Understanding fire performance through science

IFE Annual Fire Safety Conference – Dublin
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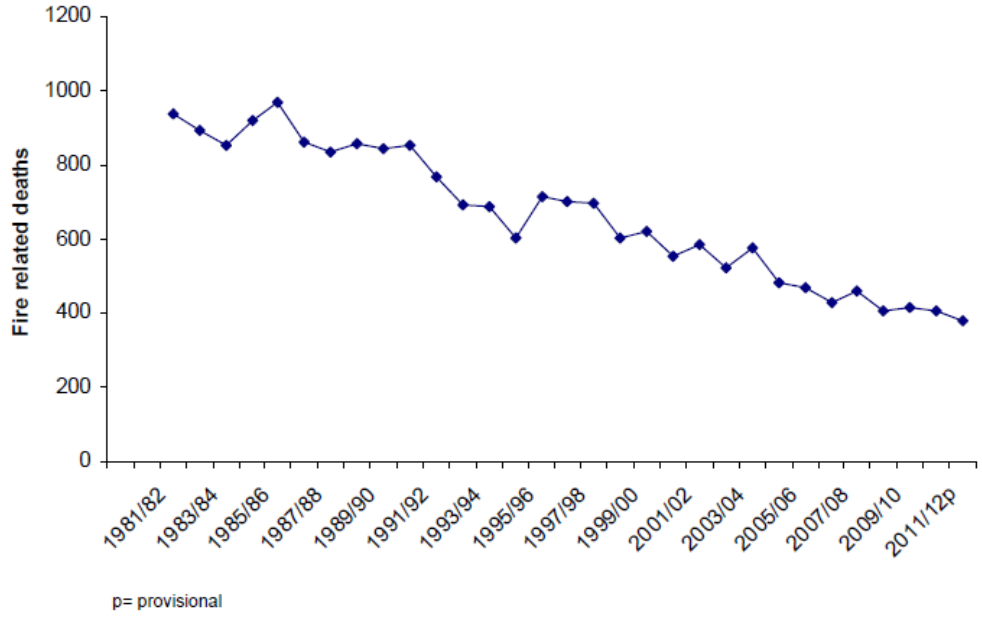
Dr Debbie Smith OBE
Managing Director, BRE Global

Trend in fire deaths in the UK since 1981

Department for Communities and Local Government

NATIONAL STATISTICS

Figure 1.4: Fatalities from fires, Great Britain, 2000/01 – 2011/12



Some regulatory changes

- Smoke alarms (1992)
  - 8% in 1988
  - 74% in 1994
  - 86% in 2008

- Furniture and furnishings fire safety regulations introduced in 1988
  - Match resistance
  - Cigarette resistance

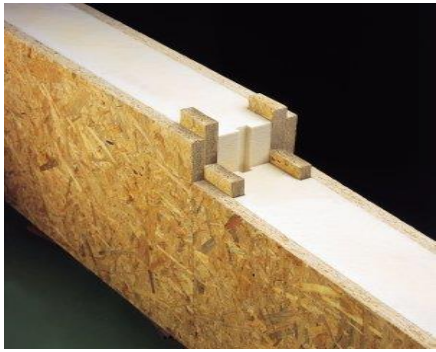
- Reduced ignition propensity cigarettes
  - Mandatory in EU countries from November 2011
  - Impact not yet clear

- Construction Products Regulation
  - Mandatory CE marking for all construction products placed on the market in EU countries from 1st July 2013

Our world is continuing to change

- Most significant changes in building technology have been occurring over the last 20 years
- Moved from traditional construction (e.g. masonry, heavy) to more lightweight, easier and faster to construct
- Driven by needs to;
  - Reduce energy consumption during use
  - Reduce waste during construction and use
  - Reduce end of building life environmental impact by consideration and focus reduction of hazardous materials, recycling and re-use

