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A parametric study on unbalanced moment of piston type valve core

Jin-yuan QIAN

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Simplified model of piston type globe valve

Three characteristic structural parameters：R_f is the bending radius of the inlet flow channel, D is the diameter of the special-shaped pipe, H is the height of the valve core.

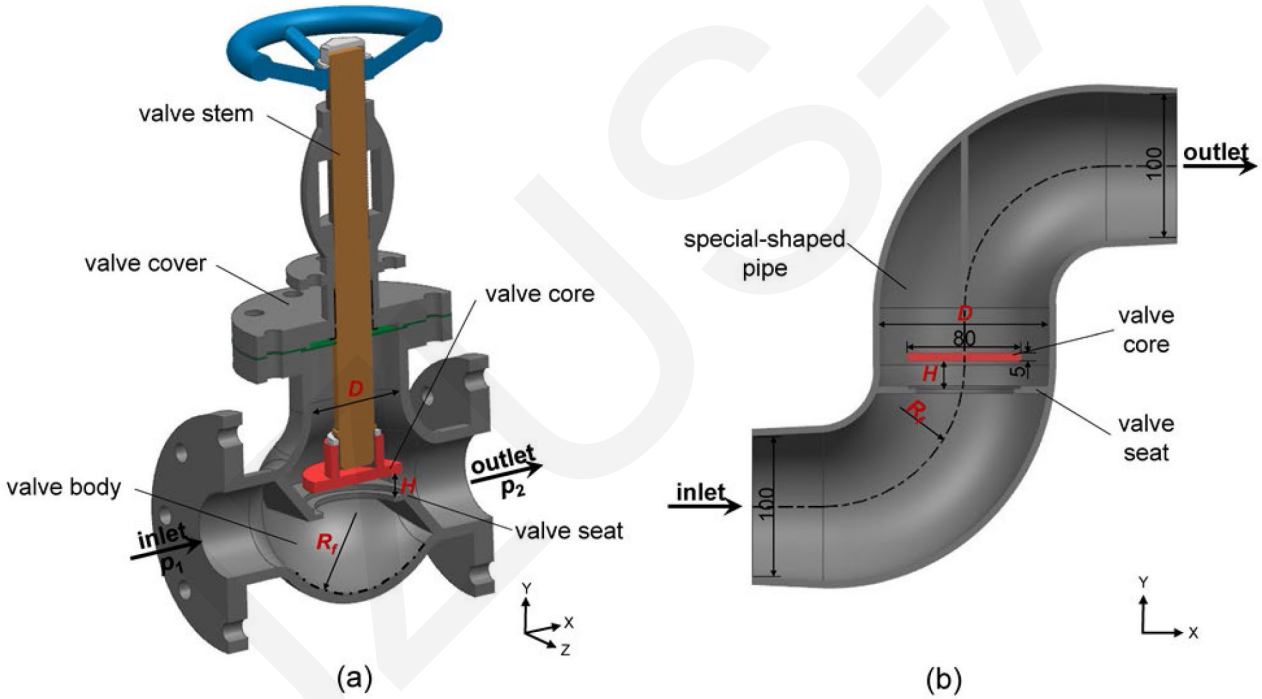


Fig. 1. Structures of the piston type globe valve and the simplified model (a) piston type globe valve (b) simplified model

Unbalanced pressure on the valve core

The pressure distribution on the bottom of the valve core is asymmetric. The pressure at the bottom of the valve core near the outlet side is greater than that near the inlet side.

