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Discussion

Comment on "Direct solution for discharge in circular free overfall by Z. Ahmad, H. Md. Azamathulla" J. Hydrol., in press. doi: http://dx.doi.org/10.1016/j.jhydrol.2012.04.025

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SUMMARY

Recently, it is proposed [by Ahmad and Azamathulla (2012)] a closed form equation for discharge in terms of end depth in subcritical flows by simulation of the free overfall in a circular channel with a sharp-crested weir. As shown in this discussion, the theoretical discharge relationship can be accurately integrated with the aid of popular mathematical software and series expansion method is not required. According to this study, the theoretical end-depth ratio (EDR) is almost constant with an average value of 0.766 over the entire practical range. Using the numerical results which are accurate to six significant digits, this discussion shows that the proposed power equation by the authors for theoretical discharge in subcritical flow regime is not very accurate (the errors increase up to 12%), thus it is proposed a new accurate equation (with maximum error less than 0.35%) for prediction of theoretical discharge in circular channel with a single measurement of end flow depth.

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The discusser would like to thank the authors for proposing a closed form equation for discharge in terms of end depth for subcritical flows in the circular channels. The discusser, however, would like to add a few points.

The authors have presented the simulation of the free overfall in a circular channel with a sharp-crested weir. The proposed theoretical model yields the end-depth ratio (EDR) and end depth–discharge relationship (EDD), which needs to be verified using the experimental data.

1. End-depth ratio (EDR)

Substituting Q from Eq. (3) of the original paper into Eq. (12) yields

$$\phi_3(X_1) = \frac{1}{D}\int_0^{y_1}\sqrt{\frac{y}{D}\left(1-\frac{y}{D}\right)\left(1-\frac{y}{H}\right)}dy \tag{26}$$

Let $y = y_1 t$ then Eq. (26) becomes

$$\phi_3(X_1) = X_1^{3/2}\int_0^1\sqrt{t(1-X_1t)\left(1-\frac{X_1}{H/D}t\right)}dt \tag{27}$$

Substituting H/D from Eq. (9) into Eq. (27) one gets

$$\phi_3(X_1) = X_1^{3/2}\int_0^1 \times\sqrt{t(1-X_1t)\left(1-\left[1+\frac{F_1^2}{32X_1}\frac{\phi_1(X_1)}{\phi_2(X_1)}\right]^{-1}t\right)}dt \tag{28}$$

For critical flow condition, Eq. (28) takes the form

$$\phi_3(X_C) = X_C^{3/2}\int_0^1 \times\sqrt{t(1-X_Ct)\left(1-\left[1+\frac{1}{32X_C}\frac{\phi_1(X_C)}{\phi_2(X_C)}\right]^{-1}t\right)}dt \tag{29}$$

Eq. (29) can be accurately integrated for the known value of X_C with the aid of popular software such as Maple, Mathematica, Matlab, or Mathcad, and series-expansion method is not required.

Substituting Eq. (29) into Eq. (18), X_E can be calculated for a given value of X_C using a standard numerical method such as Newton–Raphson. The final results with six significant digits are presented in Table 2. According to these accurate numerical results there is a linear relation between X_C and X_E as $X_E = 0.766\,X_C$ ($y_E/y_C = 0.766$) with percentage error [$100 \times (X_C - X_E/0.766)/X_C$, in which $X_E/0.766$ is an approximation for accurate numerical value of dimensionless

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