

# Evacuation Philosophies for High Occupancy Buildings

Presented by

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# Learning Objectives



1. Understand factors that influence evacuation design for high occupancy buildings
2. Understanding of human behavioural science
3. Familiar with key aspects of a fire strategy for a high occupancy buildings
4. Cognizant of the key role fire safety management assume in the evacuation of high occupancy buildings

# Presentation Summary



The objective of this presentation is to outline the issues that need to be considered when addressing fire safety for a high occupancy building. The presentation will cover the following:

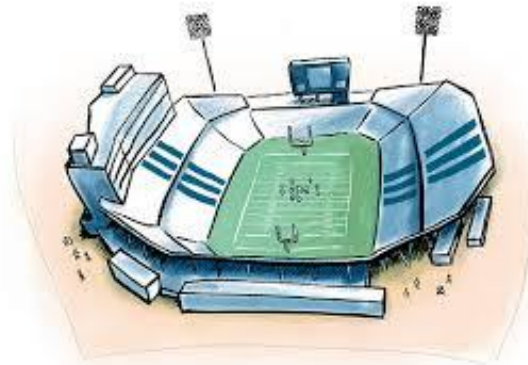
- Types of high occupancies
- Challenges faced when dealing with high occupancies
- Human behavioural science and case studies
- Design of the egress provisions and the technologies available
- Evacuation philosophies and the role of the fire alarm system
- Fire safety management

# Biography – Robert Davies BSc MSc CEng MIFireE CFPS



- Graduated in Fire Safety from University of Central Lancashire in 2001
- Started career with AkerKvaener carrying out fire protection system designs for Petro-Chemical and Pharmaceutical facilities
- Joined to International Fire Consultants Limited (IFC) in 2003 and gained experience in Fire Resistance Testing, Fire Risk Assessments and Fire Safety Strategies and Fire Engineering Solutions
- Completed a Masters in Fire Safety Engineering at the University of Ulster in 2006
- Moved to UAE and joined Buro Happold in 2007 working on large mixed use / high rise developments throughout the ME region.
- Obtained Chartered Engineer status with IFE and qualified through the NFPA as a Certified Fire Protection Specialists in 2009
- Worked as a fire safety advisor for the Planning and Development authority for Riyadh (Arriyadh Development Authority) during 2010
- Joined WSP in 2011. Now Associate Director and Deputy Head of Fire & Life Safety
- Specialties: NFPA/Qatar/UAE/KSA/Bahrain/Oman Code Consulting, Fire Safety Strategies, Fire Risk Assessments, Fire Safety Management, Fire Testing

# High Occupancy Buildings





# Challenges



- People
- Lots of people
- Awake but unfamiliar with surroundings
- Potential lack of alertness
- Reliant on good management (worldwide issue)



# Influences on Human Behaviour

- Population and density
- Individuals alone or in groups
- Familiarity with building
- Distribution and activities
- Alertness
- Physical/cognitive abilities
- Role/responsibilities
- Location Commitment to task
- Focal point
- Gender/Culture/Age
- Prior fire/evacuation experience
- Smoke and toxic gases
- Temperature/Visibility



# Human Behaviour in High Occupancy Buildings



**Alertness** – Awake but potentially distracted

**Familiarity** – Returning to Main entrance/exit

**Grouping** – Following the crowd

**Ownership** – Staying committed to a task/objective

**Leadership** – Being responsible for others



# 'Panic' in Fire Situations



The word 'panic' is frequently used in media accounts and statements of survivors of emergency evacuations and fires, but what does it really mean, is it a phenomenon that actually occurs?

Despite evidence that panic is a very rare occurrence in fires, the idea of panic and the term continues to be used by the public as well as fire experts.

Large numbers of deaths in catastrophic events are often attributed to panic, just as is the action of a parent going back inside a burning house to save his child

Experts conclude that occupants who state that they panicked in a fire is usually a judgment made in retrospect, which does not consider the perspective of the person at the time of the event

**All human behaviour in fire can be rationalized when the event is seen through the subject's perspective**

## **Gothenburg Discotheque Fire, Sweden, October 29, 1998**

Fire was discovered in one of the two stairwells of the two-story building. The upstairs dance hall was approved to hold 150 patrons, but there were between 340 and 400 people. When patrons rushed toward the only available exit, crushing and congestion occurred. When one of the DJs warned the crowd of the fire, many of those in the hall ignored the warning and continued to dance.

## **Station Nightclub Fire, USA, February 21, 2003**

- Evacuees describe aggressive behaviour, either their own or others, but do not mention cases of irrational or illogical responses
- Occupants demonstrate two characteristics:
  - Hope to escape through dwindling resources
  - Aggressive concern about own safety

# Design of Egress Provisions



- Determine appropriate Occupant Load Factor
- Identify Main Entrance/Exit
- Determine minimum number of exits
- Determine required minimum exit widths
- Ensure exits are arranged to provide adequate separation
- Avoid converging exits at the discharge points
- Provide appropriate signage/lighting to ensure exits are marked and visible
- Ensure egress components are appropriately designed (stairs, ramps, doors, handrails)
- Avoid obstructions (security barriers, columns)
- Ensure a adequately sized assembly area is provided outside and away from the exits
- Local code requires design to be based upon full simultaneous evacuation

# Technologies – Egress Modelling



Commonality between egress modelling and pedestrian movement/comfort modeling

- Avoid bottlenecks (provide multiple egress routes)
- Coordinate with general circulation
- Avoid crush conditions

**All Floors –  
Model Four**

# Evacuation Philosophies

- Full simultaneous (total) evacuation
- Zoned evacuation – One zone evacuated
- Staged evacuation – Zones evacuation in sequence
- Defend-in-place (typically used in residential)
- Relocation (typically used in prisons and hospitals)



# Fire Alarm Systems



- Components:
  - Detection Devices – Smoke/heat detectors, flow switches, manual call points
  - Notification Devices – Voice alarm, audible and visual alarms
  - Monitoring – Fire alarm panels
- Cause and effect matrix i.e. actuation of detector (cause) results in actuation of alarm (effect)
  - Single knock
  - Double knock
  - Investigation periods
- Voice alarm – Proven benefits for high occupancy buildings
- Positive alarm sequencing
  - Acknowledgement within 15 seconds
  - Investigation period of 180 seconds
  - Alarm activated if alarm is not acknowledged or system is not reset

# Fire Safety Management



- Information
  - Fire Safety Manual including policies and procedures
  - Accessible at all times
  - Containing plans and a list of hazardous materials
  - Location and provisions for those with mobility impairment
- Education and Training
  - Fire safety awareness training for all
  - Training in evacuation procedures for all operational staff
- Records
  - Frequency of training or drills
  - Who is trained or drilled
- External Crowd Management
  - Assembly points
  - Interaction between Fire Department access and assembly points
  - Liaison with attending Fire Department



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# ANY QUESTIONS?