

PROTECT – LONDON LOCAL RESILIENCE FORUM USE ONLY
Individual Risk Assessment 50 – Complex Built Environments: HL105

A - Hazard Category: Structural		Sub-Category: Major Incident in Complex Built Environments
Ref No.	Hazard Description	Outcome Description
The following outcomes are possible as a consequence of a major incident affecting large buildings / complex built environments. Incidents in these facilities have the potential to trigger a complex chain of events that lead to serious consequences for public safety.		
CBE1	Fire in a complex built environment	Fire in a large building. Up to 100 fatalities, 250 casualties with burns and/or smoke inhalation.
CBE2	Structural failure	Up to 100 fatalities depending on the size and construction of building, and occupation rates, and 350 casualties. Potential for a number of persons to be trapped or missing. Localised loss of power and other essential services. Local access routes affected due to road closures.
CBE3	Service failure	Loss of power or other key service to a large public building. Potential for trapped persons, safety issues etc.
CBE4	Crowd panic	Up to 100 fatalities due to stampede effects in confined spaces. Crush injuries and asphyxia.

Document History		
Review Date	Version	Summary of Changes
2007	0.1	Drafting
January 2008	1.0 (draft)	First version
October 2008	1.1 (draft)	Further drafting by Lead Assessor. Admin amendments.
January 2009	2.0	Scores endorsed at Dec 2008 LRF meetings. SE LRF area specific information added.
Apr 2009	2.1	Amended risk categories according to new risk matrix, LLAG 2008
Sept 2011	2.2	Admin Review
August 2014	2.3	Admin Review – change to overall risk rating in line with National Risk Register

Distribution History		
Date	Name	Version
Nov 2007	NC LRF Risk Assessment Working Group	0.1
Jan 2008	London Risk Advisory Group	1.0 (draft)
Oct 2008	London Risk Advisory Group	1.1 (draft)
Sept 2014	Circulated to LLAG.	2.3

B- Overview of Hazard

PROTECT – LONDON LOCAL RESILIENCE FORUM USE ONLY
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A complex built environment could be: Sports stadia, City or town centre complexes; Large educational establishments; Entertainment venues and arenas; Business and office complexes; Cruise ships, ferries and passenger ports; Major tourist attractions; Retail parks and shopping centres; Airports and railway stations; Conference/exhibition centres; Tunnels and tunnel complexes; Mass rapid transit systems.

The key point is that the interaction between masses of people and a complex environment may cause a small initial event to create a disproportionately great effect. This can happen very quickly. In the case of fire this may be because a mass people are unable to escape (such as at King's Cross Station, Bradford City football ground or Dusseldorf Airport). Alternatively, as a mass of people try to escape, members of the crowd may be killed or hurt by crushing and asphyxiation. There may even be a combination of the two effects (such as in the Dublin Stardust incident). In addition, surge effects within crowds can occur without direct physical stimulus, and be compounded by confined space and lack of a escape routes (such as at Hillsborough and Ibrox Park football grounds).

CBE1: Fire

Within a complex environment fire is the most potent risk owing to its multiple effects. Flame and smoke are potentially lethal. Smoke degrades visibility, obscures visual safety instructions and disrupts control. These effects can induce distress and panic.

CBE2: Structural Failure

These failures can occur as a result of design deficiencies, inadequate construction quality, degradation or overloading. In the past 25 years failures have tended to originate from the first 2 factors (such as with the Hyatt Hotel in Kansas and Charles de Gaulle Airport in Paris). Nevertheless the monitoring of possible structural degradation remains a fundamental safety management responsibility. Overloading risks can arise from changes in use, procedures and crowd movement. Therefore, any variations in those areas must be associated with a new risk assessment. Again, it is essential not to underestimate the possible impact of what may appear to be trivial changes, especially in areas and passages that carry large flows of people.

CBE3: Service Failure

Although not directly life-threatening, the loss of critical services such as lighting and ventilation can produce distress which, if unmitigated, may create serious risks. The continuity of services – as far as is reasonably practicable - is a safety-critical issue and management responsibility.

CBE4: Crowd Panic

Risks can arise from the behaviour of a mass of people, especially when they are contained in a complex and unfamiliar environment. The likelihood of adverse crowd effects depends on a range of factors, and behaviour patterns can change rapidly depending on the prevailing conditions. This is a safety management challenge that must be addressed holistically, systematically and continuously.

