THESIS

COMPARISON OF SEDIMENTATION FOR KURRAM TANGI DAM BY USING HYDROLOGIC (USBR) AND HYDRAULIC (HEC-6) MODELS

By

Engr. Mahmood Ahmad Javaid
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ABSTRACT

Dams and reservoirs are the integral part of the irrigation system in the modern world, especially for the meteorological region like Pakistan where almost 80-85% runoff is generated within the three months i.e. from mid of June to mid of the September. The excess water during the wet period can be stored in a reservoir that can be used during the low flow periods in order to meet the potential demand. This fact clearly indicates the importance of storage dams for efficient and economical use of water resources.

Each dam has its own useful life. Unlike other structures, the useful life of a dam is not in terms of its structural life but in terms of its functionality. The useful life depends on its ability to store water. Sedimentation depletes the storage ability of the dam. More precisely, the useful life of a reservoir can be defined as the length of time in years from the date of commissioning to the date when its 80% live storage capacity is lost.

Whenever a dam is built across a river, retention of water born sediments can be expected. Accumulation of sediments in the reservoir over time occupies storage space needed to carry out the basic functions of the dam and reservoir. To extend useful life of the dam, the planned storage of the dam is increased by an amount necessary for the storage of the sediments entering the dam during its life.

The purpose of this study was to compare the sedimentation results, for Kurram Tangi Dam, generated by two methods i.e. USBR and HEC-6 Model, commonly used for sedimentation analysis and to evaluate the deviations occurring in the results. Reasons for any inaccuracies are evaluated. If possible, an effort is to be made to minimize these deviations keeping in view the actual field conditions.

The Kurram Tangi Dam has gross, live and dead storage capacity of 920, 620 and 300 Th.AF, respectively. The average inflow of water and sediments was determined as 807 Th.AF and 5.9 MST/year, respectively. The sediments gradation is 6% sand, 70% silt and 24% clay. For USBR method reservoir sedimentation was determined by using Brune Curve and depth-wise distribution curve. For HEC-6 modeling purposes, the reservoir was represented by 27 cross sections. Future flows was synthesized from historic flow data. The reservoir water levels were obtained from reservoir simulation. The model was worked for 250 years period using 10-day time interval.

The gross storage capacity of Kurram Tangi Dam after 50, 100, 150, 200 and 250 years of reservoir operation was determined as 729, 547, 368, 194 and 46 ThAF respectively by USBR method and 741, 560, 376, 236 and 73 ThAF respectively by HEC-6 model. The live storage capacity after 50, 100, 150, 200 and 250 years of reservoir operation by USBR method was 557, 475, 361, 194 and 46 ThAF respectively while the values came for the same years of operation by HEC-6 model as 500, 382, 270, 187 and 73 ThAF respectively. The dead storage capacity after 50, 100, 150, 200 and 250 years of reservoir operation by USBR method was 172, 72, 7, 0 and 0 ThAF respectively

while the values came for the same years of operation by HEC-6 model as 241, 178, 106, 49, and 0 ThAF respectively.

The sedimentation results generated by the two methods found to be comparable with each other on volumetric basis for gross and live storage capacity. For the case of dead storage capacity a slight deviation in results was observed. An error was observed in HEC-6 model results while predicting the delta formation in the reservoir. It showed a high sediment deposition at the reaches u/s of the reservoir rim (cross section 1-5) where the depth of sediment deposits is more than 50 ft. Similarly the sediment deposition in upper reaches of reservoir was very excessive and results above even the normal conservation level. Such excessive sedimentation is physical unrealistic. This error may be due to averaging of highly variable flow and not portraying accurately a flash flood of very short duration which usually have high sediment transportation capacity. USBR method is recommended for reservoir sedimentation analysis due to its simplicity and ease.