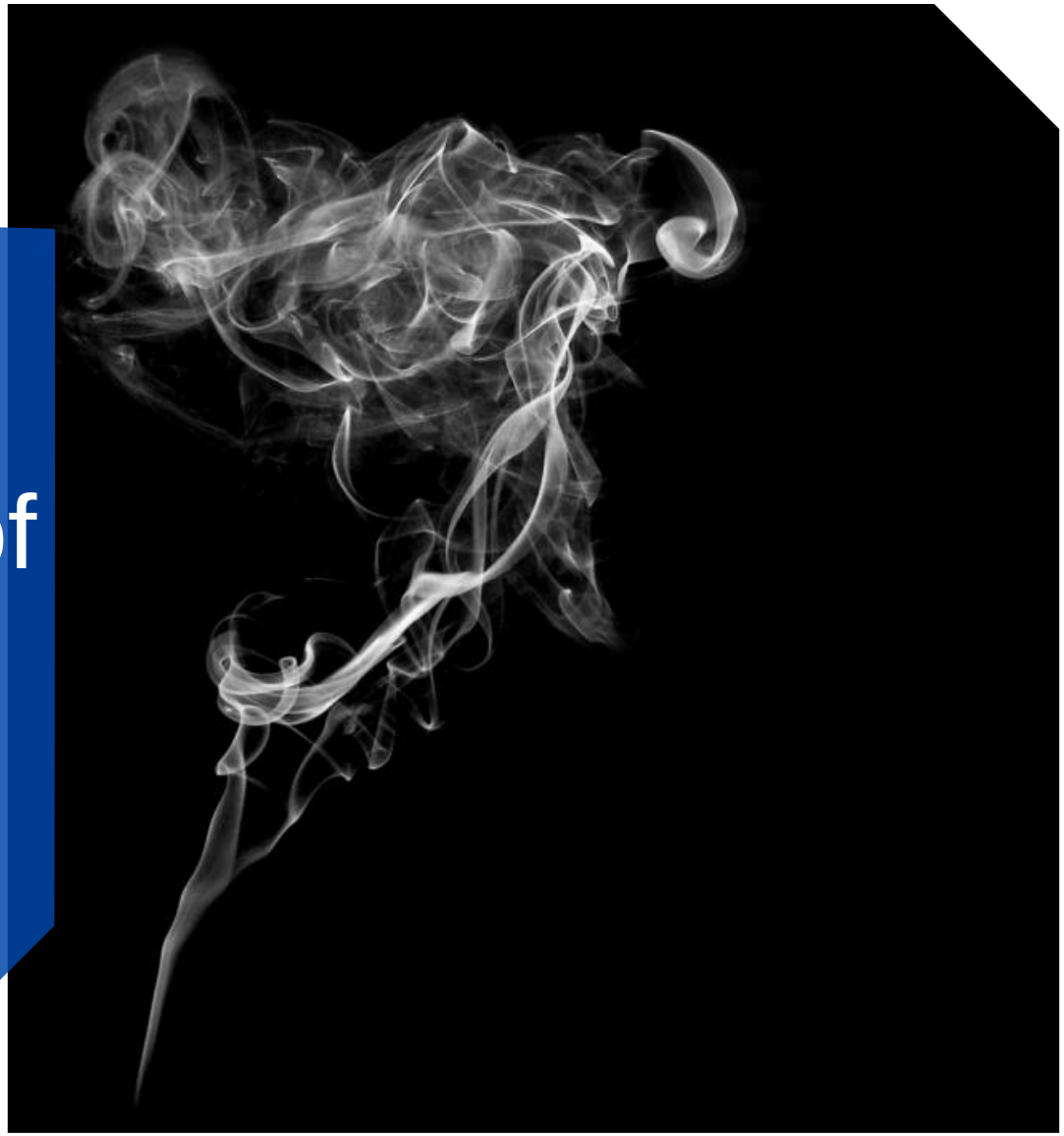
Safety Design in Buildings

Muscat Conference

Monday, November 21, 2016, Crowne Plaza Muscat

The Fundamentals of Smoke Control

Methods, Requirements and Regional Perception of its Performance



November 2016

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COURSE DESCRIPTION

Smoke control is a widely misunderstood concept within the design of buildings. Often smoke control and post fire clearance is seen as the same thing.

