Guiding Future Fire Safety Engineering Practice

Stephen Grubits

Outline

- Reflection on FCRC and existing guidelines
- Reflections on current practice
- Trends in engineering and building design
- Risk-based Fire Safety Design Code
- Reflections on the environment
- A vision for the future guidelines
- Turning a vision into reality

Fire Code Reform Background

- Six year ambitious program of research
- Joint venture between government, industry and researchers
- $13M funding from government and industry
- Development of both the deemed-to-satisfy and the performance aspects
- Advocated **Risk Assessment** approach
- Development of risk methodology
- Fire Engineering Guidelines for the **interim**

Fire Code Reform Objectives

For all classes of building occupancy:

- Establish a scientific foundation for safety requirements and develop additional design solutions
- Introduce a risk assessment methodology and performance assessment into the fire safety requirements
- Development of a comprehensive fire safety design code

Fire Code Reform Program

- Comprehensive program of 7 projects:
  - Project 1. - Performance Regulation Framework
  - Project 2. - Fire Performance of Materials
  - Project 3. - Fire Resistance and Non-Combustibility
  - Project 4. - Fire Safety Risk Engineering Models
  - Project 5a.- Fire Engineering Guidelines
  - Project 5b.- Fire Safety Design Code
  - Project 6. - Low-rise Shopping Centre Fire Safety

FCRC Project 5a
Fire Engineering Guidelines

- Split from Project 5 to provide an **interim** document until **risk-based code** can be adopted
- Recognised both deterministic and probabilistic analysis
- Pioneering document internationally setting the framework for performance-based design
- Recognised importance of FEB to setting benchmark
- Few warts, some have been ironed out
- Arguably too successful as it relieved pressure for risk-based code

Life of an Interim Standard?

- What should be life of a standard that was only ever intended to have a life of a few years?
- 3 years, 5 years, 7 years maybe 10 years?
- Is 20 years (and counting) too long?
- The Fire Engineering Guidelines was first published in 1995 and revised in 2001 and 2005
- Intended to be an interim document until risk-based Code was published
- Unfortunately work on the risk-based Code ceased in 1997 and never resumed.

FCRC Project 5b
Fire Safety Design Code

- Initial scope of this was defined in Building Regulations Review Taskforce report in 1990!
- Was to be based upon risk methodology developed through Project 4
- Acceptability of risk to be based upon harmonized risk of deemed-to-satisfy provisions
- Monte Carlo simulation of a wide range of fire scenarios
- Recognised need for reliability and fire statistics data

Fire Safety Design Code

1	SCOPE AND GENERAL	Preliminaries
2	MATERIALS AND COMPONENTS	Preliminaries
3	BUILDING FIRE SAFETY SYSTEM REQUIREMENTS	Overall requirements
4	BUILDING CHARACTERISATION	Overall requirements
5	OCCUPANT CLASSIFICATION AND RATING	Overall requirements
6	FIRE INITIATION AND DEVELOPMENT	Fire in enclosure of origin
7	SPREAD OF SMOKE AND TOXIC PRODUCTS	Fire in other enclosures
8	FLAME SPREAD	Fire in other enclosures
9	OCCUPANT COMMUNICATION AND RESPONSE	Occupant reaction
10	FIRE BRIGADE COMMUNICATION AND RESPONSE	Fire brigade intervention
11	OCCUPANT AVOIDANCE	Occupant reaction
12	CONSTRUCTION	Post design
13	COMMISSIONING AND VERIFICATION	Post design
14	OPERATION MAINTENANCE AND INSPECTION	Post design
15	TESTING	Additional considerations
16	EXISTING BUILDINGS	Additional considerations

Current State of Fire Safety Engineering

- Good progress in terms of adoption and market
- Major projects use Fire Safety Engineering
- Mostly “BAND-AID” FSE – fix DTS non-compliances
- Mostly DETERMINISTIC analysis or OPINION
- Educational courses readily available
- ISO Fire Safety Engineering Standards
- Significant International Developments
- Risk methodology still not common!

