The Collection of Topics which Comprise Fire Protection Engineering

FCIA
Key Biscayne, FL
November 12, 2009

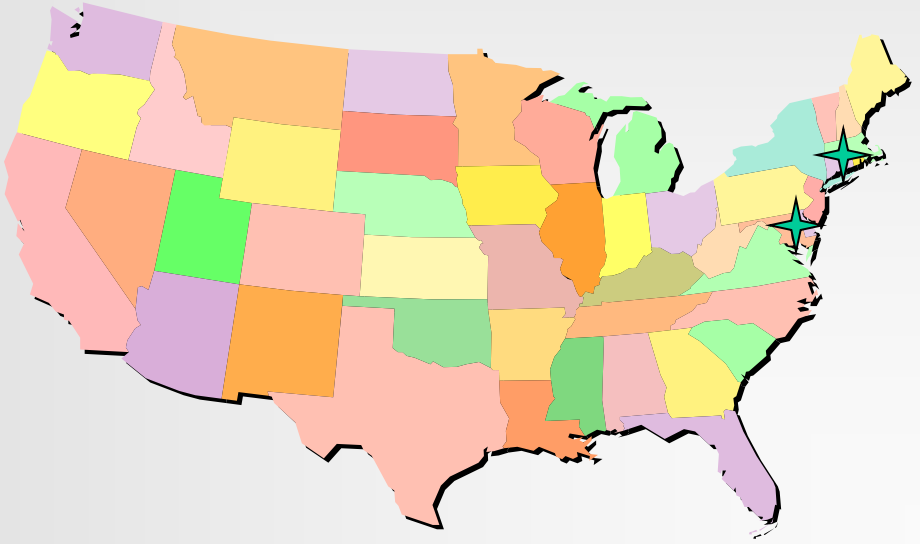
Jim Milke, Professor and Assoc. Chair

Department of Fire Protection Engineering

University of Maryland

U.S. FPE Degree Programs

- University of Maryland
  - B.S., M.S., M.Eng., Ph.D.
- Worcester Polytechnic Institute
  - M.S., Ph.D.



University of Maryland FPE Programs

Degree	Number of credits	Time (years)
Bachelor of Science (B.S.)	122	4-5
Master of Science (M.S.)	B.S. + 30 (including thesis)	1-2
Master of Engineering (M.Eng.)	B.S. + 30 (no thesis)	1.5-3
Doctor of Philosophy (Ph.D.)	B.S. + 60 (done in cooperation with other engineering departments)	4-6

History of UMD FPE Department

- 1956 – B.S. program initiated by Dr. John L. Bryan
- 1962 – 1st B.S. graduate (936 graduates)
- 1976 – B.S. program 1st accredited by ABET
- 1990 - Graduate program initiated
- 1992 - 1st M.S. graduate (151 graduates)
- 1995 - 1st M. Eng. Graduate (86 graduates)
- 1998 - 1st Ph.D. awarded (17 graduates)
- 2003 – Distance option for M. Eng. initiated

Current Enrollment (approximate)

- B.S. – 130 students
- M.S. – 20 students
- M.Eng. – 60 students (10 on-campus, 50 distance)
- Ph.D. – 10 students

Full-time Faculty

- Marino di Marzo, Professor and Chair
  - Suppression, Fire fighter safety
- Jim Milke, Professor and Associate Chair
  - Detection; Structures; Egress; Smoke management
- Jim Quintiere, John L. Bryan Professor
  - Fire dynamics; Scaling; Flammability
- André Marshall, Associate Professor
  - Fire flows; Combustion; Suppression
- Arnaud Trouvé, Associate Professor
  - Turbulent Combustion; Fire modeling
- Peter Sunderland, Assistant Professor
  - Soot; Hydrogen; Diagnostics; Vehicles

BS Degree: Mission

- Graduates should
  - Have the ***technical knowledge and skills needed to practice fire protection engineering*** locally, nationally and internationally in a variety of modern professional settings
  - Have the ***basic competencies needed to pursue advanced studies*** in fire protection engineering or related fields
  - Have the ability to ***understand and communicate societal, environmental, economic and safety implications*** of engineering decisions on the local and global communities
  - Are prepared to attain ***professional certification and licensure***
  - Appreciate the need to ***maintain continual professional competency and to practice ethically***.

BS Program

- 122 credits total
  - 24 credits general education
    (writing/communication, literature, history, arts, social sciences)
  - 30 credits math, physics, chemistry
  - 15 credits engineering fundamentals
  - 38 credits fire protection engineering
  - 15 credits math and engineering electives

Engineering Fundamentals

- Statics
- Mechanics
- Dynamics
- Fluid Mechanics
- Thermodynamics
- Heat Transfer

Fire Protection Engineering

- Fire Phenomena
- Response to Fire

Fire Phenomena

- Experimental fire assessment methods
- Fire dynamics
- Computer modeling (zone and CFD)

Experimental Fire Assessment methods

- Perform experiments following standard test methods and ad hoc methods involving material burning behavior and suppression

