# Calculation of the end valve head

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June 10, 2024

## 1 Brief Procedure

Generally, we have

$$V\frac{\partial H}{\partial x}+\frac{a^2}{g}\frac{\partial V}{\partial x}=0 \tag{1}$$

$$g\frac{\partial H}{\partial x}+V\frac{\partial V}{\partial x}+\frac{fV|V|}{2D}=0 \tag{2}$$

Substitute (1) into (2), we have

$$g\frac{\partial H}{\partial x}-\frac{gV^2}{a^2}\frac{\partial H}{\partial x}+\frac{fV|V|}{2D}=0 \tag{3}$$

The second term in (3) can be neglected, so we have

$$g\frac{\partial H}{\partial x}+\frac{fV|V|}{2D}=0 \tag{4}$$

Since $V=Const$ and $V>0$,$H(x)$ can be calculated by

$$H(x)=H_0-\frac{fV^2}{2gD}x \tag{5}$$

(5) can be used to calculate the head at the end valve, which indicates the head loss of the pipeline depending on the coefficient of friction $f$, so $f$ do matters though not given in the article.

Also, the numerical results show that the loss of the velocity can be neglected but the head loss is significant.