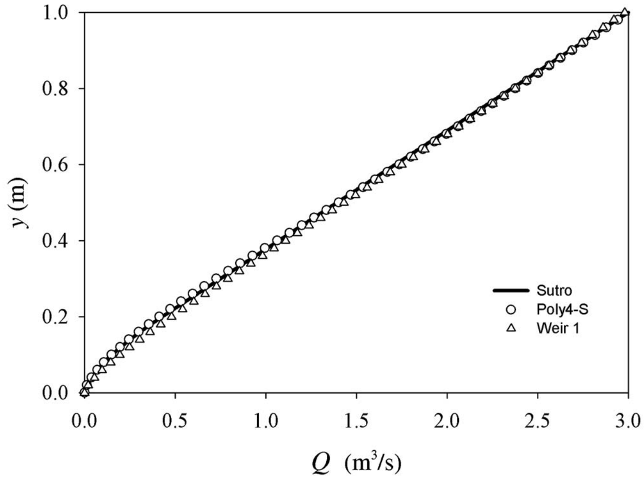

Fig. 1. Comparison with nonlinear domain of the Sutro weir

example, the max discharge for Weir 4 at $H=1$ m calculated with the values given in the table by the discussers is only $Q=2.93\ \mathrm{m}^3/\mathrm{s}$ and not $3.0\ \mathrm{m}^3/\mathrm{s}$. This alone represents a roundoff error of 2.3%. Adding the numerical error to the uncertainty in the value of the discharge coefficient would make the error calculations in the table by the discussers irrelevant.

Finally, it is worth noting that polynomial weirs could also reproduce quite accurately the behavior of the weirs given in the table by the discussers. Consider, for example, Weir 4 given by $b=-268.5366+1918.1572(y+50)^{-1/2}$. The best polynomial fit is the linear (i.e., trapezoidal) weir $b=a_0+a_1y$ where $a_0=2.7255$ and $a_1=-2.6726$. The head-discharge equation of this polynomial weir is according to Eq. (11)

$$Q=K\left(\frac{2}{3}a_0H^{3/2}+\frac{2}{15}a_1H^{5/2}\right) \tag{1}$$

Assuming $C=0.6$, this rather simple equation plotted in Fig. 2 is reproducing accurately both linear and nonlinear domains of Weir 4, including a maximum flow of $2.9349\ \mathrm{m}^3/\mathrm{s}$ at $H=1$ m for the polynomial weir compared to $2.9349\ \mathrm{m}^3/\mathrm{s}$ for Weir 4.

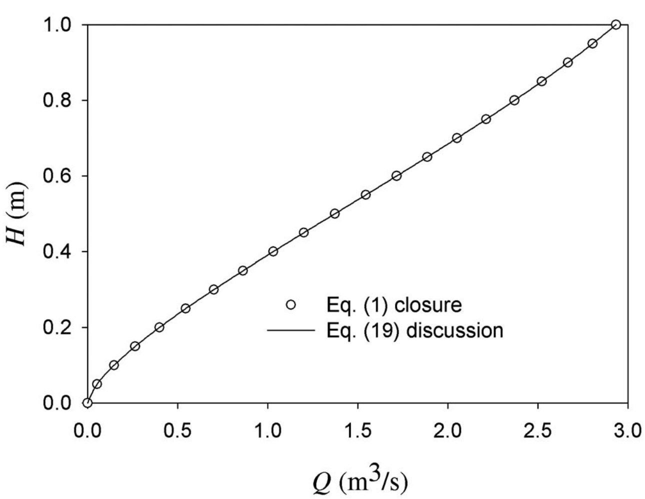

Fig. 2. Comparison of Weir 4 with polynomial weir

By comparing Eq. (19) of the discussion and Eq. (1) of this closure, it can be concluded that the polynomial weir is not only more versatile in reproducing a wide range of behavior, but also has a much simpler head-discharge equation.

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Discussion of "Simplified Design of Hydraulically Efficient Power-Law Channels with Freeboard" by Ahmed S. A. Hussein

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The author is appreciated for presenting a new procedure for the design of hydraulically efficient power-law channels with freeboard. The discussers simplified the design procedure further as presented herein.

For the design of hydraulically efficient power-law channels with freeboard the wetted perimeter and shape factor can "exactly" be determined for any exponent and side slope with the aid of software such as MathCad, Maple, or Mathematica. A curve-fitting process could then be applied to the results to provide a simpler design procedure. Two iterative relationships are presented herein for calculating optimum exponent for the ranges of Z_m and K mostly encountered in practice, i.e., $0.05\leq Z_m\leq 1$ and $0<K\leq 1$. Furthermore, for the same range of Z_m a direct relationship is obtained for the case of ignored freeboard.

Using Eq. (1) of the original paper, the wetted perimeter can be determined as follows:

$$W=2\int_0^{T/2}\sqrt{1+\frac{1}{Z^2}\left(\frac{mx}{ZY}\right)^{2/m-2}}dx \tag{1}$$

Considering $x=\eta ZY/m$, the Eq. (1) of this discussion reduces to

$$W=\frac{2ZY}{m}\int_0^1\sqrt{1+\frac{\eta^{2/m-2}}{Z^2}}d\eta \tag{2}$$

Therefore the shape factor takes the form

$$\frac{W}{\sqrt{A_f}}=\sqrt{2Z\frac{(m+1)}{m}}\int_0^1\sqrt{1+\frac{\eta^{2/m-2}}{Z^2}}d\eta \tag{3}$$

where $Z=Z_m(1+K)^{1-m}$.

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