Disclosing Catalog for Sewerage Pipeline Survey Devices

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1. Introduction

For the management of sewerage pipeline facilities, we have a lot of needs for technical development of survey devices including improvement of survey speed and introduction at places difficult to survey. NILIM created "sewerage pipeline simulation facilities" in FY2021, reproducing a life-size pipeline and started experiments in FY2022 to clarify the function of sewerage pipeline survey devices and to promote further technological development by private companies, and also to enable local governments to select survey devices suitable for usage when conducting a sewerage pipeline survey.

In July 2024, we summarized survey devices for sewerage pipeline facilities used for two-years' experiments in "catalog for sewerage pipeline survey devices" (hereinafter referred to as "Catalog") and disclosed the Catalog in NILIM's homepage, so we will explain its overview.

2. Sewerage pipeline simulation facilities

The sewerage pipeline simulation facilities are mainly composed of pressure pipes (rigid polyvinyl chloride pipe), small diameter pipelines and large diameter pipelines (reinforced concrete pipe) (Figure-1). The small diameter pipelines and large diameter pipelines can reproduce such various abnormalities that occur within the sewerage pipeline facilities as cracks and corrosion by setting abnormality simulation steel plate at the opening (Figure-2), and also can reproduce water flow and wind inside the pipeline by using water storage tank and ventilator, therefore, it is possible to make quantitative evaluation of survey devices under conditions similar to the actual situation.

Figure-1 Bird's eye view of sewerage pipeline simulation facilities

3. "Catalog for Sewerage Pipeline Survey Devices"

(1) Selection criteria for devices subject to publication

As the selection criteria for devices which are subject to publication, we basically select survey devices used in experiments on performance verification at the sewerage pipeline simulation facilities started in FY2022. In addition, the survey devices used in experiments do not fully cover all the survey devices put into practical use.

(2) Devices subject to publication and the details

There are 17 devices in total published in Catalog and they are classified into self-running, flying and floating, etc. depending on their characteristics.

For these survey devices, we published the data considered to be referenced when selecting survey devices (applicable conditions, camera performance and daily survey length, etc.) after verifying the details with each survey device manufacturer.

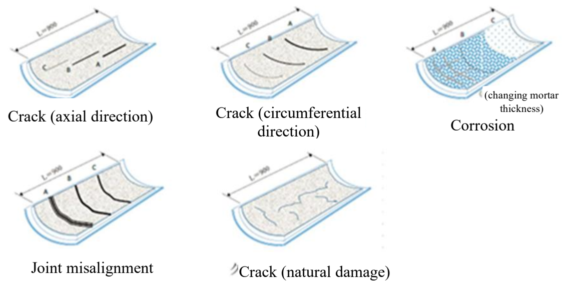

Figure-2 Abnormality simulation steel plate (for φ200 and 250)

(3) Overview of experiments

We publish the overview of experiments done at the sewerage pipeline simulation facilities and the experiment results for various survey devices at the end of Catalog as reference. In addition, as for the experiment results for various survey devices, they are the results obtained under predetermined conditions at the sewerage pipeline simulation facilities, therefore they do not necessarily guarantee the performance of each survey device.

We show the overview of the experiments done in ①～⑤.

① Survey performance experiment for abnormality inside the pipeline for small diameter pipelines and large diameter pipelines

We inserted the survey device from the starting point (entrance hole), surveyed the abnormality inside the pipeline reproduced using the abnormality simulation steel plate and the intruding water, etc. reproduced at the opening, and summarized the survey performance for abnormality in the pipeline from the survey results, and calculated the daily survey length.

As the result of the experiment, we found that it was possible to identify the extent of abnormality in addition to the type of abnormality with survey devices having high resolution.

② Roadability experiment at cross-sectional obstruction part for small diameter pipelines and large diameter pipelines

We reproduced a cross-sectional obstruction part by inserting / throwing in an obstruction object from the opening and then threw in the survey device from the starting point (entrance hole) and let it move forward up to the roadable place and summarized its roadability at the cross-sectional obstruction part.

We found out such tendencies that as for the self-running type, it was substantially affected by protrusion of branch pipes, and as for floating type and flying type, they were substantially affected by the intrusion of tree roots.

③ Long-range flying quality experiment by drone for large diameter pipelines

We inserted drone type survey device from the starting point (entrance hole) and made a continuous flying experiment making the straight-line part as flying section. When it reached the end of the straight-line part, we continued the experiment repeatedly and we measured the total moving distance and the flying speed when continuously flying with one-time charged battery. When we acknowledged that the flying was difficult due to the impact of water height in the pipeline, we suspended the flying even if the battery remained.

④ Flying quality experiment by drone under windy condition inside the pipeline for large diameter pipelines

We reproduced the wind in the pipeline using a ventilator and studied the impact to the flying quality of the drone type survey device.

Among the survey devices we did experiments with this time, there were some devices whose flying speed decreased, compared to the time having no wind.

⑤ Insertion performance experiment for pressure pipes

We verified the insertion performance (whether it is possible to insert or not, insertion length) by pushing in the survey device from the flange for air valve and observing the movement of camera and cables when passing through the curve toward horizontal and vertical directions and at full insertion.

We show a part of actual experiments on NILIM's YouTube channel (Figure-3).

4. Future prospects

As for Catalog we have disclosed this time, we expect that local governments, in particular, would utilize it as study documents to use new technologies when they bid for such projects as maintenance and management of sewerage pipelines and have discussions with the successful bidders. Therefore, we plan to update it in line with the future technological development in a timely manner.

As we have an inquiry counter on publication in catalog in Wastewater System Division of Water Supply and Sewerage Department, we would like anyone to use this counter for consultation on publishing new survey devices, etc.

In addition, from May 2024, we started offering to let our sewerage pipeline simulation facilities be used on charged basis to such external institutions as private businesses, universities and local governments. They can be used as experimental fields for private businesses' technical development in addition to performance test of survey devices for publication in Catalog.

We hope that the disclosure of Catalog and the start of lending out our sewerage pipeline simulation facilities will contribute to further technical development of survey devices and promotion of new technology utilization, and thereafter to efficient stock management of sewerage pipelines.

Left: Survey performance experiment for abnormality inside the pipeline by drone using the sewerage pipeline simulation facilities
Right: To conduct performance verification and comparative experiment for inspection and survey devices of sewerage pipelines

Figure-3 NILIM's YouTube channel

☞Detailed information is as follows.

1) Wastewater System Division Homepage, Catalog for Sewerage Pipeline Survey Devices
https://www.nilim.go.jp/lab/ebg/catalog.html