SIMULATION OF 2D FLOW FIELD FOR PERMANENT SHIP LOCK CONVEYANCE SYSTEM IN THE TGP

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The permanent shiplock is a primary building of the Three Gorges Project. It situates in the rock mass, 200 m north Tanziling hilltop, on the left bank of the Yangtze River. It is a five - flight doubleline shiplock with a total length of 6 442 m in shiplock routine and a main section of 1617m, and it has a total head of 113.10 m, with a maximum working head up to 45. 2m for each step. All these indicate that the permanent TGP double-lane five-step shiplock, which is being built in complicated operating conditions and with difficult technologies has the highest head and is of the biggest scale in the world.

The shapes of the gallery of the valve of No.1 and No.6 class of the permanent TGP shiplock are shown in Fig.1(a), adopted with top expanding structure scheme; and others in Fig.1(b) ,adopted with bottom expanding structure scheme. The valves in the main gallery section of the water conveyance valve are frequently used in complicated operating conditions. They are the key parts of the water conveyance system and the whole shiplock operation. Consideration must be taken of the water pressure caused by the gate closing in dynamic water under the normal and emergency operation conditions and of the situation of flow behind the ogee gate.

The purpose of this paper is to simulate the 2D unsteady vertical flow fields near the valve gates and in the valve wells of conveyance system in the process of opening or closing of the valve gates in the Three Gorges Project with the standard k-ε turbulent model. VOF method is used to track free surface in the valve well. The numerical simulation method has been verified and applied to simulate flow field of two structure schemes: top expanding and bottom expanding. The numerical results are demonstrated in real time way. It shows that the recirculation appears larger behind the valve gate in the bottom-expanding scheme than that in the top one; and the turbulence in the well of valve is strong while the velocity is quite limited. The physical parameters (the velocity fields of U and V, pressure field P, and kinetic energy k of turbulent flows, etc.) have been obtained by the numerical simulation method in any arbitrarily points, and by combination of the simulation technology and the visualization technology, numerical simulation can be made for the water conveyance system for any operational conditions, and the simulated results can be shown with figures, images, forms, and animated drawing. With the characteristics of fast operation, intuitive expression, and friendly interfaces, the numerical simulation research results can be used to research the cavitations in the two-way five-step ship lock of the Three Gorges Project, and can be widely used for other engineering design and construction.

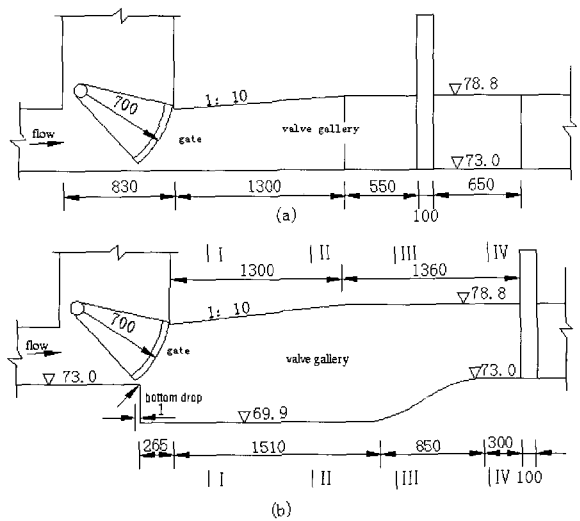

Fig. 1 the shapes of the galleries of the valves of of the permanent TGP shiplock top expanding structure scheme; (b) bottom expanding structure scheme

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