40 Years of Fire Safety Engineering at Edinburgh University

Fire safety design in practice

Prof B Lane
Arup

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Forty years of Fire Safety Engineering:

Where are we, how did we get here, and where are we going?

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Fire safety design in practice

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Over the years, Arup has maintained close ties with the fire safety engineering unit; from PhD funding, through to The Ove Arup Foundation supporting the University's research into fire safety in buildings, as well as the social aspects of fire safety Dr Graham Spinardi; plus the more recent Ove Arup + Partners Ltd sponsorship of the appointment of Dr Luke Bisby as Edinburgh's first Arup Professor of Fire and Structures

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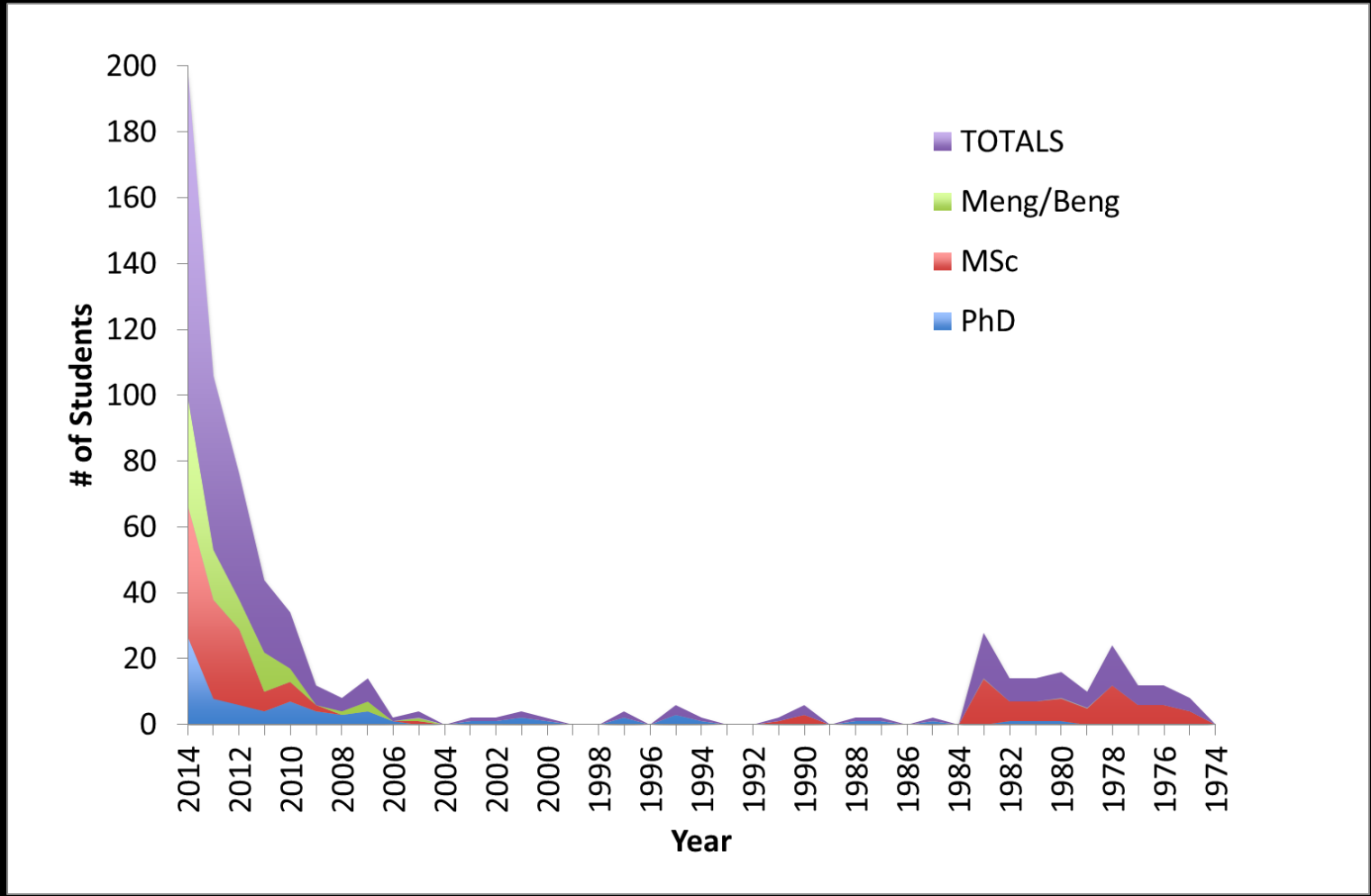
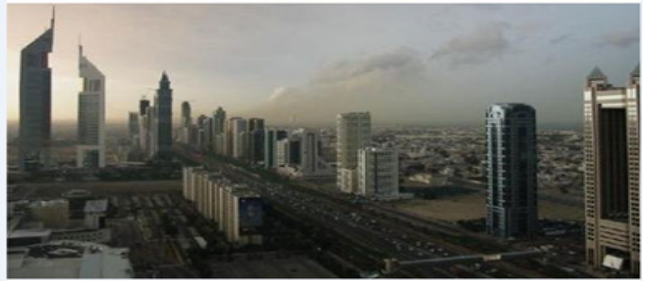

