

Course Name: Theory of Fire Propagation (Fire Dynamics)

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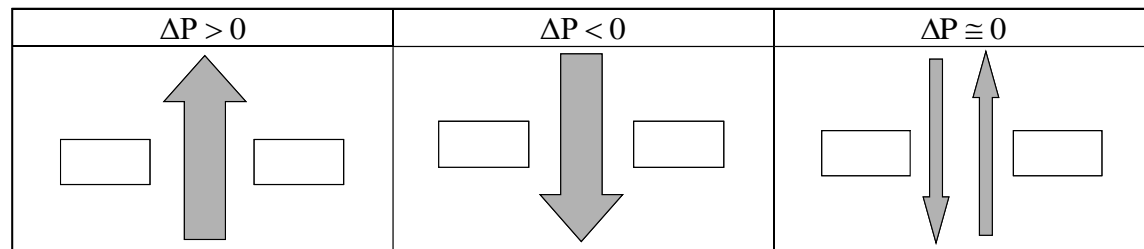
Week – 11

Lecture – 02

Module 7 – Enclosure Fires

Compartments with ceiling vents:

Ceiling vents are openings in the ceiling, through which smoke can go out. Nature of the fire induced vent flows is quite different in ceiling vents and it impacts the heat release rate and compartment temperatures. For fires in a vertically vented enclosures (wall vents - doors & windows), stratified two way flow exists. For a single vent is located at the ceiling, interesting flow patterns emerge, as shown in figure adopted from Wakatsuki (2001),



For ceiling vents, three conditions are typically observed:

1. Choked followed by extinguishment.
2. Erratic pulsing also sometimes called ghosting flames.
3. Strong steady burning.

Emmons (1996) and Cooper (1989) analysed the airflow through the ceiling vent using the concept of a flooding pressure given by:

$$|\Delta p_f| = 0.0873 \frac{\Delta \rho^2 g D}{C_d^2 \rho_f}$$

Here, $D = 4A_v/L$, A_v is vent area, L is perimeter of the vent, ρ_f is density of fluid (air) calculated at the compartment temperature and C_d is coefficient of discharge, calculated as,

$$C_d = 0.138 + 1.12 \times 10^{-4} \text{Re}$$

From the value of Δp_f flow patterns (in or out flow) can be found.