

# FIRE SAFETY ENGINEERING GROUP

University of Greenwich  
Old Royal Naval College  
London UK



## INTRODUCTION

The Fire Safety Engineering Group (FSEG) of the University of Greenwich was founded by Prof Galea in 1986. Today, with approximately 31 fire engineers, mathematicians, behavioural psychologists, software engineers and CFD specialists, FSEG is one of the World's leading centres of excellence dedicated to the pursuit of Computational Fire Engineering (CFE). As design engineers and architects create more innovative structures and regulators strive to maintain or improve safety and reliability standards, the safety engineer is expected to demonstrate performance in ever more complex and demanding scenarios. This increases the demands on model capabilities which in turn challenge our understanding of fire dynamics and human behaviour. The mission of FSEG is to rise to these challenges and deliver to industry cutting edge CFE tools. The work of FSEG includes research/consultancy, software development, international standards development and education.

## RESEARCH AND KNOWLEDGE TRANSFER PROJECTS

FSEG research and consultancy is focussed on the development and application of CFE tools used to predict how fire and people subjected to fire behave. In many instances, full-scale or laboratory scale experimentation is required as part of this research and development. FSEG have undertaken a range of such experimentation, either independently or in collaboration with University or Industrial partners. FSEG expertise is applied not only to the building sector but more widely to the aviation, marine and rail industries, essentially anywhere people come into contact with an environment fashioned by man. The group has published over 270 academic and professional publications concerning fire and related topics. Since 1991, FSEG has generated over £10 million worth of research and consultancy funding and its research and knowledge transfer activities have been supported by organisations such as: Arup Transportation, EADS, BAe Systems, Buro Happold, BMT, Canary Wharf Management Ltd., European Space Agency, Battelle, Hughes, Home Office, Cabinet Office, MCA, NHS, Thales, UK MOD, Lloyds Register, UK CAA, US FAA, US FRA, Mitsubishi, Boeing, NTSB, Bombardier Inc., Canadian Dept of Transportation, Canadian Transportation Safety Board, EPSRC and EU.

### Examples of Research Projects Undertaken by FSEG

- Analysis of the WTC 9/11 evacuation.
- Development of solid phase combustion models.
- Development of fire effluent-human interaction models.
- Development of flame spread models.
- Experimental study exploring the interaction of people with signage.
- Exploration of the impact of culture on evacuation behaviour.
- Prediction of CO/CO<sub>2</sub> generation in enclosure fires.
- Full-scale unannounced evacuation experiments focusing on occupant response and response time.
- Development of two-phase fire-water interaction models.
- Development of escalator and elevator models.
- Exploring the external spread of fires in high-rise buildings
- Experimental study into the evacuation capability of overturned rail carriages.
- Developing hybrid field-zone fire models.
- Development of pedestrian dynamics circulation movement and behaviour models.
- Experimental study of human evacuation capability of overturned rail carriages.
- Human behaviour studies relating to high-rise building evacuation.
- Development of rail car evacuation models.
- Experimental study of human evacuation performance in heeled marine environments.
- Development of CBRN indoor dispersion and evacuation models.
- Narrative analysis of statements from survivors of aircraft accidents.

### Examples of Knowledge Transfer Projects Undertaken by FSEG

- Analysis of passenger ship design for evacuation.
- Fire and evacuation forensic analysis of major fire scenes.
- Analysis of evacuation safety of naval vessels.

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- Analysis of ventilation and smoke movement characteristics for underground structures.
- Evacuation analysis of high rise buildings.
- Fire and smoke spread in aviation, building and marine environments.
- Circulation and evacuation analysis for subway stations.
- Analysis of evacuation provision for hospitals.
- Analysis of evacuation provision for historic buildings.
- Fire analysis for the Canadian Transport Safety Board as part of the MD11 Swiss Air Disaster.
- Expert witness to Inquiries such as the Cullen Inquiry into the Ladbroke Grove disaster.
- Evacuation analysis for aircraft manufacturers concerning design and certification.
- Advice to fire brigades on fire and evacuation performance of large structures eg warehouses.
- Analysis of smoke movement and ventilation requirements of atria.
- CFD based pollution spread analysis.