Requirements of a performance-based approach to fire safety

Role of FSE

CRITERION	ASSESSMENT
Performance must be clearly stated	NO
Performance must be measurable	Sometimes
Performance must not be subjective	NO
Required performance must be demonstrable	Sometimes
Measure of performance to be consistent	NO
Attainment of performance - after design	Usually
Attainment of performance - after construction	Sometimes
Attainment of performance – throughout life	NO

Drivers for Change

- Community response to disasters
- Ever increasing computing power
- Ever increasing sophistication of programs
- Price pressure
- Greater automation
    - repetitive jobs redundant – not just blue collar!
- Trade agreements
    - greater influx of products and building systems
- Push for international standards for global market

Changing Context

ASPECT	LIKELY CANGE
Building Code	Greater emphasis on performance More Verification Methods More trade-offs for cost-effectiveness
Legislation	Responsive to community pressures Better quality and consumer protection
Trade	More FSE design done offshore Acceptance of foreign tested and approved systems Less reliance on Australian Standards
Technology	Greater automation of performance evaluation More sophisticated and integrated models
Engineering	Greater emphasis on risk More explicit (but automated) treatment of likelihood
Society	Greater aversion to risk – propensity for greater safety Adverse response to disasters

Engineering Trends
Integration of simulation into design

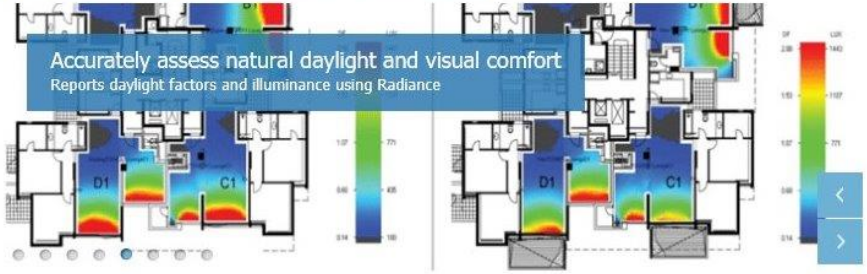
- Fully tested virtual buildings prior to construction
- Building simulation programs exist in many fields
- Add-ins to AutoCAD and other design packages
    - permit testing at design stage
- Designs will be more and more object oriented
    - Not just lines but representation of objects
- Engineering will be done by software
- Role of engineers changed to software developer

Building Simulation Software

Improve your building performance:

- Dynamic thermal modelling
- CFD (Computational Fluid Dynamics)
- Lighting simulation
- Wind tunnel simulation
- On-site-testing

DesignBuilder - Simulation Made Easy



DesignBuilder provides advanced modelling tools in an easy-to-use interface. This enables the whole design team to use the same software to develop comfortable and energy-efficient building designs from concept through to completion.

for Engineers

Our powerful simulation toolbox lets you model HVAC, daylighting, airflow, cost, energy and carbon. Optimise your solutions to meet design goals and maximise the benefits for your clients.

for Architects

Assess energy efficiency and carbon performance during early stage design. Visualise solar shading and explore designs to maximise comfort and the benefits of daylighting and natural ventilation.

for Energy Assessors

Be cost efficient and competitive by using the quickest and easiest to learn software for generating UK EPCs and Part-L2 building regulation compliance reports using SBEM.

Building Simulation

What is building simulation and how can it help you?

Are you having problems with energy consumption in your commercial or private building? Maybe you find that it's too hot in summer and too cold in winter.

Here at Building Simulation, we provide a consultancy service using computer simulation and various other techniques aimed at making sure your property performs how you want it to.

From daylight simulation and wind tunnels to dynamic thermal modelling and CFD simulations we can help you to improve the comfort, energy efficiency or cost-effectiveness of your building.

We can also provide building simulation services for structures such as train carriages, depots, service yards and car parks.

Examples of AutoCAD add-ins

AutoFEM Lite x64 (0)

OS: Win64

AutoFEM Analysis provides a solution of finite element analysis for AutoCAD® 2009, 2010, 2012, 2013, 2014 and 2015. The system is fully integrated into AutoCAD 3D environment.

