EFFECT STUDY OF VALVE HOISTIING WAY TO THE FLOW FIELD FOR SHIP LOCK IN THE TGP

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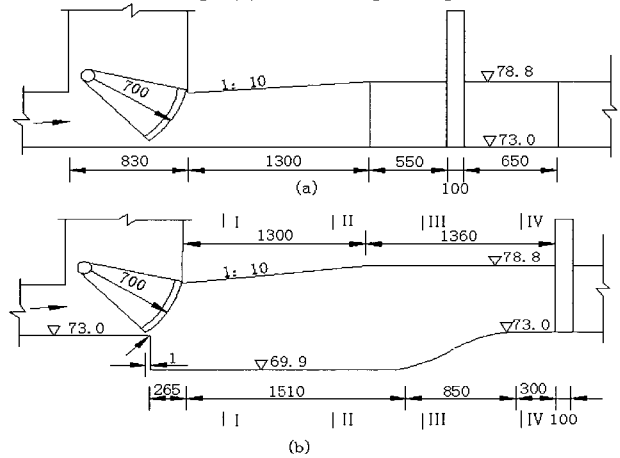
Abstract

The permanent ship lock is a primary building of the Three Gorges Project. It is a five-flight double line ship lock with a total length of 6 442m in ship lock routine and a main section of 1617m, and it has a total head of 113.10m, with a maximum working head up to 45.2m for each step. The maximum filling discharging volume is 237, 000 m^3 each time with a duration of 12minutes. In some emergent operation cases, valve gate should be closed within even 1 minute. Very strong unsteady flow will occur in the gallery. It is important to study the flow field in these cases so that a reliable operation plan can be made for authority.

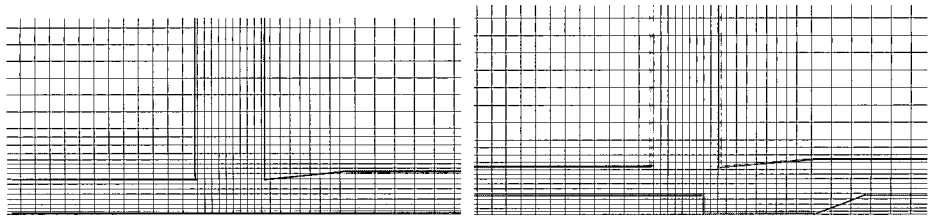
The shapes of the valve well of the permanent TGP ship lock are shown in Fig.1(a), top expanding structure scheme and Fig.1(b), bottom expanding structure scheme.



(a) Top expanding structure scheme (b) Bottom expanding structure scheme
Fig. 1 The gallery shapes of the valves in the permanent TGP ship lock

in present study, standard k-ε turbulent model is employed to simulate the flow field of conveyance system when the gate close or open in certain speed. Water goes up and down in the well of value, so VOF method is employed to track movements of free surface.

The model has been verified and applied to simulate flow field of two structure schemes. Fig.2 is the grid system used in the simulation and fig.4 are the snapshots of flow field obtained by the model.



(a) top expanding structure scheme (b) bottom expanding structure scheme

Fig.3 Computational domain meshes

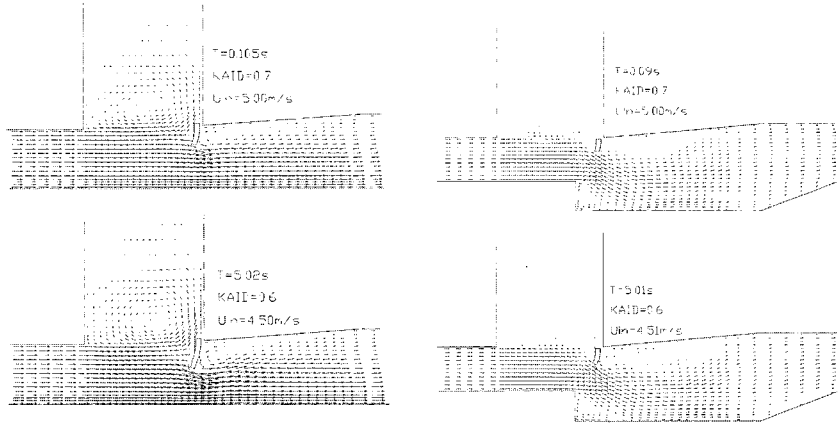


Fig.4 Snapshots of the flow field

Numerical results shows: (1) For the top-expanding scheme, re-circulation appears both behind the gate and in the valve well. The size of eddy domain behind the gate increases when the opening of gate decreases. For the bottom scheme, besides eddies described above, another strong one with small triangle region will be formed by the bottom step. (2)Flow in bottom scheme is more stable because of larger space behind the gate than the top scheme. The slope of bottom scheme limits the flow. It is helpful to slow down the velocity and improve the pressure behind the gate. From these points of view, bottom expanding structure scheme is better than the top scheme, which has been verified by the experiments done by Nanjing Hydraulic Research Institute. It turns out that the model is suitable for the simulation of flow field near the gate, it provides basic information for further study of cavitation in the conservancy system.

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