AOGS 2006

Friction Factor of Accelerated Flow

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The main purpose of this study is to investigate the frictional flow of sewerage pipe which normally has an accelerated formation when the flow free-falls at the outlet into manholes, rivers or lakes, The accelerated formation is found at the conditions of both sub-critical flow and super-critical flow. Sub-critical flow has a critical depth near outlet. On the other hand super-critical has a normal depth near outlet when the channel or sewerage pipe is relatively long enough to form uniform flow. Laboratory experiments have been conducted to develop empirical equations of friction factor of sewerage pipe. At the first stage uniform flow has been investigated in a relatively long pipe (L/D=74) to make an empirical equation of uniform flow frictional factor. Then gradually varied flow has been tested by applying new empirical equation of friction factor of accelerated flow. The new empirical equation of accelerated flow friction factor is related to Reynolds number based on the assumption that the flow is smooth turbulent. That is, the friction factor C is represented by;C=αR^β(1)where, V is the cross-sectional mean velocity, H is the hydraulic radius, υ is the kinematic viscosity, α is a constant which is mainly related to roughness and β is an exponent depending on the range of Reynolds number. The constant α is primarily related to roughness when the flow is uniform. But it seems to increase when the flow is decelerated from the value of uniform flow, and to decrease when the flow is accelerated. For the accelerated flow the constant α is related to acceleration ratio. Two ratios are proposed as followings; ζ1=ΔV/V(2), ζ2=ΔR/R(3)The constant α is then related to ζ1 or ζ2. Both relations are found to give excellent agreement with laboratory data.