This presentation explores the requirements of smoke control and outlines where they are required, and to dispel the myth that smoke control systems solve all problems.

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Presenter

Robert Davies BSc (Hons) MSc CEng MIFireE CFPS

- BSc in Fire Safety from University of Central Lancashire in 2001
- Worked with AkerKvaener as fire protection systems designer for Petro-Chemical and Pharmaceutical facilities
- Worked with International Fire Consultants Limited and gained experience in Fire Testing and Material Science
- Masters in Fire Safety Engineering from University of Ulster in 2006
- Worked with Buro Happold based in UAE on large mixed use & high rise developments throughout the ME region.
- Obtained Chartered Engineer status and NFPA Certified Fire Protection Specialists in 2009
- Worked as a fire safety advisor for Arriyadh Development Authority
- Joined WSP | Parsons Brinckerhoff in 2010. Now Head of Fire & Life Safety

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Learning Objectives

1. *Understand the difference between smoke control and smoke purging*
2. *Understand where smoke control might be required, and for what purpose*
3. *Dispel the misconception that smoke control can solve all problems*

The purpose of this presentation is to convey technical knowledge to the conference participants.

The presentation also contains slides with text that summarises the content of the presentation and the main learning objectives.

These may be used to update CPD records for relevant organisations including the Chartered Institute of Building (CIOB).

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AGENDA

- **Why is smoke a concern?**
- **Codes and standards**
- **Difference between life safety and property protection**
- **Component of a larger system**
- **Why is smoke control used across the region**
- **Terminology**
- **Performance requirements**
- **Examples of smoke control and smoke extract systems**
- **Documentation and controls**

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WHAT IS THE ISSUE WITH SMOKE?

- 212,500 fires – 322 deaths
  - 41% overcome by smoke/ gases
  - 20% due to burns
  - 20% due to combination of burns/ gases
  - 19% other

- Extensive property damage

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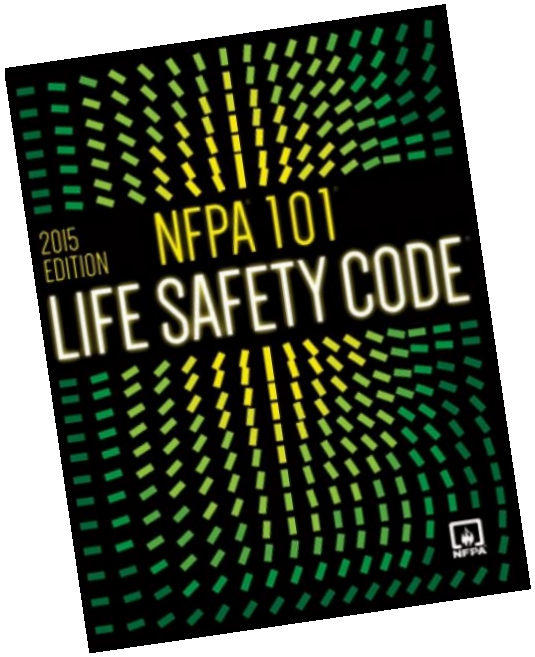
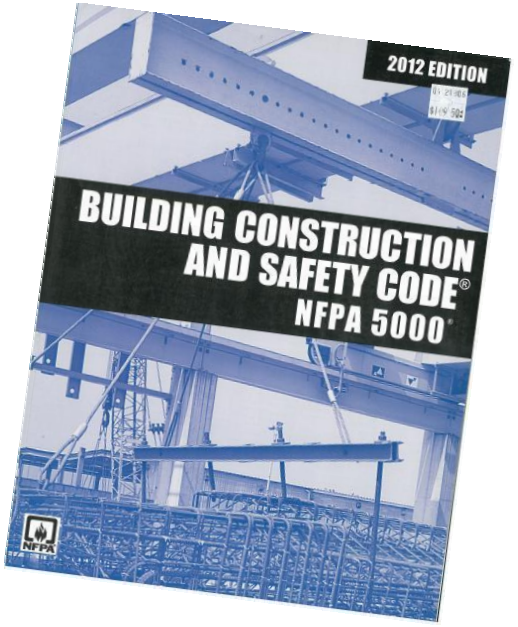
APPLICABLE CODES – BASIS OF DESIGN