Modern Built Environment

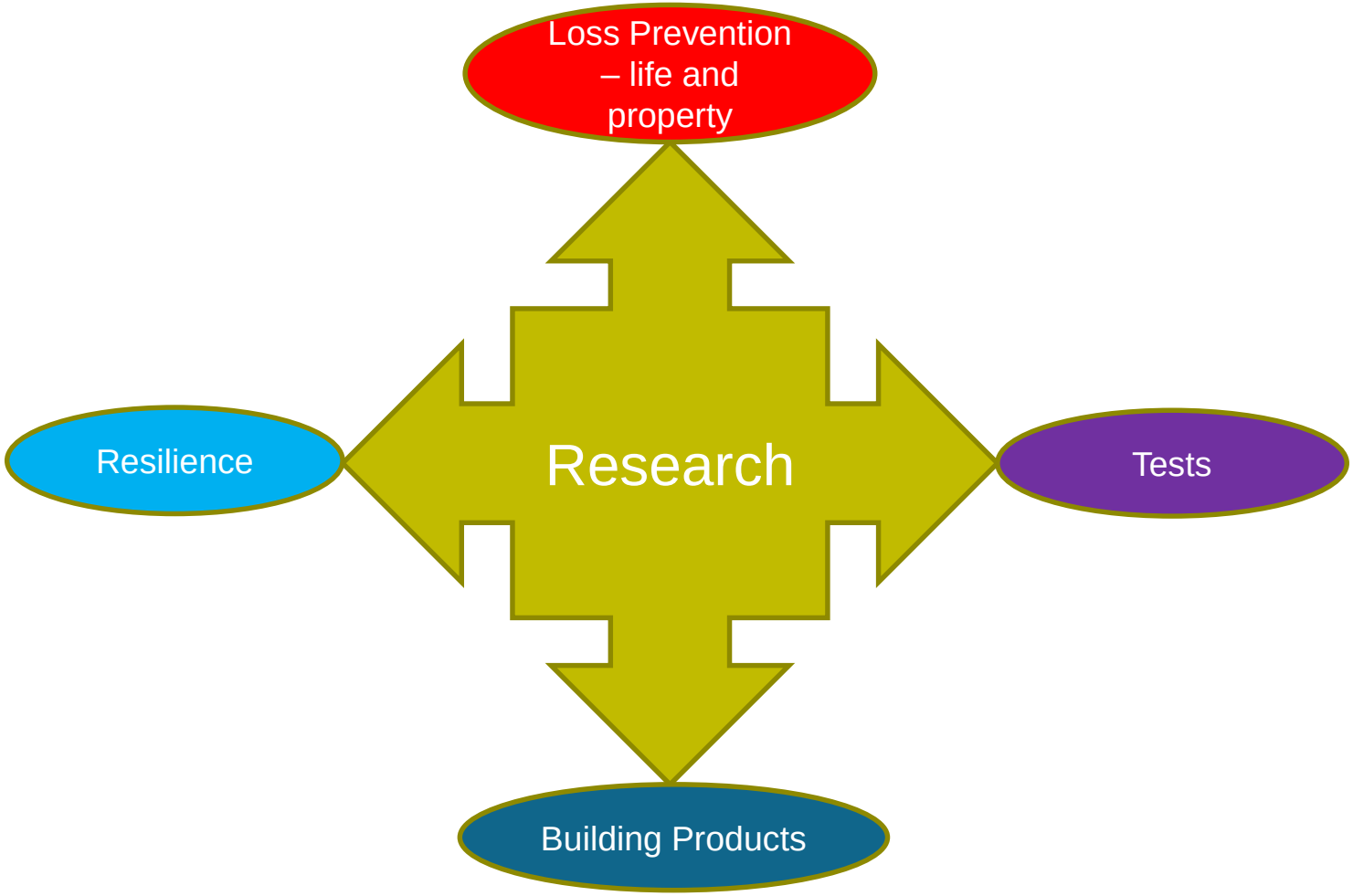


New construction technologies

Some issues we face

- No historical database available to assess performance of new systems, construction methods
- Possibility of systematic faults/poor quality of installation
- Use of new materials (in particular increasing use of highly insulating combustible materials to reduce energy demand)
- New methods for testing and benchmarking fire performance of products and systems
- New requirements for air tightness in buildings
- Levels of safety and property protection unknown
- Possibility of disproportionate damage

