

Joint Research on Drop Shaft with Multi-Directional Inflow Spiral Guideway

Whole term

2003.10 ~ 2005.6

(Purpose)

Recently, the constructions of stormwater storage pipes have been implemented to improve the combined sewerage and to prevent rainwater flood. Having a deep underground depth under the performance conditions of existing underground installations, many stormwater storage pipes are connected to the inflow pipes with a large head drop. The construction of the facility with a large head drop, however, presents challenges because the construction requires high cost and long time for completion, and the installation site may be restricted by the existing underground installations and ambient environment conservation. As a countermeasure, joint development was carried out on the design method of a new technology "Drop shaft with multi-directional inflow spiral guideway" to consolidate the facility with a large head drop.

This research was implemented by means of hydraulic model experiment on the drop shaft with a multi-directional inflow spiral guideway connected to the Moriyama Ritto rain water main drain installed in the sewage in watershed areas of central Konan in Shiga prefecture and to the Moro rain water main drain in Kanuma city in Tochigi prefecture. The purpose of this research was to clarify the issues related to the material design and the construction method as shown below by measuring dynamic load applied to the drop shaft with a spiral guideway under hydraulic conditions of multi-directional inflow and its vibration behavior.

- (1) Load applied to components and material geometry
- (2) Fixation method of drop shaft with spiral guideway

(Results)

- 1 . Load measurement (hydraulic model experiment)

The result shows that any type of vertical load is smaller than static head load. This, therefore, allows the guide plate thickness to have a same design as the case of one-way inflow. Measuring horizontal loads applied to the guide board has confirmed the consistency of test values with theoretical values derived from the jet flow equation, providing a basic guideline for guide board thickness design.

- 2 . Vibration measurement (hydraulic model experiment)

To grasp the vibration effect caused by multi-directional inflow, vibration measurement was performed by using a laser displacement gauge. The result confirms that the resonance caused by multi-directional inflow has little effect, yielding some 2 to 3 mm of maximum displacement. It shows little possibility that displacement amplification causes fracture phenomenon, verifying that the present fixing method has no problem.

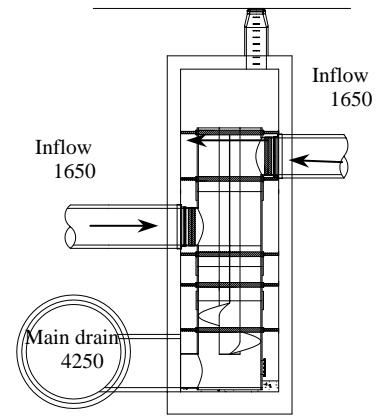


Figure 1 Installation Example
(Diameter : 2800)
(Moriyama Ritto rain water main drain)

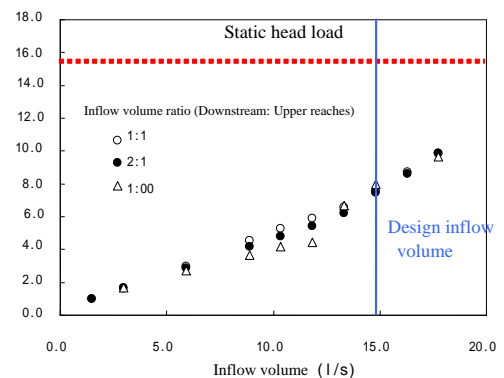


Figure 2 Vertical load of multi-directional inflow

3 . Drop shaft design

Since the experimental result indicates that vertical load is smaller than static head load, it is decided that the spiral guide plate thickness will be designed with head load same as the case of one-way inflow. The guide plate thickness must be designed by considering the safety ratio on the calculated value derived from the jet flow equation in review of hydraulic characteristics at the time of sudden inflow. One or more fixing tools must be placed within 4 m interval in consideration of construction easiness and economic efficiency.

(Future plan)

Drop shafts with a multi-directional inflow spiral guideway differ in the inflow amount of its pipe and drain, inflow direction, inflow location, etc. In individual structure design, therefore, the optimum structure must be provided by carrying out hydraulic model experiments. We will accumulate a number of examples to compile design data.

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key words

Drop shaft, hydraulic model experiment, storage pipe