11th. World Congress on Computational Mechanics (WCCM XI)
5th. European Conference on Computational Mechanics (ECCM V)
6th. European Conference on Computational Fluid Dynamics (ECFD VI)
July 20 - 25, 2014, Barcelona, Spain

EFFECT OF REYNOLDS NUMBER ON PRESSURE LOSSES IN AXISYMMETRIC SUDDEN EXPANSIONS WITH CHAMFER

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Key Words: *Pressure Loss, Sudden Expansion, Chamfer, Turbulent Flow.*

Sudden expansions are used in a wide variety of engineering applications such as mechanical, chemical, civil, and nuclear industries. Owing to its relevance to the pump requirements for the operation of a pipeline system, the irreversible pressure drop in a sudden expansion has been studied extensively. Oliveira and Pinho [1] investigated numerically the pressure drop coefficient of a laminar flow in an axisymmetric sudden expansion. For the case of turbulent flow, Idelchik and Fried [2] dealt with a diffuser of a circular cross-section with stepped walls, being focused on the optimal angle to minimize the pressure loss. More recently, Bae and Kim [3] scrutinized the impact of a chamfer on the irreversible pressure drop of suddenly expanding turbulent flow at a Reynolds number of 3×10^5, and proposed a formula to predict the pressure loss coefficient.

In the present study, the pressure losses through axisymmetric sudden expansions with a chamfer are analysed by means of numerical simulation. The primary focus of this paper is on investigating the influence of Reynolds number on the expansion losses in a time-averaged sense. With this aim, an extensive set of numerical simulations are carried out using a RANS approach for dimensionless chamfer lengths varying from 0 to 0.5, expansion ratios between 2 and 6, and chamfer angles of up to 45° at Reynolds numbers ranging from 1×10^5 to 8×10^5. The dependence of the irreversible pressure loss upon the Reynolds number is then studied thoroughly along with a discussion of the relevant flow features. On the basis of numerical results, we also propose a correlation to estimate the pressure loss coefficient in axisymmetric sudden expansions having a slight chamfer on the edge, by taking into consideration the effect of Reynolds number in addition to geometrical parameters.

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