Research on the steep gradient sewer utilities		
Period	2002.11～2003.3	

(Purpose)

This study extracts hydraulic examining subjects based on established cases and past research results of steep gradient sewer, and carries out the hydraulic model study for the important subjects (design method of tubular section , design method of alignment and design method for energy dissipation utilities), and it is coordinated as a basic data for the design standardization.

Established cases of steep gradient sewer show in the following 7 cases.

Steep gradient sewer in the Nagano City. (the commencement of service in 1995)

Steep gradient sewer in the Otsu City. (the commencement of service in April, 2000)

Haneo line steep gradient sewer (Naganohastorm-Gunma Prefecture)

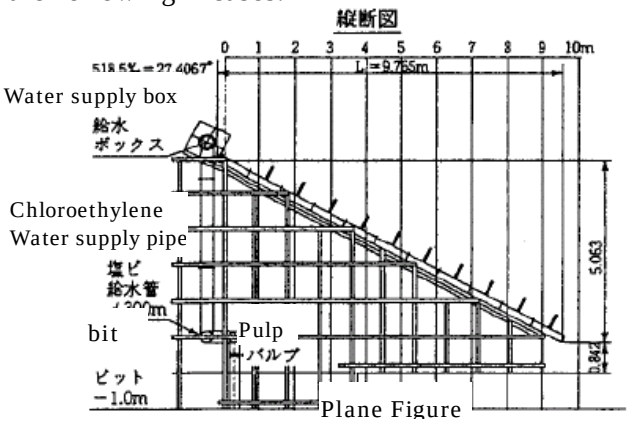
Zao process zone trunk line (Yamagata City, Yamagata Prefecture) (under construction)

Steep gradient sewer in the Atami City. (under construction)

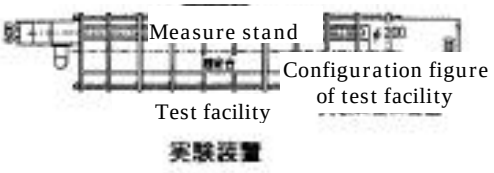
Steep gradient sewer in the Suzaka City. (under construction)

Mt. Aonoyama steep gradient sewer. (Yoshino town in Nara Prefecture).

Longitudinal Figure



Plane Figure



(1) Arrangement of the established cases and extraction of the hydraulic subjects.

・Grasp of air entrainment and contamination phenomenon and design method of tubular section of sewer

・Design method of alignment.

・Design method of variants of energy dissipater

(2) Hydraulic model study for the important subjects

(3) Examination of standardization and subject arrangement after the next fiscal year.

Above subjects are arranged, and the necessary hydraulic subjects for examination of the design standardization are extracted and arranged.

(Result)

(1) air taken /entrained phenomenon.

・ Aeration quantity

The aeration quantity is obtained by the area which subtracted the area of flow entrained air from the area of uniform flow without entrained air.

The extension of the application became possible.

①Range of Fr: $8<Fr<16$. ②Range of the flow velocity: $4.6m/s<V_w<12.7m/s$. ③Range of the water depth: $0.11<Rw/D<0.36$.

・Entrained air quantity

It is possible to calculate the taken air quantity by subtracting obtained entrainment air quantity from supplied air quantity of experiment. Still, that the relation between air entrainment speed Vap and flow velocity Vw is as same to past result was able to confirm by experiment.

(2) Energy dissipation function.

In the experiment, the following were verified for draft shape of energy dissipater: dissipation situation due to the hydraulic jump in the case which changed discharge and discharge characteristic of the sill with

the slit.

By applying the past research result on energy dissipater, it was proven that the design on the energy dissipation function was possible.

(Future problem)

(1) On the design method of section of steep gradient sewer, it is almost possible to clarify for straight part, and for the curve part, the research by the experiment is necessity in future.

(2) On the design of the energy dissipater, it is necessary to examine the design technique of the utilities which combine energy dissipation function and water flowing function of sewage.

The peculiar research : Japan institute of Wastewater Engineering Technology

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Key Words	Steep gradient sewer, air entrainment phenomenon, aeration phenomenon, pulsation event, energy dissipater, uniform flow condition, linear interval, curve interval, gradient variation interval, phenomenon of hydraulic jump, slit bill sill, Froude number J902B1010.