

Effects of U-shaped Two-step Throttling Groove Parameters on Cavitation Erosion Characteristics

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Introduction: The exact expression of σ representing the cavitation characteristics in the U-shaped groove orifice was derived. The effects of groove depth, groove radius, and flow direction on cavitation were then investigated. The location of the intensive throttle valve cavitation zone was found to vary with X, and the effects of groove depth, groove radius, and flow direction on cavitation were then investigated.

Modeling and simulating: X is the orifice opening of the inlet of the U-shaped groove valve.

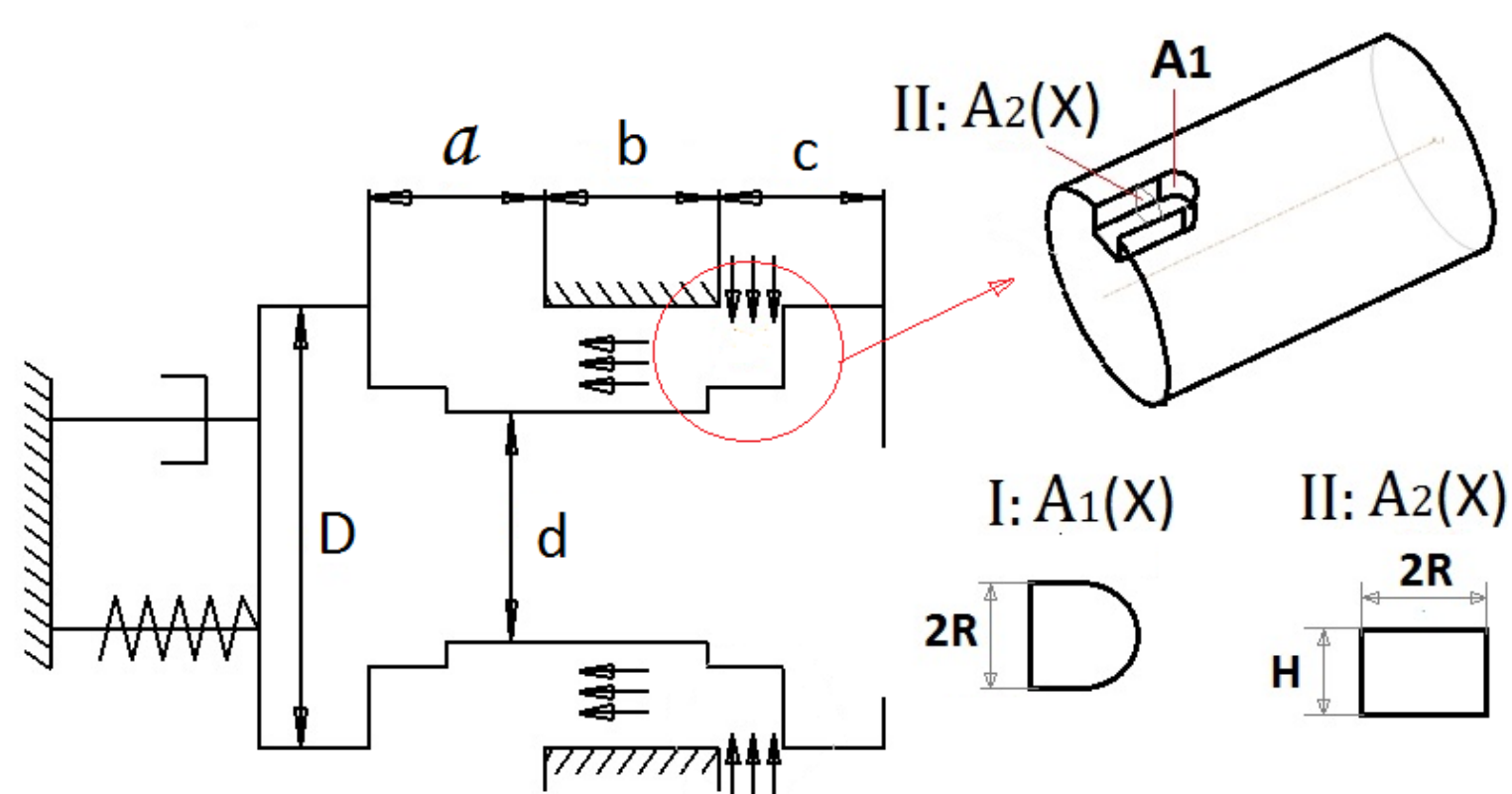


Fig. 1 Structural diagram of U-shaped throttle groove valve

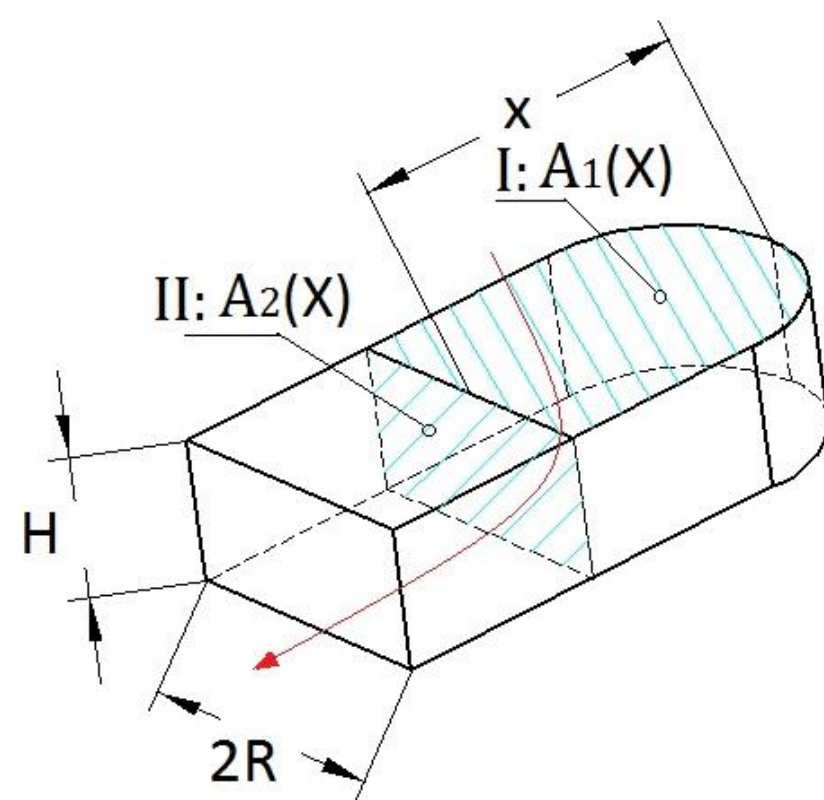
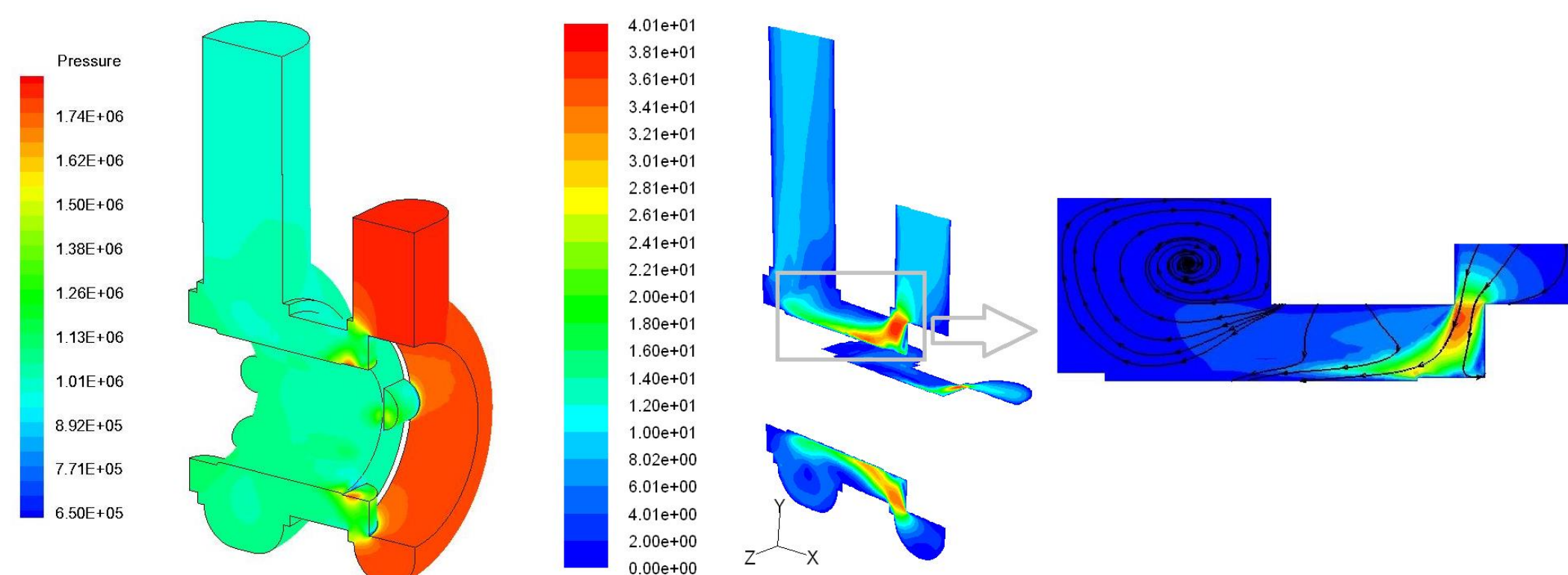
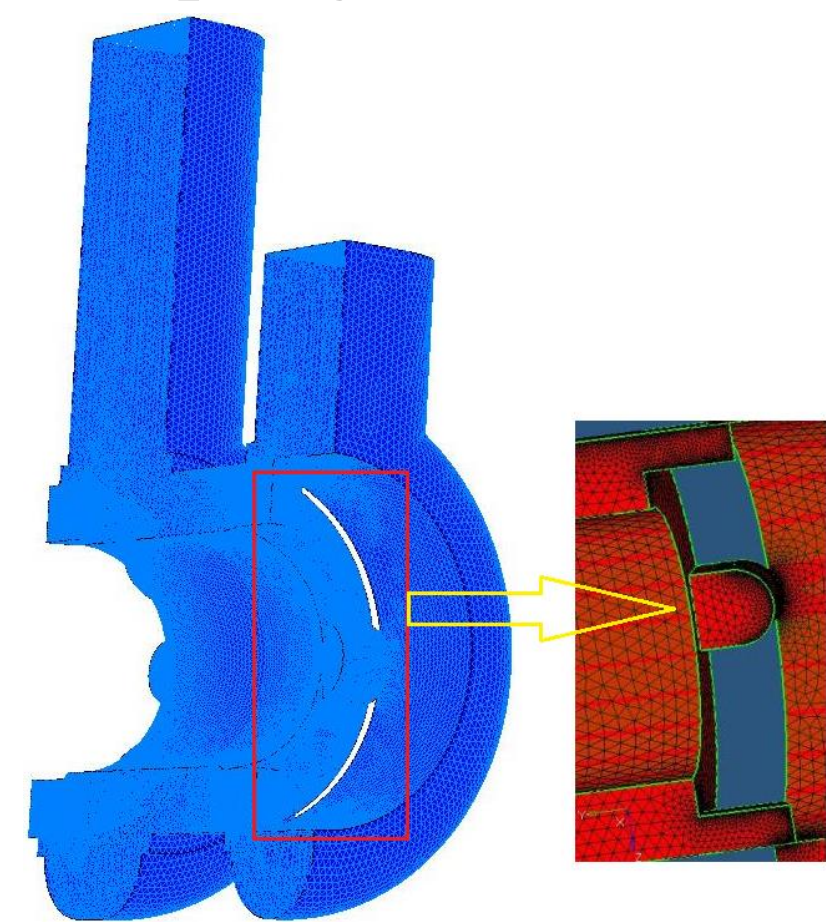


Fig. 3. Mesh of fluid regions of valve chamber



(a) Pressure nephogram (b) Velocity nephogram

Fig. 4 Oil into the main valve chamber at 6 mm spool displacement

◆ The pressure in the inlet of the groove dropped rapidly and the velocity grew quickly, forming turbulence and a low-pressure with a small range, where bubbles were very likely to take form. The collapse of cavitation bubble in throttle valve usually results in high speed flow and large instantaneous pressure, which is usually related to cavitation noise.

