FIRE SAFETY ENGINEERING IN BUILDINGS.

A TALK BY

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What is fire safety engineering?

- Fire safety engineering is the design and construction process which, by consideration of the hazards and risks involved and the precautions which are possible, achieves a balanced and acceptable level of fire safety.

- Fire engineering can provide an alternative functional approach to prescriptive regulations, especially in complex buildings.

Fire and smoke.

- The fire triangle: oxygen, heat, and fuel;
- Fire growth and fire load (kilo watts);
- Smoke (hot and cold), biggest killer is carbon monoxide, and materials such as Teflon give off very toxic fumes;
- Flash over: occurs when there is a transition from a localised fire to the ignition of all the exposed flammable surfaces within the enclosure.

Codes in use.

- BS 476 For testing of materials and components is being replaced by the EU room corner test and the single burning item tests to enable harmonization in the EU.
- DD 240 Fire engineering in buildings is being replaced by BS 7974.
- BS 5588 Fire safety design is being replaced with BS 9999.

Active fire systems.

The function of the these systems is to suppress the fire and to extinguish or restrict the fire size, and to reduce toxicity, temperatures, and structural damage. Also used to maintain smoke layer and restrict smoke to the room of origin.

- Sprinklers various types: (NOTE: halogenated gases such as BFC and BTM halon are excellent anti catalysts however they are lethal to humans and must be banned). The BBNBC still calls for their use;
- Domestic sprinklers increased use especially where fire appliance cannot get there in a reasonable time.
- Drencher systems;
- Water mist systems;
- Gaseous systems;
- Fixed or portable.

More active fire systems.

- Fire detection systems (AFD);
- Automatic fire suppression systems;
- Fire alarm systems;
- Signage and way finding;
- Smoke and heat control systems (shevs).

Qualitative design review (QDR) & use of DD240/BS 7974.

- The QDR is the first step in the design process and draws upon the experience and knowledge of all the design team members i.e. client, fire engineer, architect, structural, and services engineers, and if possible the building standards officer, and the fire brigade fire prevention officer.

The QDR process 1.

- Review architectural design
- Perform a building, occupant, and environment characterisation study
- Identify fire hazards and possible consequences
- Establish the fire safety objectives
- Identify acceptance criteria (inform client of the buildings limitations) (RV cruise control and electric breaker stories).

The QDR process 2.

- Establish trial fire safety design
- Specify fire scenarios for analysis
- Indicate appropriate methods of analysis
- Prepare a fire safety report/manual with above information for a successful scheme.

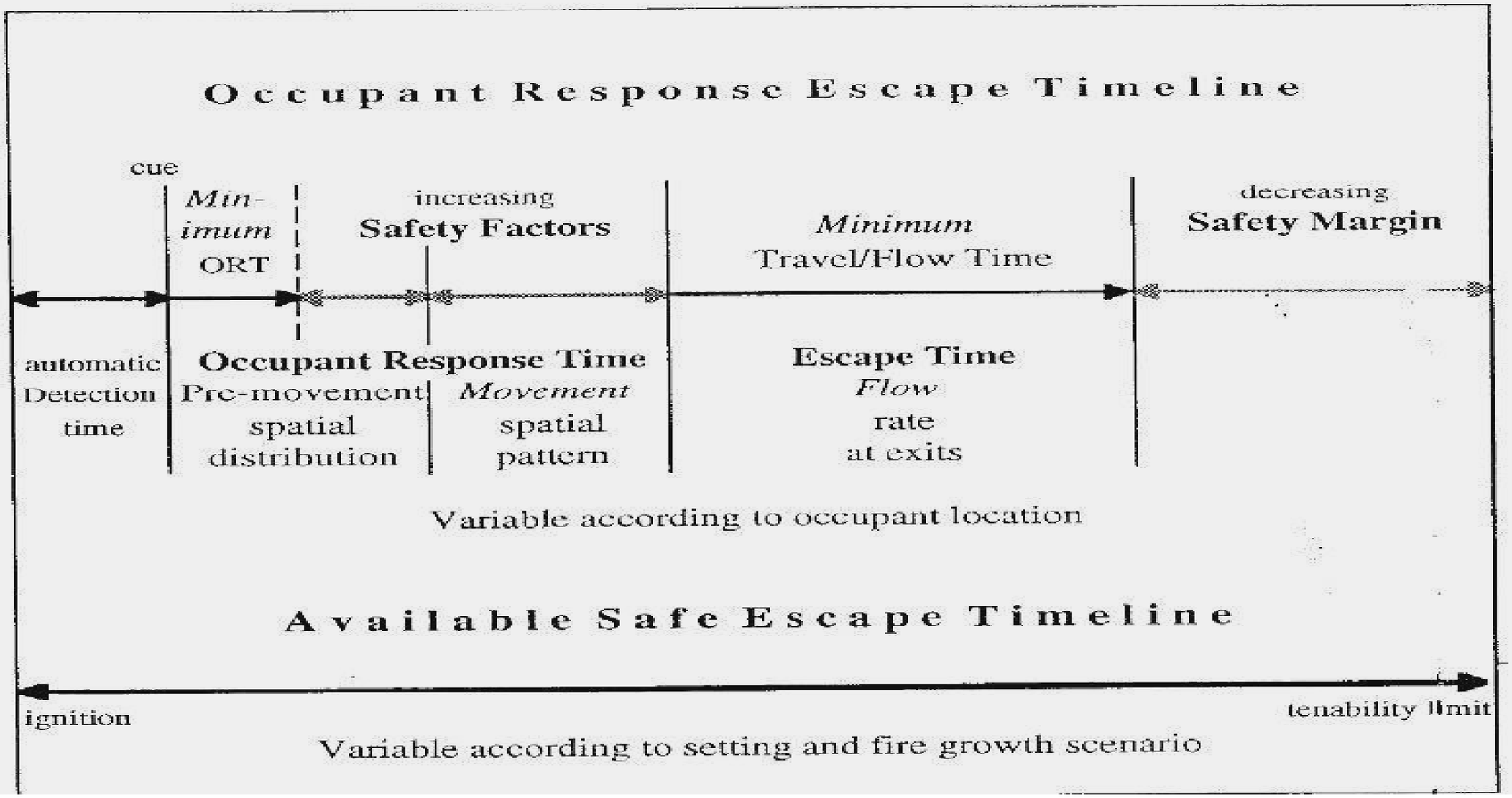
Note: Use the sub-system procedure in the BS7974 figures 1 and 2 in relation to the above items.

