Research on hydraulic phenomena in the Hie Trunk Sewer in Fukuoka City

Year of Research	2007・2008	

(Purpose)

Fukuoka City is conducting a sewerage project (urgent storm water counter-measures project in Hakata station district, "Rainbow Plan in Hakata") intended to prevent serious flooding in the region around Hakata station in the center of the city, a district which has suffered serious damage by flooding: in June 1999 and July 2003. This project is planned to cope with storm water produced by a rainfall of 79.5mm/hour, which is the recorded maximum rainfall, to improve flood safety in that area to a higher level than the conventional 10-year design rainfall of 59.1mm/hour. A new trunk sewer consisting of three large-scale conveyance tunnels, Hie No.9, No.12 and No.13, will be constructed as a part of the sewerage project.

This sewer system is designed to transport and store storm water. But during a 30-year storm event of 71.9mm/hour, there is danger that as the line progress from dry condition to full condition, hydraulic bores, surges, and similar phenomena may occur, causing inundations and/or blowing off of manhole covers. In this study, the potential for hydraulic transients, pipe filling bore, pressure oscillation, etc., in the system during storm events was investigated by performing hydraulic modeling tests. Based on the test results, different design alternatives to mitigate excess water rising in the manhole and/or to exhaust the compressed air were evaluated.

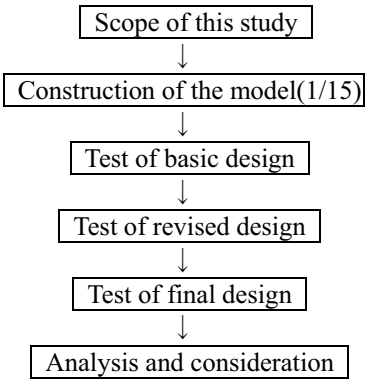

Fig.1 flowchart

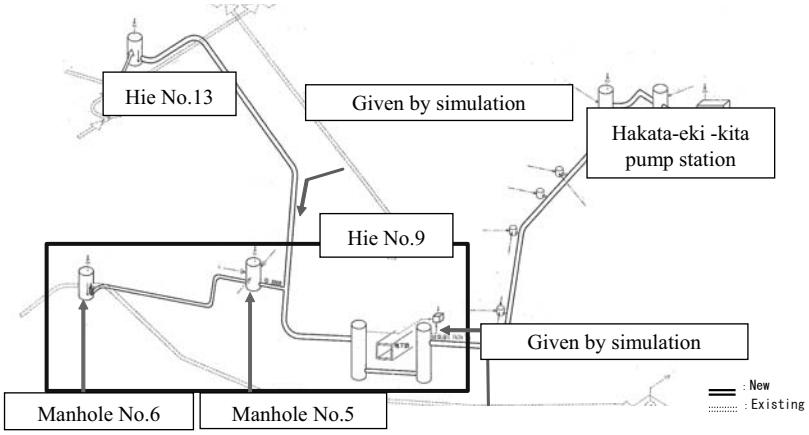

Fig.2 simulated area

(Results)

Fig. 1 is a flow chart of this study. In this model, all sections of Tunnel No.12, some sections of Tunnel No.13 and the upper half sections of Tunnel No.9 including the inverted siphon are simulated as shown in Fig.2.

The main conclusions of this study are summarized as follows.

1) The observed pressure increase at the manholes during the storm event was smooth without the expected pipe filling bore or noticeable surging. These results show that special measures for pressurization were not necessary.
2) Design air discharge values for every manhole were set based on the experimental results. So, exhaust sections attached to the tops of manholes were proposed to limit velocity of the wind to 10 to 20m/s or less.
3) The inlet configuration for Manhole No.6 was improved to increase the inflow capacity for the peak discharge of the design hydrograph. Furthermore, the inflow gate operation, which was installed in Manhole No.6, was confirmed based on the inflow characteristics obtained from a numerical simulation.
4) The maintenance procedure for sedimentation was examined based on a series of test results concerning the flash effect and transportation of sand in tunnel.

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Contact: Second Research Div., Osamu Matsushima, Shizuo Yoshikawa, and Hirokazu Toda

Key words	Hydraulic modeling test, Stormwater retention tunnel