Products and services underpinned by research to ensure technical robustness



Collaboration with Academia – longer term research

- Investing in solving fire protection problems through research and collaboration
  - In 2003, the first BRE University Centre of Excellence was set up at Edinburgh – BRE Centre for Fire Safety Engineering plus an additional 4 UCEs (Bath, Cardiff, Strathclyde, Brasilia)
  - Through education and research, the BRE Trust (a charity) promotes and supports excellence and innovation in the built environment for the benefit of all
    - Funding has been provided to support
      - Chair of Fire Safety Engineering(Prof.Jose Torero, Prof. Albert Simeoni and now Prof Grunde Jomaas)
      - 14 PhDs – the next generation of leaders in the field

BRE Trust Funded Research projects

- *Spill plume analysis*
- *Fire safety issues related to high rise and super rise buildings*
- *External cladding systems*
- *Characterisation of fire development in combustible cavities (joint project with NHBC Foundation)*
- *Cost effective fire solutions for healthcare*
- *Non intrusive examination of cavities and voids*
- *Security measures to reduce arson in schools*

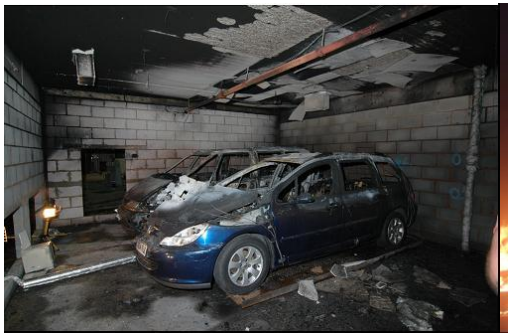
Research projects contd

- *Performance and analysis of fire protection coatings for steelwork*
- *Glazing in FSE design*
- *Water mist fire protection systems in different occupancies*
- *Smoke visualisation*
- *Evacuation of mobility impaired building occupants*
- *Defining common causes of false alarms*
- *External fire spread and building separation*
- *Defining flashover*
- *Benchmarking economic and environmental impact of fire protection measures*

Direct research – shorter term applied research

- Investigation of real fires
- Emergency use of lifts or escalators for evacuation and fire and rescue service operations (Tall building study – post 9/11)
- Fire spread in car parks
- Fire performance of escape stairs
- Environmental impact of fires
- Fire performance of SIP systems in construction
- Fire performance of wall coverings
- External cladding systems
- Compartment Sizes, Resistance to Fire and Fire safety



External fire spread – a growing issue?

- External fire spread – control of insulation materials and performance of cladding systems for use above 18m
- Can't regulate and control/manage fire performance based on material test performance
- Must make sure that we understand and control system performance

Specialist Fire Investigations

Have included

- Channel Tunnel
- Mont Blanc Tunnel
- Yarlswood Asylum centre UK
- Rose Park care home Scotland
- Harrow Court Stevenage residential UK
- Lakanal House
- and

Monica Wills, Bristol 2006

- Sheltered accommodation flats
- Building sprinklered
  - Except car park
- 22 cars and 2 vans involved
- Fire broke in through windows
- 1 fatality in flat directly above car park
- Some damage to concrete floor slab
  - Insulation on ceiling