ASTM E648 carpet test

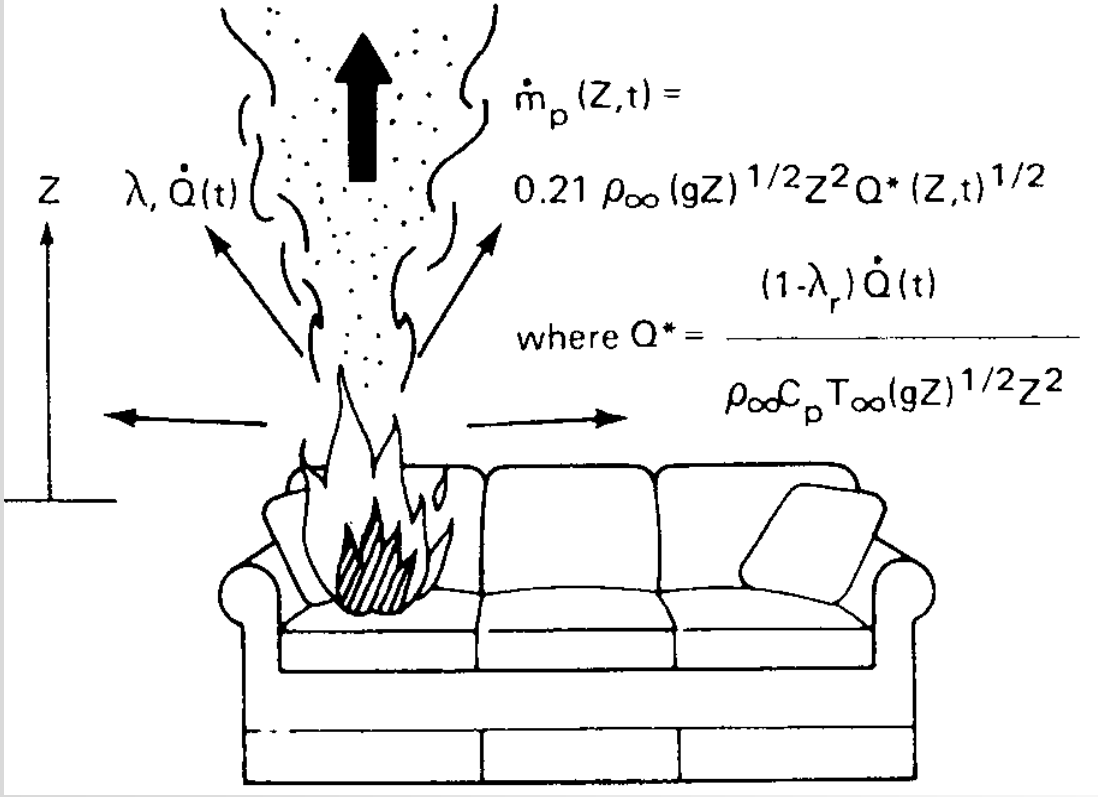
ASTM E1321 ignition test

1/20th scale test of World Trade Center

Fire Dynamics

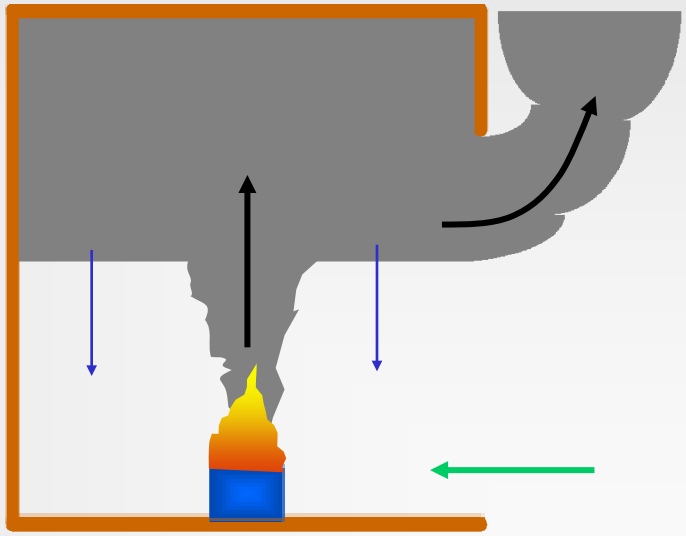
- Introduction to premixed and diffusion flames
- Ignition
- Flame spread and rate of burning
- Combustion products
- Fire plumes
- Flame radiation.

