NUMERICAL MODEL TO FLOOD ROUTING INFECTION OF ROAD CONSTRUCTION IN FLOOD DIVERSION AREA

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As an important sign to one country's economy development, highway is developing very fast with its superiority of speediness, high efficient, economize on energy, safety and etc. Before building up a highway in the flood diversion area, to analyze its affection on the flood is an absolutely necessary work. The numerical model not only can model the stream's moving discipline well around the highway, and also it has many advantages comparing with the physical model, such as low investment, short period, and it can do flood calculation of several schemes at the same time and etc. Now, the numerical model has been used to evaluate the project effect on flood control widely.

In the plane 2-D flood routing model, the main problem is the moving boundary, which is the dry land question. The moving boundary is defined as the cross line between the water and no water area in the calculation area, and there are two methods to solve it: one is to pursue the exact position of the moving boundary and divide the calculation area into water area and no water area, which is very precise in theory but is very complex to compile the program, the other method is to let the all grids in the calculation area participate into the calculation, and then use the freezing and narrow slot method to do a simplified disposal.

In this paper, a plane 2-D water mathematical model in the flood diversion area is set up, and the freezing method is used to solve this dry land question. Details about this numerical model are listed as following. Firstly, the finite volume method is applied in the model for it accompanied with methods of finite difference's clear physical concept and finite element method's suiting well with irregular boundary and high computational accuracy. Finite volume method also called finite control volume integration method, which disperse the grid into several points in the calculating area, regard these points as center and divide the total calculation area into many control volume, which are coadjacent but not lapped. Secondly, the staggered grid is adopted into the model with the superiority that it can keep the amount of water conservational. Thirdly, boundary questions of the model are as the following: the water boundary is the outside water level when the artificial levee breach begins and the outside boundary is the around border dike of the flood diversion. The method of disposing the land boundary is to make the close boundary's normal velocity be 0, and the tangential velocity is not 0, that is to say: $V_n|_\Gamma = 0, V_l|_\Gamma \neq 0$. Finally, the land boundary's position changes with the water level, and to the dry land that the water has not achieved, special process is needed. Now the relative rational method is the moving boundary method, with which to confirm the water area and the no water area, but it is very difficult and complex in the process of program compiling.

In practice, the simplified disposal method is always used in the numerical model, and the "freezing" method is used in this model, in which it should be judged whether the riverbed basset the water level or not according to the calculated water level and bed elevation, which defines the critical water depth is larger than 0.005 and less than 0.01m, and when the water depth is larger than Δh, the roughness coefficient is equal to a normal value, on the contrary, the roughness is equal to a larger value(10^{10}).

Finally, regarding the designing Han-Nan highway as example, the infection of the highway to the flood diversion area, such as the discharge process, the flood diversion time, water level and velocity, etc are calculated and analyzed, through which the actual rule is listed as following: 1) The highway's infection to discharge process: two aspects of the discharge process is analyzed in the paper, one is the largest inflow decreases in the flood diversion entrance, and the other is the flood storage process in the flood diversion area is calculated to test the conservativeness of the model. 2) The infection to flood diversion time, which is analyzed with two sides: one is the effect on the arriving time at each feature points of flood diversion area, the other is to analyze the effect of the highway on the flood diversion duration when the storage capacity is achieved. According to the result, the flood's arriving time are delayed in the south of the highway after it is built up, but the north of the highway is not affected by the highway. When the flood diversion area is stored up, the flood diversion duration is delayed 2.05h. 3) The infection to both sides of the highway's velocity. After calculated, the arriving time of the feature points' peak velocity, which lies in the south of the highway is delayed, however, the arriving time of the feature points which lies in the north of the highway does not affected by the highway, except the points that near the trestle, whose velocity is larger than that before the highway is built up obviously for the concentric flow, the duration time is comparatively longer. 4) The infection to water level. When the storage capacity achieved, the 0.01m's back water occurred in the flood diversion area for one part of the storage capacity are occupied by the roadbed. 5) The infection to the velocity near the dike. After the highway is built up, the maximum increase of the velocity is 0.053m/s near the trestle and dike.

The above analysis indicates that this model not only satisfies the water volume conversation law, but also can preferably model the flood routing on dry land. The application indicates that the model can exactly model the change of the flood character before and after the highway is built up, and it can be widely applied into the similar flood control evaluation project.

Keywords: Flood diversion area; Dry land; Highway; Numerical model; Moving boundary