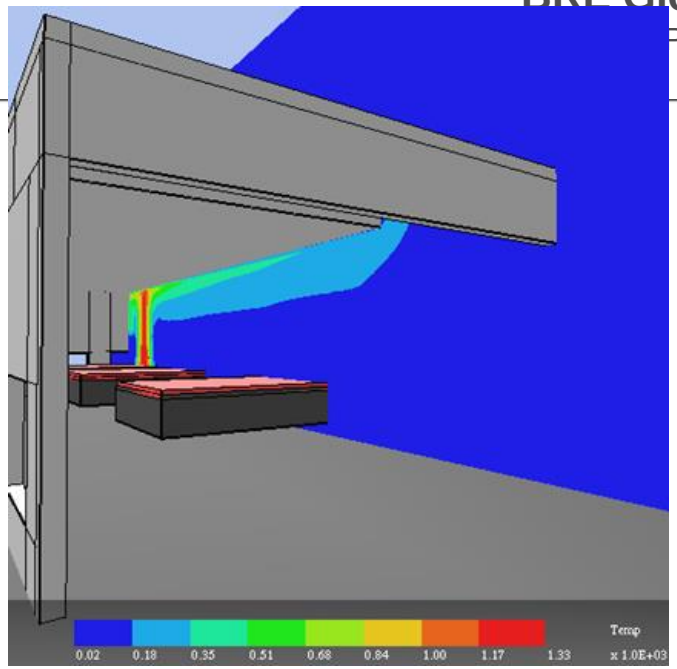
Photos courtesy of Avon Fire and Rescue Service

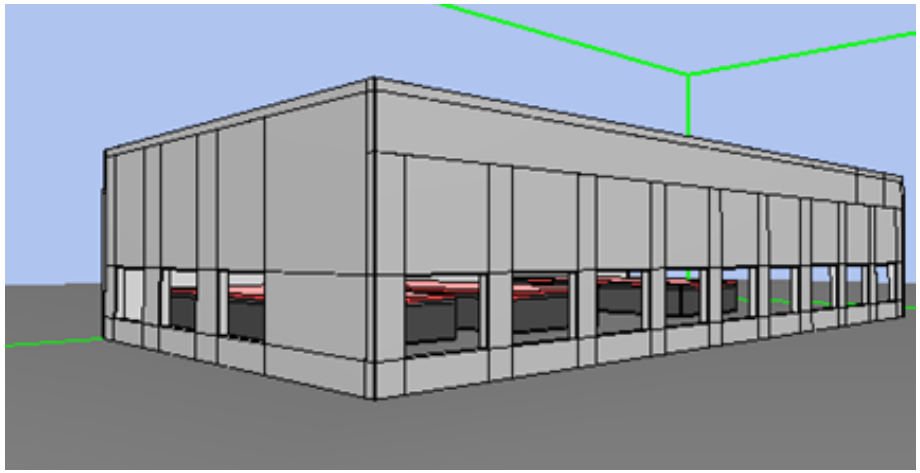
Naples Street, Manchester 2008

- Secure, residents car park beneath recently converted apartment building
- Two cars destroyed, multiple others with heat damage
- Entire apartment block evacuated due to smoke
  - Corridors smoke logged prior to any alarm detection
- Flames reached an apartment bedroom through service pipes, burning the bed
- No linked detection between car park and residents apartments

Research

- Experimental design
- Computer modelling
  - Validation
  - Prediction of outcomes