Fire Dynamics

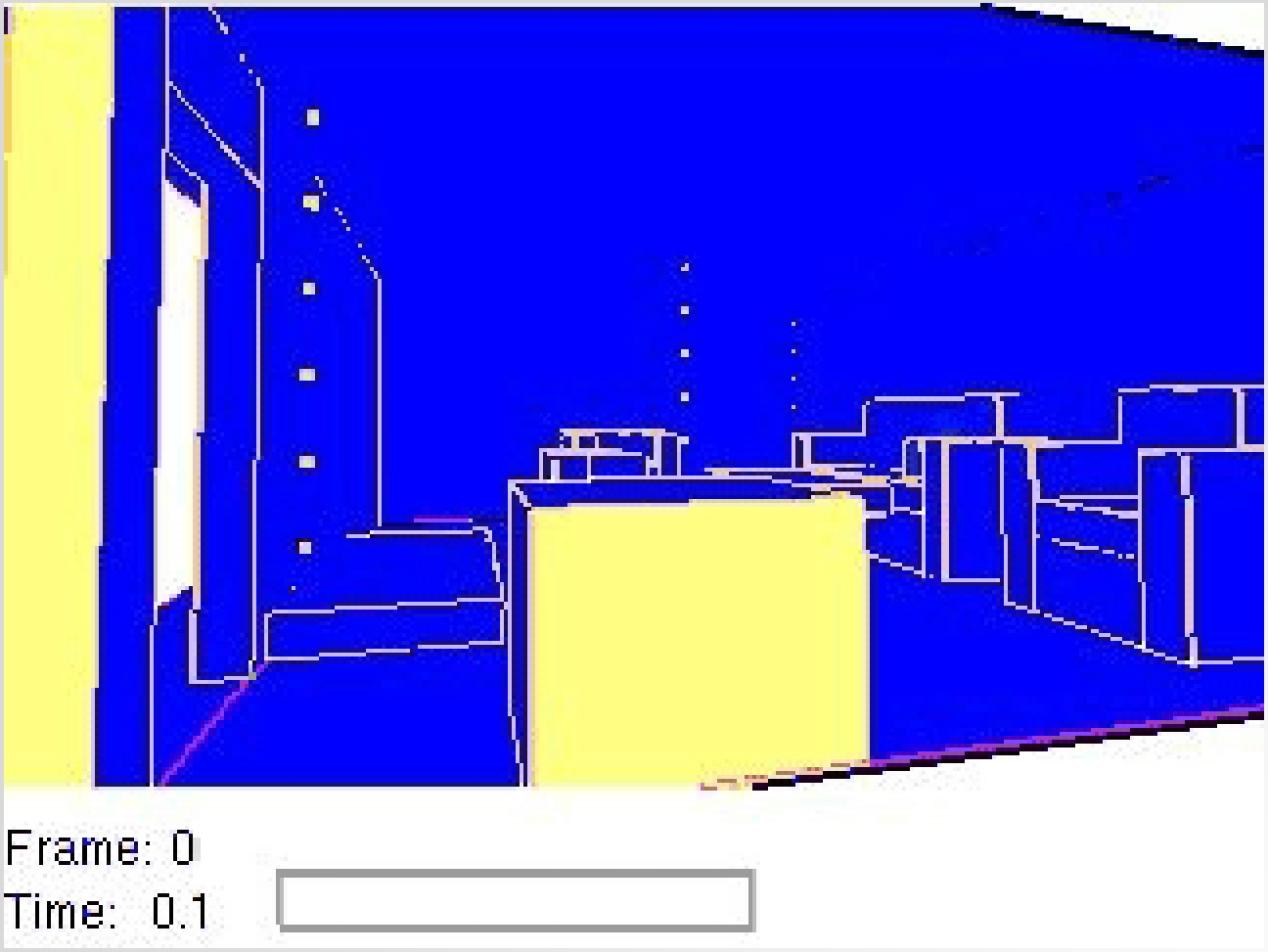


Fire Modeling

- Computer-based fire modeling applications to explore enclosure fire development.
- Development of computational methods to review aspects of enclosure fires (ceiling jets, smoke layer development, onset of flashover, etc.)
- Application of models – FAST, FDS.



Fire Modeling

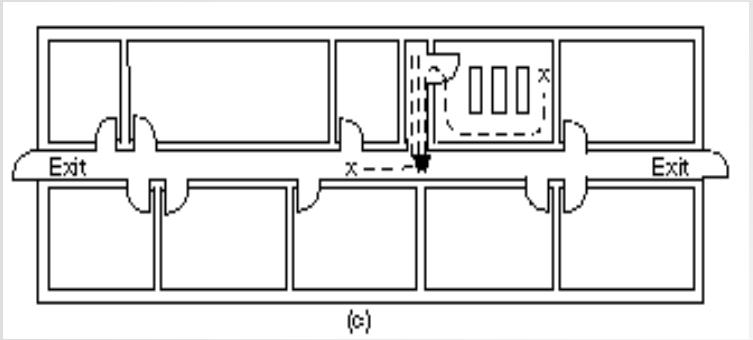


Response to Fire

- Life safety analysis
- Suppression systems
- Detection and alarm systems
- Structural fire protection
- Smoke management
- Hazard and risk analysis

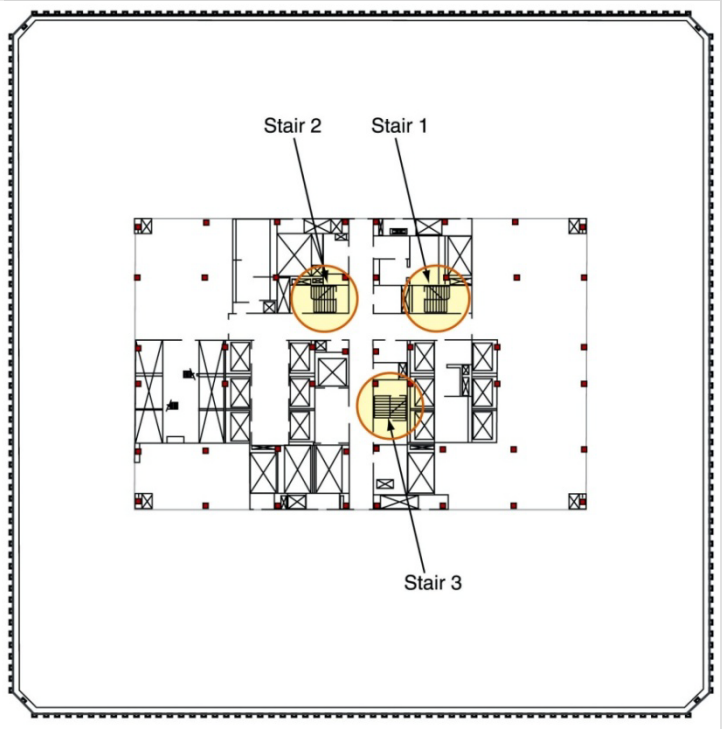
Life safety analysis

- Introduction to fire protection engineering and building regulation, building safety systems, and egress system design.
- Evacuation modeling. Human behavior in fires. Tenability analysis.
- Building survey (Life Safety Code)



