NUMERICAL AND EXPERIMENTAL MODELLING OF TURBULENT FLOW IN CURVED CHANNELS AND DIFFUSERS

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Modelling of turbulent flow in curved channels and diffusers of rectangular cross-section was aimed at the evolution of secondary flow and origin of flow separation and their connection with energy losses and pressure recovery. Results of numerical simulations carried out using software CFX TASCflow 2.12 were compared with experiments made in a water channel. Turbulent flow in diffusers of rectangular cross-section with the constant channel height, flow turn angle 90 deg and area ratio $AR = 1.5$ was investigated. Numerical simulation was carried out for flow in diffusers with the cylindrical inner wall and with the cylindrical centreline. Turbulent flow in a curved channel of constant cross-section was investigated for comparison. Further, the effect of the inner wall radius on the character of flow in the diffuser was studied. Flow separation occurs on the inner wall of the channel before the bend exit and its extent is restricted to the central part of the channel due to secondary flow going from the sidewalls to the channel axis. The extent of separation region and consequently the energy losses decrease with the increasing radius of the inner wall curvature.

Key words: *turbulent flow in curved channels and diffusers, numerical and experimental modelling, computational fluid dynamics*

1. Introduction

Curved channels and diffusers of non-circular cross-section appear frequently as components of fluid-flow machines and devices in turbomachinery, hydraulics, and ventilation and air-conditioning systems. So called plane diffusers with constant height and/or width shapes are used very often for their production or installation simplicity. The configuration of the diffuser can substantially affect the efficiency of the whole system. Flow curvature results in secondary flow and possibly in flow separation with increase of energy losses as the consequence. A lot of publications deals with experimental modelling and numerical solution of turbulent flow in curved channels of rectangular cross-section, e.g. Humphrey et al. [3], Iacovides et al. [4], and Sudo et al. [13]. A detailed analysis of flow regimes in curved diffusers of rectangular cross-section was accomplished by Fox and Kline [1]. Sagi and Johnston [11] proposed on the basis of their experiments a method for design of curved diffusers applicable for diffusers with relative length $L_\mathrm{i}/W_\mathrm{i}$ from 4 to 10, where considerable flow separation on the inner wall does not appear. Many data exist for estimation of energy losses in curved channels of various cross-sections, see e.g. Idelchik [5] and Miller [9]. Most of

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