Colebrook–White correlation

Empirical implicit correlation for Darcy friction factor f in non-smooth pipelines $\epsilon > 0$ which works for non-laminar ($\mathrm{Re} > 2,000$) flow:

(1) $$\frac{1}{\sqrt{f}} = -2\log\left(\frac{\epsilon}{3.7\,d} + \frac{2.51}{\mathrm{Re}\sqrt{f}}\right)$$

where

Re	Reynolds number of a pipe fluid flow
d	Inner diameter of a pipe
ϵ	inner pipe walls roughness

There are numerous explicit approximations of Colebrook–White correlation, particularly (Monzon, Romeo, Royo, 2002):

(2) $$f = 0.25\left[\log\left(\frac{\epsilon/d}{3.7065} - \frac{5.0272}{\mathrm{Re}}\log\Lambda\right)\right]^{-2}$$

where $\Lambda -$ is dimensionless parameter:

(3) $$\Lambda = \frac{(\epsilon/d)}{3.827} - \frac{4.657}{\mathrm{Re}}\log\left[\left(\frac{\epsilon/d}{7.7918}\right)^{0.9924} + \left(\frac{5.3326}{208.815 + Re}\right)^{0.9345}\right]$$

See also

Physics / Fluid Dynamics / Pipe Flow Dynamics / Darcy–Weisbach equation / Darcy friction factor / Darcy friction factor @model

[Surface roughness]

References

Colebrook, C. F. 1939. “Turbulent flow in pipes, with particular reference to the transition between the smooth and rough pipe laws.” J. Inst. Civ. Eng. 11 (4): 133–156, doi.org/10.1680/ijoti.1939.13150