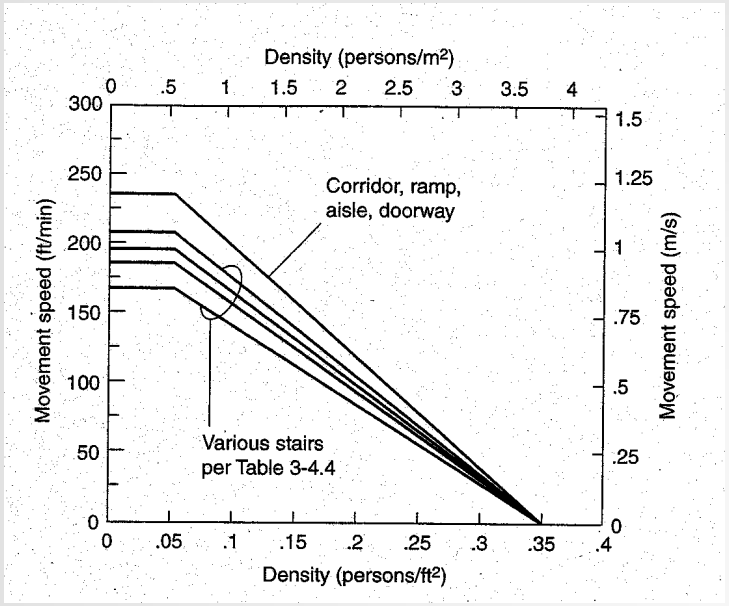
NFPA 101

Evacuation Analyses



FEMA Report of WTC

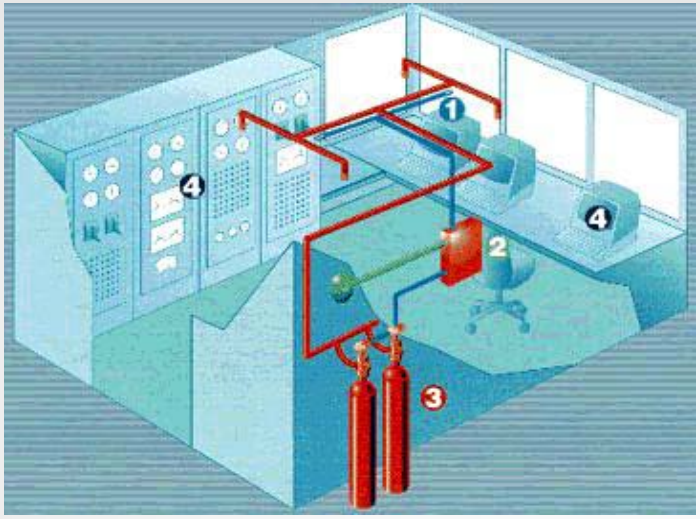
The Station Fire

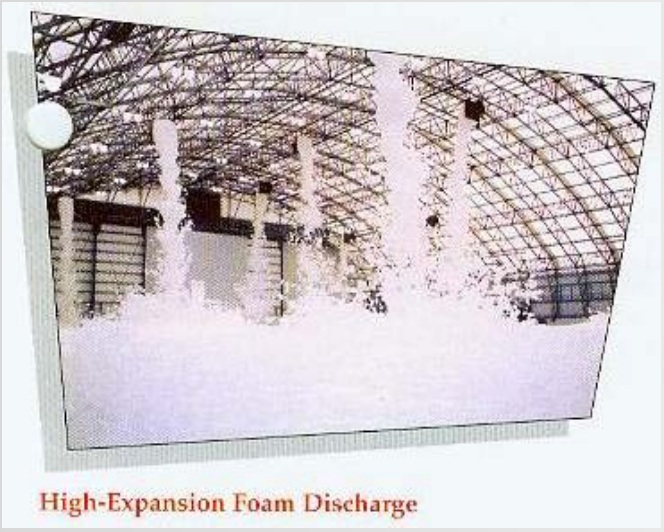


SFPE Handbook of Fire Protection Engineering

Special Hazard Suppression Systems

- Study of gaseous and particulate fire suppression systems.
- Examination and evaluation of code criteria, performance specifications and research.
- Design special hazard system (with detection) for actual hazard
  - Aircraft hangar
  - Clean room
  - Computer room
  - Museum space

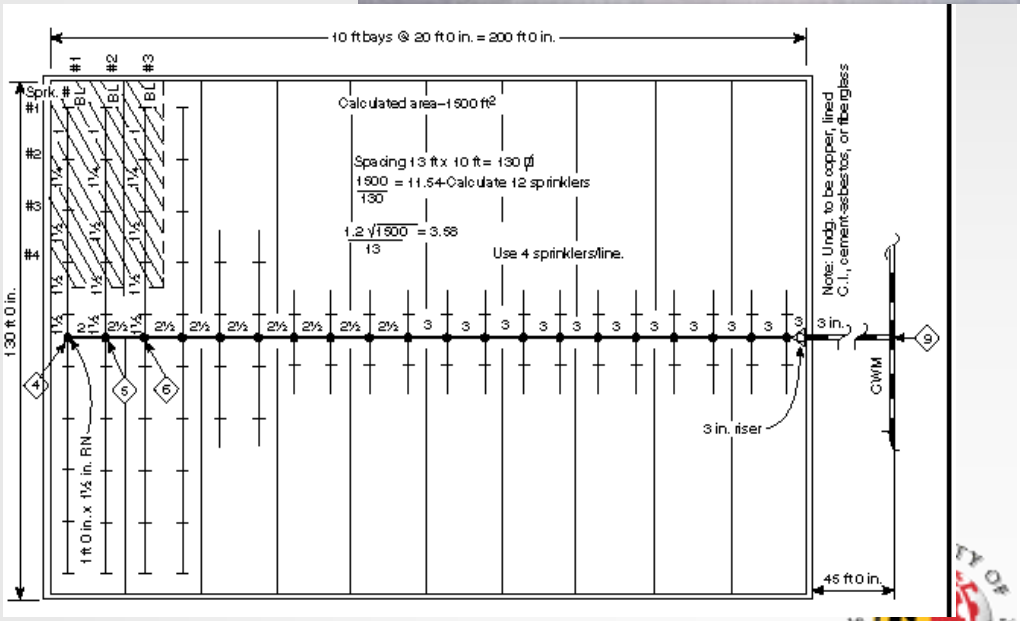




High-Expansion Foam Discharge

Water-based Suppression Systems

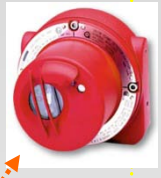
- Review characteristics of sprinkler systems: response time, suppression effectiveness.
- Design of sprinkler system for selected hazard
- Water mist systems



Detection and Alarm Systems

- Design of detection components – location of initiating devices (heat, smoke , flame detectors), response time
- Alerting – methods, location of devices

Response of Detectors



Sensitivity of detector
- *Specific to fuel*
- *Specific to angle*

Transmission through air
- *Intensity varies with $1/d^2$*
- *Transmissivity of air*

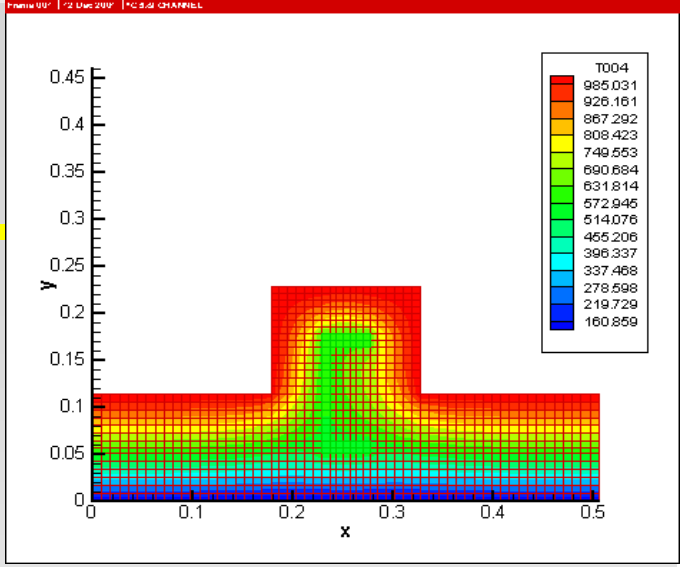
Radiant heat output from fire
- *Heat release rate of fire*
- *Radiant fraction*
- *Area of flame envelope*

