MAJOR ASPECTS OF SEWERAGE HYDRAULICS

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Several important aspects of hydraulics in sewerage pipes are defined and described such as flow characteristics of pipe and outlet. The methods of estimating critical depth and normal depth are developed primarily to obtain explicit equations for engineering design.

Laboratory experiments have been conducted in two laboratory pipes, and the water depth at outlet was primarily measured on the condition of free fall. Two flow conditions were devised: sub-critical and super-critical.

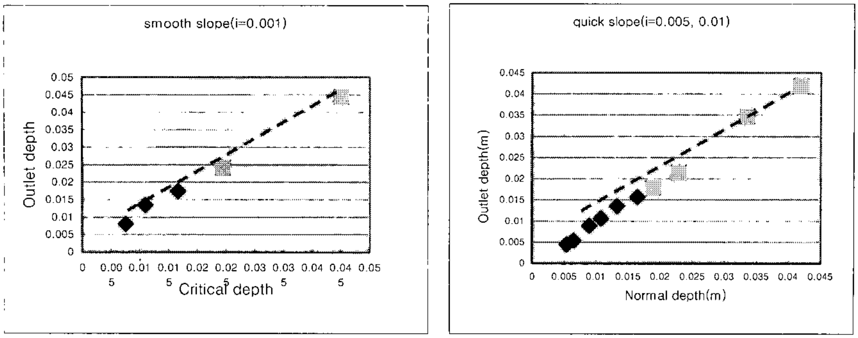
The use of Manning(Hagen) equation, which is based on the concept of rough turbulent flow is a wide practice in hydraulic engineering design, not because it is accurate but because it is simple and the field condition is too complex even in an artificial channel. In recent years, however, many suggestions are found that the open channel flows are generally smooth turbulent even in steep slope natural channels. Explicit approximate equations of critical depth and normal depth have been developed based on the concept of smooth turbulent flow, too(Bazin, H.E., 1865; Prandtl, L., 1925; Varwick, F., 1945).

When the flow has a free fall, the flow depth at outlet can be pre-determined. The flow condition at outlet is determined by Froude number. When the flow is sub-critical, the water depth at outlet becomes critical depth. On the other hand when the flow is super-critical, the water depth at outlet becomes almost normal depth which is computed by the present new method(Bray, D. I., 1979; Noori, B.M.A., 1984).

Laboratory experiments have been conducted to measure the outlet depth in two circular pipes. The specifications of the two laboratory pipes are presented in Table 1. When the pipe slope is 0.001, the flows of both pipes become sub-critical, i.e., the normal depth is bigger than the critical depth. In this case the outlet depths are found almost the same as the critical depths as shown in Fig. 1(a). On the other hand when the slope is 0.005 or 0.01, the flows of both pipes become super-critical, i. e., the normal depth is smaller than the critical depth. In this case the outlet depths are found almost the same as the normal depths as shown in Fig. 1(b).

Table 1. Specifications of two laboratory pipes

	Small	Medium
D	41.5mm	90mm
L	2m	7m
Stuff	acryl	acryl
Slope	0.001 ~ 0.01	0.001 ~ 0.01
Manhole	none	1
Joint	flange 1 point	flange 5 points



(a) sub-critical (b) super-critical

Fig. 1 Measured outlet depth in comparison with critical depths and normal depths

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