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CODE STRUCTURE

ROP Fire Standards

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LIFE SAFETY OR PROPERTY PROTECTION

People

Property (Insurance)

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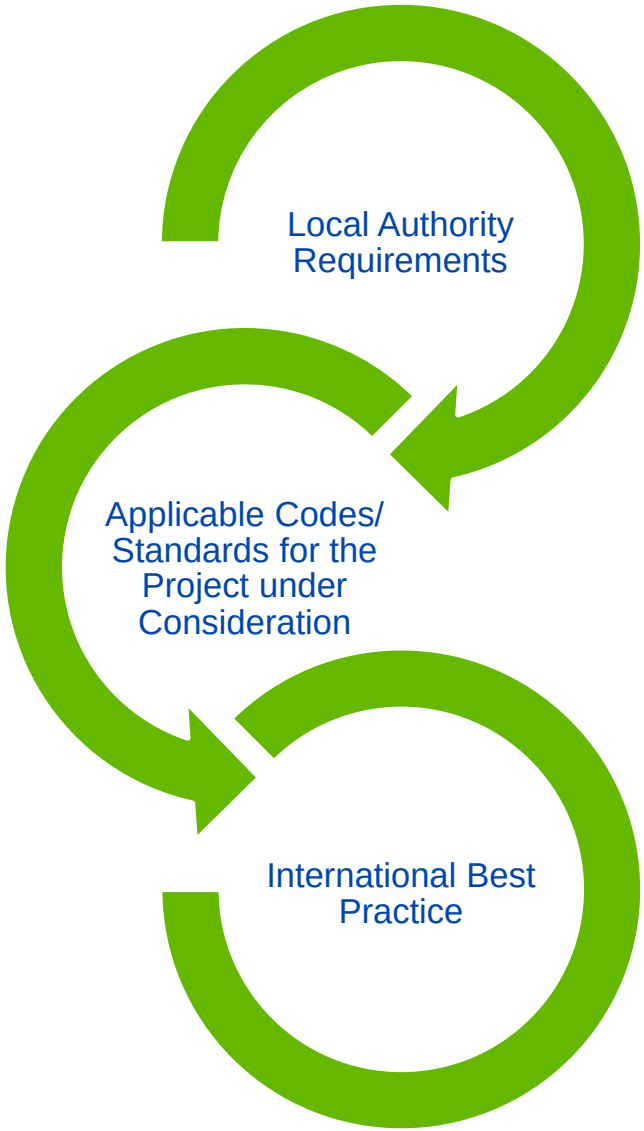
HOLISTIC ENGINEERING ANALYSIS



