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Mixed Convective Heat Transfer Flow over Two Circular Cylinder in Tandem Arrangement for Newtonian Fluid

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Abstract—*The fluid flow and heat transfer characteristics around two heated circular cylinders arranged in a tandem configuration with respect to the incoming flow is studied numerically. The Aiding Buoyancy Mixed convection is examined for the Richardson number with a fixed value of Re and Pr (i.e. 100 and 0.7 respectively). The calculations are performed in an unconfined domain for the following ranges of conditions: Richardson number (Ri)=0−0.5, Longitudinal spacing (L) and Transverse spacing (T) =0-1 within the framework of the Boussinesq approximation. The suitable forms of the momentum and thermal energy equations for the Newtonian fluid model have been solved numerically. Results are discussed for 16 cases by varying the locations of second cylinder with respect to the fixed location of the first cylinder, The numerical simulations were carried out by the commercial CFD software ANSYS FLUENT. Extensive numerical results are presented, such as total drag coefficients, Lift coefficient, Nusselt number.*

1. INTRODUCTION

Study of the cross flow over circular cylinders in different arrangements has received considerable attention from both engineering and fundamental fluid-dynamics perspectives for close to a century now. The problem of mixed convection past a heated bluff body is important both from a practical as well as fundamental point of view. The problem has diverse applications in the design of cooling systems involving extended surfaces, cross flow heat exchangers, hot wire anemometers. Sarkar et al. [1] investigated that in the presence of aligned free and forced convection, the vortex shedding is diminished and the separation points are shifted downstream. When the free convection acts in the opposite direction, the point of separation is advanced upstream. Hussein [2] observed that over the past few decades, considerable attention has been paid to various aspects of this flow configuration and a voluminous body of knowledge encompassing a wide range of phenomena has emerged.

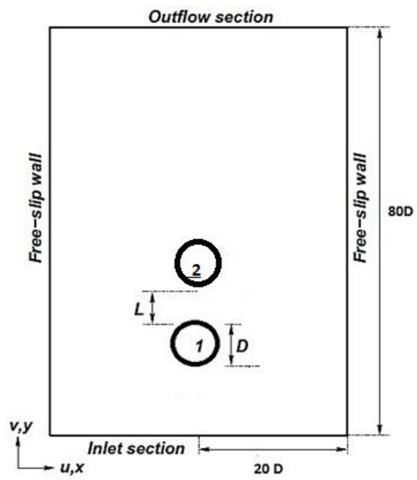


Fig. 1: Physical Domain

Extensive numerical results are presented, such as total drag coefficients, Lift coefficient, Nusselt number, and transition from a time periodic regime to a steady, and Separation points. The overall drag coefficient and its components increase with the Richardson number for most of the values of longitudinal spacing (L). Under this aiding buoyancy condition, in the close proximity to the cylinder, the inertia force is added with the viscous force, resulting in a separation delay and the flow Becomes steady and no shedding occurs. Furthermore Vortex size, length, and intensity decrease as Richardson number increases. The temperature near about downstream and upstream cylinder is low comparatively to the region in between of both cylinders, it is because of vortex formation, due to this fluid remain in touch for a long time rather than sides of the cylinders.

