SOME PROGRESSES OF STUDY ON STRUCTURES WITH HIGH-VELOCITY FLOW

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In the recent years, a numbers of large-scale hydro-projects have been built in China. A lot of high dams which height from 100 m to 250 m have been constructed. Such as Wujiangdu, Longwangxia, Dongjiang, Dongfeng, Ankang, Geheyan, Wuqiangxi, Ertan, the Three Gorges Project and so on. Almost the heights of the dams are between 100 m and 240 m, and the maximum discharge flow of the dams is over 100, 000 m^3/s. Among them the Ertan hydro-project, the height of the dam is

240 m, and the maximum discharge flow is 23,900 m^3/s. And there are new dams with height from 200 m to 300 m being to build in south-west part of China. The Xiluodu, Xiajiaba, Xiaowan, Nuozhadu, Longtan, Goupitan and so on. Such as the Xiluodu, hydro-project (in programming) the height of dam is 273 m, and the maximum discharge flow is 50,311 m^3/s. All of those projects feature in high water head, high velocity flow, and large discharge. In addition, the discharge facilities of the projects are most constructed in narrow river valley, and the geological conditions of the dam site are very complex. So that a great challenge on hydraulics for high dam is put forward. Especially, study on structures with high-velocity flow became even more complicated.

The research on high velocity flow related to hydro-projects are very closely combined with the practice of planning, designing, constructing and operating. People have to conscientious on the energy dissipation, discharge aeration, cavitations damage, the fluid induced vibration of structures, atomization of water jet, and so on.. Some progresses of study on high-velocity flow, such as new type of energy dissipaters, the aeration device for reducing cavitations damage, technology for reducing vibration of structures are briefly described. For example, a new type of energy dissipater—the Flaring Gate Pier(FGP) combined energy dissipater(Fig. 1) was applied in the Yantan dam. This dam 101 m in height, the design flood overflow is 9,510 m^3/s, the check flood over flow is 12,400 m^3/s. The spillway has been adopted the roller bucket stilling basin with FGP. The results of prototype observations results shows that flow regimes are much different from flow pattern in the normal roller bucket or Stilling basin. The water level in stilling basin is increased about 26.8%-43%, the surface waves are very low and stable, the scour depth after roller bucket of downstream was reduced 59.6%-43.2%. It is a very affective dissipater in high dam with low Froude Number(Fr) flow; The aeration device (Fig.2) for mitigate cavitations damage are new technology, which have been developed in last few decades. It was provided good condition for building high water head spillway, water tunnel, and other structure for discharge flow with high velocity flow; The atomization of jet may cause problems on communication around the dam area, electric device operation, some buildings and even influence the stability of banks of downstream of river. It also could cause ice problems on the transmission line, road transportation during winter in cold region. For example, differential bucket are used in the Baishan dam. A strong

atomizing rain covers whole downstream area of river. This area is 500 m long, 300 m high. Due to the depth of water in plunge pool is shallow, the atomization caused damage on outdoor temporary switch yard by stones, watering inside powerhouse and scouring on banks. In search of prevention measures against atomization, Chinese scientists have made a great achievements. Some of them gives a method of theoretical analyses, some one has studied with physical model test, and some one has made prototype observation. Due to some reasons the prototype observation of the spray is the best way to understand the influence on the area around the dam.

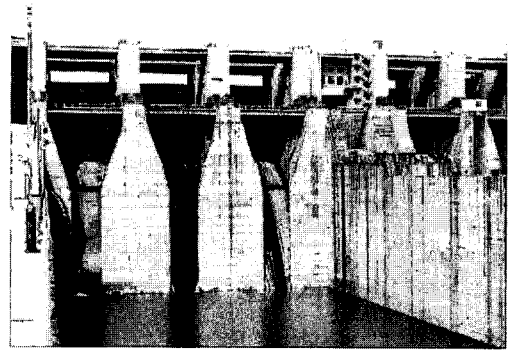

Fig. 1 New type(FGP) energy dissipater in a high dam

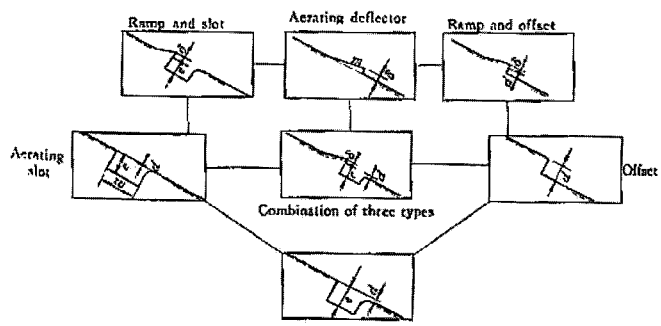

Fig. 2 Aeration devices for mitigation cavitations

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