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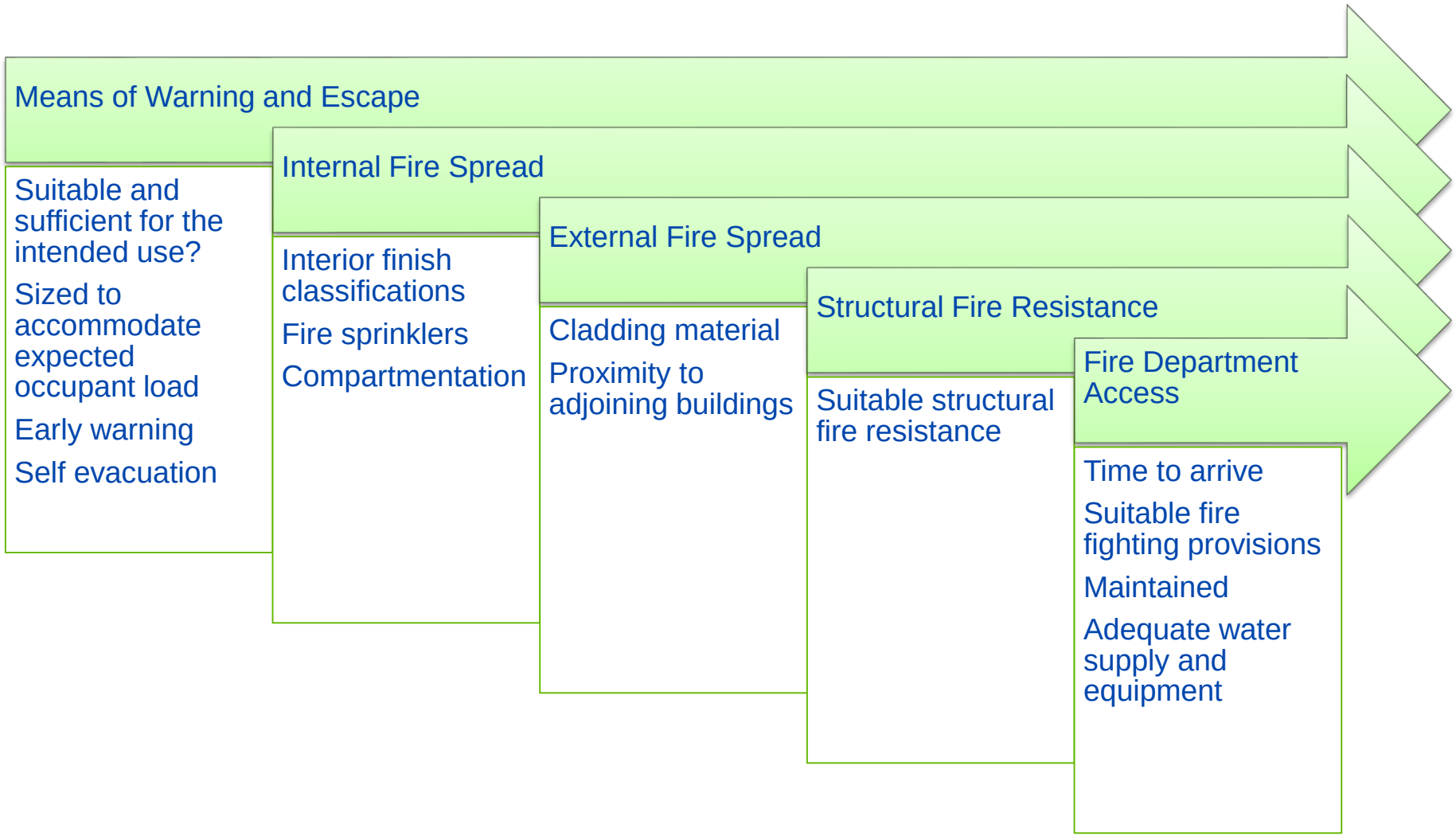
COMPONENT OF A FIRE STRATEGY



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WHY IS SMOKE CONTROL USED?

Codes and Standards

- **Remove smoke/hot gases in storage spaces – car parks, warehouses**
- **Protection of high occupancy spaces – smoke protected assembly seating**
- **Limit smoke spread due to vertical openings**
- **As part of an overall design approach – not a bolt on.**

Regional Requirements

- **Mitigate poor construction**
- **Assist evacuation of occupants**
- **Remove smoke post fire**
- **Assist fire fighting**

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WHERE IS SMOKE CONTROL REQUIRED?