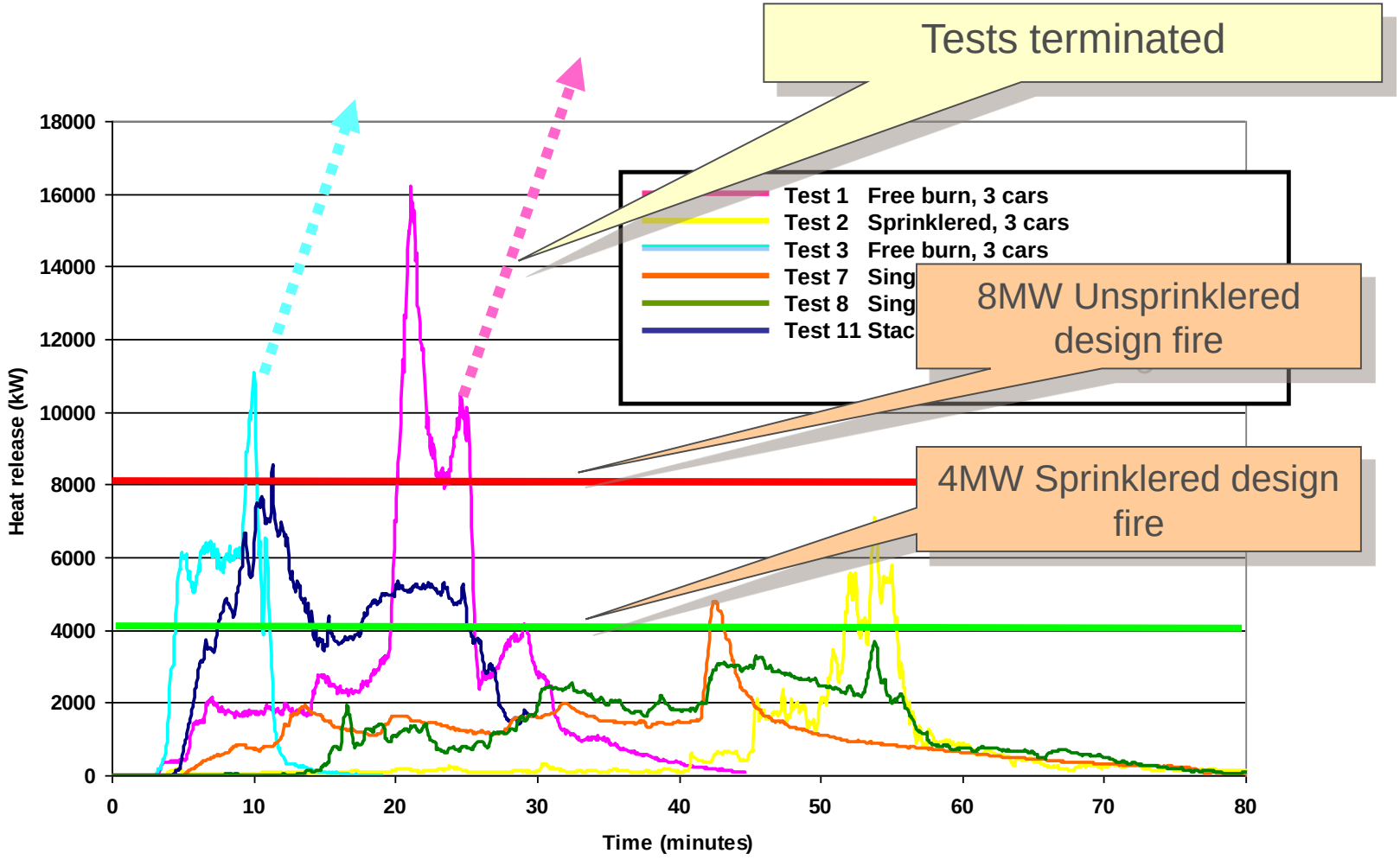




Three cars, small to medium sized, unsprinklered

Car stacker, unsprinklered

HRR from this research versus Steady state fires



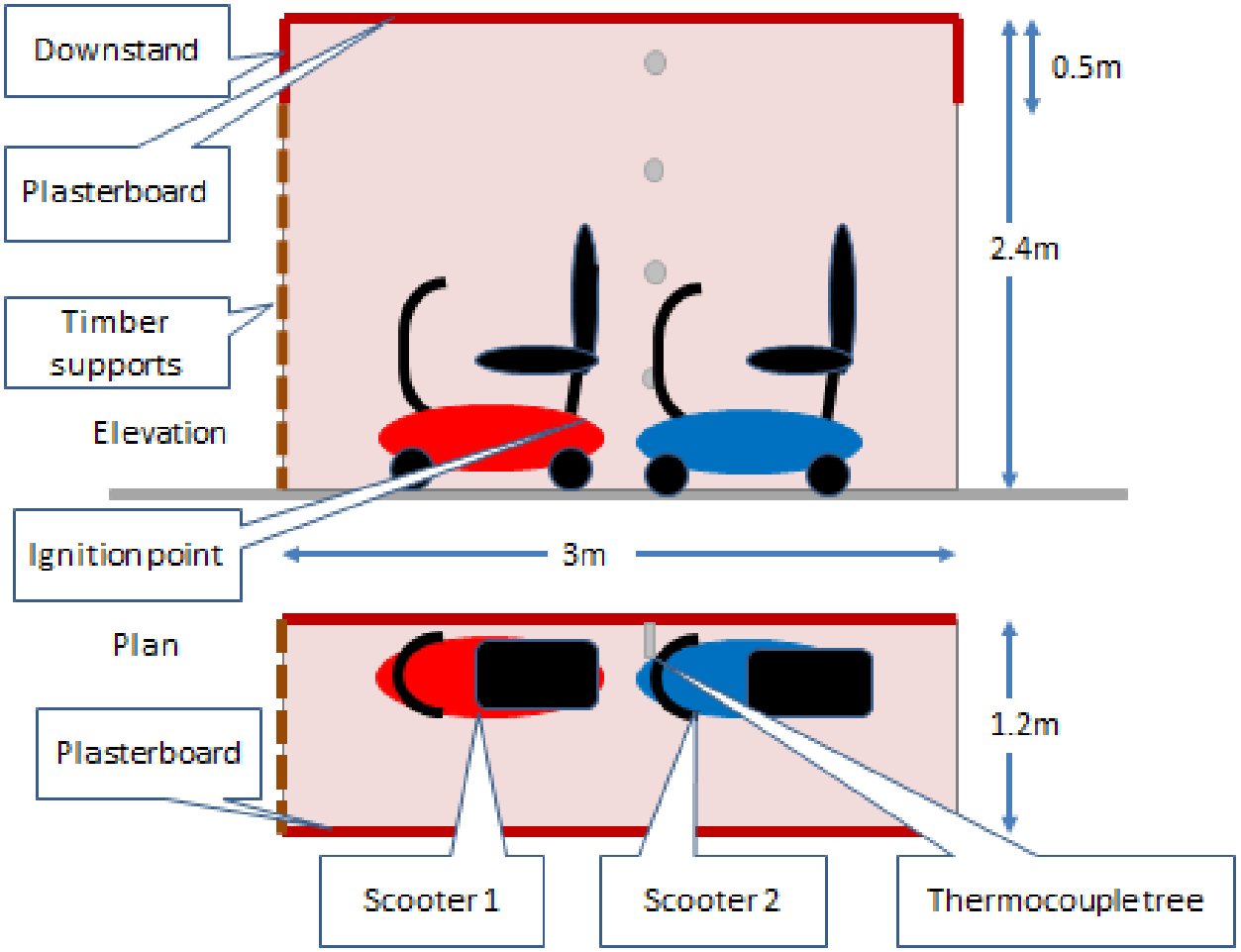
Understanding and learning

- New fire (HRR vs time) curves for FSE design solutions
- New data on fire spread between adjacent cars
- Impact of stacking cars is better understood and quantitative data for design has been produced
- All data from work programme is publicly available