Available safe egress time (ASET).

- ASET is the time available between the ignition of the fire and the time at which untenable conditions exist with in any given space in the building.

See table below:

ASET table.


Occupant Response Escape Timeline
cue
Min-imum ORT
increasing Safety Factors
Minimum Travel/Flow Time
decreasing Safety Margin
automatic Detection time
Occupant Response Time
Pre-movement spatial distribution
Movement spatial pattern
Escape Time
Flow rate at exits
Variable according to occupant location
Available Safe Escape Timeline
ignition
tenability limit
Variable according to setting and fire growth scenario

Human element.

- Deaths in large scale fires attributed to ‘panic’ are far more likely to have been caused by delays in people receiving information about the fire.
- Evacuation process:

  Fire, alarm, recognition, response, and physical movement.
- Occupant response time:

  Pre-movement, movement, escape time, travel time, and queuing.

Factors that effect safe evacuation.

- Familiarity, information provided, signs, beacons, alarms, exits, age infirmity, disability, illumination, alternatives.
- Peoples safety in fire situations cannot be guaranteed as they tend to panic which leads to inappropriate behaviour.
- People like to exit by the route they entered the building, even though an alternative exit maybe very close.

Building structures.

- The NAD for concrete structures which forms part of Eurocode 2 (boxed values) is more conservative with respect to fire design than BS 8110.
- The design of timber structures is covered by Eurocode 5.
- Steel structures are covered by BS 5950 and ENV 13381-4. Steel dramatically looses it’s strength at temperatures above 600°c, and in a fire situation unprotected steel will have a resistance to fire of approximately 25 minutes.

Building elements and components used to restrict the spread of fire.

- Compartment walls.
- Separating walls.
- Compartment floors.
- Separating floors.
- Self closing fire doors (disabled access).
- Fire shutters.
- Fire stopping at service cores.

Building components used to assist the Fire Brigade in fighting fires.

- Dry and wet riser systems.
- Hose reels (not a requirement of building regulations).
- Portable fire extinguishers.
- Fire fighting shafts in high buildings.
- Fire lifts (controlled by brigade).
- Fire hydrants.
- Access and escape windows.
- Fire access roads for fire tender.

Building standards/regulations.

- Building standards/regulations cover such items as:
  - Means of escape and design of same for life safety.
  - Non combustibility requirements.
  - Resistance to fire requirements.
  - Access and fire fighting facilities for the Fire Brigade.
  - Compartmentation.
  - Distance from boundaries.
  - Requirements for sprinklers.
  - Spread of flame requirements.
  - Hazardous uses.
  - Alarm systems (AFD).
  - Smoke and heat exhaust ventilation systems (SHEVS).

Dispensation/relaxation for building standards.

- Most functional fire engineering scenarios for buildings do not usually comply with the prescriptive standards set by building standards. As a result dispensation/relaxation of the standards is required, and an acceptable balance must be arrived at before dispensation or relaxation can be given by the building standards authority.

Questions.