RESEARCH ON HYDRAULIC CHARACTERISTICS OF ROCK RAPIDS WITH GENERALIZED EXPERIMENTS

MINGXIONG CAO[1], JIHONG JIANG [2], BINRUI ZHOU[3], and GUOZHENG CAI[4]

[1] Advanced Engineer, River and Harbor Department,
Nanjing Hydraulic Research Institute, 34 Hujuguan, Nanjing, 210024, China
(Tel: +86-025-85829315, Fax: +86-025-85829333, e-mail: mxcao@njhri.edu.cn)
[2] Doctoral student Engineer, Management Bureau of River Navigation
in Guangxi Zhuang Automous Region, Nanning 530012, China
[3] Graduate student, College of Traffic and Ocean Engineering,
Hohai University, Nanjing 210098, China
[4] Advanced Engineer, River and Harbor Department,
Nanjing Hydraulic Research Institute, 34 Hujuguan, Nanjing, 210024, China

Rock rapids is one of the main navigation-obsructing rapids in mountainous rivers. Much experience based on previous channel regulations having been accumulated, however, there are still some problems should be further studied. For example, water surface line near the rapids of mountainous rivers can't be precisely field surveyed. Working Team of Qingtan Beach (1970) proved the water surface line of the model to be dissimilar to that of the prototype in the model test of the Qingtan Beach, one of the rock rapids in Chuanjiang River. The water level of the model couldn't satisfy the requirements until the water surface slope was resurveyed on the spot with floating raft and theodolite, and the model topography modified as well. Working Team of Mountainous Channel (1975) and Cao et al. (2003) summarized the main flow patterns, Changjiang Waterway Engineering Bureau (1998) and Deng et al.(1989) discussed the flow characteristics of rock rapids, with rapids' curves of the deflected flow studied during the generalized experiment. Also some physical models have shown several hydraulic characteristics of rock rapids, yet there is no comparatively systemic conclusion.

According to the generalized rapids flume experiment, the hydraulic characteristics of outlet rapids were as follows: the water surface levels of upstream moved flat and the velocity changed little. Coming to the entrance, the former dropped sharply while the latter increased; crossing the rapids throat, the mainstream centralized around the midstream, with return flow on both sides behind the protruding points, then the velocity of mainstream increased streamwisely and water level dropped on. After a certain distance the former reached to the maximum while the latter reached to the minimum. Finally, there were adverse slope and decreasing velocity in rapids throat.

Mainly affected by topography, rapids' water surface was correspondence to the horizontal distribution of velocity, and appeared to be a plane in upstream of the entrance, then a paraboloid as crossing rapids throat. Having passed through rapids throat, the location of the mainstream was influenced by the extent of the protruding points stretching into the river and the deflected stream angle of the protruding points.

Rapids states mainly depended on the water surface slope in rapids throat, the maximum velocity in downstream, and on how dangerous the flow pattern was. The chief one was the decreasing extent of the discharge area of rapids throat.

REFERENCES

Cai, G.Z. et al., 2004. Model test on channel regulation of Shiwutan Beach of Hongshui River. J. Hydro-science and Engineering, Vol. 99, pp. 45-48.

Cao, M.X. et al., 2003. Formation condition and pattern of navigation-obstructing flow of rock rapids. Port & Waterway Engineering, Vol. 357, pp. 43-45.

Cao, M.X. et al., 1999. Physical Model Test on Channel Regulation of Nutan Beach. Nanjing Hydraulic Research Institute.

Changjiang Waterway Engineering Bureau, 1998. Navigation Channel Regulation of The Chuanjiang River (the first edition).China Communication Press, Beijing, pp. 118-123.

Deng, B.Q. et al., 1989. Navigation channel regulation of the Chuanjiang River (appendix 4) —Test on Regulation of Rock Rapids, Chongqing Institute of Communications.

Lee, C.H., 1983. Survey and application of water surface slope in rivers. Proc. National Communication on Technology and Experience of Channel Survey., Yichang, pp. 1-14.

Working Team of Mountainous Channel., 1975. Regulation of Mountainous Channel (the first edition).China Communication Press, Beijing, pp. 291-304.

Working Team of Qingtan Beach., 1970. Reports of Model Test on Regulation Engineering of Qingtan Reach in Chuanjiang River. Southwest Research Institute of Water Transport Engineering.