Abstract Submitted
for the DFD09 Meeting of
The American Physical Society

The role of diffusion in natural displacement ventilation NIGEL KAYE, Clemson University, MORRIS FLYNN, University of Alberta — The classic natural displacement ventilation model of Linden *et al.* (1990) predicts the formation of a two layer stratification when a single thermal plume is introduced into a room with vents at floor and ceiling level. The model assumes that molecular diffusion plays no role in the development of the rooms ambient stratification as such diffusion is a slow process and the plume entrainment field will act to thin the interface between the warm upper layer and cool lower layer. The prediction of a sharp interface has been confirmed by small scale salt bath experiments. However, full scale measurements and CFD simulations at larger scale indicate that the interface between the two layers is not sharp but smeared out over a finite thickness. We present two simple models for predicting the thickness of the interface as a function of the room height, floor area and vent area as well as the plume buoyancy flux and the thermal diffusivity of the fluid. The interface increases in thickness with increasing room floor area and decreasing plume strength. Our model is compared to interface thickness measurements based on CFD simulations and salt bath models and is shown to agree both phenomenologically and numerically.

Linden, Lane-Serf, & Smeed, (1990) 'Emptying filling boxes, the fluid mechanics of natural ventilation' J. Fluid Mech. **212** pp. 309–335.

Nigel Kaye
Clemson University

Date submitted: 09 Jul 2009 Electronic form version 1.4