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Buoyancy distribution in a filling box segmented by a planar jet
NIGEL KAYE, Clemson University, NICHOLAS WILLIAMSON, University of Sydney — Results are presented from a theoretical and experimental investigation of the buoyancy distribution in a filling box in which the box is divided by a planar jet. The planar jet acts as a barrier that inhibits the transfer of buoyancy from the plume side to the non-plume side of the jet. Filling box theory is used to model the layer depth and total buoyancy on either side of the planar jet. Although the planar jet initially prevents the plume outflow from spreading into the non-plume side there is still some transfer of buoyancy due to entrainment of buoyant fluid into the planar jet that is then transferred to the non-plume side. The theoretical model is validated against a series of small scale salt bath experiments. The model well predicts the initial distribution of buoyancy between the plume and non-plume sides of the jet. However, the build-up of buoyancy on the plume side eventually bends the jet toward the non-plume side and the jet no longer provides a barrier. The time at which the model breaks down is well predicted by air-curtain theory. The results are discussed in the context of the potential for air curtains to inhibit smoke spread in compartment fires and potentially allowing increased evacuation times for occupants.

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