

7. Calculation of flow of PVC drainage pipe:

- (1) The flowing effect in PVC pipe is achieved by the slope of pipe. "If it is delivered by a pump, it is not included in the description of this section". The internal wall of PVC pipe is very smooth with the roughness coefficient of 0.009 (it is 0.015 for cast iron pipe), so the flow in PVC pipe is far greater than the flow in metal pipe with the same internal diameter. And there will not be any water scale adhered to the pipe after long-term use to decrease the flow. PVC pipe is also equipped with the superior acid resistance, alkali resistance, and corrosion resistance, thus making it the most practical material for sewer construction pipe.
- (2) The flow of PVC drainage pipe can be calculated by Marling equation.

$$Q = A \cdot V$$

$$V = \frac{1}{n} R^{2/3} \cdot I^{1/2}$$

In the equation: Q: Flow (m³/sec)

A: Cross sectional area of the flow (m²)

V: Flow rate (m/sec)

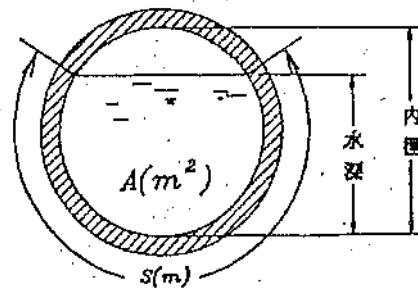
N: Roughness coefficient

R: Hydraulic radius (m)

I: Slope of pipe (expressed as a fraction or a decimal)

$$R = \frac{A}{S} \text{ (Full pipe or half pipe, } R = \frac{D}{4} \text{)}$$

S: The arc length of the water part of the flow (m)



水深	Water depth
内徑	Internal diameter

Roughness coefficient: PVC pipe: 0.009, cement pipe: 0.013, cast iron pipe: 0.015.

- (3) Functions of sewer PVC piping manhole:
 - a. For inspection and sediment clearance.
 - b. For changing direction and height (to generate slope) of sewer drainage pipe. According to the common design practice, the manholes of sewer are usually in a straight line. These manholes can be used to fix the position and change the direction. Manholes of different heights can be used according to various slopes or heights. The spacing between manholes along the sewer pipe is around 90-120M, yet this distance could vary by site, design, and sanitary engineering standard.

In terms of the material of manhole, the pre-cast concrete manhole is more popular in densely populated area due to its superior endurance, water resistance, and more economic installation labor cost.

8. Head loss and flow of PVC pipe:

- (1) Based on the straight line piping length of tap water pipe, the friction head loss generated by the flow rate in the pipe can be calculated via the following Darcy-Wisbach equation.

$$h = \lambda \frac{\ell}{d} \cdot \frac{V^2}{2g} \dots\dots\dots (1)$$

In the equation: h: Water head loss (m)

λ : Friction coefficient

ℓ : Piping length (m)

d: Pipe internal diameter (m)

V: Flow rate (m/sec)

g: Gravity acceleration (9.8m/sec²)

$$I = \frac{h}{\ell} \text{ (Moving water slope)} \dots\dots\dots (2)$$

From equation (1) and (2) we can obtain

$$V = (2g)^{0.5} \lambda^{-0.5} \cdot I^{0.5} \cdot d^{0.5} \dots\dots\dots (3)$$

- (2) Flow calculation:

$$Q = \frac{\pi}{4} (2g)^{0.5} \lambda^{-0.5} d^{2.5} I^{0.5} \dots\dots\dots (4)$$

$$= 34.771 \lambda^{-0.5} d^{2.5} I^{0.5}$$

From equation (4): $34.771 \lambda^{-0.5} = C$ (Flow coefficient)

TW flow calculation formula:

$$Q = C \cdot d^{12.72} \cdot I^{0.54} \quad (\text{It is applicable to the small caliber up to 2"})$$

Flow coefficient: $C = 215$

W&H flow calculation formula:

$$Q = 0.2785C \cdot d^{12.63} \cdot I^{0.57} \quad (\text{It is applicable to pipe larger than } 2\frac{1}{2}")$$

Flow coefficient: $C = 140$

(3) The relationship between head loss and flow of PVC pipe:

The flow of tap water pipe is closely related to pipe diameter, piping length, water head (water pressure), and flow rate. If any of the aforementioned conditions is unknown, it can be calculated from other known conditions in order to achieve the pipe design purpose.

Based on the principles of convenient, fast, and accurate pipe design, Figure 53 and Figure 54 are hereby provided for obtaining the unknown conditions via comparison approach. For example, if two of the four conditions of water head loss, flow, pipe diameter, and flow rate are known, the other two known conditions can be obtained via comparison.

Figure 52 is applicable to mid-to-small size PVC pipe

Figure 53 is applicable to mid-to-large size PVC pipe

Figure 52. Mid to Small SIZE PVC Pipe

图 52 PVC 管水损失与流量对照图 (中、小口径适用)