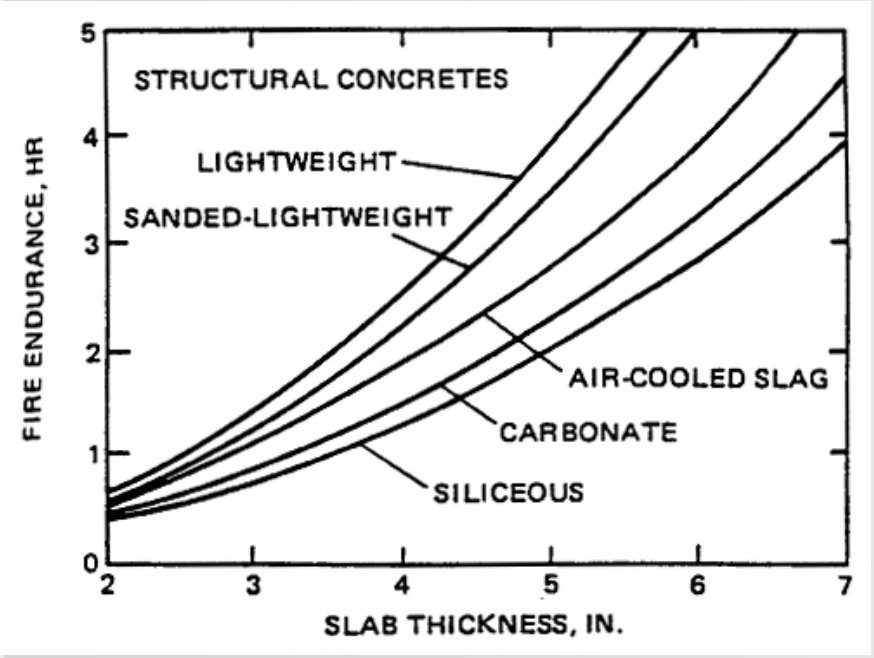
Structural Fire Protection

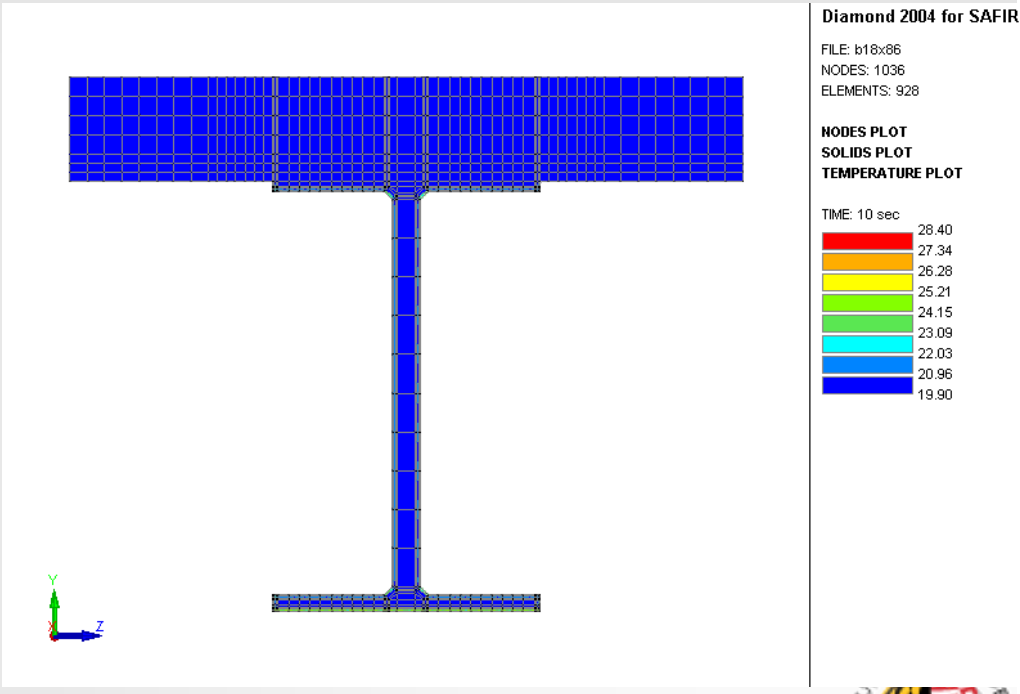
- Standard tests to assess fire resistance
- Effects of elevated temperatures on structural materials

Structural Fire Protection

- Analytical methods to evaluate fire resistant design of structures
- Computer simulation of response of structural elements

