Investigation research on structures of steep gradient sewer and spiral guideway style drop shaft in Atami City

Period	113P～118P	1999.10～2000.3

(Background and Purpose)

In the Atami City, the sewer (the plan discharge 0.143m^3/s), which connects main sewerage pipe downstream to relay pump station has been planned. This interval has total extension of 140m, differences of elevation of about 44m, and the gradient of landform is very large.

Moreover, it is collection of the steep gradient pipes which the gradient is about 1700‰ and the flow velocity is over 10m/s in the part of the main sewerage pipe just before connects with relay pump station. If conventional design technique is used, not only does construction cost increase but also the construction period is needed for throughout long term.

Therefore, the technique which combined spiral guideway style drop shaft with steep gradient sewer was adopted in this plan. However, it becomes a basic stance to make the sewage normally flow in waterway and pipe which connects with the drop shaft in the case of past spiral guideway style drop shaft (the following, drop shaft). However, the examination of the shape of inlet of the drop shaft and the connection position between incurrent pipe and it for the inflow of high-speed flow is required in this study, in order to make the supercritical sewage of high-speed flow to the drop shaft.

Accordingly, as the purpose of this study, the optimum of shape and structure corresponding to such high-speed flow are decided by hydraulic model study.

(Result)

(1) Shape of inflow division of drop shaft.

1) On the shape of inflow division of drop shaft

In order to made the water path flow along pipe wall and flow downward, the downstream end of the incurrent sewer was made as the rectangle, and the waterway which the width was reduced from 0.3m to 0.1m connected with the drop shaft at the tangential direction. And, the waterway height was vertically raised considering blockade inhibition in the drop shaft inflow division by the contaminant in respect of the rectangle division. As the result, the high-speed sewage was flowed down along pipe line and bottom face of rectangle sewer in stable condition from steep gradient pipe line to rectangle sewer. And, by making the waterway of rectangle sewer 0.3m wide as same as the pipe line in the connection of rectangle sewer and pipe line, the side wall of rectangle sewer becomes the circumscription of pipe, the smooth diffusion was executed with no problem in flow condition, and it was possible to hold jump raising of water path in vertical direction of drop shaft.

2) Pressure acting to the wall of drop shaft

The comparison of largest pressure (m) acting to the wall of drop shaft is shown at next table.

	Tangential connection with Circular pipe	Rectangular shape	Reduction ratio
Plan discharge	4.894	1.679	0.66
Overflow discharge	6.199	2.273	0.63

From the flow condition, the effects were able to be confirmed that held the raising jump of water path in the vertical direction of the drop shaft by following: that the acting pressure was hold down has appeared, and that downward flow was stabilized.

(Future problem)

Though this study was the research of drop shaft differed from the design data (draft), which is made to flow into the drop shaft in supercritical flow of inlet velocity over 10m/s without such case in past, by improving the shape of inflow division of drop shaft, and making sewage flow into the drop shaft, it was possible to confirm that sewage flows stably from this experiment.

For such special case, the experiment will be carried out in future, and in addition, we want to advance the research on expanding the application range of the drop shaft.

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