On Aspects of Construction of Hydro-Electric Power Projects

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Abstract

The present paper discusses different facets of construction of Hydro-Electric Power projects. Salient problems and possibilities are touched on.

Discussion

Hydro-electric power projects typically entail construction of a dam, reservoir, power-house etc. in hilly or mountainous terrains. In recent times, low-head power plants and run-off river plants are also being constructed. Planning, designing and constructing a hydro-electric power project involves inter-alia hydrologic, hydraulic, structural, environmental and socio-economic factors. There are quite a number of factors that impede the speedy and successful execution of projects. Some of them are dwelt on in this paper. The problem areas can be divided into different classes and that is done in what follows.

Hydrologic and Hydraulic

Reliable and long-term records of streamflow in the river on which the dam is built as also of precipitation data in the catchment of the river upstream of the location of the dam is important in order to select discharges (floods) of the design and other return periods. Such data is also important in generating synthetic future streamflows by the ARCR (Auto-Regressive Cross-Regressive) and ARMA (Auto-Regressive Moving Average) models. Lack of data of appropriate quality and quantity would adversely impact on the quality of hydrologic predictions that may be made with an acceptable degree of reliability.

It is also necessary to carry out simulations of seepage out of the reservoir and under the dam. The depth of the basal impermeable stratum at different horizontal spatial locations is necessary in order to fix the position of the lower boundary in the seepage flow domain when solving for the seepage flow by self-developed or commercially available finite-difference and finite-element

codes. Sometimes, the basal stratum exists at great depths and its exact location is not known. This would entail judgement in fixing the lower boundary of the seepage flow domain.

Seepage through the body of the dam is of concern in the case of earth dams and accurate evaluation of its amount and delineation of the strategic steps to be taken to reduce this loss of water are extremely important.

Structural

Gravity dams involve massive amounts of concreting. Normal cements have a significant heat of hydration. As a result, if a large portion of the dam is constructed in one stroke, the heat generated is likely to cause significant expansion resulting in cracks. To avoid this, small portions of the dam have to be constructed at a time. This phased construction results in delays and may be avoided if cements having lower heats of hydration without hampering strength are developed.

Dams have large spatial dimensions. Since the length of a dam is large, the earthquake effect on a dam is likely to be such that the movement of different portions of a dam, especially its two ends, are out of phase. This will result in torsional moments being exerted on the middle portion of the dam of a nature that is absent in structures of small areal extent like buildings. In-depth analysis of this phenomenon is needed to design dams more resistant to cracks in times of earthquakes.

Research is needed in quicker and more mechanised modes of construction. This is needed as faster construction will result in a lower gestation period of the project and thereby increase returns. Also, it may not be permissible to close a stream for a prolonged period in view of the irrigation and drinking water needs of the people downstream.

Managerial

Intense and effective communication between design engineers in the design office and the construction engineers at site is necessary to evolve designs and construction practices which are mutually supportive. This would preclude, among other things, the necessity to revise designs which may be found inappropriate from the view of prevailing construction practices.

The rehabilitation of people whose homes are going to be submerged by the reservoir is another issue testing the managerial abilities of technical personnel as sometimes vested interests interfere and complicate what is otherwise a solvable socio-economic issue.

Conclusion

The paper raises some issues related to construction of hydro-electric projects. More efficient construction involves better solutions to the individual problems and also to the interdisciplinary factors.