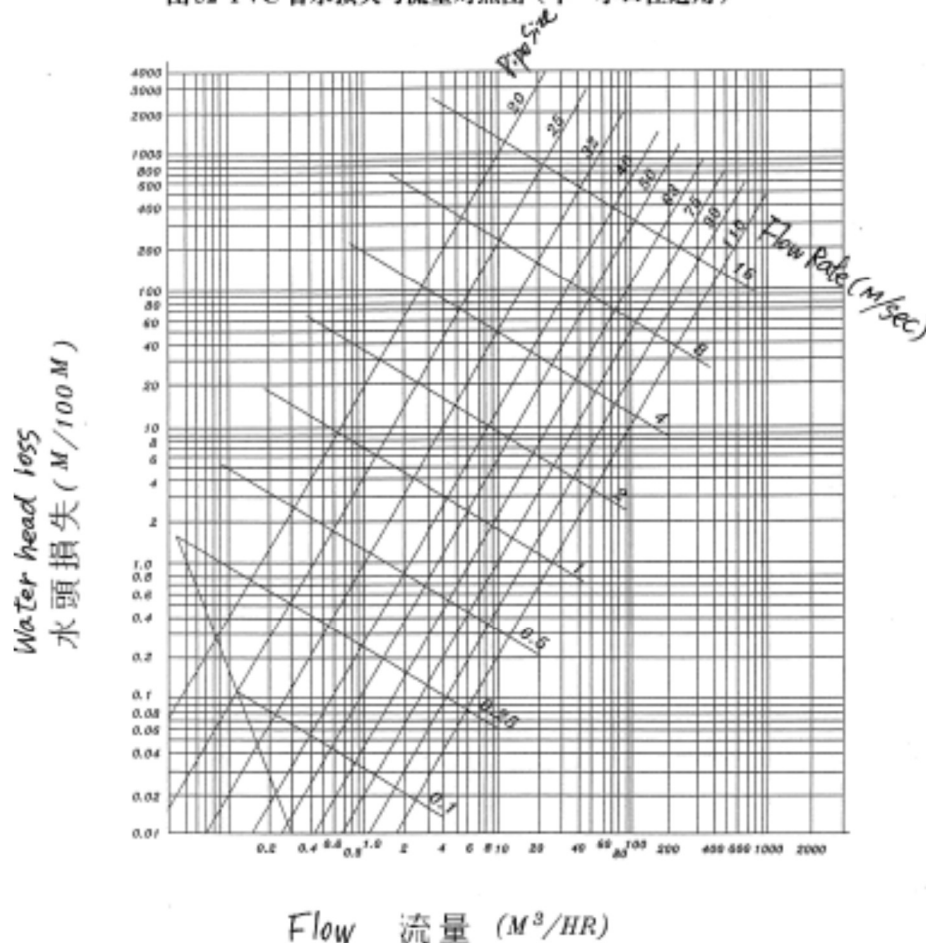
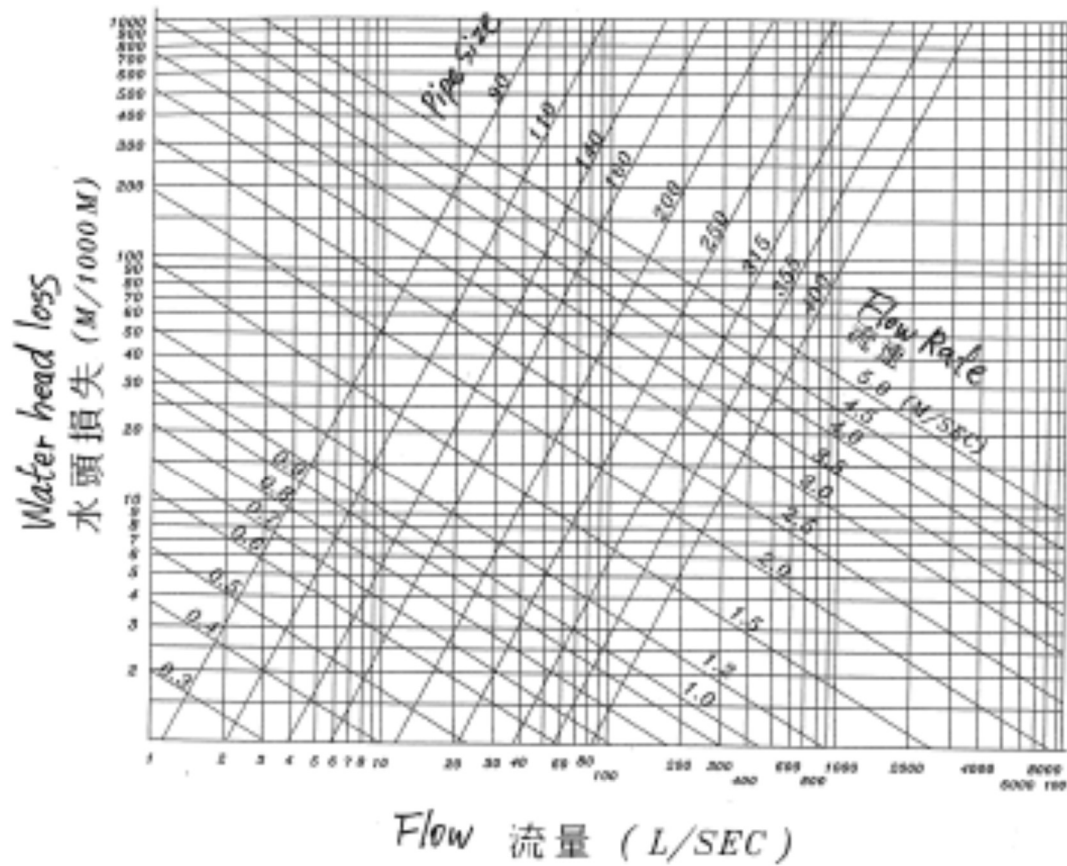


Figure 53 . Mid to Large SIZE PVC Pipe

图53 PVC管水头损失与流量对照图（中、大口径适用）



$$1 \text{ L/SEC} = 3.6 \text{ m}^3/\text{Hr}$$

$$1 \text{ m}^3/\text{Hr} = 0.278 \text{ L/SEC}$$