

University of Essex

Building Design Guide for Fire Safety

Scope

This guide is to be used in the design process for all new builds, changes of use and major refurbishments including property to be leased by the University. Content will also be used to advise design in minor works.

Aims

To align the requirements of the Building Regulations, the Fire Safety Legislation and the Institution. There is potential conflict between these as the Building Regulations are generic and often prescriptive whilst the Fire Safety Legislation encourages creative solutions specific to actual use and management.

To facilitate high standards, best value and sustainability of fire related issues in building design.

To provide an indication of non-prescriptive preferred solutions and appropriate standards. Some are variations of Building Regulations and B.S. etc. which are permissible under the Regulatory Reform (Fire Safety) Order.

How to use this guide

Sections where text is highlighted in a **blue font** explain the reasons for inclusions of content. Non-highlighted sections contain examples of successfully applied solutions which are considered ideal.

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A. INTRODUCTION

Consultation

Building Regulations require a suitable and sufficient fire strategy but are generic in their applications and quite prescriptive in detail. Fire Safety Legislation encourages creative solutions relative to the actual use and management of the building and surrounding estate.

Without a clear understanding of the buildings actual use and the institution's fire safety management practices, selection of appropriate precautions will often be problematic.

Early and comprehensive consultation with the Fire Safety Advisor is key to achieving good cost effective fire safety standards compliant with all relevant legislation.

The Fire Safety Advisors are consulted on all fire related aspects at project discovery within the projects processes and procedures. This shall be continued at each RIBA Report stage as a minimum. The Fire Authority, Building Control Officer or Approved Inspector, Principal Contractor and other relevant persons shall be consulted on a regular basis throughout, in an open and transparent manner.

Design strategy

The fire safety design emphasis shall be on early detection, suppression and evacuation for the protection of life. The protection of property of national or historic importance, property of high importance to the institution, business continuity and the environment shall also be considered.

Any variation from simple compliance with Building Regulations will require full explanation in the Fire Strategy document or the Fire Safety Manual.

The category of use for academic buildings will normally be 'Large Place of Assembly'; sleeping accommodation will normally be 'Hotel' (compliance with the regulatory fire safety order will be problematic if designed as a dwelling).

The design shall address all of the fire related challenges present:

- Multi use buildings some with content/structure of national or historic importance
- Inflated and unpredictable occupancy due to open public access and difficulty in controlling entry.
- Extensive range of users, commonly unfamiliar with the buildings, including most disabilities, ages, cultures and religions, some with little or no English or appreciation of fire safety.
- Considerable numbers of peripatetic, part time or temporary staff. Use of contractors for facilities management, security, building works etc.
- Large student body, often working unsupervised. Some anti-social behaviour including abuse of fire safety equipment, although not as prevalent as often imagined.
- Common changes of use of space. IT, electrical equipment, telephone lines etc. frequently added to or changed, breaching fire compartmentation.

- Poor evacuation performance including increasing use of headphones, even when sleeping, resulting in not hearing fire alarm sounders.
- Frequent door wedging
- Use of corridors and common areas for displays etc. with no clear understanding of fire loading restrictions.
- Limited resources in terms of fire safety management: maintenance, tests and checks.
- Difficulty in provision of persons with responsibilities in respect of fire (fire wardens and disabled evacuation assistants etc.)

B. REACTION IN THE EVENT OF A FIRE

Compartmentation

Provision

Whilst compartmentation is a requirement of the Building Regulations in certain places, it has further benefits:

- It helps to prevent rapid fire spread within the building;
- It reduces the chances of a fire becoming large, on the basis that large fires are more dangerous to occupants, fire and rescue personnel and other relevant persons.
- It helps to reduce the risk of total loss of a floor or building thus reducing the impact on business continuity.
- Provides the capacity for staged or progressive evacuation and refuge 'spaces'.

The following features should always be compartmented:

- Escape routes: protected or fire-fighting staircases; protected corridors for dead-end situations; where persons may be required to utilise some form of airlock or sterilisation system to make their escape.
- Vertically rising shafts that penetrate through horizontal compartmentation (lift shafts, risers etc.).
- Walls common to two or more buildings or separate domains (tenants etc.).
- Areas where intended activity or content involves a high risk of fire: plant rooms, workshops, laboratories, catering kitchens, sleeping risk etc.
- Voids above non-fire related ceilings when these bridge compartment partitions, doors etc.

