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Forced-convection heat transfer from tandem square cylinders in cross flow at low Reynolds numbers

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SUMMARY

This paper presents the results of a numerical study on the flow characteristics and heat transfer over two equal square cylinders in a tandem arrangement. Spacing between the cylinders is five widths of the cylinder and the Reynolds number ranges from 1 to 200, $Pr=0.71$. Both steady and unsteady incompressible laminar flow in the 2D regime are performed with a finite volume code based on the SIMPLEC algorithm and non-staggered grid. A study of the effects of spatial resolution and blockage on the results is provided. In this study, the instantaneous and mean streamlines, vorticity and isotherm patterns for different Reynolds numbers are presented and discussed. In addition, the global quantities such as pressure and viscous drag coefficients, RMS lift and drag coefficients, recirculation length, Strouhal number and Nusselt number are determined and discussed for various Reynolds numbers. Copyright © 2008 John Wiley & Sons, Ltd.

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KEY WORDS: square cylinder; tandem; numerical study; vortex shedding; fluid flow; heat transfer

1. INTRODUCTION

The flow around bluff bodies such as square and circular cylinders is encountered extensively in many structures and industrial applications, e.g. tall buildings, cooling towers, chimneys, pipelines, cables, masts and wires. Flow over a bluff body usually creates a large region of separated flow and a massive unsteady wake region downstream and they have susceptibility to flow-induced vibration. Vortex shedding observed in the wake of these bodies generates unsteady (periodic) lift and drag forces. The fundamental fluid dynamics problems of single circular and square cylinders have been examined extensively in both numerical and experimental studies [1–3]. However, there are not enough results for the flow over the cylinders in tandem, especially with the square cross-section. It seems that there is some similarity between the flow structures of the single and tandem

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