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Buro Happold Fire Engineering

Cairo Expo City

### Exhibition Centre Overview

- Exhibition halls and circulation 180,000m<sup>2</sup>
- Each Hall 120m wide and up to 360m, long
- Intended to be an exhibition hub for the Arab World
- BH multi discipline engineers including Fire Engineering working with Zaha Hadid Architects



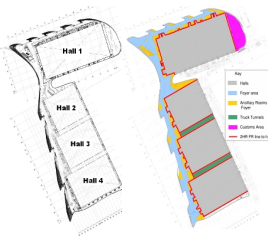
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### Exhibition Centre Fire Strategy Overview

- Design Basis: Egyptian Building Code and NFPA 101
- Separate evacuation zones/compartments

Only zone on fire evacuated initially:

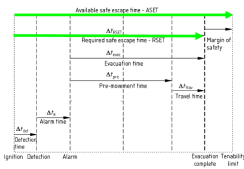
- Less numbers evacuating at same time
- Easier to manage
- More efficient escape routes



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### Exhibition Centre – Engineered Escape Strategy

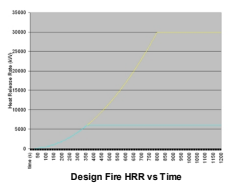
- Dimensions of the halls 120m x 360m and were also potentially heavily occupied
- Compliance with code could not be achieved for travel distances and escape widths.
- A fire engineered approach was adopted based on:
  - smoke control in foyers and halls to maintain tenable conditions during escape, case study focuses on Halls
  - Required escape times (RSET) were calculated and compared with the time taken for smoke and heat from a fire to disable escape routes (ASET).
  - Demonstrated that required escape time was less than time available to escape by significant margin of safety



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### Design & Acceptance Criteria

- CIBSE Guide E Zone model approach to design smoke extract system from each hall
- Verified by CFD analysis
- A number of Design Fire Scenarios considered, narrowed down to worst case:
  - Fast growing 30MW fire (Truck Fire)
  - Fast growing 6MW fire (typical retail display)
- Sensitivity Analysis
  - Growth rate - medium
  - Fire Location (near and remote from replacement air inlet points)
- Acceptance Criteria established

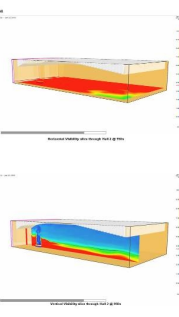


Parameter	Value	Reference & Comments
Hall Layer depth	Max 40m, max 10m at edge, 1.5m suspended to allow the CFD analysis above floor level	Agrees to design smoke conditions and CFD analysis (EN 1993, BS2019)
Temperature	Average layer depth clear than 2.1 metres above floor level (temperature is 100°C maximum only)	Agrees to fire models (EN 1993, BS2019, BS2019)
Visibility	Smoke density not to exceed 0.2, 0.25, 0.3, 0.35, 0.4, 0.45, 0.5, 0.55, 0.6, 0.65, 0.7, 0.75, 0.8, 0.85, 0.9, 0.95, 1.0	Agrees to design smoke conditions and CFD analysis (EN 1993, BS2019)
Toxicity	Exposure to toxic and irritant products is not considered. Considered for safety use to control smoke, in accordance to smoke and toxic products analysis & modelling of smoke production and release.	Agrees to CFD and smoke models at early stages of fire. Smoke not kept during the lighting. Smoke density not to exceed 0.2, 0.25, 0.3, 0.35, 0.4, 0.45, 0.5, 0.55, 0.6, 0.65, 0.7, 0.75, 0.8, 0.85, 0.9, 0.95, 1.0
Staircase heat	50 smoke max than 1.00 metres above floor, smoke to be removed 2.0 km/h (normally 200 km/h). EN 1993, BS2019	Designated at 1.00m above floor, agrees to design smoke calculations only for fire 120

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### Exhibition Centre – CFD Modelling Results

- CFD fire and smoke modelling used to demonstrate that smoke extract system was capable of maintaining tenable conditions during escape
- Visibility was limiting factor on ASET
- Visibility <10 at head height after 950seconds = ASET
- RSET calculated at 630seconds using BS 7974 methodology and NFPA 130 recommended travel times
- Margin of safety of over 5 minutes
- CFD modelling also used to inform Structural fire engineering analysis which demonstrated that structure in roof need not be fire rated resulting in significant cost savings



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## Conclusion

- To allow the architectural vision and the functionality of the space performance based fire engineering was used.
- Little compartmentation and very large travel distances could be justified.
- Project currently on hold awaiting a restart.