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(Source: based on EPC 2007: Public Safety in Complex and Built Environments Capstone Guidance on Integrated Safety Management – see http://www.ukresilience.gov.uk/~media/assets/www.ukresilience.info/cbe_guidance%20pdf.ashx).

C - Key Historical Evidence

- 10th February 2006, IKEA, Edmonton, London**, One person stabbed and several injured after 4,000 people flocked to the midnight opening of a new Ikea furniture superstore.
- 2nd January 2006, Germany** – the roof of an ice rink collapsed killing 15 people including 12 children. The collapse was due to the weight of snow on the roof following several days of severe snowfall. Subsequent investigations revealed design flaws and the use of inferior materials during construction.
- 16th February 2004, Jilin shopping Centre, China** - at least 53 people were killed and 71 injured when fire engulfed a shopping centre.
- 21st December 2001, Pretoria, South Africa** - 21 people were trapped when the roof of a shopping centre collapsed. Part of the roof fell onto an ice rink where people were skating. The collapse could have been caused by recent heavy rainfall.
- 2nd December 2000, Dongguan City, China** - at least 7 people were killed and more than 100 people were trapped when a shopping centre collapsed. Unauthorised 2nd and 3rd stories were being added to the centre at the time.
- 15th April 1989, Sheffield, England** - 96 people were crushed to death at an English FA Cup semi-final game between Liverpool and Nottingham Forest, when police open gates to alleviate crowding outside Hillsborough Stadium. The resulting rush of people onto the already filled terrace sections traps fans against riot control fences ringing the field.
- 18th November 1987, King's Cross station, London** - 27 people were killed after a major fire occurred in a machine room under a wooden escalator.
- 11th May 1985, Bradford City Football Club** – a discarded cigarette butt ignited rubbish underneath the main stand. Within 4 minutes flames had engulfed the wooden structure. 56 people lost their lives.
- 29th May 1985, Heysel Stadium, Brussels** – Liverpool v Juventus European Cup final. Rival fans at one end of the ground were separated by an inadequate fence. Fighting broke out between the 2 sets of fans, those not involved started to flee away from the trouble towards the opposite end of the enclosure but their escape was blocked by a brick wall. In the resulting crush 39 people lost their lives.
- 10th July 1980, Alexandra Palace, London** - The Great Hall, Banqueting Suite, former roller rink and theatre dressing rooms were completely destroyed in a fire. Restoration and redevelopment took 8 years to complete.
- 02nd January 1971, Glasgow, Scotland** - 66 people are killed and 140 are injured when barriers in Ibrox Stadium collapse near

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Individual Risk Assessment 50 – Complex Built Environments: HL105

the end of a match between Celtic and Rangers and fans are crushed. The incident occurs when fans leaving the stadium are met by a group trying to return after hearing that Rangers had scored an equalizer.

D - Likelihood

General Comments

In general, the safety record of public, complex urban environments is very good, and has improved significantly since the improvements to football stadia following the Hillsborough disaster in 1989. However, London has an unusual density of venues and sites for which this risk assessment is relevant.

		London
HL105	No national LRAG rating	2

E - Impact

Primary Impacts

Health

A major incident in a complex environment could cause a wide variety of serious injuries based on the nature of the incident. Burns and crush injuries are the most likely, along with asphyxia from smoke or dust inhalation. Survivors are likely to suffer from acute distress.

- Up to 60 fatalities and 200 injured
- Serious injuries - burns, crush injuries, impact injuries.
- Smoke inhalation and asphyxia.
- Walking wounded, and traumatised survivors.
- Potential widespread pressure on local hospitals and the wider NHS Pan London.
- Potential long term local health impact on victims.

Social

A serious emergency of this kind would have a major impact on the local community, due to the disruption during the response phase.

- Disruption of local services and amenities delivered from the affected site.
- Localised disruption to transport and communications.
- Widespread concern about public safety.

Economic

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Individual Risk Assessment 50 – Complex Built Environments: HL105

The economic costs would be severe for the site operator, for local traders dependent on income generated by visitors to the site and for those dependent upon the site. The impact would be very large in the short-term, but with a potential long-term effect depending on the public perception of the incident. Long term cost to repair, clear and rebuild site.

Environmental

It is likely that the environmental impact would be limited to the immediate site, but it should be noted that there is the potential for toxic release in the case of fire. The urban nature of these venues limits ecological damage in most cases. Damage caused by smoke and/or dust.

