

Investigation research on the design technique for pressure flow sewer considering air spouting

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(Purpose)

Recently, the runoff quantity of storm water increases with the progress of the urbanization, and as one of countermeasures, the large-scale construction of storm water trunk line and storage pipe are carried out in every place. In the meantime, due to intensive downpour, etc., that storm water from many peaks flows into storm water sewer and storage pipe in short time, led to the phenomenon that the levitation and dispersion of manhole lid become tangible, and the problem on the safety has been indicated. It is desired to clarify the behavior of air in storm water sewer and storage pipe as pressure flow in rainfall time and establish the design technique considering the air spouting phenomenon.

Since the design has been carried out based on existing design technique for the conventional open channel type, the phenomenon in pressure flow situation was not sufficiently reflected, and the problem occurs for the operation of sewer in pressure flow situation at present.

In this study, It was carried out for the purpose of coordinating design manual, while clarify the hydraulic characteristics of pressure flow sewer, and the design technique is presented in order to conduct appropriate design. The clarification of the flow characteristic of the pressure flow sewer is carried out by hydraulic model study and numerical analysis. Moreover, the design manual proposed in this study will show the basic stance and design technique.

(Result)

1. Hydraulic model study

The hydraulic model study was carried out by using 3 kinds of different model of contraction scaled acrylic sewer model with the shape of simple siphon culvert in order to grasp the behavior of water and air in the pressure flow sewer.

Experiment of grasp entrained air amount (steady experiment)

On the entrained air amount, entrainment ratio (entrained air amount/rate of inflow) was made to be an index, and arranged the relational expression by using the inflow head and so on as parameters.

Experiment of grasp air exhaust phenomenon (unsteady experiment)

The wind velocity of air exhaust from manhole and the inner air pressure of manhole were measured, and the air exhaust phenomenon in the unsteady state was arranged, they were used as identical verification material by the numerical analysis.

2. Design manual (draft)

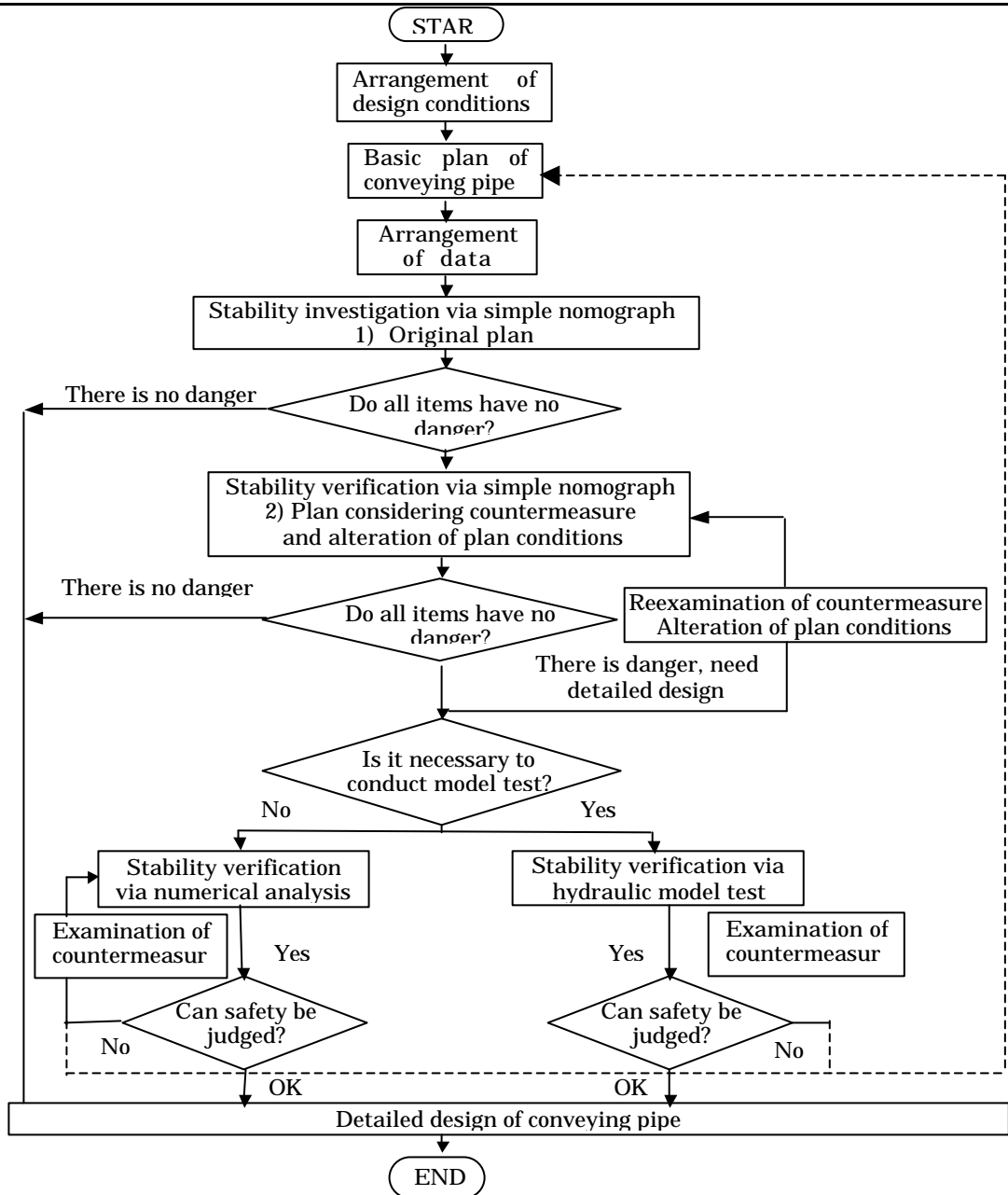
The design manual (draft) arranged safety checking technique for the levitation and dispersion phenomenon of the manhole lid by using knowledge attained from hydraulic model study and simulation result from identical numerical analysis to hydraulic model study.

Manual (draft) was arranged as following content.

- (1) Mechanism of air entrainment and spouting phenomenon
- (2) Fundamental design principle of the pressure flow sewer
- (3) Basic stance of the air spouting countermeasure technique
- (4) Safety checking with the simple decision diagram
- (5) Safety checking with the numerical analysis
- (6) Safety checking with the hydraulic model study

The simple decision diagram was graphically arranged to simply judge the safety of levitation and dispersion of the manhole lid according to such as utilities scale and discharge. The various indexes are used in the simple decision diagram so that security checking can be carried out for utilities of comparatively simple structure.

On the utilities of complicated structure or being high importance, that numerical analysis and hydraulic



Flow Chat of Application of Manual

model study according to the multi-phase flow model considering the bubble were proposed, and consideration and technique are described for using manual (draft).

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Key Words

Conveying pipeline, manhole lid levitation dispersion, air behavior in pipe, design manual, hydraulic model study, safe checking, entrained air quantity