Fire Safety Design in high rise residential buildings

Presented by Garry Weir – Director, RAWFiRE

Presentation to include:
• What’s the issue?
• It’s only a matter of time!
• Applicable regulatory requirements and objectives
• Challenges
• How do mechanical systems affect fire safety?
• Fire Safety Design Best Practice
• What’s the solution?
• Q & A
What’s the issue?

• Little changes to smoke hazard management BCA requirements?
• Little applicable change to AS 1668.1 (1998)
• Historically, services designed to different risks
• Little unified direction across the industry
• Requirements are often reactionary rather than risk based
• Perceived objectives across design team
• Gap in experience
• Changes to the built environment and occupant profile
Dubai’s Marina Torch
• 330m tall
• Fire occurred 21st February 2015, 2am
• Fire spread between level 50 – 70
• Fire spread was reported to occur via high winds
• Building is sprinkler protected

It’s only a matter of time!
Lacrosse Docklands, Melbourne

- 23 storeys
- Fire occurred 25 November 2014, 2.24am
- Fire spread between level 8 – 21 in approximately 10 – 15 minutes
- Fire spread was reported to occur via combustible facade
- Building is sprinkler protected
- One occupant evacuated lunch time the day after
10 – 20 Pa pressure difference during a fire

Building HVAC systems

Wind effects

10 – 20 Pa pressure difference due to stack affect (temperature differential)

40 Pa pressure difference due to lift piston affect
Regulatory regime affecting “Tall Buildings”

Prior to BCA 1990 - >40m tall had a Building Referees High Rise Award. This covers:

- requiring public smoke-proof lobbies connecting at least one fire-isolated stair to the lift area,
- fire and smoke proofing ducting passing through the lobby areas,
- fire rating of stairs,
- emergency telephones being located to the satisfaction of the chief officer,
- the requirement for an emergency warning and intercommunication system complying with AS 2220,
- the requirement for firemen’s emergency lifts,

BCA 1990 - The BCA covered items such as (amongst others):

- Sprinklers
- Stair pressurisation
- fire rating of stairs,
- Smoke lobby if two or more access doorways open into the stair
- emergency telephones
- the requirement for an emergency warning and intercommunication system complying with AS 2220,
- the requirement for firemen’s emergency lifts,
Regulatory regime affecting “Tall Buildings”

BCA 1996 - Onwards

- Sprinklers
- Stair pressurisation
- fire rating of stairs,
- Smoke lobby if two or more access doorways open into the stair
- emergency telephones
- the requirement for an emergency warning and intercommunication system complying with AS 1670,
- the requirement for firemen’s emergency lifts,

BCA 1996 – Performance Based Solutions (not strictly compliant or endorsed by RAWFiRE)

- Sprinklers
- Stair, lift shaft, lobby and corridor pressurisation
- Modified air relief paths
- Lobby exhaust
- fire rating of stairs and safe havens,
- emergency telephones
- Enhanced occupant warning throughout
- Lifts for the fire authority and occupant evacuation
- Natural Ventilation through central voids and corridors
BCA Objectives

• **Life safety of occupants** - the occupants must be able to leave the building (or remain in a safe refuge) without being subject to hazardous or untenable conditions.

• **Life safety of firefighters** - firefighters must be given a reasonable time to rescue any remaining occupants before hazardous conditions or building collapse occurs.

• **Protection of adjoining buildings** - structures must not collapse onto adjacent property and fire spread by radiation should not occur.
Other Objectives

- **Business continuity** - will the loss of a particular facility due to fire / smoke damage result in excessive financial impact on the client?
- **Public perception** - is there likely to be questionable public perception about the safety and operation of the facility?
- **Environmental protection** - fires of excessive sizes can have significant effects on the environment
- **Heritage salvation** - buildings can have a heritage value for both cultural and educational purposes which can be destroyed by insufficient fire protection.
- **Risk mitigation / insurance limitations** - are there specific limitations on insurance with respect to risk mitigation and fire safety design?
- **Future proofing (isolation of systems)** - what flexibility is required in the overall design
- **Occupational Health and Safety (OH&S) requirements** - specific fire safety requirements pertaining to OH&S requirements.
Relevant Performance Requirements – EP2.2