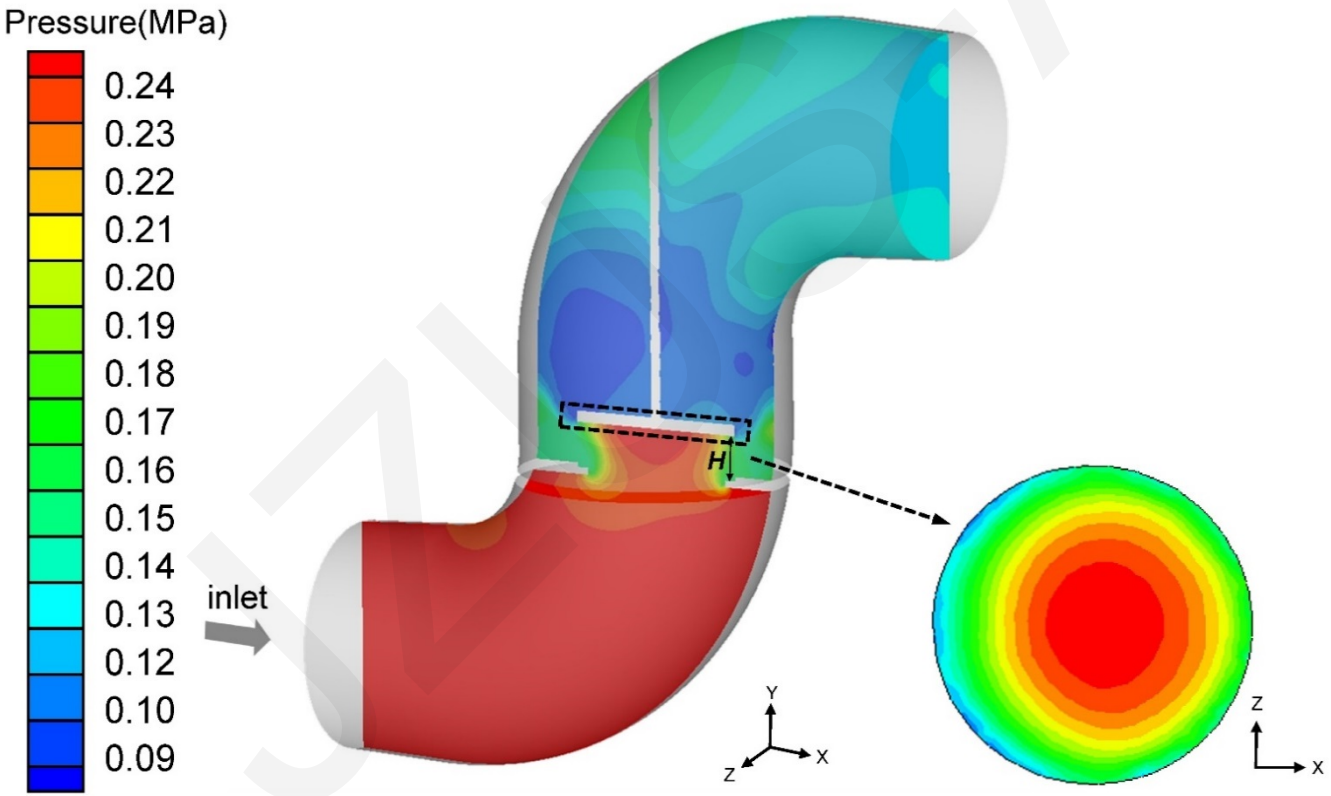


Fig. 2. Pressure contour on the bottom of the valve core

Parametric analysis and conclusions

With the increase of the bending radius of the inlet flow channel, the unbalanced moment on the bottom of the valve core decreases gradually.