- **Underground buildings**
- **Enclosed car parks**
- **Enclosed train stations**
- **Road and rail tunnels**
- **Atria within buildings**
- **Mall pedestrian way over 2 levels**

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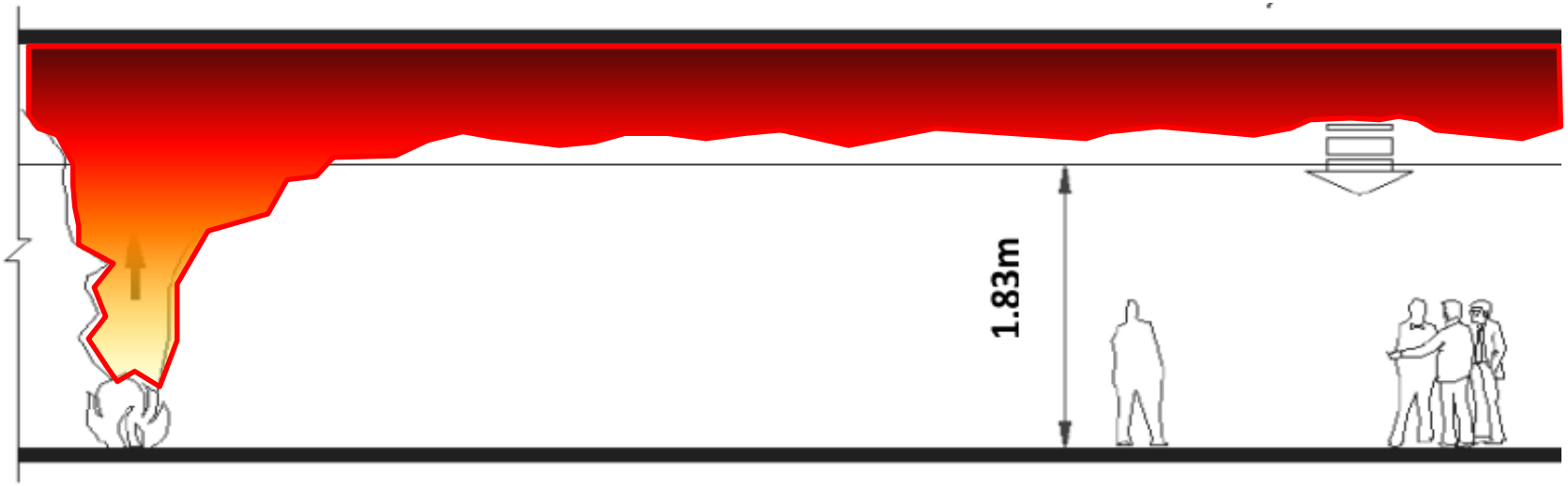
TERMINOLOGY

- **Performance criteria**
  - What is the system intended to do?
- **Tenable conditions**
  - Maintaining conditions to allow occupants to evacuate
  - Fire fighting activities
- **Smoke layer interface**
  - The location horizontally between tenable and untenable conditions
- **Smoke clearance**
  - No performance criteria
  - System designed to clear smoke post fire

TERMINOLOGY

- **Smoke control**
  - Detailed performance criteria
  - Maintain tenable conditions for minimum 20 minutes or 1.5 time the calculated egress time
- **Design fire size**
  - The fire size modelled, based upon engineering analysis
- **Atrium**
  - A space of 4 or more stories in height un-compartmented from the remained of the building
- **Back layering**
  - Smoke movement counter to direction of ventilation

TENABLE CONDITIONS (SMOKE CONTROL)



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SMOKE CONTROL

- Hand calculations
- Specialist software packages

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SMOKE CONTROL DESIGN OBJECTIVES (NFPA 72)

- Contain smoke to zone of origin
- Maintain tenable conditions
- Maintain smoke layer interface

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UNDERGROUND BUILDINGS

- Break out of smoke/ fire
- Large occupant loads
- Limited control of contents

- What is the requirement?