In recognition of their research, FSEG have been awarded several national and international honours including; 2008 Bono Award from the SFPE, 2006 the Royal Aeronautical Society's Gold Award and George Taylor Prize, 2004 European IST prize by the European Council of Applied Sciences, Technology and Engineering (Euro-CASE) for their development of the EXODUS suite of software, the Queen's Anniversary Prize 2002, RINA/LR Safer Ship award for 2001, the British Computer Society IT award for 2001, the British Computer Society Gold Medal for IT in 2001 and the 2001 CITIS Award for Innovation in IT for Ship Operation. Accolades that attest to the groups international standing include:

#### **Queen's Award Citation:**

***"The University is a recognised world leader in the area of evacuation model development...."***

#### **BSC IT Award presentation:**

***"The winners not only demonstrate technical innovation, but also show how technology can be used to benefit society at large...."*** *Judith Scott Chief Executive of the BCS*

## CFE TOOL DEVELOPMENT

Research undertaken by FSEG has led to the development of the CFE tools buildingEXODUS, airEXODUS, maritimeEXODUS and SMARTFIRE. These products are distributed world-wide by FSEG. The **buildingEXODUS** building evacuation model is currently used by Fire Brigades, Regulatory authorities, Design Engineers and Universities in 35 countries, namely: Austria, Australia, Belgium, Brazil, China, Czech Republic, Denmark, Finland, France, Germany, Hong Kong, Iceland, Indonesia, Ireland, Israel, Italy, Japan, Korea, Lithuania, Luxembourg, Netherlands, Poland, Portugal, Singapore, Slovakia, South Africa, Spain, Sweden, Switzerland, Taiwan, Turkey, UK and the USA. The **airEXODUS** evacuation model has become the recognised world leading evacuation model in the aviation industry and has been used in projects for Boeing, Airbus, British Aerospace, Bombardier, Jet Aviation and Mitsubishi. The **maritimeEXODUS** software has been used for the analysis of large passenger ships, naval vessels (Royal Navy, Royal Australian Navy, Spanish Navy, French Navy US Navy, and Royal Netherlands Navy), large pleasure craft such as Thames River boats and Off-shore oil platforms. It has users in the UK, Australia, USA, Netherlands, France, Spain, South Korea, Italy, Japan, Taiwan, Denmark and Canada. **maritimeEXODUS** has been endorsed by the UK MOD as, "the escape tool that most closely meets the needs of the MOD for the development of warship escape design guidance and assessment". The **SMARTFIRE** fire field model has users in 20 countries, namely Australia, Brazil, Canada, China, Czech Republic, Denmark, Finland, Germany, Hong Kong, Indonesia, Japan, Lithuania, Poland, Taiwan, Korea, New Zealand, Singapore, Switzerland, USA and the UK. In 2002, SMARTFIRE was selected by the Transport Safety Board (TSB) of Canada to aid in the investigation of the tragic fire on Swissair flight 111. John Garstang, Fire & Explosion Chairperson of the TSB investigative team said of FSEG and SMARTFIRE:

***"We chose SMARTFIRE and the University of Greenwich because of the model's sophistication and the fire modelling expertise of the Fire Safety Engineering Group, particularly their experience in the aviation sector. We have now licensed the software and intend to explore further its capabilities for accident investigation."***

## INTERNATIONAL STANDARDS

FSEG expertise is sought by standards bodies such as the BSI, ISO and IMO and Governments. Prof Galea is a nominated UK representative to: ISO committee TC92 since 2000, IMO Fire Protection (FP) meetings, FP45, 2001; FP46, 2002; FP50, 2006; FP51, 2007; since 1997 he has been a member of several British Standards Institute committees concerned with fire safety including FSH/24/5, which deals with issues concerned with life safety and evacuation and FSH/24/2 which deals with calculation methods for fire safety engineering and a member of the US Society of Fire Protection Engineers Human Behaviour Task Group, 2001-2003. Prof Galea was a member of SAPER (Scientific Advisory Panel for Emergency Response) since its inception in 2003 to its end in 2009. He has been a member of the Home Office Committee on CBRN modelling since 2004 and has been a member of the Home Office committees on Evacuation Modelling and Human Behaviour related to CBRN since its inception in 2010.

## EDUCATION

Members of FSEG are involved in the supervision of doctoral and masters level students concerned with fire safety and have produced 20 PhD and 7 MSc by Research graduates. FSEG is also involved with the development and delivery of fire safety engineering courses including, MSc by Research programmes and short courses for industry. Since 1997, FSEG have trained over 500 fire professionals from 42 countries through its annual short courses.

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You can find out more about FSEG by visiting our web site at: <http://fseg.gre.ac.uk> and [www.youtube.com/FSEGREsearch](http://www.youtube.com/FSEGREsearch)