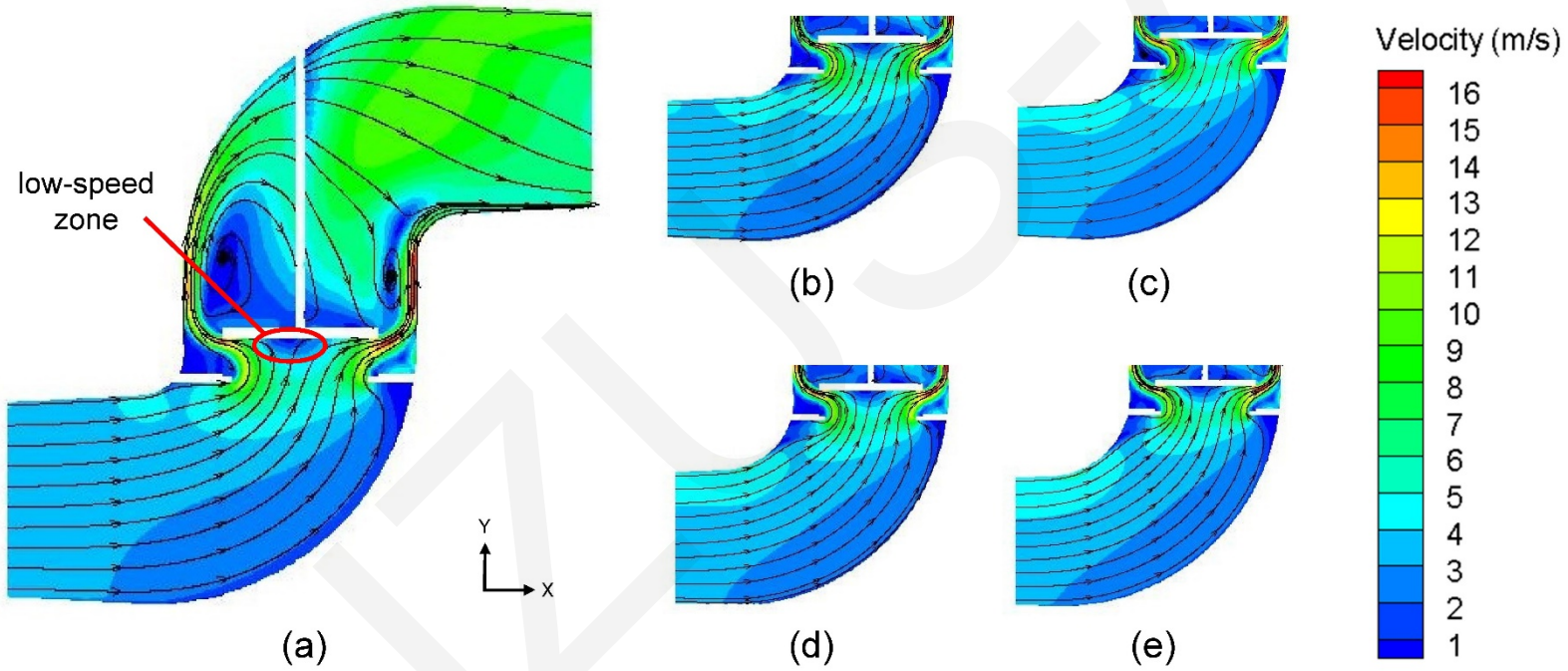


Fig. 3. Velocity profiles and streamlines on the symmetry plane
(a) Rf = 80 mm (b) Rf = 90 mm (c) Rf = 100 mm (d) Rf = 110 mm (e) Rf = 120 mm

Parametric analysis and conclusions

With the increase of the diameter of the specially-shaped pipe, the unbalanced moment on the bottom of the valve core increases slightly.

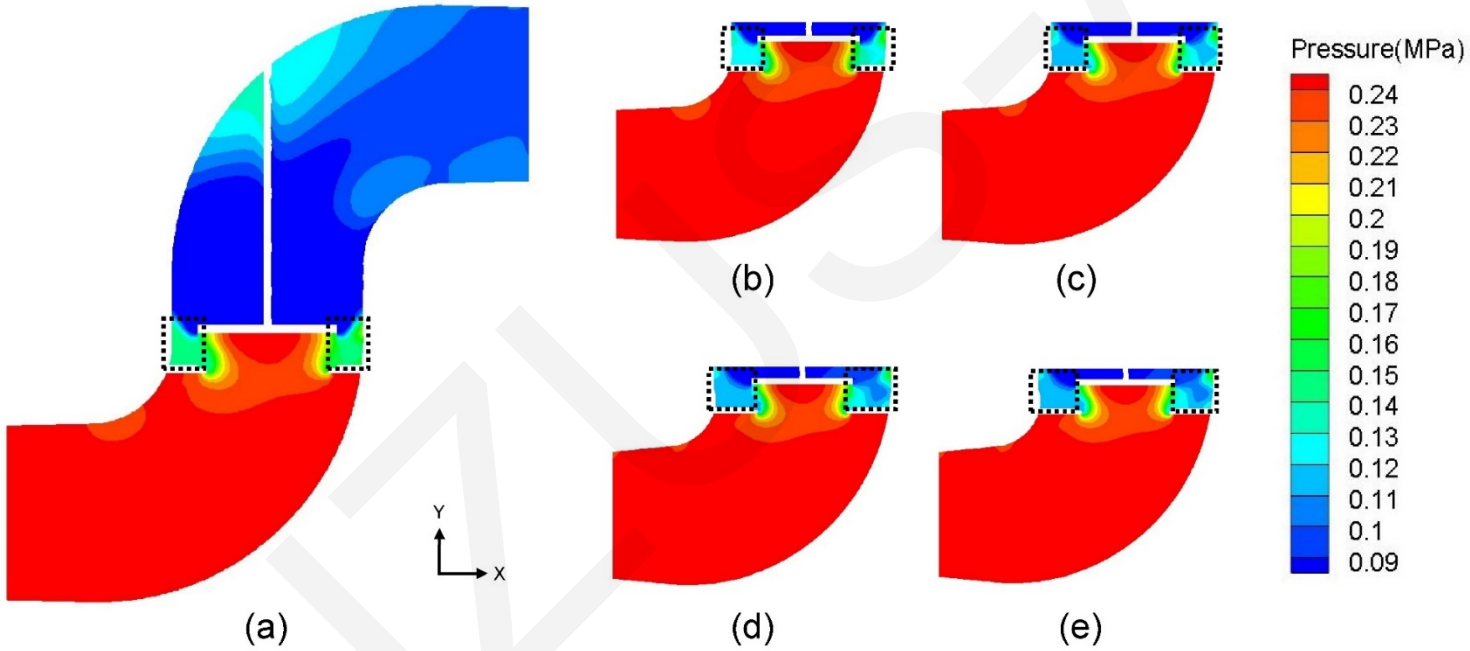


Fig. 4. Pressure profiles on the symmetry plane
(a) D = 110 mm (b) D = 120 mm (c) D = 130 mm (d) D = 140 mm (e) D = 150 mm

