

## Three-Dimensional Effects on the Flow Around an Isolated Square Prism

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The rapid growth of artificial intelligence has led to an increasing demand for data centres, which require large amounts of energy to achieve stable and efficient cooling processes. As these cooling processes account for a significant portion of total power consumption, improving cooling efficiency has become an important sustainability challenge. A key parameter affecting cooling performance is the geometric arrangement of heat sink fins and components of a printed circuit board, which influences airflow distribution around electronic components in data centres. While the flow around components arranged in a uniform array has received most attention in the literature, non-uniform or unaligned tandem arrangements remain largely underexplored. This work investigates the flow behaviour around an isolated square prism, representing a simplified heat sink fin, to provide a baseline for understanding how yaw angle influences aerodynamic forces and vortex structures relevant to non-uniform tandem prism configurations. Two- and three-dimensional large eddy simulations (LES) of flow around a square prism at a Reynolds number of 182 were conducted to validate the numerical methodology and resulting aerodynamic forces against existing literature. Subsequent LES simulations were performed at a Reynolds number of 250 to provide an analysis at conditions representative of data centre cooling flows. A grid and domain sensitivity study was performed to establish a validated baseline for subsequent simulations involving more complex geometries. Future simulations will examine an isolated square prism at yaw angles between 0 and 45 degrees to quantify changes in lift, drag, surface pressure distributions, vortex shedding and flow regimes. These results will support future investigations of mixing and heat transfer in non-uniform tandem configurations, while providing insight for optimizing energy-efficient cooling systems and flow distribution in urban centres at low Reynolds numbers.