

Joint Research on Sewer Pipe Construction in Continuously Subsiding Areas (Nagano City)

Year of research

2010

Construction of efficient sewage

(Purpose)

To compile basic data on sewer system construction, we have evaluated the applicability of different types of sewer systems for continuously subsiding areas, considering the degree of subsidence.

(Results)

(1) We have evaluated the four types of sewer systems below.

- Gravity flow system (also for subsidence measures)
- Vacuum sewer system (partly gravity flow)
- Pressure sewer system (partly gravity flow)
- Septic tank for combined treatment

(2) We have evaluated the applicability based on the life cycle cost (LCC) of each type of sewer system on population density, housing density, size of the construction site, pipe extension length and ground conditions (type of earth and groundwater). The terrain condition is flat.

(3) We have assumed that open cut method is used for pipeline construction and that the earth covering does not exceed 3.5 m on ordinary ground. On soft ground, considering need of ancillary construction and effect on nearby houses, we have limited the earth covering to 1.8 m. When the pipeline needs to be buried deeper, a manhole pump is to be used.

(4) On ordinary ground, when the population density is low (5 persons or less per ha), the septic tank has an advantage. When the population density is high (10 persons or more per ha), the gravity flow system has an advantage.

(5) On soft ground, the gravity flow system, the vacuum sewer system and the septic tank have an advantage (Table 1). The pressure sewer system can feed water with a high lifting height and therefore has an advantage in application on a rough terrain, such as mountains. On a flat terrain, this system loses advantage because of cost for the power, even considering the effect of subsidence.

(6) The vacuum sewer system has an advantage over the gravity flow system when the ground is soft, the site is large in area and the pipe extension is long. That is because the gravity flow system requires a manhole pump and that increases the operation cost when the pipeline has to be buried deep.

(7) For the evaluation, we have also assumed that the pipeline for the gravity flow system may become uneven on soft ground (assuming the pipe service life to be 36 years*). That has increased the applicability of the vacuum sewer system. This system can collect sewage even if the pipeline becomes uneven, unless the height differences exceed the lifting height, and that saves cost for reconstruction of the pipeline (Table 2).

※ The average service life of a sewer system pipe is specified as 72 years (reference value) on page 20 of the manual for prefectural planning of effective sewage treatment system construction (draft) issued by the Ministry of Land, Infrastructure, Transport and Tourism in September 2008. We have assumed that a pipe requires reconstruction in half the period.

- (8) In terms of earthquakes, the vacuum sewer system is applicable even if the pipeline is likely to become uneven, unless the differences exceed the allowable range.

Population density	Area	Area										
		5 ha	10 ha	20 ha	30 ha	40 ha	50 ha	74 ha	100 ha	150 ha	200 ha	
Population density (persons/ha)	3	Septic	Septic	Septic	Septic	Septic	Septic	Septic	Septic	Septic	Septic	Septic
	5	Septic	Septic	Septic	Septic	Septic	Septic	Septic	Septic	Septic	Septic	Septic
	10	Septic	Septic	Septic	Septic	Septic	Septic	Septic	Vacuum	Vacuum	Vacuum	Vacuum
	20	Gravity	Gravity	Gravity	Vacuum	Vacuum	Vacuum	Vacuum	Vacuum	Vacuum	Vacuum	Vacuum
	30	Gravity	Gravity	Gravity	Gravity	Gravity	Gravity	Gravity	Vacuum	Vacuum	Vacuum	Vacuum
	40	Gravity	Gravity	Gravity	Gravity	Gravity	Gravity	Gravity	Gravity	Gravity	Vacuum	Vacuum
	50	Gravity	Gravity	Gravity	Gravity	Gravity	Gravity	Gravity	Gravity	Gravity	Gravity	Gravity
	100	Gravity	Gravity	Gravity	Gravity	Gravity	Gravity	Gravity	Gravity	Gravity	Gravity	Gravity

Table 1 Selection of collection systems (soft ground)

Population density	Area	Area										
		5 ha	10 ha	20 ha	30 ha	40 ha	50 ha	74 ha	100 ha	150 ha	200 ha	
Population density (persons/ha)	3	Septic	Septic	Septic	Septic	Septic	Septic	Septic	Septic	Septic	Septic	Septic
	5	Septic	Septic	Septic	Septic	Septic	Septic	Septic	Septic	Septic	Septic	Septic
	10	Septic	Septic	Septic	Septic	Septic	Septic	Septic	Vacuum	Vacuum	Vacuum	Vacuum
	20	Septic	Gravity	Vacuum	Vacuum	Vacuum	Vacuum	Vacuum	Vacuum	Vacuum	Vacuum	Vacuum
	30	Gravity	Gravity	Vacuum	Vacuum	Vacuum	Vacuum	Vacuum	Vacuum	Vacuum	Vacuum	Vacuum
	40	Gravity	Gravity	Vacuum	Vacuum	Vacuum	Vacuum	Vacuum	Vacuum	Vacuum	Vacuum	Vacuum
	50	Gravity	Gravity	Vacuum	Vacuum	Vacuum	Vacuum	Vacuum	Vacuum	Vacuum	Vacuum	Vacuum
	100	Gravity	Gravity	Gravity	Gravity	Gravity	Gravity	Gravity	Vacuum	Vacuum	Vacuum	Vacuum

Table 2 Selection of collection systems
(the life of the gravity flow system pipes is 36 years on soft ground)

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Key words

Subsiding area, Examination of different types of sewer systems