200
180
160
140
120
100
80
60
40
20
0
# of Students
2014
2012
2010
2008
2006
2004
2002
2000
1998
1996
1994
1992
1990
1988
1986
1984
1982
1980
1978
1976
1974
Year
TOTALS
Meng/Beng
MSc
PhD

Cityscapes over the 40 years

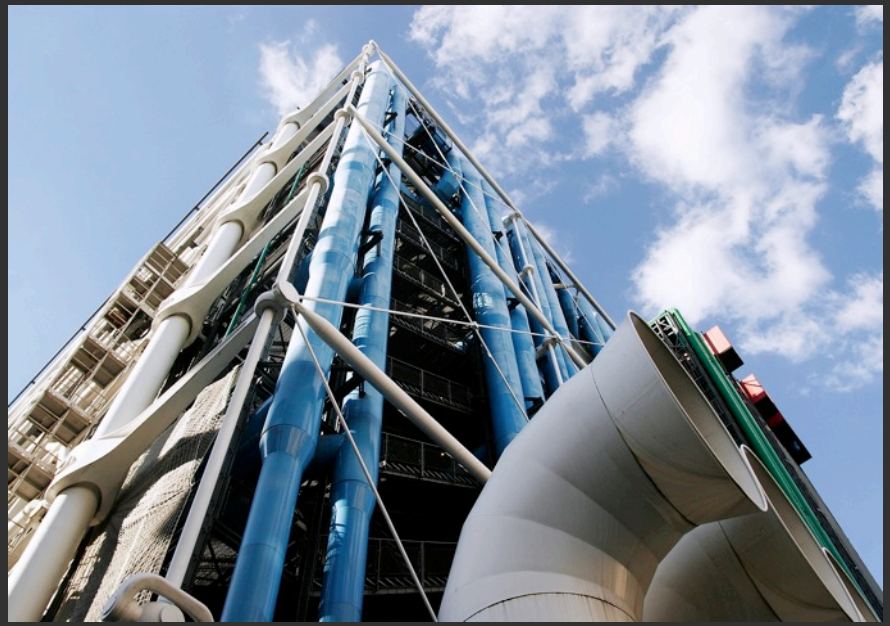
Dubai



London

Hong Kong

1970s



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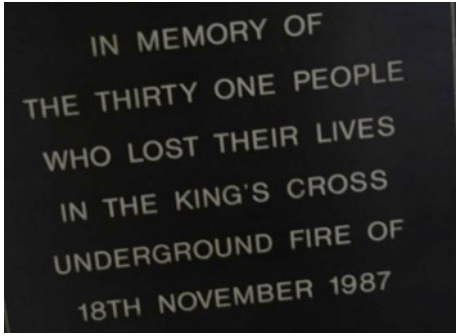
1980s



Kings Cross Underground Fire

Year: 1987
Location: London, United Kingdom

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1990s

Shenzhen Swimming Centre 1998

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Infrastructure Projects

Infrastructure Projects in the 90s

Tauern Tunnel, 6.4km long Austria, 29 May 1999
Railway Tunnel, 9km long, Salerno Italy, 22 May 1999
Mont Blanc Tunnel, 11.6km long, France/Italy, 24 March 1999
Oslofjord Tunnel, Norway, 1999
Gueizhou Tunnel, 800m long, China, 10 July 1998
Exilles Rail Tunnel, 2.1km long, Italy, 1 July 1997
Channel Tunnel, 51km long, France/UK, 18 November 1996
Isola della Femmine Motorway tunnel, 148m long, Italy, 18 March 1996
Baku Underground Railway/Metro, Azerbaijan, 28 October 1995
Pfander Tunnel, 6.7km long, Austria, 10 April 1995
Huguenot Tunnel, 4km long, South Africa, 27 February 1994
Serra a Ripoli Tunnel, 442m long, Italy, 1993
Unnamed Tunnel, South China, August 1991
Moscow Underground Railway/Metro, Russia, 1 June 1991
New York Underground Railway/Metro, USA, 28 December 1990
Mont Blanc Tunnel, 11.6km long France/Italy, 11 January 1990

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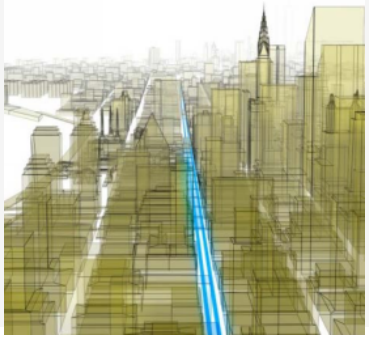

Infrastructure Projects

Connecting Cities, Connecting countries
Increasing scale of infrastructure schemes

Fire engineering essential to achieve life safety and business continuity goals.

