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Flow past an Inclined Square Cylinder[1] DONG-HYEOG YOON, KYUNG-SOO YANG, CHOON-BUM CHOI, Inha University — Numerical investigation has been carried out for laminar flow ($Re \leq 150$) past an inclined square cylinder in cross freestream. The motivation stems from characterization of flow-induced forces on a sharp-edged cylindrical object immersed in cross flow with an angle of attack. From the viewpoint of wind hazards, this study would be the first step towards understanding flow-induced forces on cylindrical structures under a strong gust of wind. In this flow configuration, there exist two kinds of critical Reynolds numbers in laminar regime; flow separation occurs at a lower critical Reynolds number (Re_{c1}) and flow becomes unsteady at an upper critical Reynolds number (Re_{c2}). It is seen that the values of Re_{c1} and Re_{c2} change depending on the inclination angle (θ) of the cylinder. In particular, Re_{c2} decreases as θ increases, being consistent with the instability theory based on Stuart-Landau equation in literature. Furthermore, the cylinder vertices at which flow separation takes place are determined by θ. Consequently, key flow characteristics such as drag/lift forces on the cylinder and vortex-shedding frequency could drastically alter depending on θ. We propose contour diagrams of mean drag/lift coefficients, Strouhal number (St) of vortex shedding, and rms of lift coefficient fluctuationon Re–θ plane.

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