60 minutes fire resisting compartmentation may be required where there are business critical facilities, areas containing high value equipment or irreplaceable information etc.

Sub-compartmentation

Building Regulations may allow a compartment size of 2000m²; this is a substantial allowance such that a fire could effectively take out a large area. Sub-compartmentation of a floor may well not be expensive as most building materials used to divide areas of floor space tend to provide a minimum of thirty minutes fire resistance.

Sub-compartmentation at floor levels and areas over 1000m² utilising the internal walls and corridors is to be considered.

Penetrations

It must be accepted that as a building moves forward in its life span there will be times where, for various reasons, someone will wish to put a breach through a fire wall; the running of cabling or wiring is one common reason.

Where cables pass through fire compartment walls intumescent protection sleeves with internal smoke barriers shall be installed. The size of the sleeve should allow for future extra cabling.

Vertical service shafts etc.

60 minutes fire resisting compartmentation is required at all access points and where services leave shafts rather than at floor levels. Detection will normally be required at the top of shafts.

Ducts and dampers

Where air handling ducts pass through fire separating elements the integrity of those elements is to be maintained by using one of three basic methods:

1. Protection using fire dampers: Automatic fire dampers provided where the duct passes through fire resisting elements. There may be a requirement under Building Regulations for these to be operated on activation of the fire alarm. Access for regular maintenance must be provided.
2. Protection using fire resistant enclosures: Air handling equipment enclosed in fire resisting construction. Access is sometimes required and this is to be afforded by fire doors which are kept locked at all times.
3. Protection using fire-resisting ductwork: Fire resisting ductwork with a minimum performance to match the penetrated element.

Means of Escape

People who may have difficulty evacuating by standard means:

Our policy is to consider all potential issues and the growing percentage of the population who may have difficulty evacuating. Ease of escape for such persons must be considered throughout the design process.

All escape routes should be designed to enable self-evacuation of people with mobility impairments wherever practical:

- Horizontal disabled escape routes into separate compartments are preferable to vertical escape where reasonably practical. Where vertical escape is necessary, evacuation standard lifts are required.
- Steps should be avoided; slopes of no more than 1:20 are preferred. Any requirement for evacuation assistance or equipment should be avoided where practical; where unavoidable Garaventa Evacu-Trac CD7 evacuation chairs will be required.
- When estimating the holding capacity of a protected refuge area, a figure of one person per square metre is considered a reasonable maximum occupant density to include standing and wheelchair users. There should also be space for escape equipment, an electric point and sufficient room for powered wheelchairs to manoeuvre.

Evacuation strategies

Defend-in-place

This will rarely be acceptable due to frequent use by people who are not familiar with the building.

Simultaneous evacuation

Simultaneous evacuation is preferred in smaller buildings. The actuation of a call point or detector gives an instantaneous warning from all fire alarm sounders for an immediate evacuation.

Staged evacuation

In large or complex buildings, a staged evacuation procedure by floor level or corridor length will generally be required in order to reduced disruption and provide manageable sized alarm zones. This will require the alignment of fire compartmentation.

The operation of a call point or detector activates an evacuation signal in the zone affected. The decision to evacuate further sections of the building will then rest with the security management and/or The Fire and Rescue Service. 'No entry' beacons will be required at zone junctions.

Occupant capacity

Occupancy figures are often the deciding factor in regards to the width of escape routes, staircases and doorways. Client specification, furniture plans or comparative data should be used to determine actual maximum occupancies. Where such data is not available a figure of 8m² per person should be used for office accommodation, 1m² for lecture space etc. Allowance should also be made for people waiting in common areas for their next class.

Future flexibility of use and all restrictions on exit capacity must be considered and agreed with the institution. Although client specifications will be met there is often spare exit width or occupancy capacity in completed designs which is not defined. This information is crucial when considering changes of use, items to be placed in corridors etc.

Maximum capacities for each space, permitted by the final design, shall be included in the Fire Safety Manual.

Exit routes

Single direction escape routes and rooms within rooms should be avoided. Staircases and lifts should normally be installed at the extremities of the buildings.