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History of Fires (Infrastructure)

1980's
- King's Cross Station Fire, London 1987
- Caldercott Tunnel, Oakland USA, 1982

1990's
- Mont Blanc Tunnel, 11.6km long, France/Italy, 1999
- Channel Tunnel, 51km long, France/UK, 1996
- Baku Underground Railway/Metro, Azerbaijan, 1995

2000's
- Burnley Tunnel, 3.5km long, Australia, 2007
- Channel Tunnel (during construction), UK, 2005
- St. Gotthard Tunnel, 16.9km long, Switzerland, 2001
- Santa Clarita, California, USA 2012

Key lessons learnt
- Fire behaviour in tunnels – Fire testing needed
- Fire sizes significant
- Impact on structure
- Human behaviour
- Business continuity implications

Infrastructure Projects

Crossrail London






2000s

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1 Bligh Street, Sydney, NSW

Evolution of Tall Buildings

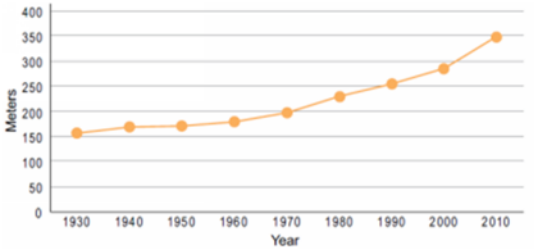
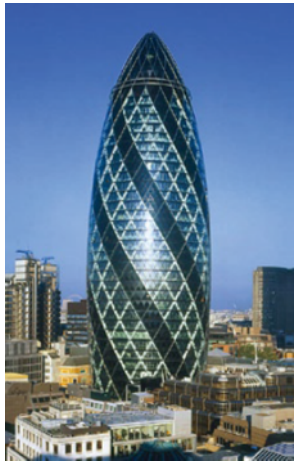


Figure 1: Average height of the 100 tallest buildings in the world [CTBUH, 2010]

Highpoint 1, London, Residential,
Engineer; Ove Arup, 1935

Standard Bank,
Johannesburg
1968
158m

Hopewell Tower,
Hong Kong
1977 – 1998
308m



30 St. Mary Axe,
London,
2001-2004
180m

Guangzhou TV Tower
2010
610m

The Shard, London
2009 – 2013
308m

Tall buildings
video






World Trade Center Towers Collapse

Year: 2001
Location: New York, United States of America

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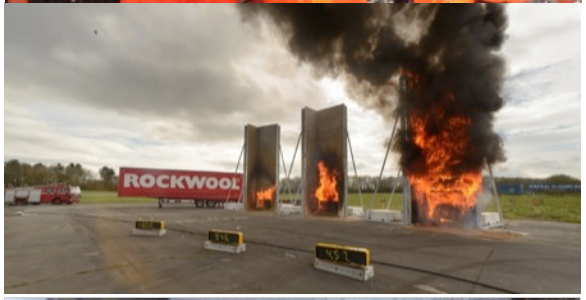


2010s

Significant drivers for the changes through this period include:

- The Information age and the digital revolution
- Spaces to live and work for the digital age
- Urbanisation of our population and the growth of mega cities
- New materials and the role of global warming and/or energy regulation depending on your politics
- Increasing affluence and desire for wealth (financial markets)

Forty years of Fire Safety Engineering:

*Where are we, how did we get here**, and where are we going?***

Facade Evolution

Facade Evolutions

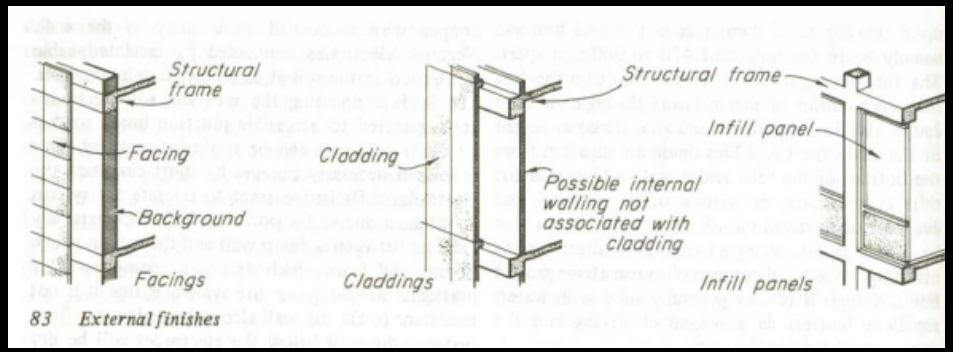
Significant changes in the facade design driven by thermal performance, improved solar control, reducing facade build ups and visual appearance

BREEAM (Building Research Establishment Environmental Assessment Methodology) – first published 1990

Internationally most used method of assessing, rating, and certifying the sustainability of buildings

LEED (Leadership in Energy and Environmental Design) – first published in 1994

US rating system to design, construct and operate and maintain sustainable buildings



An Aging World

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Within only 10 years, there will be one billion older people worldwide.

