Joint Research on Hydraulic Analysis of Daishigawara Detention Pipe Using Computation Fluid Dynamics (Kawasaki City)

Year of Research	2012・2013	Implementation of anti-inundation measures

(Purpose)

Kawasaki City has long been working to improve anti-flood measures for 10-year probable rainfalls, to reduce pollution loads, and to significantly reduce raw sewage discharge in its CSO control system. Currently, the city is constructing the Daishigawara Stormwater Storage Pipe aimed at both flood prevention and CSO control. A diversion manhole (the Daishigawara Diversion Manhole) to be connected to this detention pipe has a complex design due to the limited size of the site. The purpose of this research is to verify, before construction, whether the facility fulfills diversion and outflow functions as designed by using a computation fluid dynamics model and to develop a proposal for improvement as needed.

(Results)

(1) Method of examination

We used a computation fluid dynamics (CFD) model to visualize potential problems for verification and evaluation of the diversion and outflow functions.

(2) Problems identified in the current design

The current design will not allow proper diversion of CSO, because large volumes of water flow into the connecting pipe (1)' shown in **Figure 1** and its backwater influences the diversion weir located upstream (1). Moreover, the opening of the drop structure (2) is too small to cope with water volumes and causes a significant hydraulic loss, which makes the influence of backwater reach as far as the connecting pipe (1)'.

Furthermore, it was found that the volume of inflow into the 1Qs waterway (3) exceeds 1Qs, influencing the flow at the entrance to the drop shaft (4).

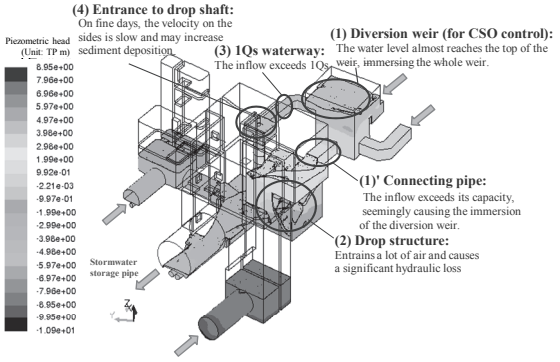

Figure 1 Problems in the current design

(3) Proposal for improvement and validation of effects

The improvement proposal is to control the inflow into the connecting pipe (1)' by installing an upstream gate. For the drop structure (2), it proposes reducing hydraulic loss by reviewing the layout of the intermediate slab to enlarge the opening of the drop structure (2). (See **Figure 2**). The proposal also suggests installing an orifice in the 1Qs waterway (3) to limit the inflow into 1Qs and to ensure proper volumes of inflow by installing a regulator in the drop shaft (4).

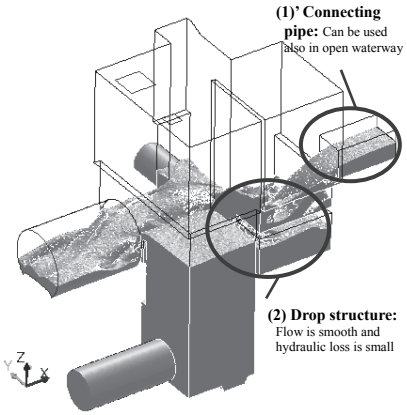

Figure 2 Validation of proposed improvements

(Summary)

In identifying problems in the current design, the drawback of an experiment with a traditional hydraulic model was that, while it would allow us to verify how water flows, it would be difficult to visualize in freely selected sections such details as local pressure increases in the manhole. In this study, we used a CFD model and demonstrated how such a model can be used to identify the cause of problems and make it easier to develop improvement measures and solve problems arising from complicated hydraulic phenomena. In the future, we would like to pursue a study to further improve safety measures for sewerage service.

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Key words	Computation fluid dynamics (CFD), flood prevention, CSO control, identification of hydraulic characteristics