Travel distances will account for use by people with mobility impairments, 18m is the usual maximum acceptable single direction travel distance.

Display information and items are often required within corridors. Where this is the case, fixed encased display facilities are to be provided.

Widths

Allowance may be required for client specified furniture, break-out areas etc. Allowance must also be made for the width of powered wheelchairs and to take account of disabled persons who may need to go against the flow or wait in a refuge.

Spare exit width over the client occupancy specification permitted by the finished design shall be outlined in the Fire Safety Manual.

Way finding

Illuminated escape signage shall be utilised as far as reasonably practicable and shall augment emergency lighting. Non illuminated signage shall be photo-luminescent. All signage should be as large as practical to aid those with impaired vision.

Standard signage (no wheelchair symbol) shall be used for routes suitable for all users. Routes not suitable for the use of people with mobility impairments shall have the standard wheelchair user symbol in green crossed through added to the standard 'running man' signage. Routes specifically for the use of people with mobility impairments (i.e. alternatives to staircases such as to evacuation lifts) shall be indicated with the standard wheelchair user symbol in green.

There should be clear colour contrast of doorways, edge marking of stairs and steps etc. to aid those with impaired vision.

Lifts

Lifts will be used for disabled self-evacuation on operation of the fire alarm. All lifts are to be to evacuation standard unless use of an accommodation lift can be justified by risk assessment.

They should not be linked to the fire alarm but remain in normal operation to enable unaided escape by mobility impaired people who will, in the main, have been notified. They must be operable on operation of a fire alarm without the need for a key or other specific technical knowledge.

Lifts should carry standard 'do not use in a fire' signage supplemented with the standard wheelchair user symbol in green where suitable.

Emergency lighting

Systems shall include a self-test facility unless individual units are clearly identifiable. Consideration must be given to areas where hazards are present in respect of people with vision impairments that affect their ability to see in reduced light levels.

Doors:

Final exit doors shall be fitted with single action locks and provide level exit or be ramped to 1:20 max.

All fire doors shall be:

- Fitted with intumescent strips and brush type smoke seals

- Operable one handed with a maximum of 30kn force opening force.
- Of contrasting colour to the walls or frame

Room doors shall be fitted with a self-closing device only where there is a fire safety or other need (unlikely where there is dual means of escape). Free swing closing devices are preferred on room doors likely to be wedged open. Corridor doors are generally to be provided with free swing door closers or magnetic hold open devices interlinked to the alarm system. 'Perco' style closers are preferred where vandalism is likely (accommodation, common rooms etc.).

All electronic door locks, hold open devices or closers must fail safe in the event of an alarm activation or power failure. Where used at the junction of alarm zones they must release on activation of the alarm system of either zone.

All doors with manual locks must have a handle or other simple fastening that can be easily operated by people with poor dexterity, without the need for a key or other specific technical knowledge, on the side approached by people evacuating.

Tamper proof open door alarms are required on all fire doors of teaching space and student kitchens.

Access control systems must be programmed such that all escape routes serving areas which may be occupied are available should there be a fire. There should be no requirement to use a card, code etc. to exit under these circumstances.

Fire action notices.

These should preferably be in pictogram format to prevent language issues, combined with First Aid information. An example is available on request from the Fire Safety Officers.

C. ACTIVE SYSTEMS

Suppression Systems

Sprinkler or water mist suppression systems are to be seriously considered at initial design stage; where they are not to be provided a detailed explanation and justification will be required. Water mist systems rather than sprinkler systems will be preferred as they greatly reduce the risk of water damage and the spatial need for water storage tanks.

Suppression systems shall generally be in accordance with the appropriate B.S. but may vary at the discretion of the Fire Safety Officers.

The installation of a suppression system can have many positive benefits:

- Greater flexibility in building design.
- The reduction, through risk assessment, of active and passive fire safety measures.
- Reduced disruption and business continuity risk.
- Reduction of insurance premiums;
- Meeting environmental targets by a reduction in the risk of water pollution from firefighting, the amount of waste materials damaged in the fire going to landfill and the need for the use of raw materials for rebuilding purposes.