Effects of groove parameters

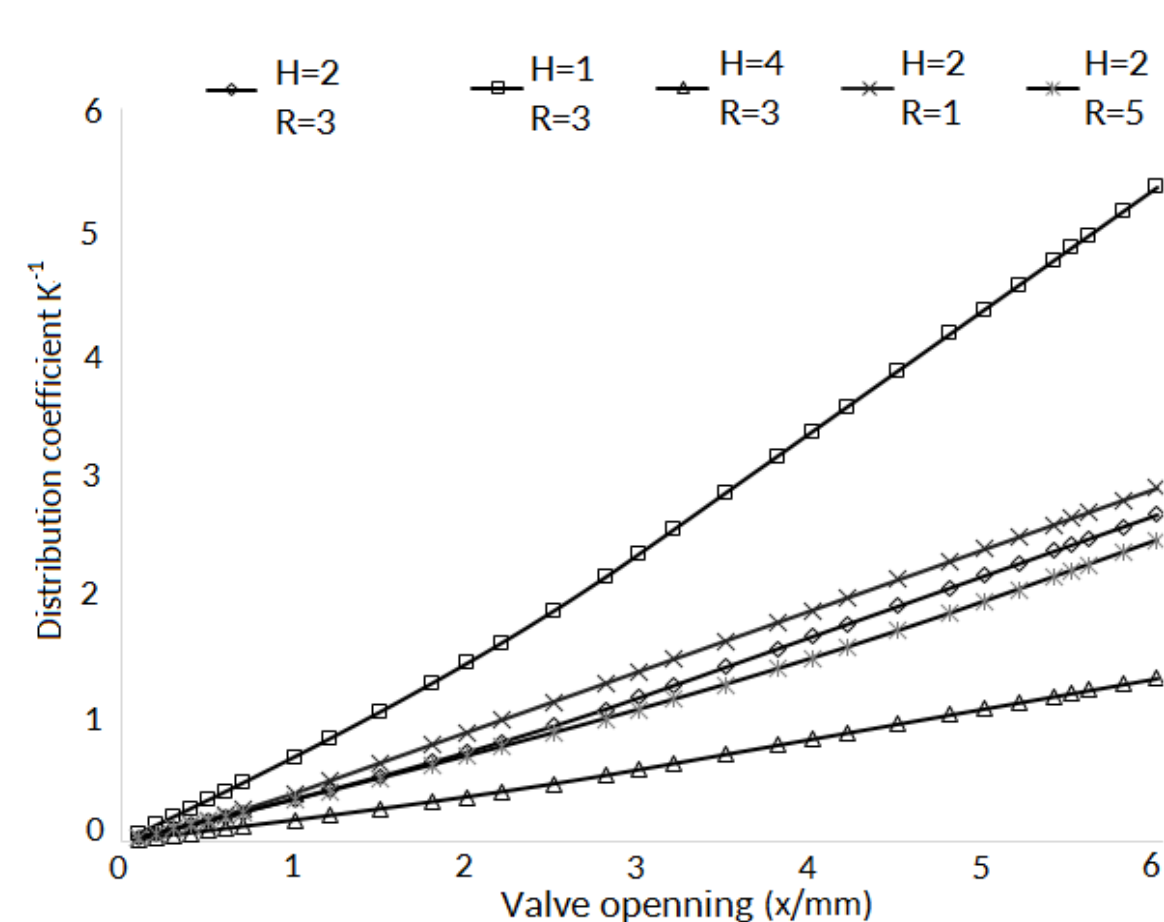


Fig. 7 U-shaped groove throttling pressure drop distribution coefficient K^{-1}

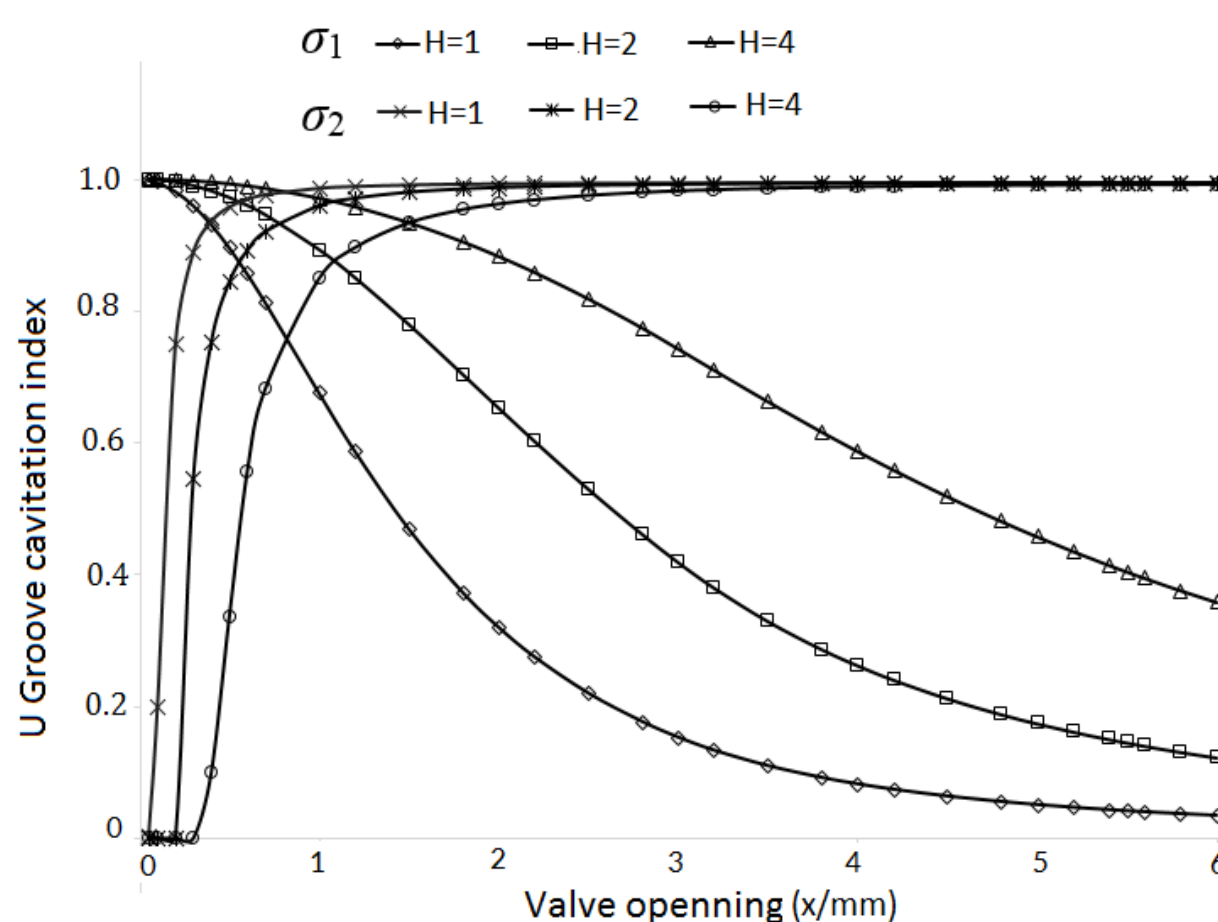


Fig. 8 U-shaped groove σ_1 and σ_2 under different throttling depth H

