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A Numerical Analysis on Water Circulation Efficiency Improvement in Artificial Lake

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Abstract. An artificial lake has many dead water zones incurred by the limitation of discharge supply and the low velocity of running water. This study aims to suggest an operation scheme that can enhance the water cycle and provide a solution to dead water regions. For this, the study, using MIKE 21 FM model, analyzed the water level, velocity and water exchange rate of Cheongna Central Lake that change according to the operation conditions such as the use of flow generator, drainage location and discharge supply condition. Regardless of the discharge supply and drainage conditions, operating the flow generator increased the average velocity of running water by more than 4 times throughout the entire lake, while removing maximum 35% of the whole dead water zone. The study indicates that the operation of flow generator is crucial in removing the dead water zones in a short term as the water exchange rate was lower than 60% when the flow generator did not operate.

Keywords: Numerical Analysis, Artificial lake, Water Circulation Efficiency

1 Introduction

In the past, the artificial lakes were built for the stable water supply, whereas most of them are built in these days to provide a waterfront space for a rest and learning nature.

Generally, the water runs at low velocity, flowing in complicated, multiple directions in the lake. As a result, most theories and research methods have been established to study the quality of water and many researches have focused on the reservoirs produced by dams, rather than working on the lakes in cities [1]. The low velocity of running water causes the dead water zones to occur in the artificial lake and the eutrophication worsens the quality of water. Recently, there is an increasing number of attempts to reduce the size of dead water zone and enhance the quality of water by installing the flow generators and water purification facilities.

Therefore, this study used the MIKE 21 FM model, universally used on analyzing the complicated characteristics of the water flow in the artificial lake, to analyze the water level, velocity and water exchange rate that change according to the operation conditions such as the use of flow generator, drainage location and discharge supply

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condition. The objective of study is to suggest an operation scheme that can provide a solution to dead water regions and enhance the efficiency of water cycle through the study's analysis result.

2 Modeling

The study used the function of Mike Zero Model's mesh generator to constitute the geographical data and mesh of Incheon Chengna Central Lake. The altitudes of east-west & south-north waterways were set at E.L 0m, that of central lake at E.L. (-) 0.5m, and a total of 3,330 meshes were set up.

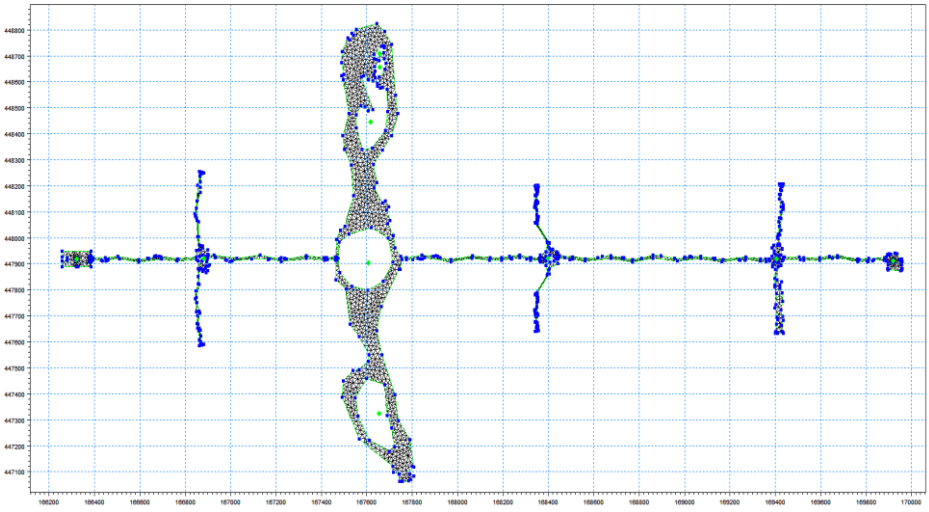

Fig. 1. Creation of geometry and mesh in MIKE Zero

3 Experiment Conditions & Results

The changes of water level and velocity were analyzed by applying different water drainage conditions at each time when the flow generator was used or not. The Table 1 below shows the experiment conditions, while the Figure 2 is the distribution chart of water velocity resulted from numerical simulations based on the MIKE 21 FM.

3 Conclusion

The study drew the following conclusion from the numerical model experiments that were conducted in the Cheongna Central Lake by using the MIKE 21 FM to analyze hydraulic characteristics on different conditions such as discharge supply, drainage location, use of flow generator.

With the discharge supply and drainage conditions being equal, the average water velocity increased when the flow generator operated, relieving stagnation regions.

In constrast, when the flow generator was not used, the dead water regions occurred due to lack of water cycle as can be seen in the first and third sections of the central lake. It is considered that the operation of flow generator will remove these dead water regions.

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References

1. Choi, G.W., Km, D.E., Yoon, G.H. and Han, M.S.: The Effect and Application of Flow Induction Machine in Artificial Canal Way and Lake through Water Quality Model Test. Korea Water Resource Association (2011)