Free

AutoRebar (0)

OS: Win32 and 64

Reinforced Concrete Detailing software and automatic Bar Bending Schedules.

$25.00

Evacuations Cad-Projects 1.1.0 (0)

OS: Win32 and 64

This plug-in can be used with AutoCAD® to simplify the process of determining evacuation routes and distances.

$10.00

Pathfinder Trial (0)

OS: Win32 and 64

The pathfinder app will find the shortest distance between two points, taking obstacles into consideration. It can be to generate egress/escape paths.

Trial

Vehicle Performance Simulator (0)

OS: Win32 and 64

The application Vehicle Performance Simulator is an AutoCAD® add-on that simulates the performance of a vehicle along a route.

Trial

A vision for the Future Fire Engineering Guidelines

Do we share original vision?

1	SCOPE AND GENERAL	Preliminaries
2	MATERIALS AND COMPONENTS	Preliminaries
3	BUILDING FIRE SAFETY SYSTEM REQUIREMENTS	Overall requirements
4	BUILDING CHARACTERISATION	Overall requirements
5	OCCUPANT CLASSIFICATION AND RATING	Overall requirements
6	FIRE INITIATION AND DEVELOPMENT	Fire in enclosure of origin
7	SPREAD OF SMOKE AND TOXIC PRODUCTS	Fire in other enclosures
8	FLAME SPREAD	Fire in other enclosures
9	OCCUPANT COMMUNICATION AND RESPONSE	Occupant reaction
10	FIRE BRIGADE COMMUNICATION AND RESPONSE	Fire brigade intervention
11	OCCUPANT AVOIDANCE	Occupant reaction
12	CONSTRUCTION	Post design
13	COMMISSIONING AND VERIFICATION	Post design
14	OPERATION MAINTENANCE AND INSPECTION	Post design
15	TESTING	Additional considerations
16	EXISTING BUILDINGS	Additional considerations

Some questions to answer

- How do we focus on departures from dts?
- Are the original sub-systems needed?
- Degree of redundancy required?
- What are appropriate design scenarios?
- Is equivalence or more, required?
- What are shortcomings of existing guidelines?
- OH&S for fire fighters, provision for rescue?
- What is acceptable risk for structural failure?

Perfect Risk Assessment Tool

- What would it do?
- How would it do it?
- How would you use it?
- What would be the inputs?
- Where would you get the data?
- What would be the outputs?
- How would you verify it?
- What documentation would you need?

What comes first?

OR

- Guidelines
- Risk Assessment Tool

Fire Engineering Methodology

- Move from deterministic to probabilistic design
- Greater emphasis on likelihood, reliability and risk
- Underpinned by appropriate research program
- Reliable risk simulation tools developed
- Integrated into advanced CAD software
- Calculators developed for Verification Methods
- Societal Risk and F-N curves measure safety
- Societal risk acceptance criteria:
  - ❑ ALARP: design is within ALARP REGION
  - ❑ Comparison to benchmark: RISK < REFERENCE

Performance Benchmark

- Should not have to reverse-engineer acceptable risk
- A number of reference buildings analysed and harmonised in terms of risk
- Benchmark buildings specified both in terms of risk and deterministic acceptance criteria
- Acceptance of performance solution based on equivalence to relevant benchmark building
- Credible design scenarios specified for reference buildings
- More Verification Methods in NCC
- Automated calculators for Verification Methods

What can the Society for Fire Safety Do?

- Define ALARP acceptance criteria for buildings
- Define a range of Reference Buildings for comparison
- Collate reliability data for fire safety systems to Australian Standards
- Sponsor development of risk-based FSE Code
- Promote vision among external stakeholders

Turning a Vision into Reality

- **Share the vision!**
- Expound the virtues of the change
- Justification of the necessary expenditure in terms of future benefits – microeconomic reform
- Develop a clear road map
- Work with the pioneers and encourage early adopters
- Education and research required to underpin change
- Above all – **DO SOMETHING!**

Thank you!

Questions?