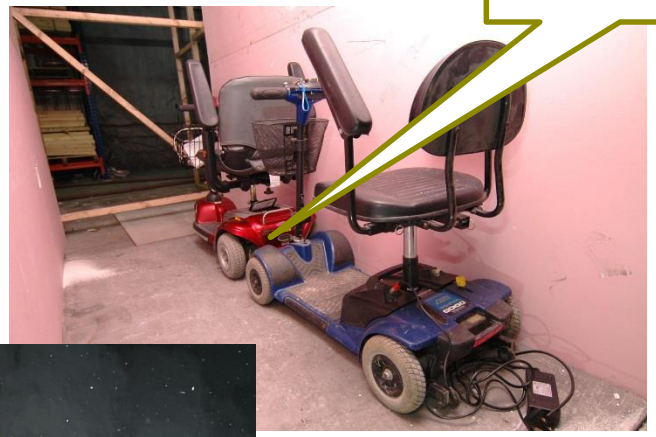
The problem with mobility scooters

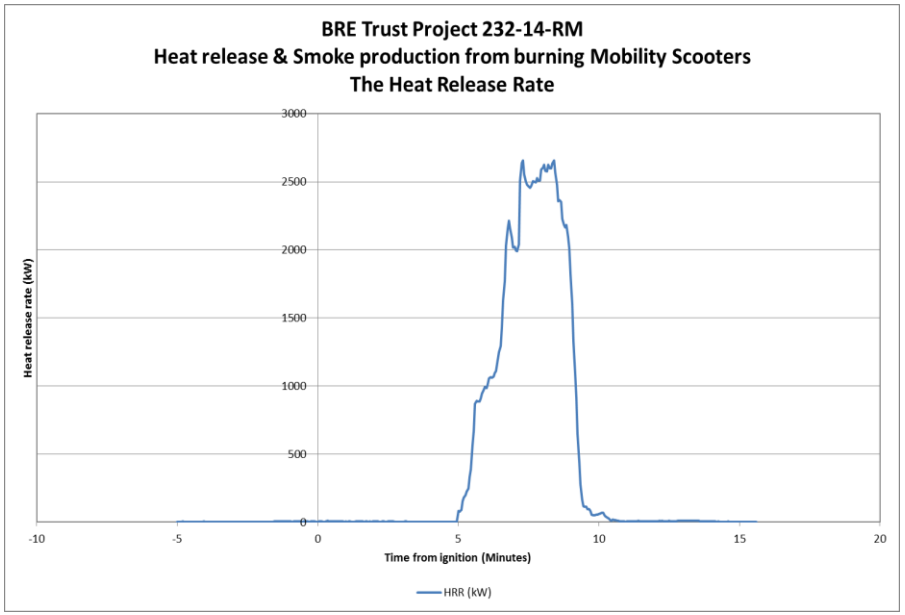
- There have been a number of fire incidents involving mobility scooters already reported:
  - A fatal fire involving a mobility scooter left on charge overnight.
  - A case of a fatal fire that was a result of an arson attack on a scooter.
  - In one case, it is reported that the scooter “exploded”.

