Risks Associated with Smoke and Smoke Travel

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DEFINING SMOKE

Smoke is the generic term for the gaseous, solid and liquid products that are released when a fire occurs. These tend to be issued more when a fire is under-ventilated and there is insufficient air to enable the combustion to be completed. The components of the smoke will also be decided by the materials involved. Most smoke from domestic fires contains a complicated mixture of volatile organic compounds, particles of carbon and ash, water vapour and a range of toxic gases, minerals and metals. However, the best known components and the reason for the majority of fire deaths, are Carbon Monoxide (CO) and Hydrogen Cyanide (HCN).

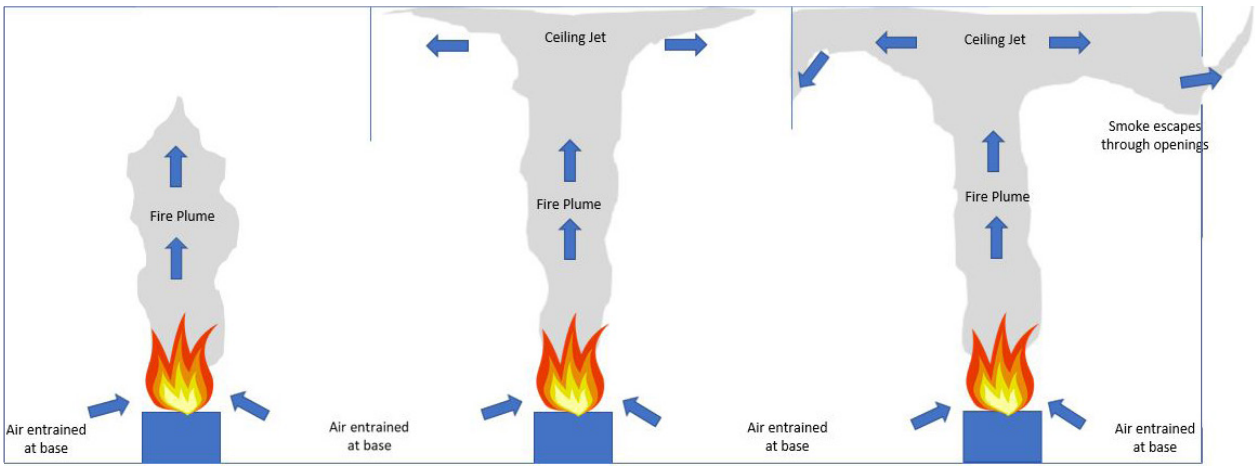
The Woolworths store fire in Manchester in 1979 involved large quantities of foam filled furniture. Ten people were killed as a result of the intense poisonous smoke produced and the fire led to the introduction of The Furniture and Furnishings (Fire Safety) Regultions 1988

CO is released when organic fuels such as wood burn. As the oxygen supply to the fire is limited, the percentage of CO in the smoke increases. CO mixes with Haemoglobin in the blood to create Carboxyhaemoglobin and the presence of CO in the blood, prevents the transport of oxygen, ultimately resulting in Asphyxia. HCN is produced when natural fibres such as wool and silk and synthetic polymers, such as polyurethane and nylon, are not completely consumed during a building fire. HCN also enters the bloodstream and prevents the take up of oxygen, potentially leading to chemical asphyxiation.

SMOKE TRAVEL

As smoke is produced in fires it is heated which causes the cloud of gases to expand and become less dense than the air around it. As a consequence, it rises creating what is known as a fire plume. As the fire plume rises, it entrains clean air from its surroundings which in addition makes the plume larger. In most cases, a supply of cooler fresh air will be drawn into the fire at lower level, feeding the fire and continuing the movement of gases. Typically, the fire plume will continue to rise until in a compartment, it will interact with the obstruction of a ceiling. The plume will then be forced outwards and along the underside of the ceiling where it is referred to as a ceiling jet. The ceiling jet will continue to spread outwards, cooling as some of its heat is transferred to the ceiling via conduction until it reaches another vertical obstruction such as a wall, or an opening where it will flow through, still driven by buoyancy as it attempts to rise further. That buoyancy will cause an increase in the pressure of the gas allowing it to be forced through even the smallest openings.

The buoyant flow of fire gases is the dominant method by which smoke travels through a building. The transfer of heat as this occurs is known as convection.



PROTECTION FROM SMOKE

The phrase 'fire proof' must also extend to smoke travel, as hot gases are capable of spreading fire and smoke alone is the main cause of deaths in fires. The propensity of smoke to escape though even the smallest of openings makes its containment challenging.

Compartmentation is the process of dividing a building into separate sections, or compartments. Each one is protected using fire-rated materials. This means that any fire is contained within its compartment and other compartments remain protected and resistant to fire until the materials break down, allowing any occupants to escape to a place of safety.

Good example of fire stopping

In any modern building, there will be the requirement to pass the essential services between compartments and particularly between floors. This means openings being provided for the passage of electric cables, water and waste pipes, ventilation ducts, heating pipes etc.

Building Regulations provide guidance on how best to provide fire stopping measures, particularly where services pass through the structure. There are many types of methods of sealing openings or spaces around pipes etc. to prevent the passage of smoke and hot gases. These can range from fire sleeves and fire collars which fit around pipes, to mortars, sealants and gap fillers that can be used to seal openings and prevent the passage of smoke and heat.

Lack of fire stopping

VIGILANCE

The ability of smoke to penetrate any opening in its path means that constant vigilance is required by those responsible for buildings. Any work carried out by contractors that involves breaching any wall or floor should be rigidly inspected at the conclusion to ensure that existing fire / smoke stopping measures have not been compromised and that no new openings have been created that have not been provided with approved fire stopping materials.

Virtually every fire produces some form of smoke. The less ventilation the fire has, the more incomplete will be the combustion and the more toxic the products coming from it. It is impossible to tell how toxic smoke is merely from its visual appearance. It is wise to assume that any smoke has the potential to kill.

ADVICE AT THE CLAIMS SCENE

When dealing with fire claims in buildings it is important to be aware of the measures likely to be present to control smoke. Where smoke from a fire in a compartment has escaped that compartment into another, question why and how? Here are some considerations;

- Examine the fire risk assessment and check for any comments about fire stopping inadequacy.
- Are the self-closing devices on the doors operating properly? Are they defective or have they been 'wedged' open?
- Are doors sufficiently tight fitting to prevent the passage of smoke?
- Are there any visible openings in the compartment walls or ceiling – particularly where services pass through?
- Are smoke dampers fitted in air conditioning equipment? Are they working and when were they last tested?
- In the case of a staircase or lobby, are pressurisation systems working?
- In the case of an atrium, have high level smoke vents operated?

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