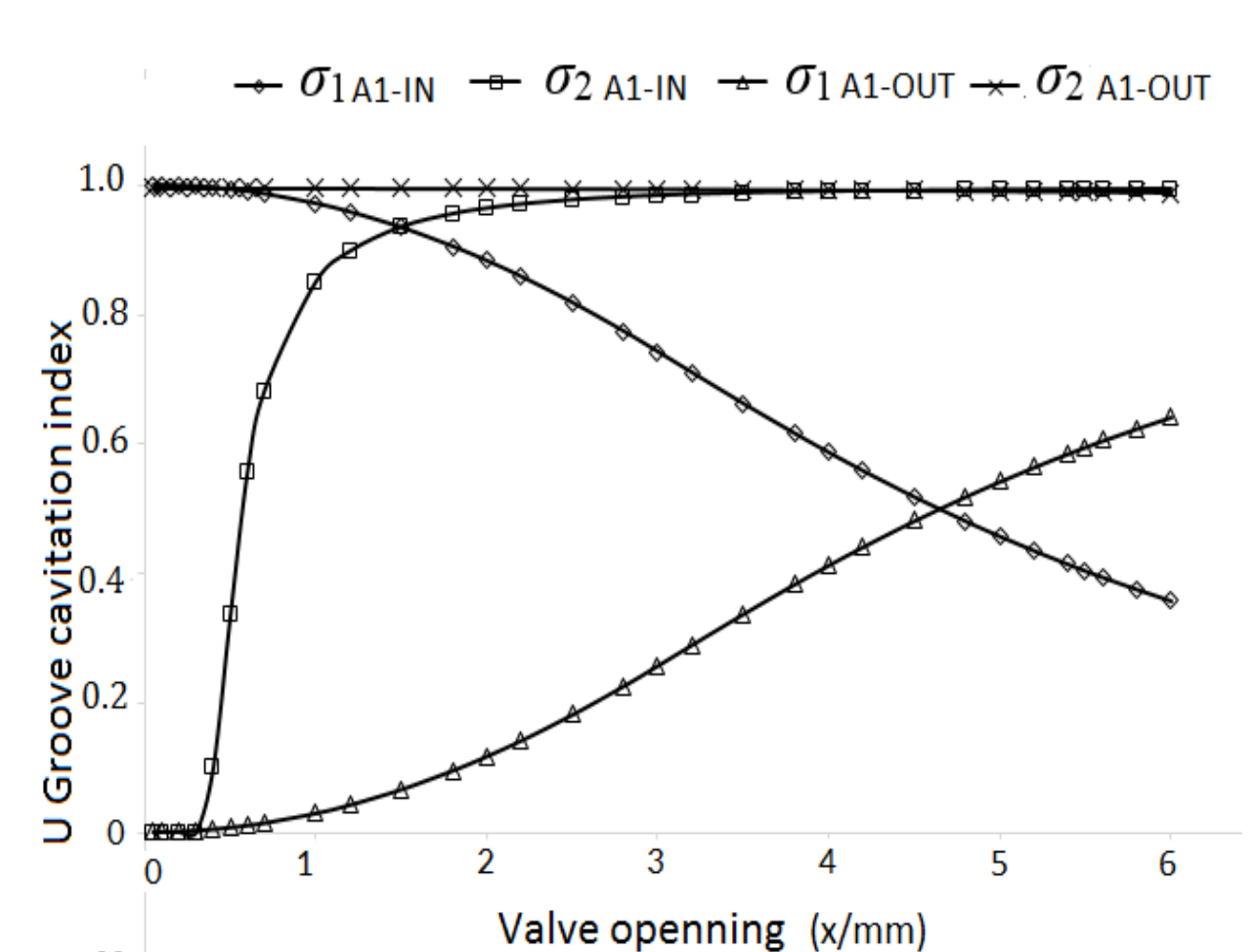


Fig. 9 U-shaped groove σ_1 and σ_2 under flux in and out section I

◆ The following analysis showed that a larger H in the U-shaped groove induced a larger cavitation index of section I and had the risk of cavitation erosion. While, the pressure reduction in section II dropped and cavitation was abated, to some extent, which increased the time needed of the cavitation index(σ_2) to reach its peak value.