COMPARTMENT TEMPERATURE

Compartment temperature during a fire is a critical aspect in fire safety and building design. It refers to the temperature within a specific enclosed space (compartment) where a fire is occurring. Understanding and managing compartment temperature is essential for designing effective fire protection systems, ensuring structural integrity, and safeguarding occupants.

Factors Affecting Compartment Temperature:

1. **Fire Characteristics:**
   a) Type of Fire: The type of materials burning influences the temperature. Different classes of fires (A, B, C, D) generate varying temperatures.
   b) Fire Load: The quantity and type of combustible materials present impact how quickly and intensely a fire will develop.
2. **Compartment Construction:**
   a) Material Properties: Walls, ceilings, and floors affect heat transfer. For instance, concrete has good thermal mass but may crack under high temperatures, while steel can lose strength rapidly when heated.
   b) Insulation: Insulation materials affect how heat is retained or dissipated within the compartment.
3. **Ventilation:**
   a) Natural Ventilation: Openings like windows and doors influence how hot gases escape, affecting the internal temperature.
   b) Mechanical Ventilation: Systems such as smoke vents or fans can control heat and smoke distribution, impacting temperature profiles.
4. **Fire Dynamics:**
   a) Fire Size and Duration: Larger and more prolonged fires generate higher temperatures.
   b) Fire Growth Stage: The temperature profile changes from the initial stage to flashover and then to decay.

Temperature Profiles in a Fire

1. Initial Stages:
   - Ignition: Temperatures start to rise rapidly. Early temperatures might be around 200-300°C.
   - Growth: As the fire grows, temperatures can quickly reach 400-600°C.
2. Flashover:
   - Flashover Point: Occurs when temperatures reach approximately 600-700°C, causing all combustible materials in the compartment to ignite simultaneously. This results in peak temperatures ranging from 800-1100°C or higher.
3. Fully Developed Fire:
   - Steady-State: During this stage, temperatures stabilize but remain high, often around 800-1100°C, depending on the fire load and ventilation conditions.
4. Decay Stage:
   - Temperature Drop: As the fire consumes available fuel, temperatures decrease. This phase can last until the fire is fully extinguished.

Summary

Compartment temperature during a fire is influenced by the type of fire, materials, construction, and ventilation. Accurate measurement and modeling are crucial for understanding how temperatures evolve during a fire, which informs the design of fire protection systems, safety protocols, and structural maintenance. Managing these temperatures helps in preventing structural damage, ensuring safety, and effectively controlling fires.