By 2050 nearly one in five people in developing countries will be over 60

Consequences by 2050 include Dementia, Diabetes, Cancer, COPD, Heart Disease and Sensory Loss

UK Population Growth Projections				
	Growth over next 10 years	*Revision since 2004*	Growth over next 20 years	*Revision since 2004*
Over 50s	3.5 m (17%)	*+ 100k*	6.2 m (30%)	*+ 430 k*
Over 65s	2.3 m (24%)	*+ 100k*	4.9 m (49%)	*+ 350 k*
Over 80s	640 k (25%)	*+ 120 k*	2.2 m (79%)	*+330 k*
Total Population	4.5 m (7%)	*+ 1.9 m*	8.6 m (14%)	*+3.6 m*
Source: Population projections, 2006-based, principal projections, Office of National Statistics, 2007				

Britain is going through an extraordinary demographic transition:

- *20.3 million people are over 50, up 490,000 since 2002 (2.5%)*
- *11.2 million are over State Pension Age, up 320,000 since 2002 (2.9%)*
- *2.6 million are aged over 80, up 120,000 since 2002 (4.8%)*

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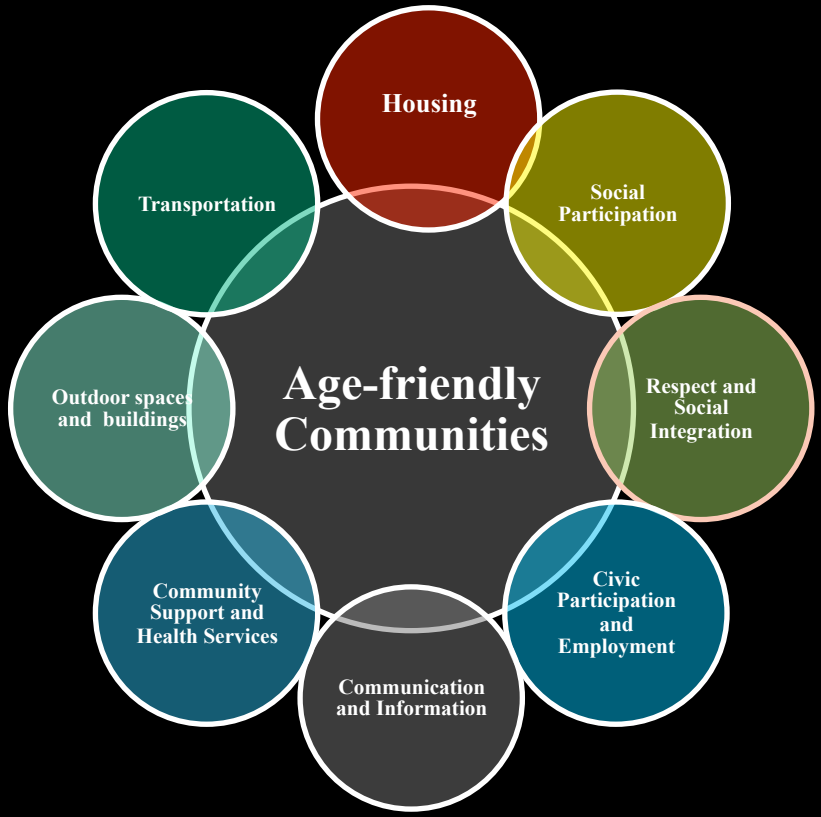
Independent Life

…. So what do people need to enable it?

A *liveable community* is one that has affordable and appropriate housing, supportive community features and services, and adequate mobility options, which together facilitate personal independence and the engagement of residents in civic and social life



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Key Considerations:

What is the impact of the built environment on the mental health of older people?

Do behavioural change programmes increase the use of technology in health and social care?

How can smart city planners ensure the development of liveable communities?

What are the optimum designs for transport systems for older people and those with disabilities?

How can we design cities to favour mixed communities?

What are the most effective interventions for increasing older urban dwellers' contact with nature and how does this affect wellbeing?

How could street lighting be improved to optimise vision in older people and those with visual challenges?

What type of accessible walkways would help increase physical exercise and the social integration of older people?

Could autonomous vehicles solve transport difficulties experienced by older people?

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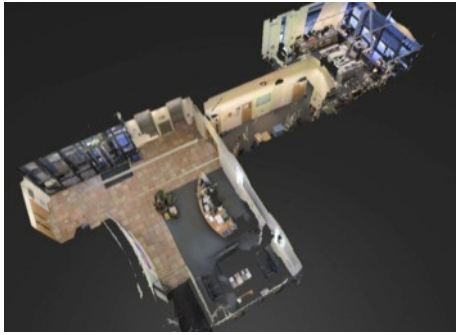
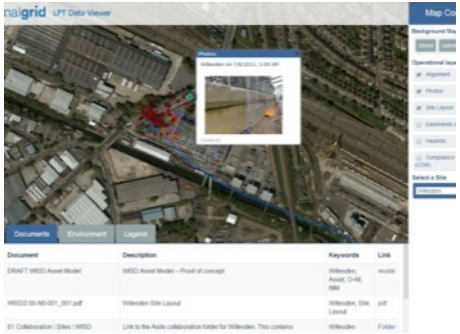
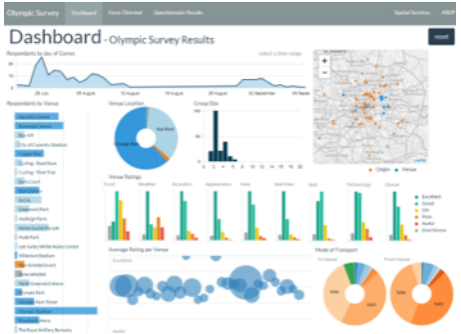
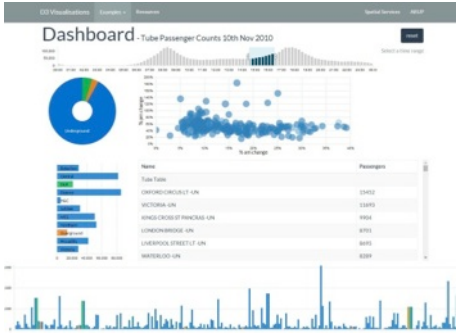
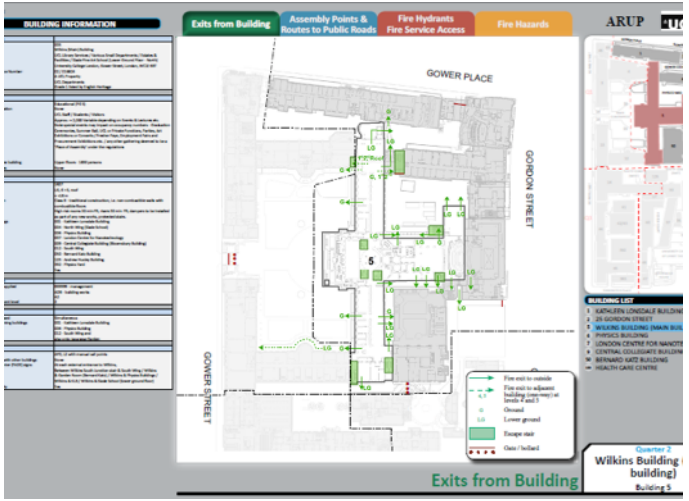








