EXPERIMENTAL INVESTIGATION OF INFLUENCE OF INLET FLOW CONDITIONS ON SWIRLING FLOW GENERATED IN A THREE-DIMENSIONALLY CONNECTED DUAL ELBOW

Tatsuya. Kubo[a], Shinji. Ebara, Hidetoshi. Hashizume

Tohoku University, 6-6-01-2, Aramaki-aza aoba, Aoba-ku, Sendai, Miyagi 980-8579, Japan

[a]Corresponding author: Tel.: +81227957906; Fax: ++81227957906; Email: tkubo@karma.qse.tohoku.ac.jp

KEYWORDS:

Main subjects: flow visualization
Visualization method(s): a matched refractive-index PIV
Other keywords: inlet flow condition, FAC, Secondary flow

ABSTRACT: It has been frequently reported that pipe wall thinning is caused by Flow-Accelerated Corrosion (FAC) in nuclear or thermal power plants and the FAC depends on flow conditions and environmental ones, such as pH of flowing water, and that a swirling flow also largely affects the FAC [1]. It is well known that swirling flows are often generated in pipings composed of a number of curved pipe elements, and occur in the three-dimensional layout of elbows. However, it is not clearly elucidated what the swirling flow generated is like and how it decays as flowing downstream through the piping. Additionally, it is not well known that how the inlet condition affect generation of the swirling flow in the piping. This study focuses on the flow in a three-dimensional dual elbow as the simplest piping with three-dimensional layout. In this study, a flow experiment, in which a matched refractive-index PIV measurement employing sodium iodide as a working fluid and acrylic channel is used to visualize the flow, is conducted to evaluate the swirling flow generated in the dual elbow with varying the inlet flow conditions and also the piping layout which can be always regarded as an important factor for the flow formed. A test section consists of two acrylic 90-degrees elbows whose ratio of the curvature radius to a pipe inner diameter, D = 56 mm, is 1.5. They are three-dimensionally connected and the distance between elbows is changed by inserting a straight pipe between them, as shown in Fig. 1. In addition, the inlet flow condition is changed by putting a baffle plate to generate a drift flow or a swirler to generate a swirling flow at the entrance region. Reynolds number for this experiment is 300,000. From the experimental results, it is confirmed that the flow condition at the outlet of the dual elbow is strongly affected by piping layout unless the inlet condition does not change significantly from a fully-developed turbulent flow. From many tested conditions, a swirling flow appears when the distance between elbows is short, as shown in Fig. 2. When the distance becomes 2D, any swirling flow doesn't form in the downstream of the dual elbow. The details are given in the full paper. In this experiment, the piping layout is very dominant for the flow generated downstream of the piping

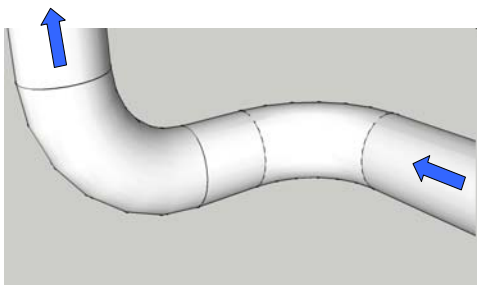

Fig. 1 Schematic of three dimensionally connected dual elbow

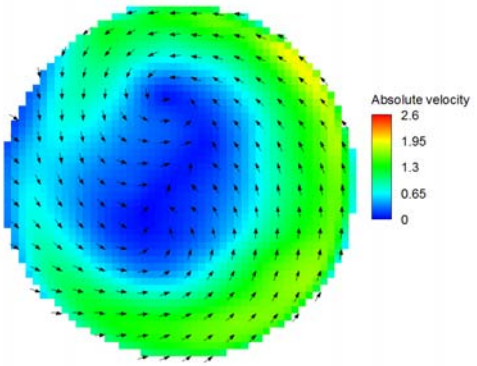

Fig. 2 Swirling flow formed 1D downstream of the outlet of the 2nd elbow in the case of fully-developed turbulent flow

References

1. Masashi KAMEYAMA . *Analysis of pipe wall Thinning Phenomenon in Secondary Pipe Rupture at Mihama Unit 3.* JSME annual meeting Vol. 2005 ,No5, p 42-45