(a) In the event of a fire in a building the conditions in any evacuation route must be maintained for the period of time occupants take to evacuate the part of the building so that-

(i) the temperature will not endanger human life, and

(ii) the level of visibility will enable the evacuation route to be determined, and

(iii) the level of toxicity will not endanger human life.
Relevant Performance Requirements – EP2.2

(b) The period of time occupants take to evacuate referred to in (a) must be appropriate to-

(i) the number, mobility and other characteristics of the occupants, and

(ii) the function or use of the building, and

(iii) the travel distance and other characteristics of the building, and

(iv) the fire load, and

(v) the potential fire intensity, and

(vi) the fire hazard, and

(vii) any active fire safety systems installed in the building, and

(viii) fire brigade intervention.
Building Design Challenges

- Apartments are becoming smaller resulting in increased occupant numbers
- Unique building designs leading to complex fire safety strategies
- New materials for construction
- Reduced land area resulting in taller buildings
- Lack of industry cohesiveness, Standards, Code guidance on challenges of smoke hazard management
- Community expectations on building safety (evacuate vs remain in place)
- ESD vs smoke hazard management
Occipant Challenges

- Aging population and associated mobility
- Cultural backgrounds and positions of authority
- Disabled occupants (mobility, hearing, vision impairment, Physically limited)
- Cognitive limitations
- Temporary impairments (pregnant, sick)
- Lack of Emergency Management Planning
- Perceived levels of risk
- Mobility affected by group dynamics
- Number and location of occupants
Fire Brigade Challenges

• Way-finding for fire fighters
• Understanding the complexities of building design, fire service operations and occupant characteristics
• Managing large occupant groups within and outside the building
• Co-ordination amongst all emergency services
• Fire attack vs search and rescue
• Point of fire attack across multiple levels
• Internal communications between fire fighters
• Communication to remaining occupants
• Falling debris calling multiple fire
• Clean-up operations
How do mechanical systems affect fire safety

<table>
<thead>
<tr>
<th>Service Design</th>
<th>Affect on fire safety strategy</th>
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<tbody>
<tr>
<td><strong>Sprinklers</strong></td>
<td>Increased sprinkler reliance vs lowering of compartmentation</td>
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<td>Sprinkler failure resulting in heavy reliance on active smoke management / compartments</td>
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<td><strong>Stair, lift shaft, lobby and corridor pressurisation</strong></td>
<td>Relief air path required leading to smoke spread paths, increased cost and maintenance</td>
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<td>Interaction on air movement</td>
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<td><strong>Modified air relief paths</strong></td>
<td>Efficacy of smoke containment</td>
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<td><strong>Lobby exhaust</strong></td>
<td>Complicated functional requirements with increased costs and long term maintenance</td>
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<td><strong>fire rating of stairs and safe havens</strong></td>
<td>Places limits on duct design through such areas</td>
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<td><strong>Enhanced occupant warning throughout</strong></td>
<td>Must be tailored to evacuation strategy</td>
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<td><strong>Lifts for the fire authority and occupant evacuation</strong></td>
<td>Lobby design bounding lifts to enable safe waiting periods and transport via lifts</td>
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<td><strong>Natural Ventilation through central voids and corridors</strong></td>
<td>Wind and environmental affects require consideration</td>
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Fire Safety Design Best Practice

- Must consider objectives
- Must consider building design as a whole
- Experienced Engineers / mentoring required
- Understand the Efficacy in design solutions
- Address each of the nominated challenges
- Review failure modes
What's the solution?

Safe havens

Sprinklers

Modified air relief paths

Lobby exhaust

Enhanced occupant warning throughout

Stair, lift shaft, lobby and corridor pressurisation

Lifts for the fire authority and occupant evacuation

Natural Ventilation through voids & corridors

Lobby exhaust
What's the solution?

• Establish the objectives
  – BCA compliance or others
• Establish the unique challenges
• ALL design team members to work together and understand the complexities at hand
• Review the efficacy of the proposal including cost options, practicality and maintenance
• Communicate the solution clearly to all
Q & A’s?