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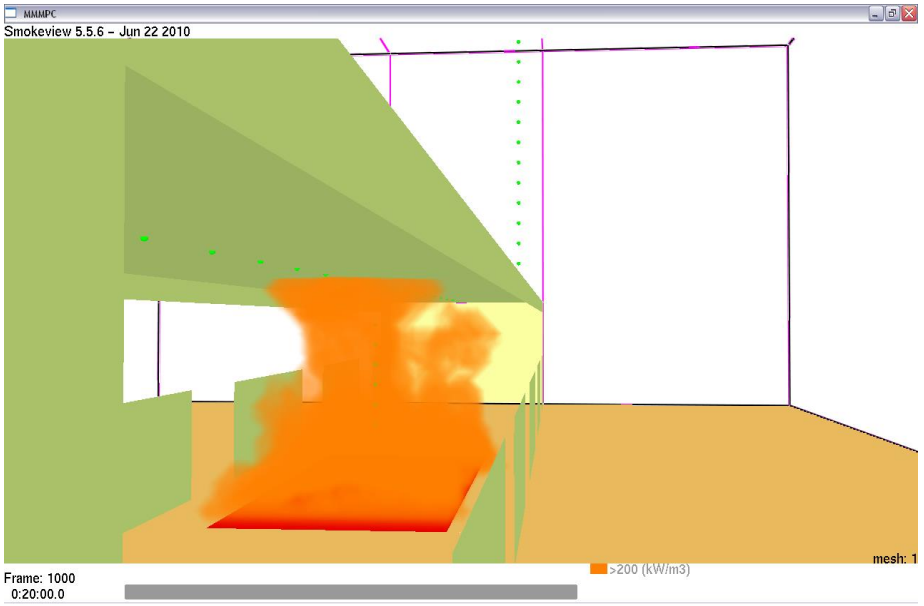
ENCLOSED TRAIN STATION

- Platform evacuation time
- Tenable conditions on concourse level
- Concourse is a place of relative safety
- Demographics of transit systems