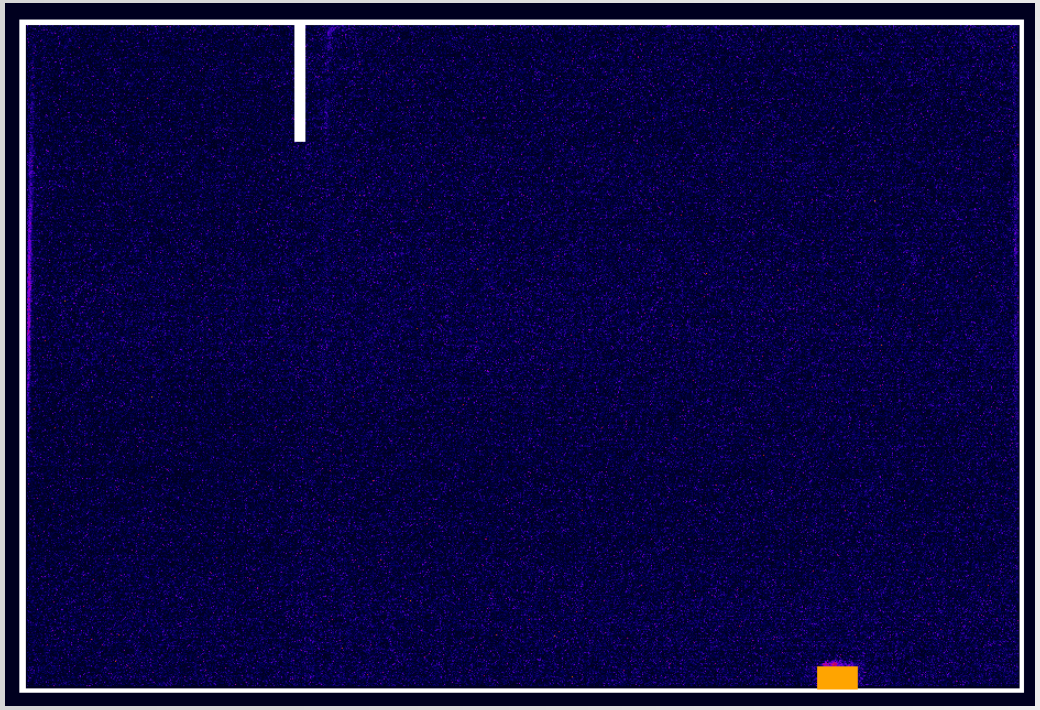


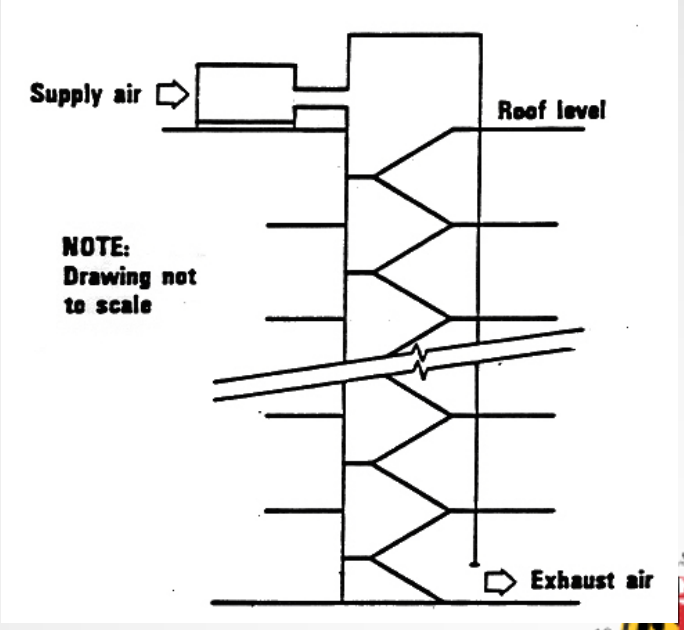




Smoke Management

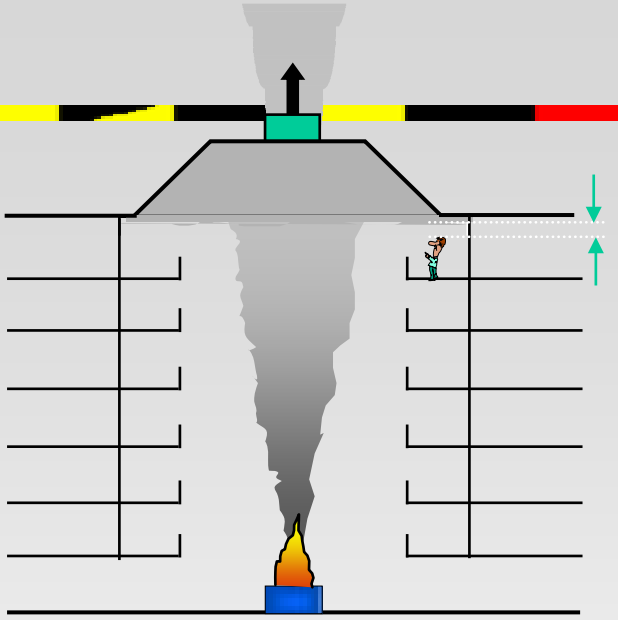
- Smoke movement characteristics
- Analyze performance of smoke management systems
  - Stairwell pressurization
  - Zoned smoke control
  - Smoke management systems in atria and covered malls

