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The role of heat source area on the transition from displacement to mixing flow in natural ventilation NIGEL KAYE, Clemson University, GARY HUNT, Imperial College London — We present a theoretical model for the role of heat source area on the transition from displacement to mixing flow for a naturally ventilated room. We examine the relationship between the existing standard models for natural ventilation of a room with floor and ceiling level vents (Linden *et al.* 1990 and Gladstone & Woods 2001). We show that the uniform heat distribution model of Gladstone & Woods is the limit of an infinite number of localized heat sources based on the Linden *et al.* model. We then examine the transition from localized to distributed heat source behaviour as a function of the horizontal extent of the heat source. Our model is based on recent measurements of the plume flow above large area heat sources that suggests the flow rate increases linearly with height. The flow transition is a function of the room vent area scaled on the ceiling height squared and the ratio of the ceiling height to heat source radius. As the heat source radius increases there is a rapid transition from displacement ventilation, driven by localized heat sources, toward mixing ventilation, driven by distributed heat sources. This transition is independent of the floor area of the room implying that for displacement ventilation to be established the heat source(s) need to be small compared to the vertical, as well as horizontal scale of the room.

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