Spatial services: Data capture



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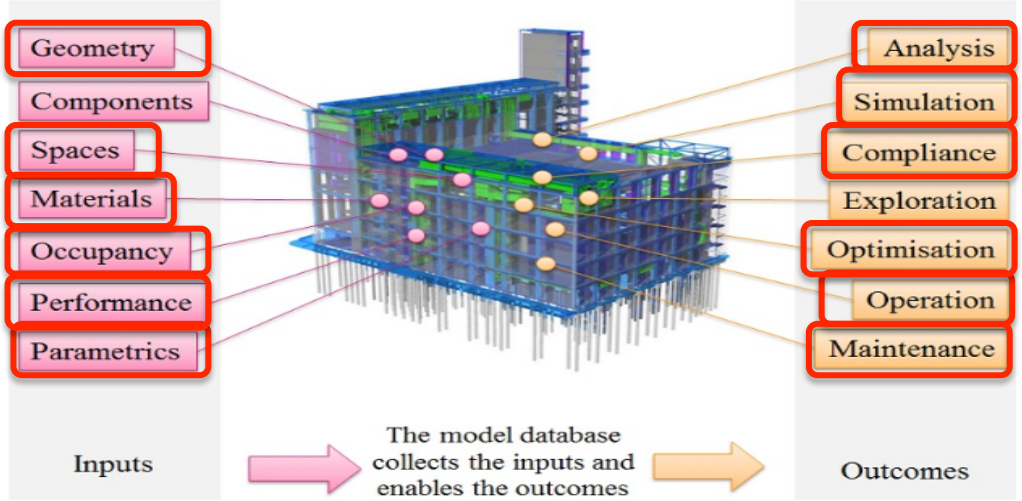
BIM

- BIM = Building Information Modelling, or Building Information Management
- BIM ≠ 3D modelling

