Available online at www.CivileJournal.org

Civil Engineering Journal

Vol. 3, No. 4, April, 2017

Numerical Analysis of Energy Loss Coefficient in Pipe Contraction Using ANSYS CFX Software

Kourosh Nosrati [a], Ahmad Tahershamsi [b*], Seyed Heja Seyed Taheri [a]

[a] *Postgraduate Student of Civil and Environmental Engineering, Amirkabir University of Technology, Tehran, Iran.*

[b] *Professor of Civil and Environmental engineering, Amirkabir University of Technology, Tehran, Iran.*

Received 4 March 2017; Accepted 29 April 2017

Abstract

The purpose of this study is the numerical analysis of energy loss coefficient in pipe contraction using ANSYS CFX software. To this end, the effect of the dimensionless parameters of Euler number, Reynolds number, and relative roughness on energy loss coefficient has been investigated and eventually an overall formula to determine the energy loss coefficient in these transitions has been provided. In order to solve the fluid turbulence equations in the pipe, standard K-Epsilon model has been used. For this purpose, first the geometry of pipe transitions was designed in 3-D, using Solid Works software, and then the transitions were meshed by ANSYS MESHING. The initial simulation of transitions including boundary conditions of outlet, inlet and wall, was carried out by a pre-processor called CFX-PRE. Furthermore, to solve the equations governing the fluid flow in the pipes (Navier-Stokes equations) the CFX-SOLVER was used. And finally, the results were extracted using a post-processor called CFD-POST.

The results indicated that the energy loss coefficient, contrary to the findings of previous researchers, is not only related to transition geometry, but also is dependent on the Reynolds number, relative roughness of the wall and Euler number. By increasing the Reynolds Number and turbulence of fluid flow in transitions, the energy loss coefficient is reduced. Moreover, by increasing the relative roughness in the transition's wall the energy loss coefficient is reduced. The increase in pressure fluctuation causes the increase of Euler number which leads to the linear increase of energy loss coefficient.

Keywords: Energy Loss Coefficient; Pipe Contraction; Standard K-Epsilon; ANSYS CFX; ANSYS Meshing.

1. Introduction

Pipe transitions are considered as one of the most common types of fittings in water transmission lines. These fittings are usually used in the installation of hydro mechanical equipment's in which the diameter of the pipe needs to be changed. Furthermore, in many cases, while designing the water pipeline and outlets in dams and on-site installation of butterfly valves and splits, due to the speed limit, the diameter of the pipe needs to be changed. The energy loss is mainly caused due to the friction between fluid particles with each other and also friction between fluid particles and the pipe wall. When a real fluid (viscose) flows in the pipe, it consumes part of its energy for the cohesion among particles. Through internal friction and turbulence flow, this energy is converted to thermal energy. Such an energy conversion, which is considered an energy loss, is divided into two types. The first type, which is basically in the entire length of the pipe, is called friction loss (major loss – linear loss). The second type is called minor loss (singular loss-local loss) which is caused by fittings such as valve and bends which are placed in the flow path and or caused by cross section pipe (contraction or expansion). Friction loss is mainly due to fluid viscosity and flow regime (turbulent or laminar flow). This loss is significant in the pipe length and cannot be ignored. In general, major loss (h_f) is calculated by Darcy-Weisbach (1845) equation [1]:

* Corresponding author: tshamsi@aut.ac.ir