deciding the size of the flood to be controlled by the project.

Two main factors which determine the site of a water resource project are the areas needing water and the location where water supply is available for development. For economic reasons, the water source must be near the place of use so as to save on cost of conveyance. Also, the source should be at higher elevation than the service area to avoid pumping. In case of projects where water is stored only for the purpose of flood control, there is no conveyance cost involved.

One can build a dam almost anywhere if one spends enough money. But, there is obvious advantage in having a dam site in a narrow section of a stream channel where sufficiently strong and impervious foundation (rock or consolidated material) is available. The abutments must be of sufficient height and be strong and impervious. Further, the dam site should not be located on or very close to an active earthquake fault. The dam site must have suitable site for spillway (a structure which releases surplus water after the reservoir has been filled up to its maximum capacity) which can be made part of the main dam only in case of a concrete dam. A dam requires a very large quantity of construction material (cement, aggregates, impervious and pervious soils, rocks, etc.) which should be available within economical hauling distance of the dam site. An easily accessible site is preferred as it involves least expenditure on communication works required for the transport of construction machinery, power house equipment construction material, and so on, to the dam site. The value of the land and property which would be submerged by the proposed reservoir should be less than the expected benefits from the project.

The area upstream of the dam site would constitute the reservoir component of the project. For economy in dam height, a reservoir site should be wide and on a mildly sloping stream in order to have a long and wide reservoir in proportion to the height of the dam. The reservoir must not be sited on excessively leaky formations. The site with the possibility of landslides, rock-slides or rockfalls into the reservoir area (which reduce the storage capacity of the reservoir) must be avoided. The site should not be, as far as possible, on valuable land being used for some other purposes, such as agriculture, forestry, communication, and habitation by people. Sites with mineral deposits in and around the reservoir area should also be avoided. As far as possible, a reservoir should not be provided on a stream carrying large sediment loads which would eventually get deposited in the reservoir, thereby reducing its useful storage capacity. However, all streams carry some amount of sediment. Hence, part of the total reservoir storage is reserved for the accumulation of sediment which is likely to enter the reservoir during its intended economic life. Possibilities of constructing sedimentation basins a short distance upstream of the reservoir and/or providing catchment protection and management against sediment erosion must also be explored.

PLANNING OF DAM PROJECTS

ECONOMIC CONSIDERATIONS

The cost of a water resource project includes capital investment for constructing the project facilities and the annual or recurring expenditure for operation and maintenance (including replacement) of the project. The capital cost includes the costs of planning, investigations, designs, and construction besides the cost of acquiring rights to the use of water, litigations, and rehabilitation of the affected people. The capital cost also includes the interest on the money invested during construction and up to the start of the project. The benefits likely to be received from a water resource project are widely distributed. As such, the investments on the project cannot be compared with the benefits in terms of monetary units. However, the benefits are expressed, as far as possible, in terms of monetary units and the investment and operational costs are thus compared with the benefits.

It is difficult to quantify some types of project benefits. For example, in an irrigation project, the benefits extend beyond the farmer through a chain of related activities to the people of the area. Social benefits (such as protection against loss of life by floods), recreational benefits, etc. are also difficult to estimate in monetary terms. However, benefits of municipal and industrial water services and hydroelectric power generation can be easily estimated by working out the cost of producing the same results by another reasonable alternative arrangement or by determining the market value of the product. Benefits from a flood control project can be estimated by working out the reduction in flood damages in agricultural, residential, commercial, industrial, and such other activities. The value of the land protected from floods increases and this fact should also be included in the benefits of a flood control project. Other possible benefits from a water resource project may be in the form of a fishery enhancement, water quality improvement (in downstream flows from storage releases during dry seasons), and navigation improvement on large rivers (due to storage releases during low flow seasons). Construction of a water resource project provides employment to people of the locality and is vital in areas of persistent unemployment.

Because of uncertainties involved in the estimation of project benefits, the computed benefit-cost ratio is generally not considered as the sole criterion for determining the economic viability of a project. Nevertheless, such computations do provide a logical basis for arriving at meaningful decisions on the size of the project, inclusion and exclusion of different project functions, the priority of the project, and so on. Other considerations such as social needs, repayment potential, and environmental aspects are also examined in determining the worth of a proposal for water resource development.

WS 2021	Hydraulic structures	Report 2

Names:……

University: ……

CONCRETE OR EMBENKMENT DAM ACCORDING THE INITIAL TECHNICAL CONSIDERATIONS	

Initial TECHNICAL CONSIDERATIONS:

- narrow valley
- 7 m depth to rock fondation
- rock materials suitable for dam construction - 120 km from the dam site
- earth materials (mostly cley) - 50 km arround the dam site

Your reasonned decision: ….....

Which TECHNICAL CONSIDERATIONS could you draw in addition? *(You can read the document "PHISICAL FACTORS" in the Library folder)*

1. ….....
2. .....
3. .....

…….....

Which ECONOMIC CONSIDERATIONS could you draw? *(You can read the document "ECONOMIC CONSIDERATIONS" in the Library folder)*

1. ….....
2. .....
3. .....

…….....