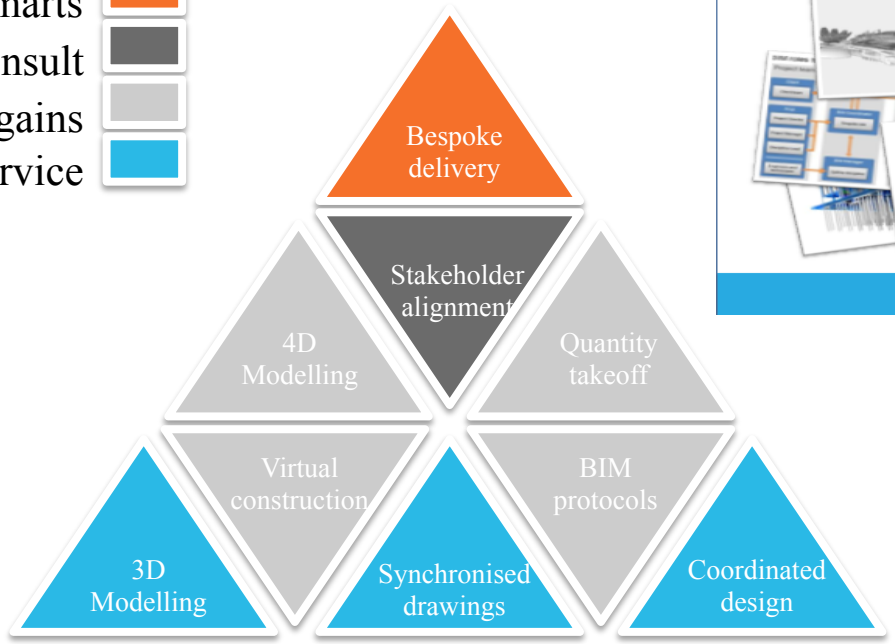


as fire engineers we deal with this

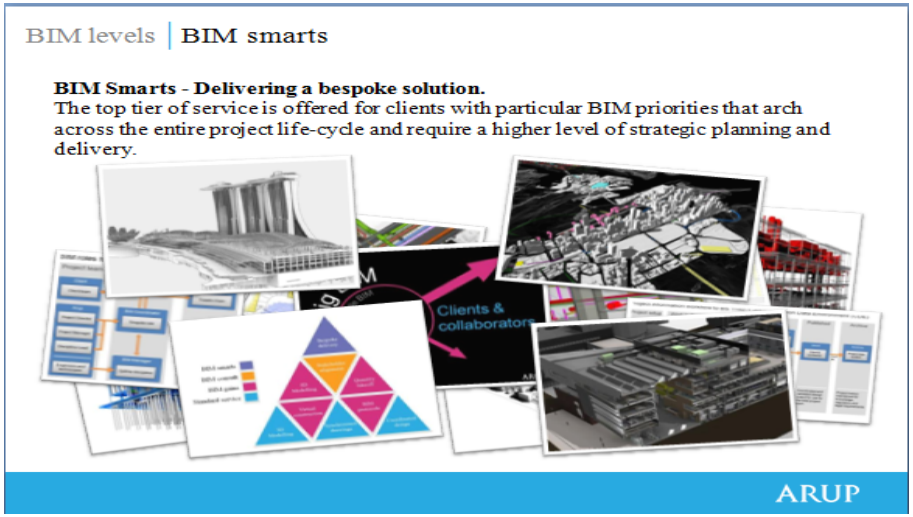
Image from bimguide.arup.com

BIM opportunities

BIM smarts
BIM consult
BIM gains
Standard service

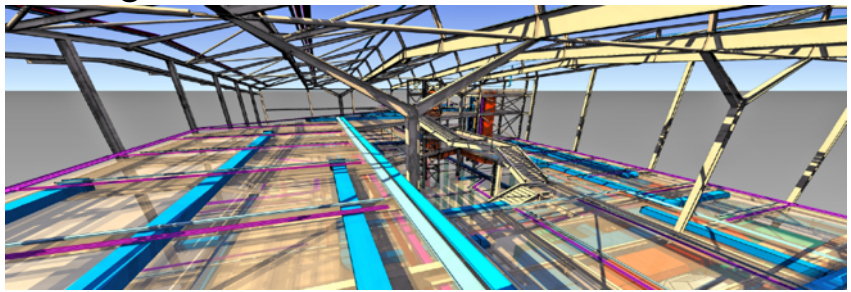


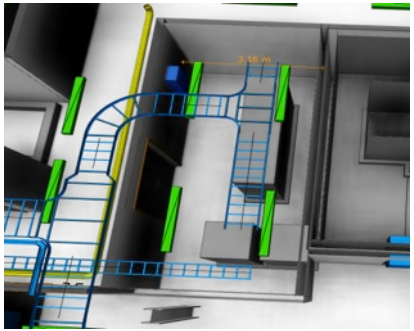
BIM value triangle | client engagement tool



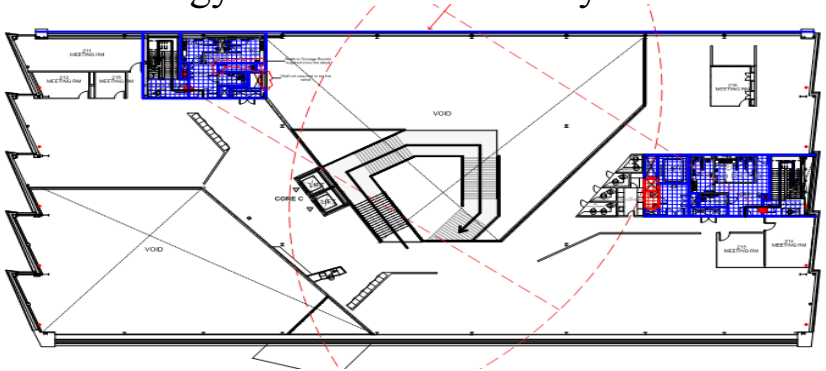
An example – during design

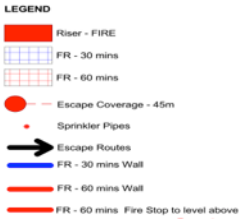
Architecture, SMEP coordinate and exchange information in 3D



