Ensuring Safe Evacuation – The Next Steps

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The role of a Fire engineer
The role of a Fire engineer

Handover and Use

Preparation

Design & Approvals

Construction

Specification

Fire Engineer

Specifications
Message 1:
Early consultation and an integrated and coordinated approach are critical to ensure a successful strategy.
Validating Egress Strategy
Overview

Section 1: Prescriptive Code Vs Performance Based Design

- Performance Based Design - Fire Engineering
- Fire Safety Code guidance

Section 2: MassMotion – evacuation modelling

- The Software
- Applications

Section 3: Case Studies

- Evacuation modelling
Section 1 – Prescriptive Code Vs Performance Based Design
A design is either prescriptive or fire engineered!
Why use Fire Engineering/Performance based design?
So why use Fire Engineering?

- Cost savings – removing unnecessary features
- Operational and business continuity
- Quality and functionality of space – enabling architecture
- Improving commercial viability of the building – end user requirements/obligations/security
- Sometimes a prescriptive solution is *simply not* possible.
Fire Escape Principles
Prescriptive Guidance – Traditional Assumptions for Buildings

What are the exit flow rates based on?

What is safe queuing time for occupants to escape?
Prescriptive Guidance – Traditional Assumptions for Buildings

What are the exit flow rates based on?
Research from the 40’s

What is a safe queuing time for occupants to escape?
~ 2.5 minutes
Performance based design – high ceiling
Performance based design – controlled fire load
Performance based design – progressive escape
Performance based design – ventilation
Performance based design – sprinklers
<table>
<thead>
<tr>
<th>Conventional Prescriptive Design</th>
<th>Performance based design</th>
</tr>
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<tbody>
<tr>
<td>No or limited allowance for</td>
<td>Fire Safety Features allow for</td>
</tr>
<tr>
<td>compensatory features</td>
<td>relaxations in escape requirements</td>
</tr>
<tr>
<td>It’s a one solution fits all</td>
<td>It allows flexibility in the design and can</td>
</tr>
<tr>
<td>approach</td>
<td>consider specific operational requirements</td>
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<tr>
<td>It can break down when</td>
<td>It can be used for high populations,</td>
</tr>
<tr>
<td>considering complicated evacuation</td>
<td>various scenarios and changing</td>
</tr>
<tr>
<td>strategies or high populated</td>
<td>parameters</td>
</tr>
<tr>
<td>spaces</td>
<td></td>
</tr>
<tr>
<td>It can lead to significant over</td>
<td>Potential to reduce the numbers of</td>
</tr>
<tr>
<td>or under design</td>
<td>escape routes/Rationalise the design</td>
</tr>
</tbody>
</table>
Message 2: Evacuation modelling can bring tailored solutions and flexibility where prescriptive guidance can’t.
Section 2

MassMotion – evacuation modelling
Mass Motion – The Software

- Product of Oasys-software (Arup In-house software firm).
- Pedestrian simulation for designing and optimizing high occupancy facilities.
- Create and model large scale (1,000,000+ individuals).
- Used in demanding pedestrian environments including
  - mass-transit stations,
  - performance venues,
  - airports,
  - stadiums.
- Communicates complex problems in a highly visual manner.
MassMotion capability

Transport facilities

Process modelling

Crowd management

Existing buildings

Live construction environments

Stadia and venues
Section 3

Case studies – Evacuation
European Stadium – Overview

- Land surrounding existing stadium to be developed.
- Currently ample space provided around the stadium for escape.
- Proposed master plan meant reducing the available space surrounding the stadium for escape.
European Stadium – Aims and Challenges

**Masterplan client**
- Maximising the potential land space for future construction by developing a design with a minimal amount of restrictions.

**Stadium management**
- Providing maximum future flexibility to cater for concerts, sports events and retail areas surrounding the stadium.

**Masterplan architect**
- Realising their vision for the expo centre while maintaining sufficient emergency provisions.

**Local police**
- Incorporating security locations at the entrances to the stadium.
- Providing locations for flexible fan segregation.

**Emergency services**
- Providing access to and from the stadium for ambulance and fire services in the event of an emergency.
European Stadium – Our approach

Proposed master plan with constrained space

Modelling approach simulated 80,000 persons for a concert mode

MassMotion model visual

Crowd density maps for different phases
European Stadium – Simulation Video
Birmingham New Street, UK - Overview

- Existing sub surface rail station with 12 platforms with a shopping centre located above.

- Accommodates over 140,000 passengers per day. Designed to accommodate half this number.

- Major refurbishment works currently on-going to train station and shopping centre.

Birmingham New Street, UK – Aims and Challenges

- **Operational continuity**: All construction works are undertaken in a “live” transport hub and shopping centre.

- **Construction phasing**: The construction phasing programme provided demanding time scales for assessment of each new phasing option and required quick response.

- **Fire and population scenarios**: A large number of evacuation and fire scenarios needed to be assessed for each phasing option during the on-going construction programme.

- **Traditional methods**: Traditional hand calculations took significant time to complete and presented difficulties in meeting the demanding deadlines.

- **Stakeholders**: The results of the assessments needed to provide all stakeholders confidence that their decision making would not affect escape from the live building.
Birmingham New Street, UK – Our Approach

Typical model of existing situation

Typical model of one construction phasing option

Typical results from CFD analysis for ASET

Typical results of one construction phasing option
Birmingham New Street, UK – Simulation Video
Summary of Applications (Fire)

- Large exhibition spaces – Indoor/outdoor events
- Airports
- Construction phasing
- Phased Evacuation/Progressive horizontal Evacuation
- Masterplanning
- Transport facilities – Rail/Underground
- Sports Stadia
- Duplicate Services – Ped Planning, Security etc
Message 3:
Modelling can bring value to numerous projects
Summary and Conclusion

- Fire Engineering Input at initial stages can assist in identifying and realising the goals,
- A coordinated approach is necessary,
- Evacuation Modelling can bring benefits and opportunities
- It can be used at on various types of projects of all scales
- Provides clear visual representation of all possible scenarios
- It allows for flexibility tailored to complement as opposed to conflict with the operational strategy.