Experimental rig

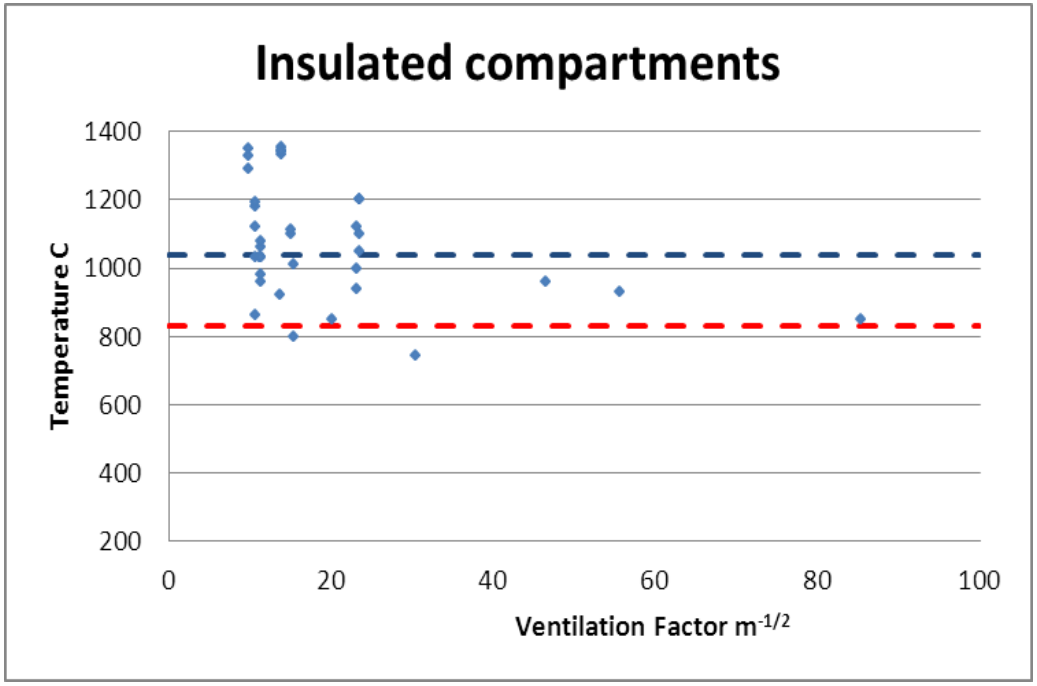


Scooters under test





Impact of insulation on compartment temperatures
(U values 0.8 to 3 W/m2/ ºC)

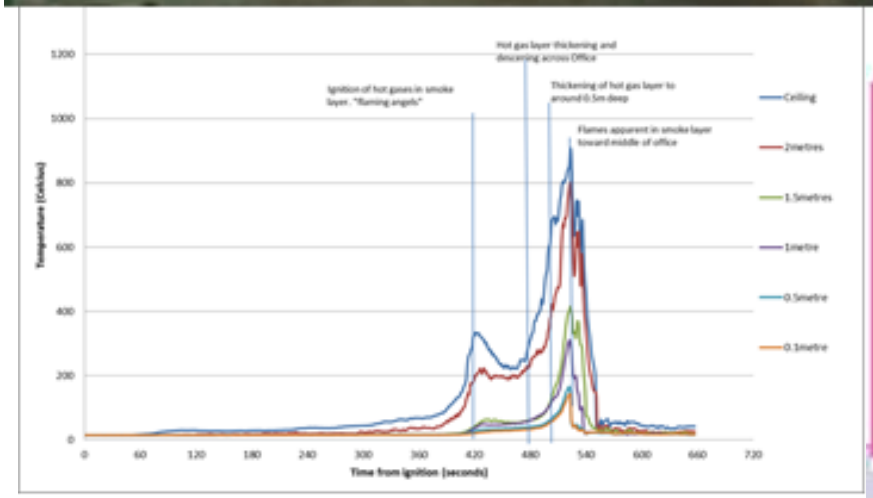


Current Building regulations
U values between 0.16 and 0.28 W/m2/ ºC

$O = \frac{A_S}{A\sqrt{H}}$ m$^{-1/2}$

Moore, D and Lennon, T. 'The natural fire safety concept - full scale tests at Cardington' Vol. 38, pp. 603-643. *Fire Safety Journal.* 2003,

Understanding fire development



Summary

- All aspects of fire safety and fire protection are important
- Fire investigations can give early indication of emerging trends
- Understanding is developed through experimental investigation (and testing)
- Identification of systematic issues
- Computer simulation is an important tool
  - Only as good as its validation
  - Input data is key – rubbish in = rubbish out
  - Boundary conditions must be well defined
  - Can’t predict human intervention reliably e.g. poor quality of construction and installation of fire protection (active and passive)

Thank you

Dr Debbie Smith
Managing Director
BRE Global Limited

BRE Global Limited, Bucknalls Lane, Watford,
Hertfordshire, WD25 9XX, UK
T: +44 (0) 7772 228715
W: www.bre.co.uk