Myths

- When there is a fire all the sprinkler heads go off at once. Wrong. Each head is independent and only the head(s) adjacent to the fire go off.
- Water damage is as bad as the fire damage. Wrong. A typical sprinkler discharges 55 litres per minute. A firefighting hose discharges over 600 litres per minute. You can expect a sprinkler to discharge less than five per cent of the water used by the fire service.
- Sprinklers can go off accidentally. Wrong. Records show that the chance of an accidental discharge is in the region of 16 million to one.
- Sprinkler Systems are expensive. Wrong. The costs can be recovered over a period of about 10 years through reduced insurance premiums and less disruption to business continuity when a fire occurs. Installed in a new building, a sprinkler system should not cost more than one to two per cent of the total build cost.

Gas systems

Gas suppression systems should be used to protect valuable materials or equipment where they would not react well to water.

These systems will normally have a pre-determined countdown period before activating to allow for persons to egress from the area and if they should still be in the area after activation it will still be possible for them to make good their escape without any adverse effects.

Systems for kitchens

Ansul systems are required over cooking ranges and deep fat fryers.

Automated Fire Alarm Systems

Although not always required by building regulations, automated fire detection is to be incorporated into most new buildings.

A well designed system, incorporating the best methods of detection for each space, will result in the earliest warning of a fire without excessive amounts of unwanted alarms and result in optimum evacuation performance.

Standard

New systems should be compatible with the existing Morley provision. Installations must be adaptable to enable changes in respect of false alarm reduction and changes of room use.

The level may vary but in the main we expect L3 enhanced with detection in all rooms where the normal occupancy is over four persons, plant rooms, service ducts, lift shafts, air handling ducts and high risk areas. The normal standard in sleeping accommodation is L1 with sounder beacons at all bed heads.

Monitoring

All detection and alarm systems shall facilitate 24hr monitoring at the campus security control point, where zoned evacuation is required remote activation of other zones must be facilitated. Links to call handling centres will not normally be required (other than Loughton campus).

Zoning

Alarm zones must be based on confirmed fire compartmentation, usually by floor level. They must include other compartments which provide a single means of escape. The extremities of fire alarm zones shall generally be provided with a call point inside each exit from the zone and illuminated No Entry signs activated outside the entrances to the zones.

Detection

We will generally require addressable, open protocol, detector bases allowing the fitting of ancillary equipment such as sounder and beacon units.

Combined programmable rate of rise heat and optical smoke units are normally preferred. Bedroom detectors must be positioned such as to reduce the likelihood of triggering by aerosols, shower steam etc. Computer server rooms may require specialised systems.

Where CCTV cameras are to be installed for security purposes, consideration shall be given to using Infra-Red enhanced cameras. These give better night time vision thus allowing operators to more easily identify smoke and small fires. These will be particularly useful in Loughton where attendance to alarms by trained personnel may be delayed.

Alarm equipment

Voice alarm systems are preferred as they are proven to improve evacuation times. Alarm sounders shall be enhanced with visual beacons such that a beacon can be seen in all

escape routes, rooms occupied by more than four people, toilet blocks, stores, plant rooms and other noisy areas.

Sounder levels near refuge communication equipment are to be reduced to allow for effective verbal communication. Sounder levels in bedrooms are to provide 75dBA at the bed head.

Illuminated 'Fire No Entry' light boxes shall be provided outside each entrance to each alarm zone; these must continue to function after sounders are silenced until the alarm panel is reset.

Cause & effects

Programming must be agreed with the University Fire Safety Officers as management practices often vary from those normally expected; it will usually be such that one device evacuates the zone only, two devices evacuate the floor or building.

Heat detection settings are generally slower to react to a fire but will be required in areas where smoke detection is likely to cause frequent false alarms. Where the risk of false alarms is during defined periods only (i.e. commercial kitchens, science laboratories etc), detection should be programmed to smoke outside of the risk periods. Student kitchens may be used at any time so heat detection only is appropriate.

Ancillary equipment

Gas supplies and air handling systems must be interfaced to cut off on activation of the fire alarm and be provided with an automated reset. All such interfaced equipment must be provided with a key switch to allow independent testing of the system and equipment or activation by the Fire Service if required.

Access & facilities for the fire service

Any locked equipment for fire service use shall be provided with FB1 locks. This will include access gates and barriers, dry riser inlets and outlets, firefighting lift controls, fireman's switches etc.

