Vortex Rings for Delivering Conditioned Air

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Abstract

Recently a few researchers have suggested that vortex rings can outperform conventional jets in supplying conditioned air for the comfort of the targeted occupants. This is especially the case in large space settings such as airports, atriums, and industrial buildings. The self-propagating rotating vortex ring can carry the conditioned and/or fresh air over an extended throw with minimum directional deviation and dilution along the path. The state-of-the-art on this engineering innovation is currently limited to idealized numerical and experimental settings. Moreover, the small number of studies on this front only employed moving piston to generate one vortex ring at a time. We argue that installing controllable accelerating pistons to generate vortex rings at air diffusers is unrealistic. We propose pulsating the central blowers or cycling air distribution among the branches of ductwork as a pragmatic means to create desirable vortex rings via appropriately modified diffuser designs. While the simplest design may be of orifice type, smoothly contoured flexible outlets promise significantly lower pressure loss and the realization of laminar vortex rings with inconsequential mixing and dilution. We further propose employing closely timed pulses of air flow to create two vortex rings in proximity, for realizing leapfrogging to boost the throw, and increase the conditioned air delivery rate, as required.

Keywords

Air distribution, HVAC, vortex ring, throw, air conditioning, grille, nozzle, diffuser, jet.