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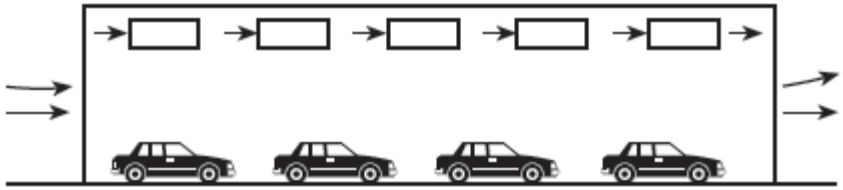
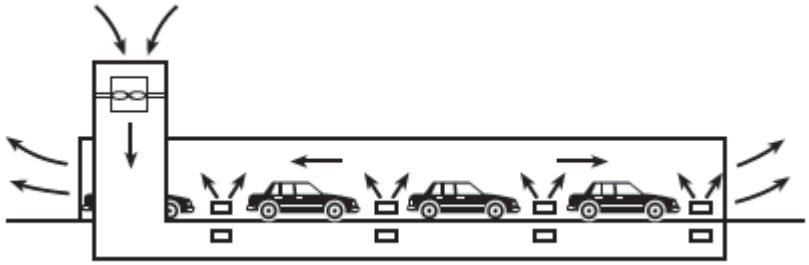
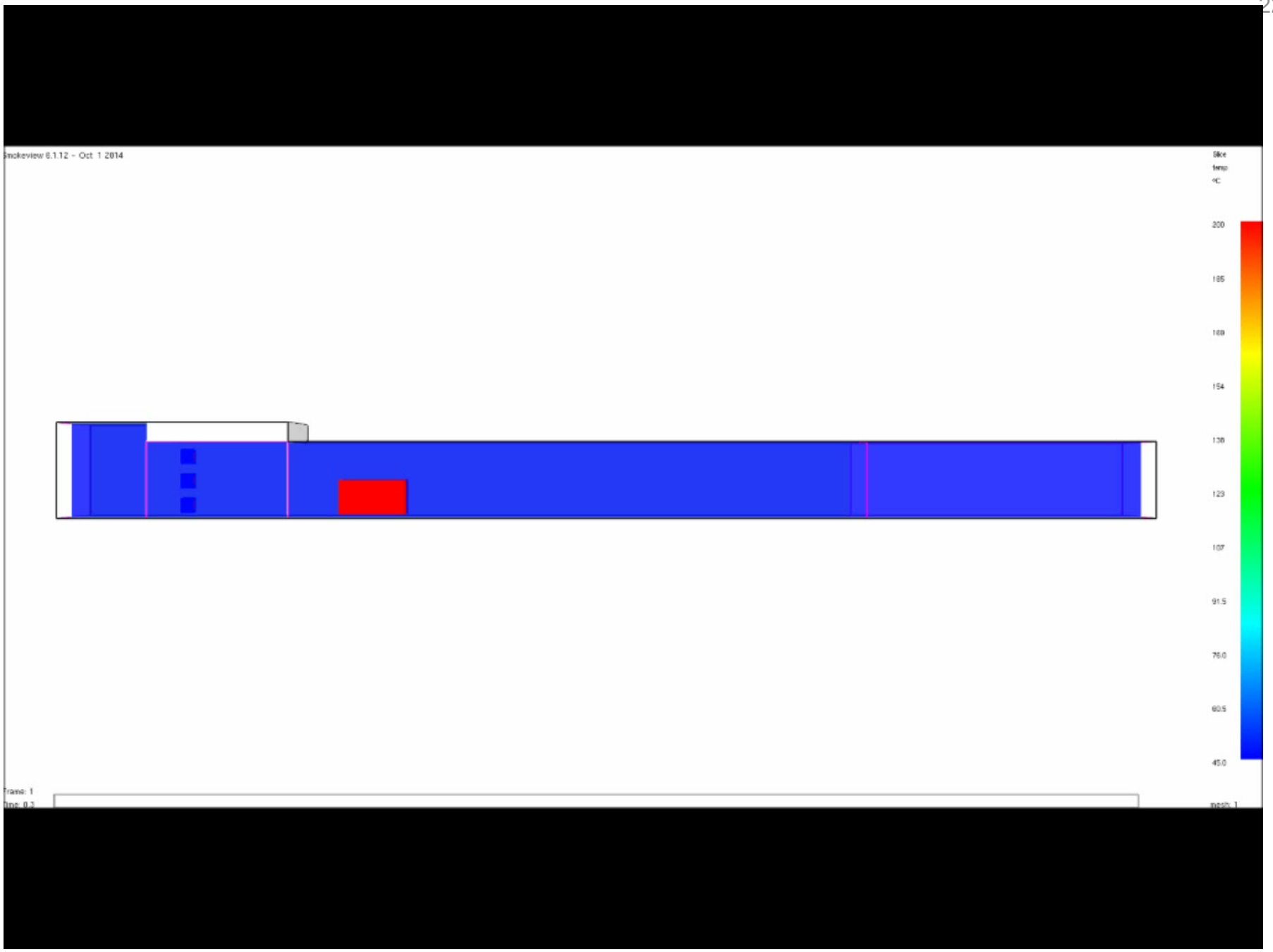
TUNNELS

- Prevent back layering
- Egress time
- Fire fighting access

- Engineering Analysis part of '*holistic multidisciplinary engineering analysis*' (NFPA 502)

