Model studies for the Kaolos multipurpose scheme

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The author describes hydraulic model studies which were carried out on a 62 m-high earth embankment dam in Iraq to check the performance of the various structures for the design discharge.

THE PROPOSED Kaolos dam will be sited on the Chaqan river near the city of Sayid Şadiq in northeastern Iraq. The catchment area is 260 km² and the average flow of the river is estimated to be 99 m³/s.[1]

The scheme is designed to irrigate an area of 10 000 ha mostly for wheat cultivation in the Shanadari plain, and to provide flood control. It is also expected that a fishing industry can be developed based on the 83×10^6 m³ reservoir capacity, and the possibility of developing the area for tourism is also being explored.

Geology

The region of the dam site is composed of sedimentary rocks, limestone, dolomite and dolomite-limestone. Part of the region is also covered with alluvial deposits.

Description of the dam

The dam is designed as an earthfill structure with a central clay core. The upstream side has a design slope of 1:2, while the downstream slope will be 1:1.8. The length of the dam at the crest (el. 712 m) will be 500 m and the height in relation to the lowest ground elevation is 62 m.

The left bank has good exposed rock and a chute spillway is located on this side. Downstream of the chute either a trajectory bucket or a stilling basin (as a second option) will be provided for energy dissipation.

The spillway consists of three bays each 8 m wide, separated by two piers each 3 m wide and 23 m long, and equipped with three radial gates. The maximum design discharge is 1437 m³/s.

The chute is connected directly to the spillway without any transition. Its bottom width is 30 m, and its total length measured horizontally is 236 m.

The bottom outlet is 2 m wide and 3 m high, and can be closed by a radial gate. Its discharge capacity is 180 m³/s.

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Hydraulic model tests

The purpose of carrying out hydraulic model stu[dies] was to check the performance of the structures for th[e de]sign discharge[2]. On the basis of these studies some mo[difica]tions have been proposed for the design of the structures.

A geometrically similar model was constructed to a scale of 1:40 and flow conditions were tested. For the adopted scale, the corresponding ratios for velocity, time and discharge were determined:

Velocity ratio – $V=L^{1/2}=1:6.32$

Time ratio – $t=L^{1/2}=1:6.32$

Discharge ratio – $Q=L^{5/2}=1:10\,119.3$

Components included in the model were:

- part of the storage basin;
- the approach channel, spillway, chute and bucket;
- the intake tower at the entrance of the diversion tunnel, diversion tunnel and the silting basin behind it, and,
- the downstream portion of the river valley for a length of 600 m.

Some of the main conclusions derived from model studies are as follows.

Flow conditions in the approach channel of the [spillw]ay were, by and large, satisfactory.

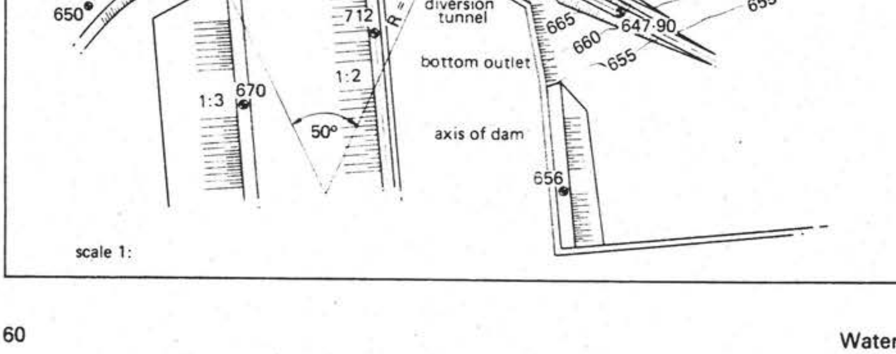

Fig. 1. The dam and appurtena[nt struc]tures which are represented on [the hyd]raulic model.

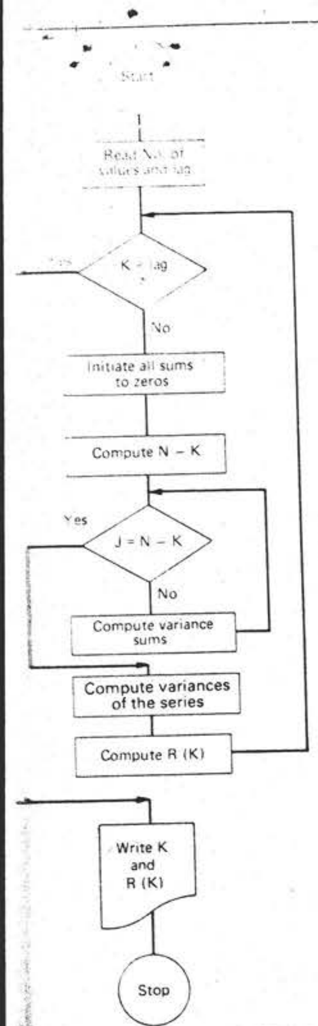

Fig. 2. Schematic diagram of the program for generating the auto-correlation coefficients.