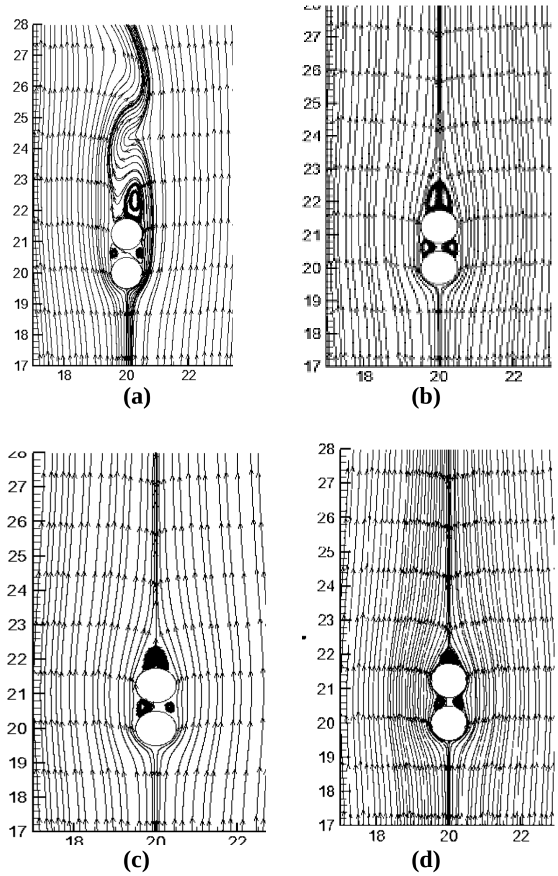
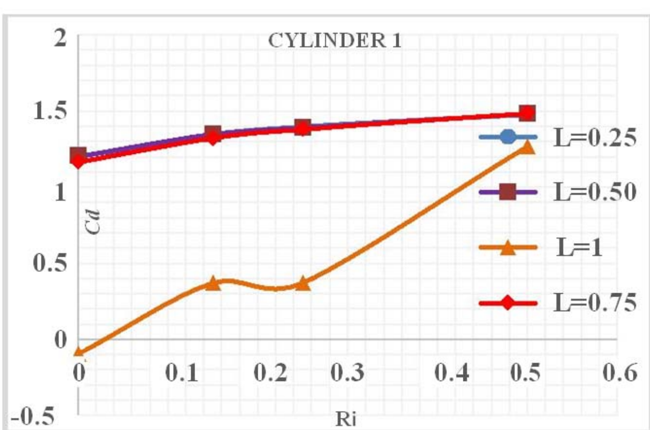


Fig. 2: Vorticity contours for different values of Richardson Number at L=0.25, T=0, (a) Ri=0 (b) Ri=0.15 (c) Ri=0.25 (d) Ri=0.50

Drag force coefficient firstly starts from minimum value and after that reaches its maximum with increase in Ri. The magnitude of drag force is found to be maximum for upstream cylinder than that of downstream cylinder. Minimum value of the drag force is observed for Ri= 0.50 for upstream cylinder



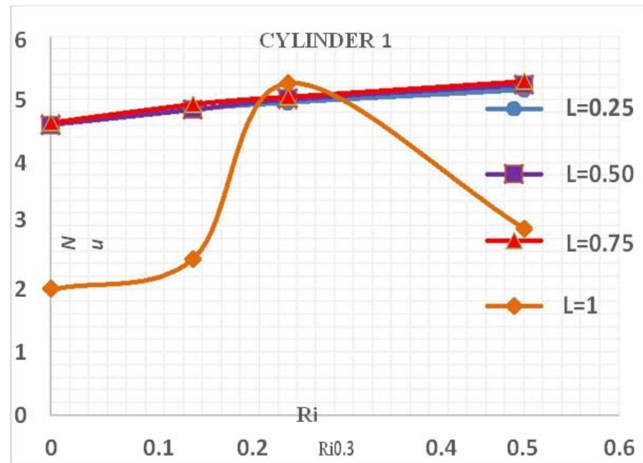


Fig. 3: Variation of drag coefficient (C_D) and Nu number with different values of Ri.

REFERENCES

[1] Sarkar, S., Dalal, A. and Biswas, G., International Journal of Heat and Mass Transfer 53 (2010) 2628–2642.

[2] Hussein, A.K., Journal of Basic and Applied Scientific Research 3 (10) 328-338, 2013.

[3] Daniel, A. and Dhiman, A., Industrial & Engineering Chemistry Research, 52 (48) (2013) 17294 - 17314.

[4] Sharma, A. and Eswaran, V., Numerical Heat Transfer, Part A, 45, 601–624, 2004.

[5] Sharman, B., Lien, F. S., Davidson, L. and Norberg,

[6] C., Int. J. Numer. Meth. Fluids 47, 423- 447, 2005.