Analytic estimates are developed for depth of penetration and lateral entrainment of negatively buoyant, ceiling jet-driven wall flows during early times of compartment fire scenarios.

When walls are not too far from the fire source of the order of the fire-to-ceiling distance, it is found that the penetration of these downward wall flows is a large fraction of the fire-to-ceiling distance, and that this fraction is relatively independent of the details of fire size and fire-to-wall spacing.

Also, net rate of entrainment into the wall flow as it is buoyed back upward to the ceiling elevation is found to be several times larger than the flow rate of the driving ceiling jet flow immediately upstream of wall impingement.

Data from five studies reported in the literature are reviewed relative to the analytic results obtained. One of these involved a field model simulation of the flow generated by a buoyant source in an enclosure.

Two experimental laboratory studies involved fires in enclosures with characteristic dimension of the order of several meters. Two other involved saltwater plumes in freshwater tanks with characteristic dimension of the order of several tenths of a meter.

These data are found to be consistent generally with the analytic results, and, in particular, with the notion that the wall flows in question provide the mechanism for mixing which leads to the deep and rapid stratification typically observed in enclosed compartment fire environments.