A copy of the Fire Safety Plan Drawing shall be provided in A3 encapsulated form. This must be readily available at the entrance to the building for Fire Service use, either on the mobile security vehicle or in a Gerda style box.

The location of electricity supply switches, gas shut offs and unusual or high risks to firefighters shall be indicated by appropriate door signage.

Firefighting equipment

The institution operates a general no fire-fighting policy; most staff and students are not trained in extinguisher use. Extinguisher provision will generally be lower than the usual standard; they shall be provided at the extremities of single direction escape routes and at floor entrances.

The standard specification is Britannia Fire P50 units (suitable for all categories of risk except metal fires); anti-tamper alarms are required as standard. Fixed hose reels are not generally accepted.

Specialist extinguishers and suppression systems may be required in science laboratories, computer server rooms, commercial kitchens, areas with valuable contents or high voltage electrical risk. Fire Blankets shall be provided in kitchens, science laboratories, and large sections of escape route corridors.

D. FIRE PREVENTION

The incorporation of fire prevention measures in the design stage can have significant benefits rather than attempting to apply such measures after completion. Input at the design stage from an experienced fire officer or fire engineer may well have significant benefits.

Fire/Fuel Load

Information regarding fire loading capabilities for certain materials and products can be found in the PD 7974 series of documents, however they are more to assist in designing fire engineered solutions. These must be used as sets rather than choosing sections of text to suit the need.

Consideration must be given not only to proposed use but also potential future use. Future potential furnishing and storage requirements should be considered, not least to discourage the desire to turn escape routes into storage areas. Clear explanations of fuel load limits imposed by the design must be supplied such that end users can interpret them; this is particularly important for escape routes and circulation spaces.

Waste materials

Our approach to environmental issues requires provision for storage of different materials. The client must be consulted to gain information as to the amount to be stored and the types and numbers of receptacles to be used.

The design should incorporate adequate secure storage for bulk waste and receptacles either externally at least 8m from buildings or in a 60min fire compartment within the ground floor only accessed via a locked external door.

Storage

Consideration must be given to the provision of lockable storage areas and cleaner's cupboards not only for combustible materials but also bulky or temporary equipment and furniture to prevent the obstruction of escape routes.

Storage in vertical risers and plant rooms will not be acceptable unless suitable compartmentation and means of warning in case of a fire are provided.

External Spread

There should be no combustible materials within 5m of the building. If the outside of the building may be used for display purposes such as large advertisement banners, small neon signs or external awnings, the risk must be addressed.

Location of high fire risk areas

Where practical, high fire risk areas should be located such that any fire arising in them would have the minimum impact i.e. locating science laboratories, kitchens etc. on the top floor. However, access for firefighting must be considered and additional compartmentation at ground floor level may present a suitable solution.

Gas cylinders, hazardous chemicals and substances are necessary in some areas. As the Fire Service may decide not to enter such areas in a fire particular consideration is required. Suitable external storage is preferred.

Highly flammable and oxidising materials –bulk amounts will require a blast proof fire compartmented and suitably vented storage area. The vent shaft or ducting should be fire resisting to the same level as the storage area and should vent as directly as possible to fresh air. The venting for each store should be self-contained if it passes through a building, i.e. it should only ventilate that store and should not be used for venting of fumes from other areas or stores within a building. Where the vent shaft/ducting passes through a fire compartmented wall or floor fire dampers must be installed to prevent fire spread.

Compressed or liquid gas cylinders – All compressed gas cylinders have the potential to react or explode in a fire. Wherever possible all cylinders will be stored externally with the relevant gases being piped around the building. Where that is not possible only one cylinder of each substance should be stored internally at the point where needed, with all others being stored in a secured external area. Where gases are stored internally, Hazardous Chemical signage complying with the Classification, Labelling and Packaging Regulations will be required at the external entrances into the building and on the door leading into the room where the cylinder/s is kept. Consideration should be given to facilitating the removal of cylinders by the fire service in a fire situation; the higher up a building cylinders are stored the more difficult and time consuming this would be.

Equipment, plant etc.

Sufficient electrical sockets on sensitive RCD devices must be provided to negate the need for multi-point adaptors and compensate for the managerial limits of portable appliance testing (PAT).