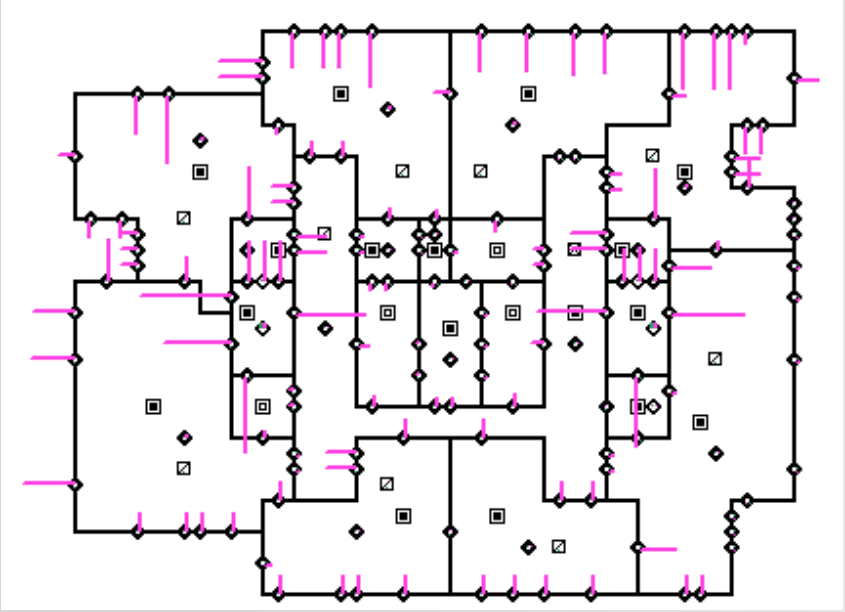


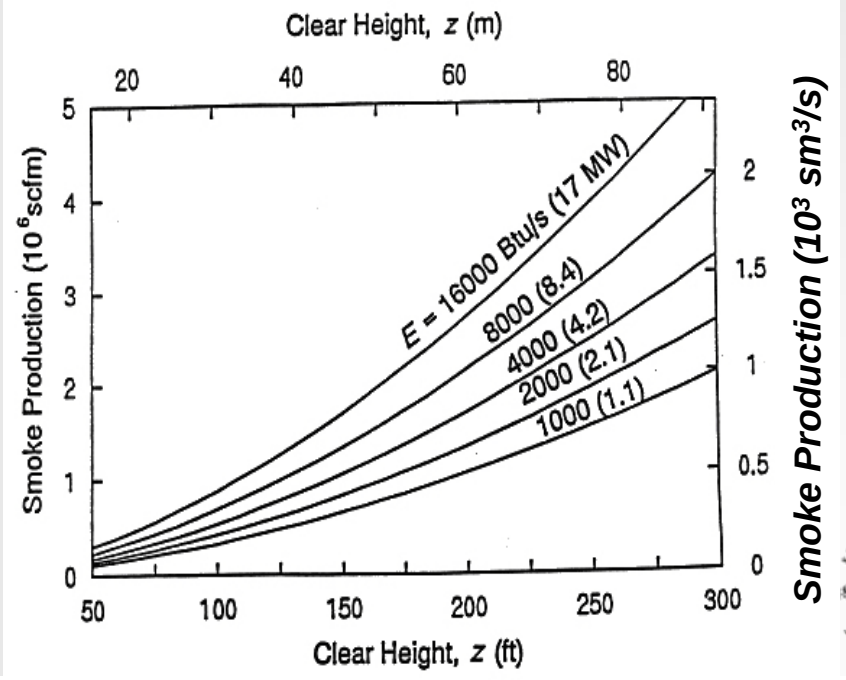


Smoke Management

- Analysis methods for design

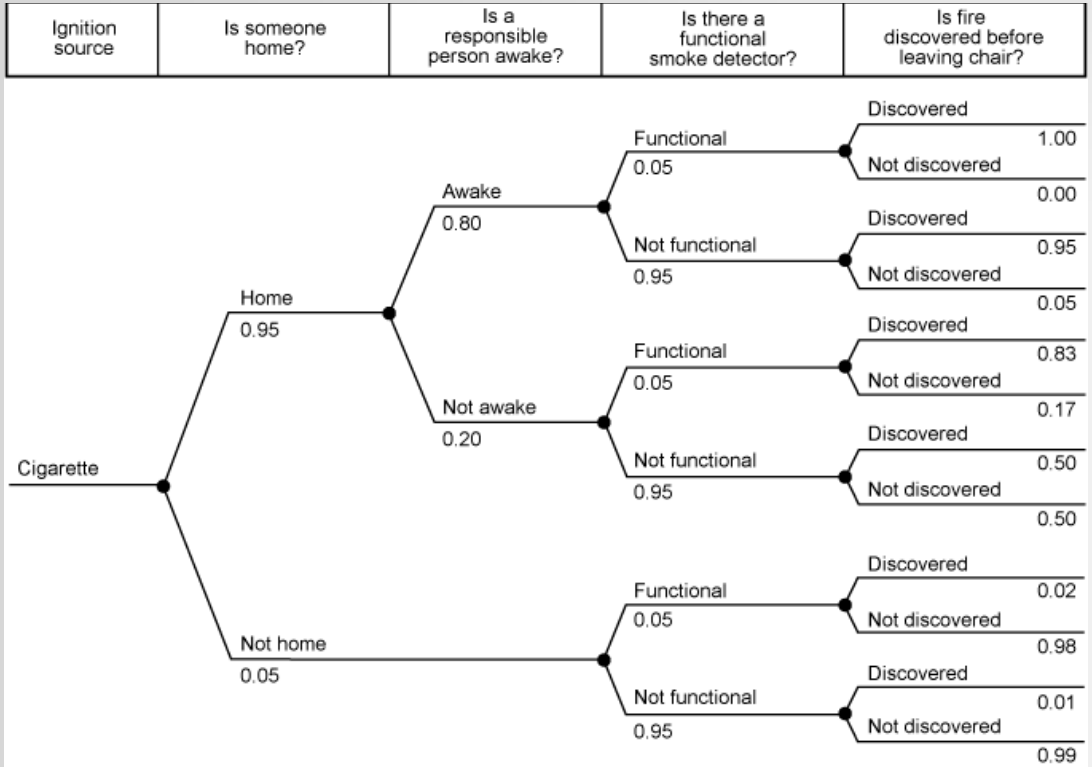






Hazard and risk analysis

- Application of systems analysis, probability theory, engineering economics, and risk management
- Methods to develop criteria for the design, evaluation and assessment of fire safety or component hazards.