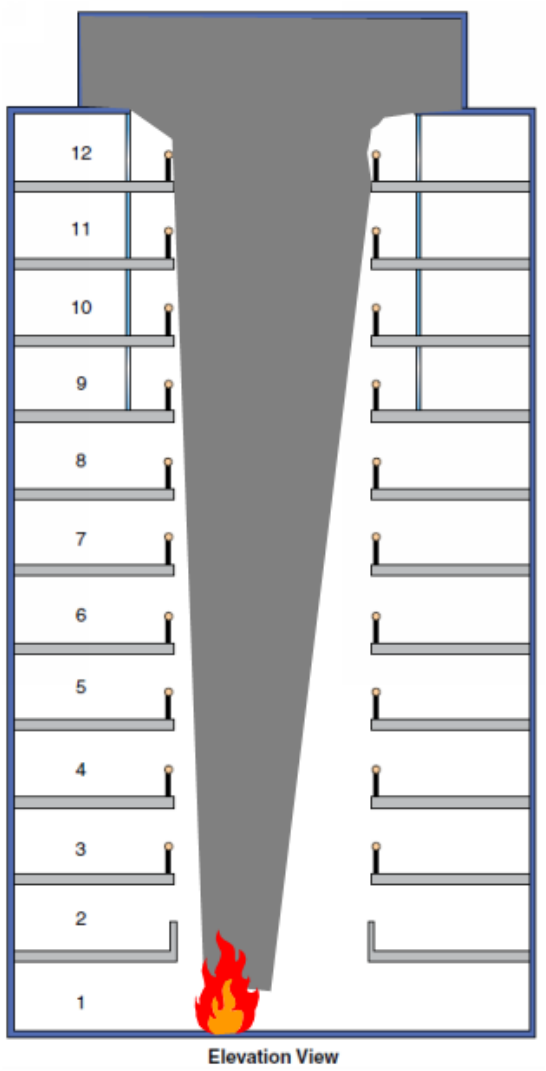





Smokeview 6.1.12 - Oct 1 2014
Slice
temp
°C
200
185
169
154
138
123
107
91.5
76.0
60.5
45.0
Frame: 1

MALLS AND ATRIA

- Tenable conditions
- Enclosed upper levels
- Consider make up air
- NFPA 92



Elevation View

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CAR PARK VENTILATION

- ✓ Assisting fire fighters to clear smoke during and post fire
- × Provide smoke free access for fire fighting
- × Protect means of egress

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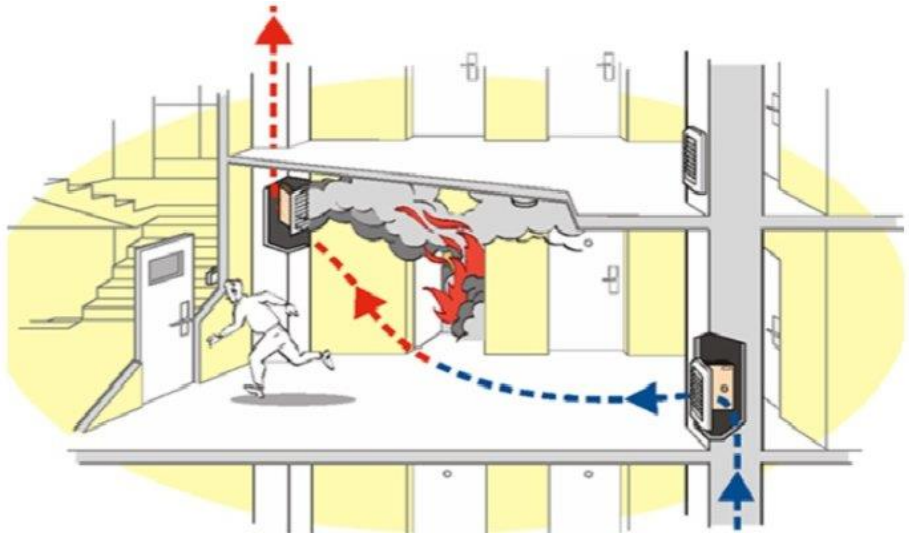
CORRIDOR SMOKE EXTRACT

- Not NFPA
- High level extract
- Low level makeup air
- 6 ACH system



SMOKE CONTROL DESIGN DOCUMENTATION

- System purpose
- System design objectives
- Design approach
- Design assumptions (building height, ambient conditions, reliance on other fire protection systems, leakage, etc.)
- Location of smoke zone(s)
- Design pressure differences
- Building use limitations that arise out of the system design
- Design calculations
- Fan and duct specifications
- Damper specifications
- Detailed inlet or exhaust inlets site information
- Detailed method of activation
- Smoke control system operation logic
- System commissioning procedures

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CONTROLS

- → Automation
- → Local controls
- → Fire fighters controls

SUMMARY

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Thank you

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