Easily accessible emergency gas shut-offs shall be provided outside the building and each room fed.

Automated cooking fume extraction sufficient to prevent operation of corridor smoke detection shall be considered. Automated cooker cut-offs to prevent leaving cooking unattended shall be fitted in all non-commercial kitchens.

E. MANAGEMENT ISSUES

Management provision requirements

The future management of fire safety is a considerable burden which must be considered at design stage bearing in mind the 'fire related challenges' indicated earlier in this document. Design should accommodate the circumstances of the establishment and fit with our standard practices. Managerial burden should be reduced as far as is reasonable practicable; in line with good risk control practice, engineered solutions are preferable to those reliant on management.

The aim shall be to minimise the resources that will be required. Examples of how this may be achieved include:

- Small alarm zones, with compartmentation, such that those responding to alarms can also deal with evacuation and firefighting issues.
- Evacuation systems which negate or reduce the need for specialist equipment or assistance; allowing for self-evacuation of disabled people for example.
- Systems which are common to other campus buildings as this can reduce the training requirements for all users. See also the 'Materials' section of this document.

Fire risk management procedures and a programme of audit and management review shall be detailed in the Fire Safety Manual.

Fire Engineering

Where Fire engineering is proposed, the additional challenges of the institution must be included in thorough sensitivity analysis testing. Fire engineered solutions which rely on enhanced management as a component will require a management solution tailored specifically to the design; these must be agreed with the client before the solution can be accepted (Level 1 is unlikely to be achievable).

Where evacuation simulation models are to be employed, 3rd Party accreditation is obligatory. Adequate safety margins must be built into evacuation time studies allowing for the 'fire related challenges', in particular slow response times and the potential numbers of users who may have difficulty evacuating which will include staff and students with temporary issues as well as disabled persons.

Responsibilities

Designer - It is the responsibility of the designer to ensure there is a suitable fire strategy and to initiate the fire safety manual ensuring it is populated as design information becomes available.

Fire Safety Officer (University), the 'competent person' for fire safety within the University - advise on all fire related issues in building design from inception to completion of projects.

This will include agreeing:

- The Fire Strategy.
- The preliminary fire risk assessment in accordance with the Building Regulations, if it is to be used as part of the submission.
- All variations from standard practice.

- Content of the Fire Safety Manual.

On hand over, the Fire Safety Officer will be responsible for the fire safety manual.

Principle contractor

- In consultation with the Fire Safety Advisor (Establishment), conduct a fire risk assessment for the period of works and ensure that suitable control measures are implemented, supervised and monitored.
- Ensuring that the Fire Safety Officer is consulted before implementing any changes which may affect the arrangements in respect of fire, during or on completion of the build.
- Supply of the Fire Safety information as required by the CDM Regulations, Building Regulations and B.S.9999 Annexe H. This should be in the form of a 'Fire Safety Manual' which will contain design information and the fire strategy as MS.Word documents supplemented with plan drawings in CAD format.
 - These shall be provided to the Fire Safety Officer, as designed or specified, during the early design stages, revised and completed during the project. The required content is detailed in the Appendices. The completed versions shall be confirmed 'as built' before hand-over.
- Ensuring that completed fire safety installations are checked for conformity to the approved drawings and system design.
- Ensuring that all fire safety features, equipment and signage are in place before handover. This is to facilitate completion of the Fire Risk Assessment by the 'competent person' for the establishment which must be in place prior to occupation.
- Ensuring that all required 3rd Party accreditation is in place.

F. SLEEPING ACCOMMODATION

These areas present the highest life risk therefore extra precautions are required. They are likely to be used both for student living accommodation and, effectively, as hotel accommodation outside term time; use by people not familiar with the building will be common. Design based simply on dwellings, flats or student accommodation is unlikely to be suitable.

Installation of a sprinkler or mist system and bi-directional means of escape from all normally occupied rooms is expected.