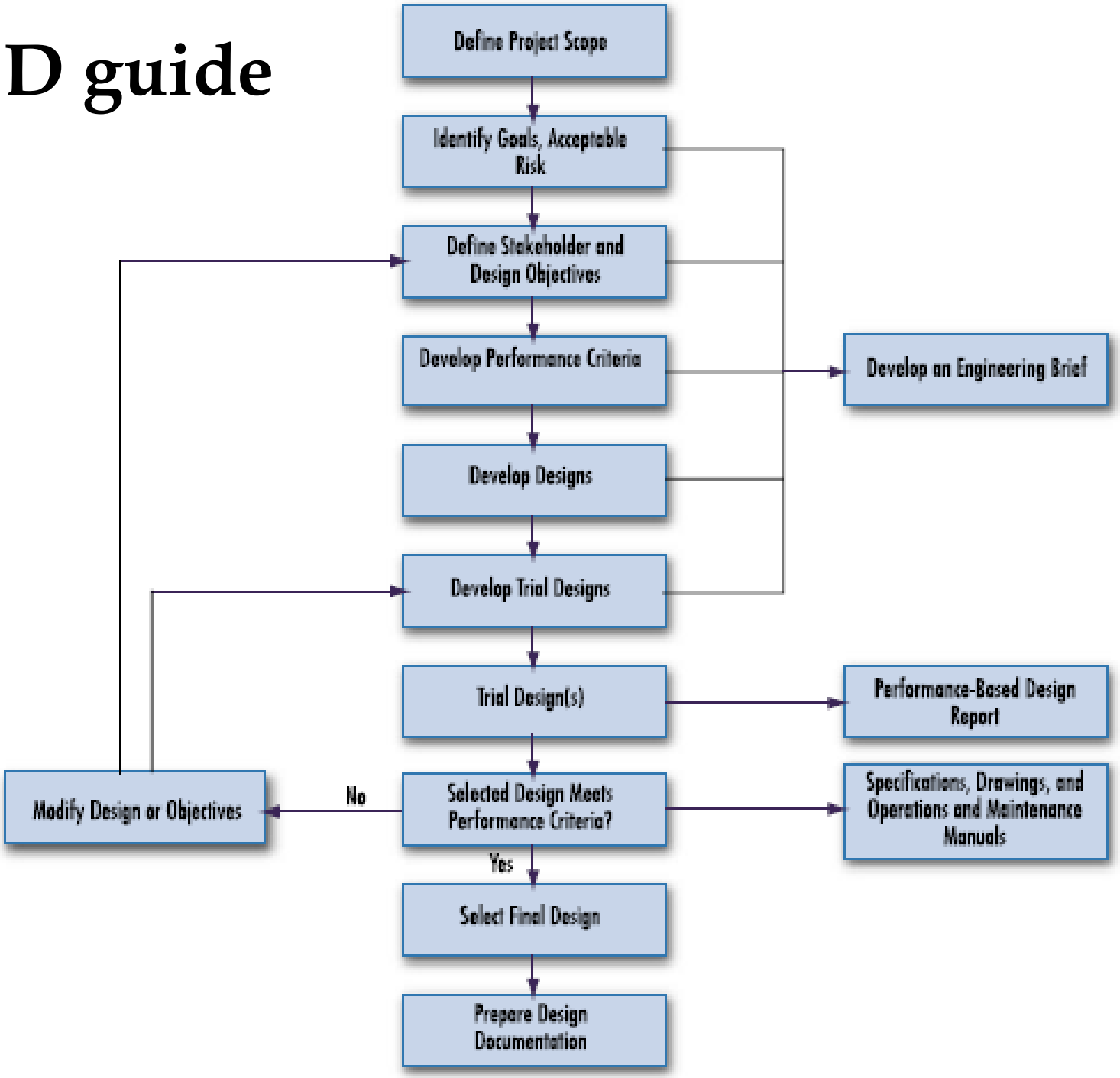


Analysis of upholstered furniture fires

Hazard and Risk Analysis

- Capstone Course
  - Integrates material from all other courses
  - Project in course involves development of appropriate fire protection strategy for selected hazard
    - Fire safety in single family residences
    - Protection of computer rooms
    - Dormitory fire safety
    - LNG Storage

SFPE PBD guide



Capstone Project

- Follow SFPE Performance-Based Design Guide
  - Analyze whether selected fire protection strategies satisfy performance criteria
  - Performance criteria address
    - Level of risk
    - Cost-benefit or cost effectiveness

Special Programs/Options

- Internships
  - On- or off-campus
- Co-op education
- Study abroad
- Hinman CEO (living-learning entrepreneurship program)
- Quest (innovation, quality systems management and teamwork, joint program with business school)

Undergraduate Scholarship Support

- **Sources**
  - **Endowed scholarships**
  - **One-time or annual gifts**
  - **Outside Sources**

$152,450 in 2008-2009

- **FCIA: Thank you!**

Master of Science

- Program seeks to explore advanced principles of fire protection engineering; development of analytical tools
- Requires 30 credits (24 credits of coursework + thesis)
- Approximately 10 M.S. graduates per year
- M.S. Theses since 2003 posted online:
  - http://www.fpe.umd.edu/research/index.html

Master of Engineering

- Established M. Eng. Distance Program – Fall 2003
  - *Designed to help professionals hone their skills and advance their careers while studying on a part-time basis*
  - *Focus on the latest performance-based building fire safety analysis and design*
  - *Coursework can be completed in 15 months*
- 2 courses offered per term, 4 terms per year (each term is 12 weeks long)
- No thesis

FPE Graduate Courses

Course	On-campus	Distance
Fire Induced Flows	X	
Human Response to Fire	X	X
Fire Dynamics Laboratory	X	
Analytical Procedures of Structural Fire Protection	X	X
Fire Protection Engineering Hazard Analysis	X	
Advanced Fire Modeling	X	X
Smoke Detection & Management	X	X
Advanced Fire Dynamics	+	X
Fire Assessment Methods		X
Advanced Fire Suppression	++	X
Forensic Fire Analysis	++	X
Performance-based Design	+	X
Advanced Fire Risk Modeling		X
Diffusion Flames and Burning Rate Theory	X	

Distance Faculty

- Jim Milke, Ph.D., P.E., Prof. & Director - *Smoke Detection & Management*
- Arnaud Trouvé, Associate Professor, Ph.D. – *Advanced Fire Modeling*

- <u>Adjunct Faculty</u>
- Douglas Carpenter (Maryland) – *Fire Dynamics*
- Steven Gwynne, Ph.D. (Colorado & UK) – *Human Response to Fire*
- Morgan Hurley, P.E. (Maryland) - *Performance-Based Design*
- David Icove, Ph.D., P.E. (Tennessee) - *Forensic Fire Analysis*
- Marc Janssens, Ph.D., (Texas) - *Fire Assessment Methods*
- Francisco Joglar, Ph.D., P.E. (Virginia) - *Advanced Fire Risk Modeling*
- Susan Lamont, Ph.D., C.Eng. (UAE), *Structural Fire Protection*
- David Purser, Ph.D. (UK) – *Human Response to Fire*
- Richard Roby, Ph.D., P.E. (Maryland) – *Fire Dynamics*
- Eric Rosenbaum, P.E. (Maryland) - *Performance-Based Design*
- Jason Sutula, Ph.D., (Maryland) - *Advanced Fire Suppression*

Doctoral Program

- PhD Option available through cooperation with other engineering departments
  - *Graduate 2 – 3 PhD's per year*
- Long-term goal: Initiate FPE PhD program
- Dissertations posted on-line

Thank you for the invitation and scholarship support.