Secondary Impacts

Health

- Inhalation of smoke, dust etc from the site.
- Potential release of asbestos.

Social

- Disruption to local services during response phase due to transport disruption.

Economic

- Loss of confidence.

Complex Build Environments

	Health	Social	Economic	Environmental	Overall Impact
London Average	4	3	4	2	3

F - Vulnerability and Resilience

London has a large number of sites including high numbers of football stadia. However these sites are typically well-managed, with local arrangements in place for security, communication with businesses and other building users, and local engagement with the police and other emergency services.

G – Overall Assessment

	Health	Social	Economic	Environmental	Overall Impact	Likelihood	Risk Category
London Average	4	3	4	2	3	2	MEDIUM

PROTECT – LONDON LOCAL RESILIENCE FORUM USE ONLY
Individual Risk Assessment 50 – Complex Built Environments: HL105

LRF Specific Information - Sites to which these hazards are applicable are listed below.	
Central	Westminster <ul style="list-style-type: none"> • Various locations in Theatreland – cinemas and theatres
North Central	Barnet Camden <ul style="list-style-type: none"> • Kings Cross St Pancras Station • Euston Station • Various locations in Theatreland – cinemas and theatres Enfield Hackney Haringey <ul style="list-style-type: none"> • Tottenham Hotspur Football Ground, Tottenham. • Alexandra Palace. • Wood Green Shopping City. Islington <ul style="list-style-type: none"> • Arsenal FC Football Ground (The Emirates Stadium)
North East	Newham <ul style="list-style-type: none"> • Westfield Shopping Centre Havering <ul style="list-style-type: none"> • Mercury, Liberty, The Brewery Shopping Centres • Queens Hospital
West	Hammersmith & Fulham <ul style="list-style-type: none"> • Westfield Shopping Centre Brent <ul style="list-style-type: none"> • Wembley Stadium • Wembley Arena
South East	Croydon <ul style="list-style-type: none"> • Crystal Palace FC. Football ground. • The Whitgift Shopping Centre. Bexley <ul style="list-style-type: none"> • Cineworld, Multi Screen Cinema Complex. • The Mall Shopping Centre, Broadway, Bexleyheath. Bromley

PROTECT – LONDON LOCAL RESILIENCE FORUM USE ONLY
Individual Risk Assessment 50 – Complex Built Environments: HL105

	<ul style="list-style-type: none"> • Crystal Palace National Sports Stadium. • Intu shopping centre. <p>Greenwich</p> <ul style="list-style-type: none"> • O2 arena and surrounding facilities. • Charlton Athletic FC - Floyd road SE7 • Odeon Charlton <p>Lewisham</p> <ul style="list-style-type: none"> • Millwall FC. Football Ground, The New Den, Zampa Road. • Riverdale Shopping Centre. Lewisham.
South West	

Controls in Place

Legislation

- The Health and Safety at Work Act 1974.
- The Management of Health & Safety at Work Regulations 1999.
- Fire and Rescue Services Act 2004 & guidance pursuant to the Regulatory Reform (Fire Safety) Order 2005.
- Safety at Sports Grounds Act 1975 and Fire Safety and Safety of Places of Sport Act 1987.
- Dept Culture, Media & Sport published 'Guide to Safety at Sports Grounds' edition 5, June 2008.

Prevention Measures

- Local building safety systems and practices.
- Safety Advisory Groups in place at major sports grounds.

Response

- LFB USAR Capability
- LAS USAR / HART Capability - Working in or on collapsed structures to support Fire Service colleagues with casualty management. This involves triage, stabilisation, and advice on best methods of recovery.
- Regional Site Clearance Plan, Mass Fatalities Plan, Humanitarian Assistance Centre Plan, Regional Command & Control Protocol and supporting documents/arrangements.
- Site operators on-site emergency plans (where applicable)
- Cat 1 responder contingency plans (generic and/or site specific) including Health Service Mass Casualty Plans.
- Local authorities: evacuation and rest centre plans.
- Individual venue contingency plans.

Additional risk treatment required

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Individual Risk Assessment 50 – Complex Built Environments: HL105

- Borough EP Managers to ascertain level of comms and engagement with stadia and CBEs as part of local risk assessment and EP practices.
- December 2008 London LRFs endorsed the recommendation for all Safety Advisory Groups established for complex built environments (e.g. sports stadia) to consider the risk assessment for Complex Build Environments (HL105).