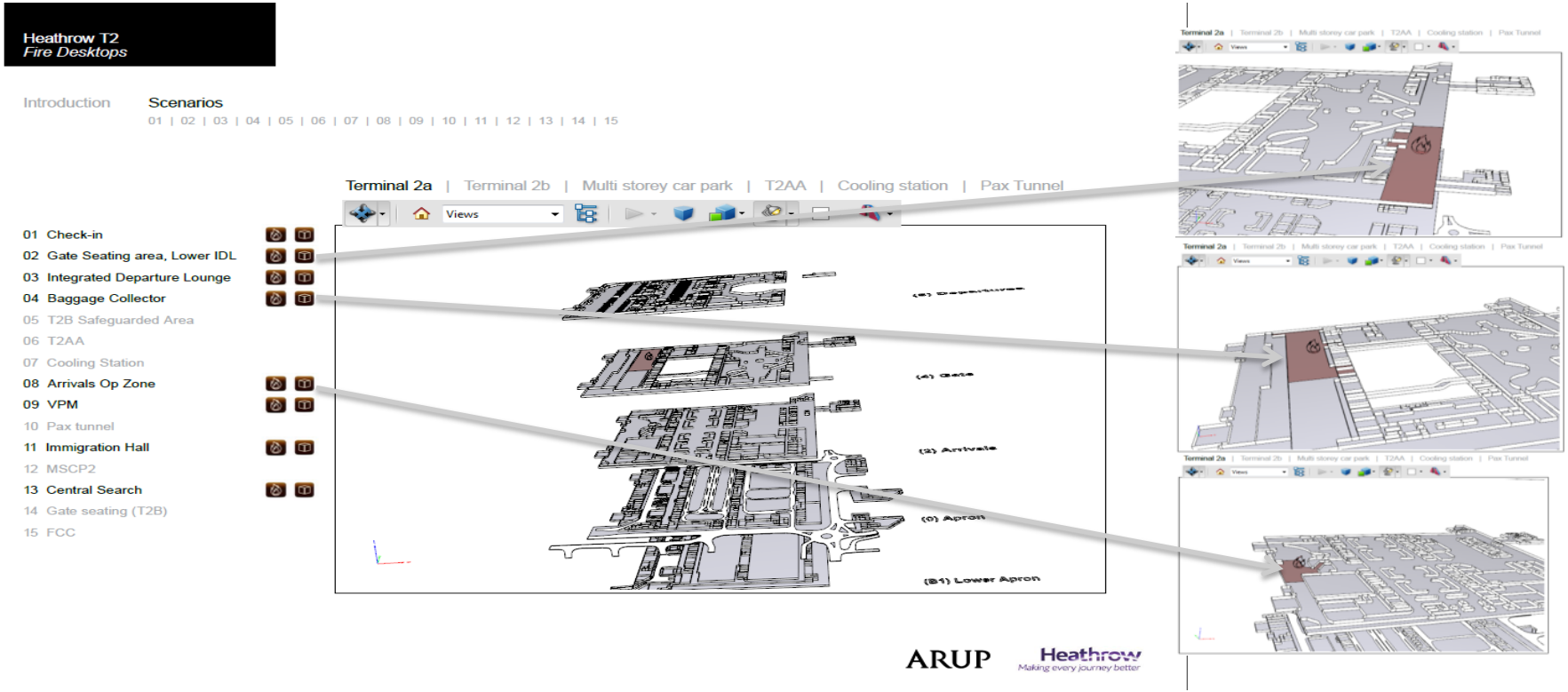


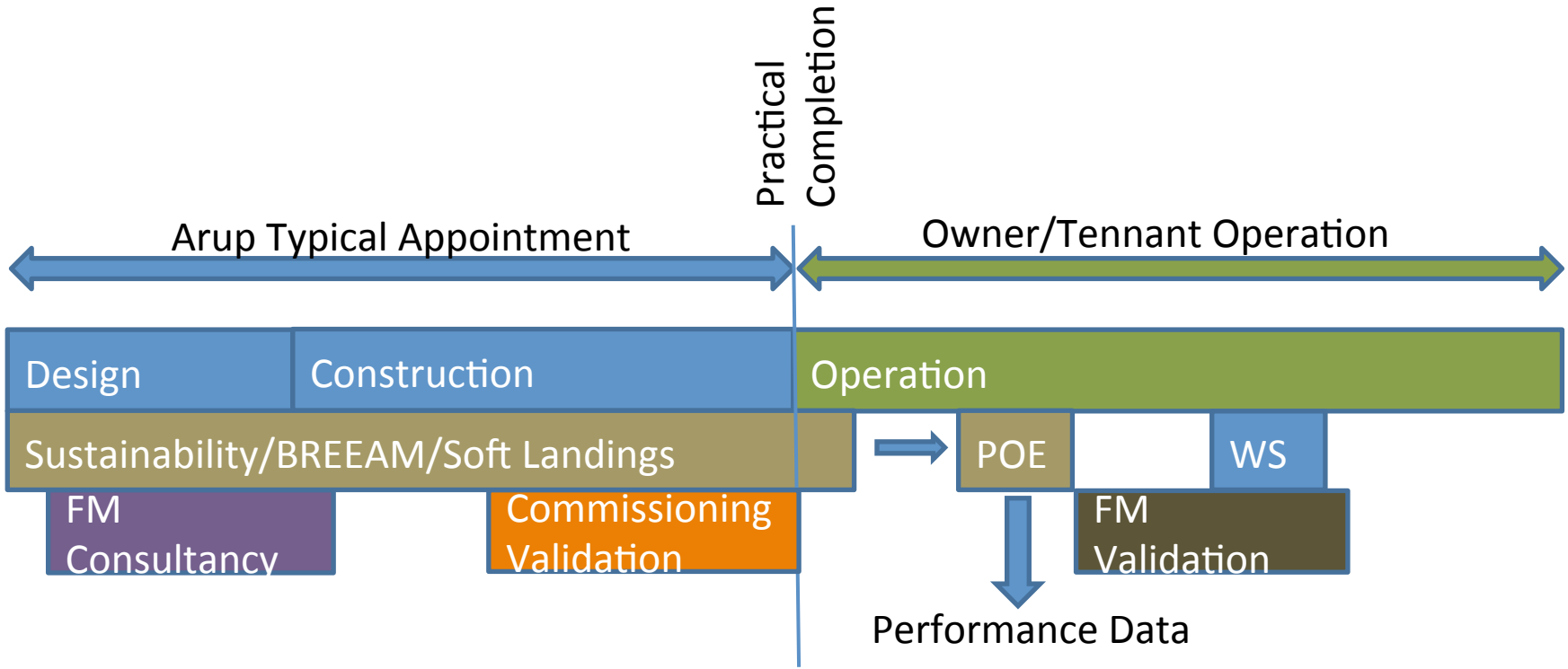
Fire strategy coordination entirely done in 2D



