Research on the technology development of steep gradient sewer in the Nagano City		
Period	1994.10～1995.3	39P～　45P

(Purpose)

In public sewerage Meshituna No.1 trunk line of specific environmental preservation, there is one sewer route in plan road laying place of the seven curve sites, which is sharp curve and steep gradient road of city road of Daizahoushiti ・ Seikou line. By laying it as a steep gradient sewer in the vicinity hill slope, the advantages such as the avoidance of the difficult positions for construction and reduction of construction expenses was achieved, so the Nagano City adopted the route plan. Therefore, the research was carried out for the purpose of examining laying methods and high-speed supercritical flow countermeasures and maintenance countermeasures, etc. as the problems in the laying sewers, by adding to determining the rational facilities by the Nagano City accompanied with the Organization.

In addition, as a high-speed supercritical flow countermeasure, the hydraulic model study was carried out in order to obtain flow characteristic with high accuracy.

(Result)

1. Piping material and laying method.

"Reinforced plastic compound multiunit pipe (FRPM Pipe)" should be adopted by the consideration of laying condition, meteorological phenomena, flow characteristics and workability, etc.. As a result of comparative examination considering possibility of the construction in the steep slope, etc, the laying method of "the concrete protection + anchor plan", which it is able to deal with the surface displacement and fallen trees and sliding, etc., and comparatively ease to the correspond to the repair was adopted. And, the sandbag was used for the back filling.

2. Hydrology examination of sewer

Non-uniform flow calculation of sewer was carried out in order to obtain the inflow velocity of upstream flow of energy dissipater and stabilized flow condition in sewer. As F 250mm that the ventilation of the air was possible for the pipe diameter without becoming the pressure flow, the inflow velocity V=6.3m/s to the energy dissipater was calculated out.

3. Energy dissipation system and structure

The energy dissipater returned to normal flow from supercritical flow in the most downstream end of sewer in the high discharge district is required. By the type of general energy dissipation system it is classified into the water head type, hydraulic-jumping type (the level strike style, inclination apron style, the bucket-shaped style, and enforcement hydraulic jumping style), ski-jump type free falling type and collision- disturbance style (impact type). Form above mentioned, the hydraulic jump type energy dissipater" was selected and adopted for that the certainty of the energy dissipating effect is high and it is difficult to generate the sedimentation of the impurities without staying the sanitary sewage, and the structure is simple.

The hydraulic calculation was carried out on this type, and it was made to be energy dissipater hydraulic model of length 3.70m, width 1.00m and sills high 0.30m as draft.

4. Hydraulic model study of energy dissipater

In order to decide optimum shape by adding necessary improvement, Energy dissipation function of the energy dissipater design draft was investigated and examined by the hydraulic model study for the model of energy dissipater of contraction scale S=1/1.5. As a result of the experiment for design discharge $Q=0.048m^3/s$ within 0.2Q～1.2Q, the energy dissipation effect is sufficiently verified. Improvement experiment of the 24 cases was carried out, since water surface vibration of the sill downstream by infiltration of the hydraulic jump and right and left transfer of the jet to upstream sewer was generated, and the plan which the training channel was equipped on upstream and downstream of sill with upstream sewer was made to be a final draft.

Evaluations of the final draft are as follows.

(1) Energy dissipation becomes possible at all 0.2Q-1.2Q(Q=0.048m^3/s) discharges.

(2) Upstream pipe is not blocked in the hydraulic jump.

(3) For the downward flow of sand and impurities, it is cleaned with the time past, and the sedimentation is hard generated.

(4) Water level for hydraulic jump is within the height of energy dissipater

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Key Words	Steep gradient sewer, non-uniform flow calculation, energy dissipater, hydraulic model test