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Heat transfer enhancement around a square cylinder under the incident of Couette - Poiseuille flow

Swati Sharma[1] **and Dilip K. Maiti**[2]

[1] Department of Mathematics, Birla Institute of Technology and Science, Pilani - 333031, *RJ*, *INDIA*

[2] Department of Applied Mathematics with Oceanology and Computer Programming, Vidyasagar University, Midnapur - 721102, *WB*, *INDIA*, *d_iitkgp@yahoo.com*

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The present study deals with the numerical investigation of heat transfer from cylinder of square cross section (of height A^*) either dissipating constant heat flux or maintaining at a constant temperature. The cylinder is kept at a fixed gap height of $0.5A^*$ from the wall. The incoming flow field is considered as Couette -Poiseuille based non uniform linear/non-linear velocity profile. The conventional fluids are taken as water and $EG : W$ and nanoparticle materials are chosen as Al_2O_3 and CuO. The thermophysical properties of the nanofluids such as density, specific heat, thermal conductivity and viscosity are calculated based on the relationships available in the literature. The effect of the Brownian motion of the nanoparticles on the effective thermal conductivity and viscosity is considered here. The pressure correction based iterative algorithm SIMPLE based on finite volume method (FVM) with staggered grid arrangements is used to simulate flow field and heat transfer from the cylinder. Effect of pressure gradient P (at the inlet), temperature of base fluids, thermal conditions (T_W or q_W) and parameters governing the nanofluids (particle concentrations (ϕ), diameter (d_{np}), particle materials and base fluids) on the heat transfer (Nusselt number ($\overline{Nu}_M$)) of the cylinder is investigated here. The heat transfer from the cylinder is found high at lower base fluid temperature. $\overline{Nu}_M$ has strong dependency on P (increases with P) and base fluid ($EG : W$ produces more), moderate dependency on ϕ (increases with ϕ) and type of thermal boundary conditions (q_W produces more), and weak dependency on nanomaterials (more for CuO).

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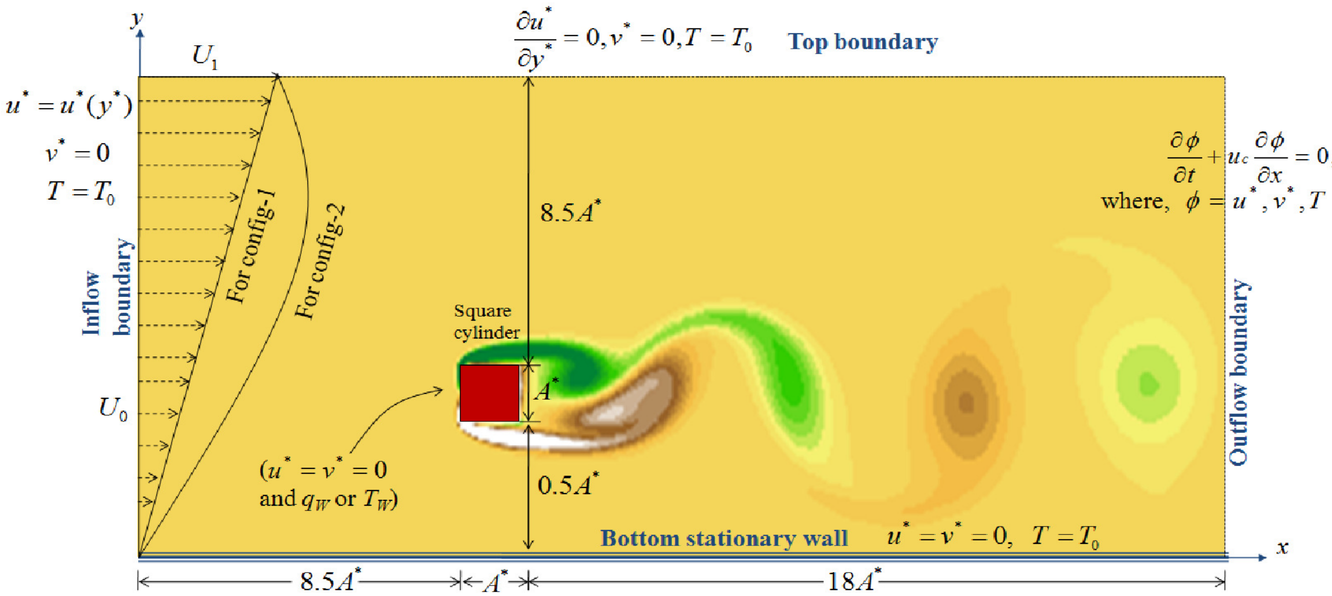

Figure 1: Schematics of the two flow configurations (config-1 and config-2) depending upon inlet velocity profile.