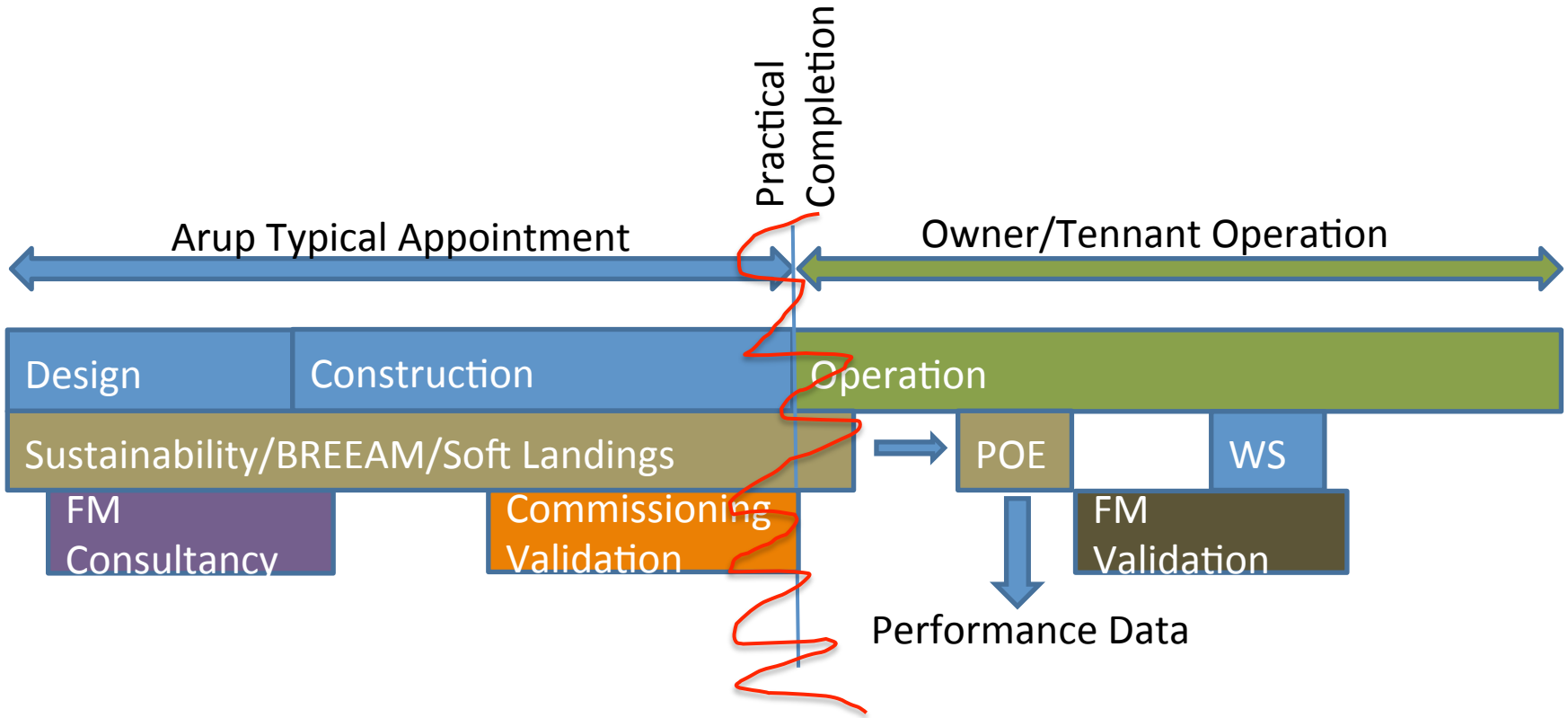


In Use – Operational Readiness





If you add in a range of specialists/consultants


Practical Completion
Arup Typical Appointment
Owner/Tennant Operation
Design
Construction
Operation
Sustainability/BREEAM/Soft Landings
POE
WS
FM Consultancy
Commissioning Validation
FM Validation
Performance Data

Fire engineers for the Total Fire Safety concept

Great things can happen when, "all relevant **fire design, construction and operation** decisions have been **considered together** and have been **integrated into a whole** by a **well organised team**."

Thank You

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