# Beyond Idealized Models: Experimental Characterization of Indoor Airflows in Educational Settings

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**Abstract**

The accuracy of indoor air quality (IAQ) simulations is often limited by the use of idealized boundary conditions that neglect the thermal complexity of real-world environments. We present a comprehensive experimental campaign aimed at characterizing IAQ in the School of Engineering at the University of Cádiz. Representative room types-ranging from single-occupancy offices to large lecture halls-were monitored over distinct weather conditions. We use a high-resolution sensor network to obtain the CO2 concentration, PM2.5, temperature, and humidity in three dimensions, specifically designed to detect vertical stratification. These internal measurements are coupled with external boundary characterization, including building envelope pressure distributions recorded via portable weather stations and wall surface temperature mapping using thermographic cameras. Preliminary results highlight a significant divergence between chemical and thermal mixing: while CO2 concentrations often appear well-mixed, rooms can simultaneously sustain large temperature gradients of up to 5oC due to the thermal inertia of embedded objects and occupant heat loads. This dataset provides a high-fidelity benchmark for validating Direct Numerical Simulations (DNS) and assessing the limitations of simplified turbulence models in predicting IAQ indicators under realistic, heterogeneous conditions.

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