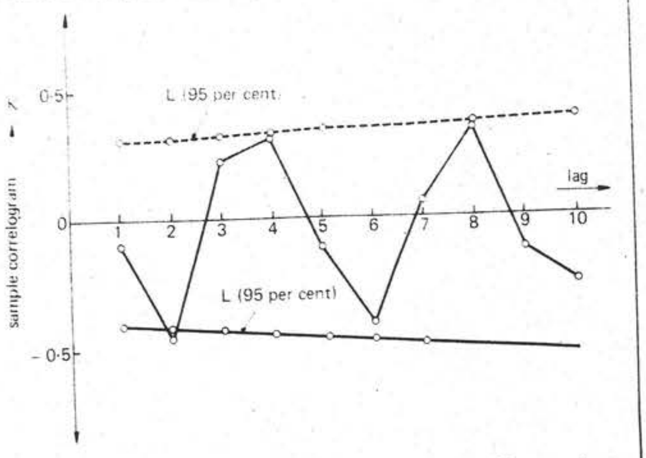

Fig. 3. Correlogram of annual river runoff of the Chaqan river.

he spillway discharge capacity and the flow conditions g the nappe were satisfactory.

he proposals for energy dissipation at the exit of the rsion tunnel were considered to be adequate. The cities were high and a pronounced vortex action near oe of the dam on the downstream side were noticed.

v data generation

athematical model based on stochastic studies[3] was eloped for generating the annual flow data of Chaqan r. The long-term data derived can be used for rvoir operation and for optimizing the benefits.

he auto-correlation coefficients at 10 lags are ined through the developed model as shown in the matic diagram of the programme (Fig. 2) and the results are shown in Fig. 3. From this it is shown that the series is independent. By using the Chi-square test[4] it can be proved that the distribution is normal.

A total record of 50 years has been obtained, the statistics of which are compared with the historic data (1940-1960). A visual comparison of observed and generated discharges is shown in Fig. 4 which shows that the records appear to be from the same family of curves, the peak flows in particular. A comparison of historic and calculated total annual flow values gives the following results:

Mean annual flow (in $m^3 \times 10^6$): for the historic—99.20, and for the generated—97.58; standard deviation (σ): for the historic—42.41, and for the generated—49.00.

Conclusions

The model of 1:40 scale shows the necessary modifications in the discharge structures under the best flow conditions for the spillway, diversion tunnel and downstream flows, etc.

The stochastic studies of the annual flow in Chaqan river reveal that the series is independent and the distribution is normal. The generated data, especially concerning peak flow for the coming 50 years seem to be from the same family of curves as previous data. □

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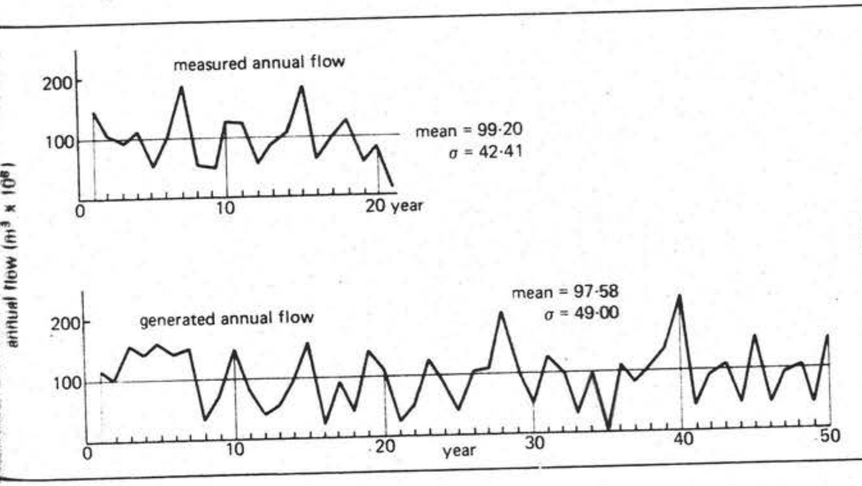

Fig. 4. Comparison of measured with generated data.