Parametric analysis and conclusions

The larger the height of the valve core, the greater the outlet flow rate, which aggravates the unbalance of the moment distribution on the bottom of the valve core.

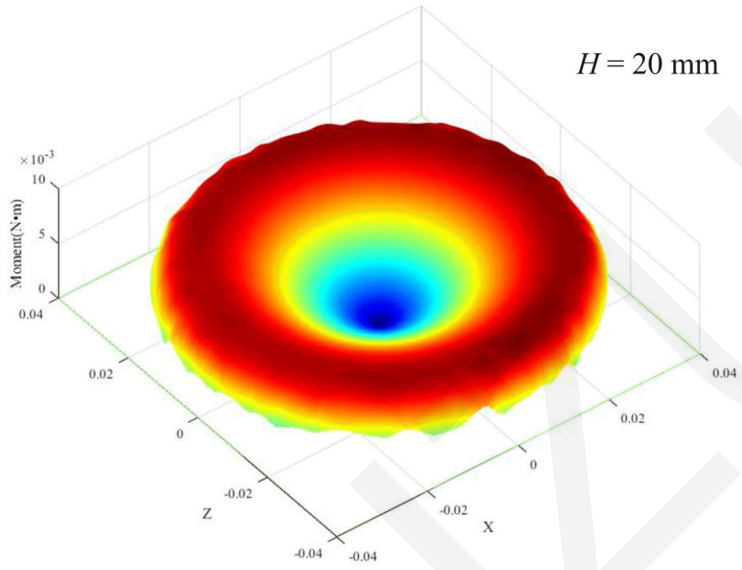


Fig. 5. Moment distribution at the bottom of the valve core

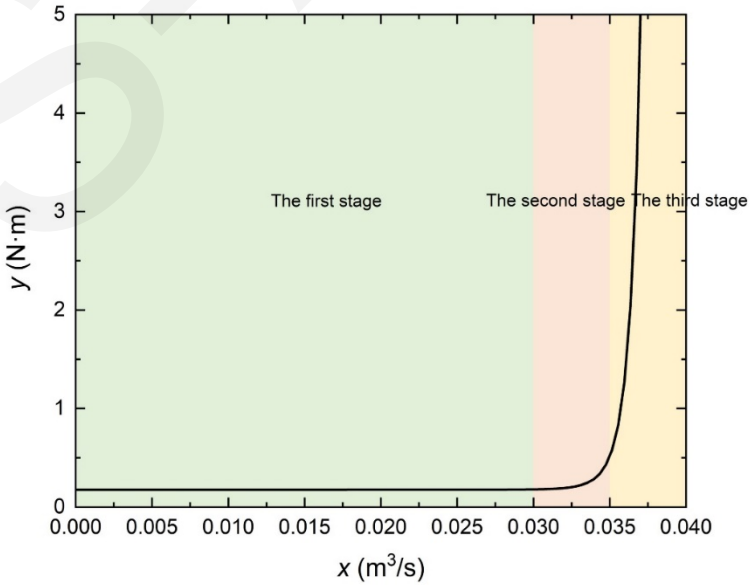


Fig. 6. Variation classification of moment with a flow rate based on the equation:

$$y = 0.176 + 1.14^{-4} \times \exp\left(1.99^{8} \times x^{5.08}\right)$$

Related papers

■Jin-yuan QIAN, 2020. Valve Core Shapes Analysis on Flux through Control Valves in Nuclear Power Plants. *Nuclear Engineering and Technology*, 52(10): 2173~2182. https://doi.org/10.1016/j.net.2020.03.008

■Jin-yuan QIAN, 2020. Effects of Throttling Window on Flow Rate through Feed-Water Valves. *ISA Transactions*, 104: 393~405. https://doi.org/10.1016/j.isatra.2020.05.017

■Jin-yuan QIAN, 2020. Pilot Pipe and Damping Orifice Arrangements Analysis of a Pilot-Control Globe Valve. *Journal of Fluids Engineering*, 142(10): 101210. https://doi.org/10.1115/1.4047533

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