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Buoyancy and Pressure Induced Flow of Hot Gases in Vertical Shafts with Natural and Forced Ventilation YOGESH JALURIA, Rutgers University, GUNNAR OLAVI TAMM, US Military Academy — An experimental investigation was conducted to study buoyancy and pressure induced flow of hot gases in vertical shafts to model smoke propagation in elevator and ventilation shafts of high rise building fires. Various configurations were tested with regard to natural and forced ventilation imposed at the upper and lower surfaces of the vertical shaft. The aspect ratio was taken at a typical value of 6. From a lower vent, the inlet conditions for smoke and hot gases were varied in terms of the Reynolds and Grashof numbers. The forced ventilation at the upper or lower boundary was of the same order as the bulk shaft flow. Measurements were taken within the shaft to allow a detailed study of the steady state flow and thermal fields established for various shaft configurations and inlet conditions, from which optimal means for smoke alleviation in high rise building fires may be developed. Results indicated a wall plume as the primary transport mechanism for smoke propagating from the inlet towards the exhaust region. Recirculation and entrainment dominated at high inlet Grashof number flows, while increased inlet Reynolds numbers allowed greater mixing in the shaft. The development and stability of these flow patterns and their effects on the smoke behavior were assessed for several shaft configurations with different inlet conditions. The comparisons indicated that the fastest smoke removal and lowest overall shaft temperatures occur for a configuration with natural ventilation at the top surface and forced ventilation up from the shaft bottom.

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