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Discussion

Exact equations for pipe-flow problems

By P.K. SWAMEE and P.N. RATHIE, Journal of Hydraulic Research, IAHR, 2007, 45(1), 519–528.

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The Authors are congratulated for solving a basic pipe flow problem. The Discussers would like to draw the attention to a point of interest.

Although the maximum error associated with Eq. (35) for D_* over the entire range of relative roughness, ε/D, and R = Reynolds number encountered in practice is slightly higher than 2%, it is limited to less than 0.6% for applications in practice. The error associated with Eq. (20) by using five terms of the series is relatively high. For example, Eq. (10) for $\varepsilon/D = 0.001$ and $\mathsf{R} = 50{,}000$ yields $f = 0.0240128$, while using five terms of Eq. (20) yields $f = 0.0190005$, resulting in 21% error E defined as

$$E = \left|\frac{f_{(10)} - f_{(20)}}{f_{(10)}}\right| \times 100, \tag{36}$$

where the subscripts (10) and (20) refer to the equation number.

The deviations of Eq. (20) using five terms from that of Eq. (10) for the entire range of ε/D and R are plotted in Fig. D1. It indicates that the maximum error related to Eq. (20) reaches about 100%. Obviously, incorporating more terms in the series would improve the result but increase the floating point operations as well.

Sonnad and Goudar (2006) presented a relationship for the friction factor which was improved by the Discussers to

$$f = \left(a \ln\left(\frac{d}{(s-0.28)^{\frac{s}{s+0.98}}}\right)\right)^{-2}. \tag{37}$$

Here $a = 0.8686$, $d = 0.4587\,\mathsf{R}$, and $s = 0.1240\,(\varepsilon/D)\mathsf{R} + \ln(0.4587\,\mathsf{R})$. The errors associated with Eq. (37) over the entire practical range of ε/D and R are shown in Fig. D2 resulting in a maximum error of less than 0.04%. Although Eq. (37)

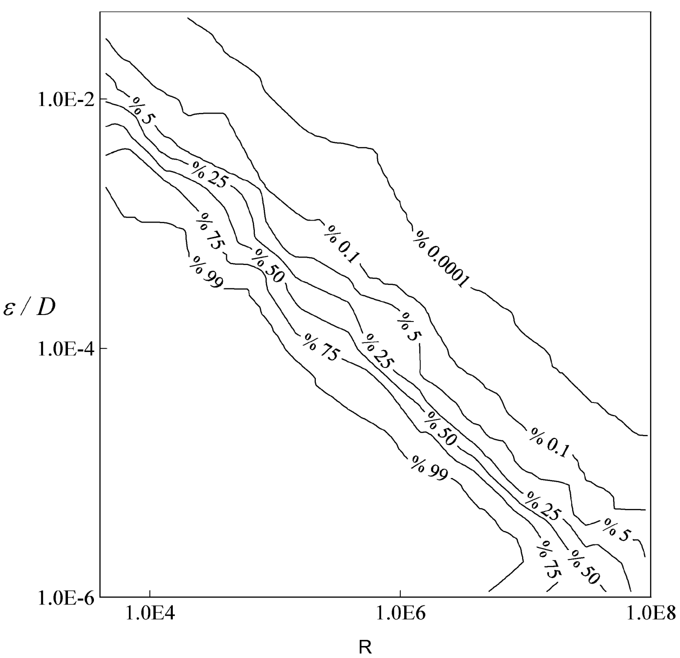

Figure D1 Error E associated with f based on Eq. (20) for the entire practical range of ε/D and R

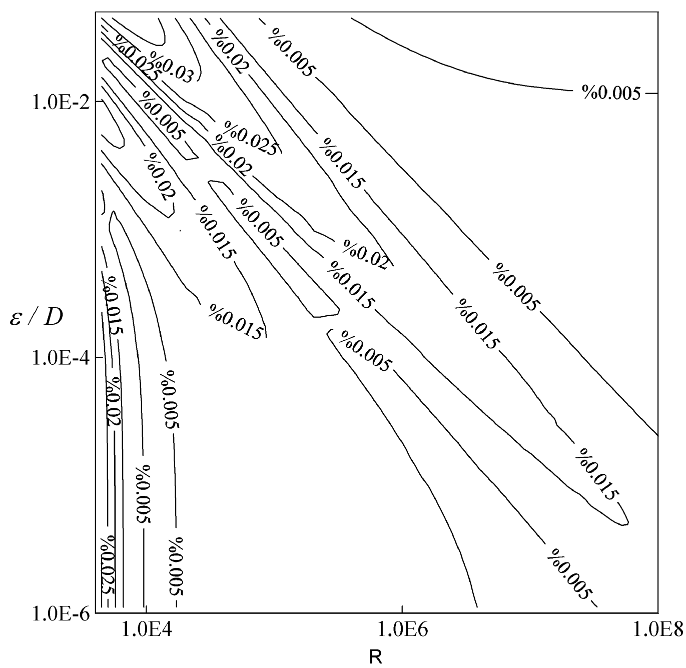

Figure D2 Error E associated with f based on Eq. (37) for the entire practical range of ε/D and R