NUMERICAL SIMULATION OF 2-D SHALLOW WATER FLOW OF THE WATER ENVIRONMENT IN ZHENJING CITY

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Zhenjiang reach is located downstream the Yangtze River. There is a yolk-like lake called as Neijiang River, between the north of Zhenjiang city and the south of the mainstream of the Yangtze River. The polluted water of the city channels discharges into Neijiang River directly. Neijiang River is the main water volume of Zhenjiang city rivers, exchanging the water with the Yangtze River through tidal flows (see Fig.1).

The main problems existing in the water environment of Neijiang River are bad water quality, high sediment concentration in the water, feculent water, chemical polluted material, small amount of exchanged water during each tidal circulation, weak ecological functions, and so on. The project of Technical Study of Water Environment Quality Improving, Ecological Rehabilitation and Demonstration Engineering was authorized as one of the 10th-5-year great scientific and technological specialized project of China Scientific and Technological Ministry. This paper is a part of the project. In this project, a hydrodynamic mathematical model is adopted to study the numerical method suitable for Neijiang River morphology, numerical model verification and analyze hydrodynamic conditions of Neijiang River and water-exchanged volume according to the results of the mathematical model.

Two-dimensional flow equations are applied to describe the wide and shallow water flow. The controlling equations include the continuity and momentum equations (Zienkiewicz and Ortiz, 1995). Boundary conditions for two-dimensional shallow water flow include the conditions of the inlet, exit and solid wall, such as buildings, river bank and waterside.

The CBS finite element method is adopted to deal with complex river morphology. Applying the fractional step method and Galerkin finite element method, the variables are discretized in time and space. The assembled matrix equations are solved using the general minimal residual algorithm (GMRES) (Saad and Schultz, 1986) with the advantage of fewer computer memory size, fast computation speed, well convergence of iteration.

Using the advancing front method (Peraire et al., 1988), the triangle mesh is generated to divide the flow field with irregular river morphology. In each step of the simulation, the attributes of nodes are defined according to the bed elevation and water level at nodes, as submerged ones, waterside ones, non-submerged ones, inlet ones and exit ones. The solution area is determined according to the nodes attributes and equation characteristics of variables.

The verification of boundary variables includes the water level at the inlet of the navigation channel, the discharge process at Jiaonan dispatch and the water level process at the exit of Yunliang channel. The flow velocities and directions of the simulation at 5 points in Neijiang River are compared with the field data, e.g. Point 1 to Point 5 (see Fig.1). The boundary variables of the simulation are in agreement with those of the field experiment. The velocities and flow directions of the simulation have a difference from the field data. However the varying trends of the velocities and flow directions of the simulation are in agreement with those of the field experiment for most of the data.

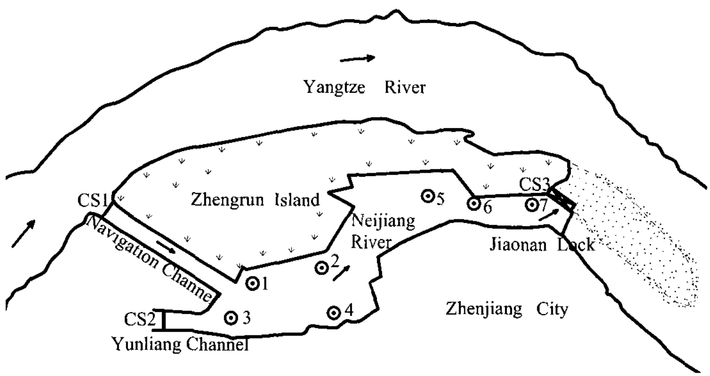

Fig.1 Sketch of Neijiang river in Zhenjiang reach

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