

Joint Research on Spiral Guideway Drop Shaft

Year of Research

2007•2008

(Purpose)

Information on the spiral guideway drop shaft (hereinafter “DRS”) was made available in the Design Data for Spiral Guideway Drop Shaft (draft) document issued in 1999 and the revised version issued in October 2002. Since the publication of these documents, the shaft diameter of the DRS has gotten larger, the number of installations at large depth has increased, and multidirectional inflow has been introduced to reduce costs. These subjects and maintenance methods were not dealt with in these documents because they could not have been predicted at the time. Thus, there is an increasing need to clarify the measures to be taken with regard to these issues. There is also a demand for design review regarding wall thickness and the like. As the number of connections to underground retention pipes has increased, the entrained air in the retention pipe has also increased. Thus, research on entrained air venting methods is desirable. In view of the above, this study conducts hydraulic model tests, strength tests, theoretical analysis, and the like to clarify the related specifications, and makes additions and revisions to the current design data with the aim of compiling them into a technical manual. Figure 1 shows the study flow.

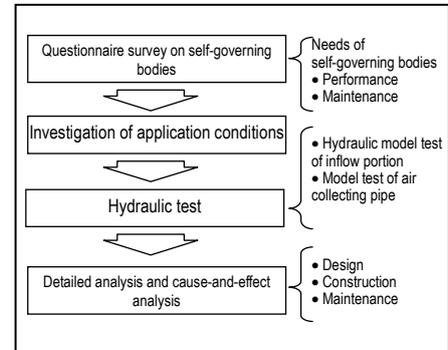


Figure 1 Research flow

(Results)

(1) Results of questionnaire survey and hearing

We sent a questionnaire to 486 self-governing bodies, including those which have introduced DRS or which participate in the liaison council, not to mention all the prefectures and ordinance-designated cities. We received answers from 238 of these self-governing bodies (about 50 percent).

1) Needs of self-governing bodies

As shown in Figure 2, one of the most pressing needs among the self-governing bodies is for enhanced manuals. This reflects the fact that 60 percent of the self-governing bodies use technical data (draft) provided by our institution as reference material for designs.

2) Market needs and research topics

- Large diameter: Diameters exceeding 2,800 mm have been on the increase since 2003.
- High drop: Drops exceeding 40 meters are rare → Dealt with by aggregating past data.
- Improvement of inflow portion: Considerable need for multidirectional inflow and connectivity improvement.
- Improvement of outflow portion: There is a need for air entrainment reduction → Verification of adequacy of set topics.

3) Problems

Three of the six problems that occurred were noise and three were blockages by wood and the like that had flowed down the pipe. As a result of the hearing, one case of noise was found to be attributable to the pipe culvert. Many self-governing bodies deal with blockages by installing a 150- to 300-mm screen at the inlet of the inflow to the DRS.

4) Maintenance

One third of all the self-governing bodies perform regular inspections. Some self-governing bodies outsource the inspections.

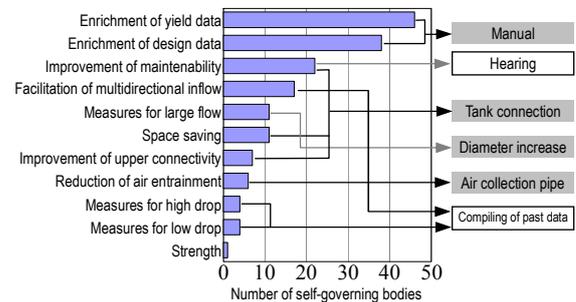


Figure 2 Aggregated results of needs of self-governing bodies

(2) Hydraulic test

Using a 1/8 model, problems and issues related to the tank connection method were extracted.

1) Problems

Pulsation occurred at a flow rate in excess of 1.2 times the normal rate. The pressure fluctuations propagated upstream.

2) Measures

A pulsation reduction by the following measures was confirmed

(Figure 3).

- ① A training wall is fabricated and installed from the inflow pipe to the DRS inflow portion to conduct the water.
- ② A rear plate is also installed on the rear face of the DRS inflow portion for more reliable water conduction.

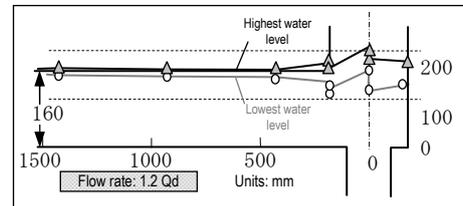


Figure 3 Dynamic water level for excessive flow rate (Training plate + rear plate)

(Future plan)

In FY2008, we will determine the optimum technique for tank connection through hydraulic tests. An air collection pipe test will be conducted in parallel with this. With regard to required information, we plan to aggregate and compile the past test data into a technical manual that will contain information concerning design, construction, and maintenance.

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Key words

High drop, drop shaft, deep installation, multidirectional inflow