Challenges

Design standards must account the following additional challenges:

- Use for conference visitors and the public.
- Although disabled accommodation is often provided separately, use of all areas by temporarily disabled students, staff and disabled visitors is common; means of escape from all areas must be suitable.
- False fire alarms; mainly due to cooking with the kitchen door open, steam from showers and use of aerosols near detectors.
- Poor evacuation performance.
- There is not normally a managerial presence in the residential buildings, particularly at night. Checking on evacuation is problematic and failure to evacuate is common.
- Limited supervision and enforcement of fire safety rules.
- Inexperienced people cooking with unfamiliar equipment (cause of over 90% of fires).
- Extensive and often inappropriate use of electrical equipment, commonly including items which do not conform to British Standards.
- Cultural or religious use of Hooker Pipes, candles etc. where naked flame and smoking would normally be banned.
- Extremely varied and unpredictable sleep, work and social behaviour patterns.
- Privately owned, designed and operated accommodation in the vicinity, often not to expected standards, resulting in pressure to cut cost.

Automatic fire detection and alarm systems

We require alarm sounders and beacons in all escape routes, common areas and normally occupied rooms. Sounders to be set at 75dBA measured at the bed head in bedrooms. There must be facility to fit vibrating alarms for hearing impaired residents.

Cause and effect programming of detection and alarm systems is crucial. False alarms caused by smoke detector activation by cooking fumes, shower steam and aerosol use are historically common. Systems should be designed to reduce these as far as reasonably practicable including enhanced automated cooking extraction and careful positioning of detectors.

Call points should be sited on escape routes in secure areas (i.e. inside flat exits) rather than by final exits to reduce malicious activations when sited in common areas. Sufficient points

shall be installed to ensure that anyone leaving a room shall pass one on their escape. Alarmed covers and CCTV coverage are likely to be required for any that have to be in common areas.

Kitchens

Communal kitchens in residential accommodation with single direction means of escape must be located at the furthest end from the exit to facilitate escape.

Measures must be taken to reduce fires caused by students cooking. These could include purpose designed water mist or other suppression systems cookers or cooker timers which require manual reset after 10 minutes if left unattended.

Self-closing kitchen doors are frequently wedged open causing false alarms. The risk of this is to be prevented by the installation of open door warning devices (door screamers).

G. MATERIAL SPECIFICATION & INSTALLATION

General

Passive fire protection systems if designed, specified and installed correctly will provide many years of reliable protection to the building. However, because they are part of the building, it is often considered that they can be installed by general builders with no specific training or competency evaluation of staff. This can lead to incomplete or inappropriate installation.

In order to achieve the most effective and reliable fire protection, all active and passive fire protection products, installers and commissioning companies are to be third party certificated by a body holding UKAS (United Kingdom Accreditation Service) accreditation for the product or services they certificate. Manufacturers in such schemes will be pleased to provide details of their certification, typically by bodies such as BRE / LPCB, Warrington Certification, BM TRADA, IFCC, FM Global and UL. Should there be any doubt or ambiguity clarification can be readily sought by visiting the appropriate website.

Competent Installers

Standard specifications often cover 'workmanship' in a generic way which provides little practical or specific guidance. Instructions such as "unless otherwise specified the standard of workmanship required shall be to BS 8000", are not sufficient as the BS is very general and contains little detail on passive fire protection.

Passive fire protection is rarely a complete package of work delivered by a specialist installer. Elements are typically split into related sub-contractor packages and often undertaken by people not adequately skilled leading to poor standards of installation. As stated in the ASFP document 'Ensuring Best Practice for passive fire protection in buildings': "as the objective of passive fire protection material installation is to protect the life of the building occupants the work should not be allocated to contractors for whom it is an add-on function".

The CIBSE Fire Engineering Guide also recognises these issues, stating that "it is common that the fire separating elements are not properly installed or maintained" and "the fire-resisting performance of a compartmentation element is only as good as the weakest link".

With all built-in components, especially those concealed within the fabric of the building, it is difficult to assess the quality of workmanship once installed. It is often equally difficult, and potentially very costly, to upgrade the performance of a system that has been incorrectly installed.

Modern methods of construction often include materials which are less robust and forgiving of latent defects caused by poor workmanship than in the past; there is a very small margin for error if the required fire performance is to be achieved.

Monitoring of 'passive' fire protection is often extremely difficult and failures not apparent until a fire occurs. There is a reluctance to carry out invasive inspections or access hidden voids at the 'handover' stage of a project or later in the life of buildings.

Under the Regulatory Reform (Fire Safety) Order the Responsible Person is charged with ensuring that Competent Persons are used. Any work that is not of the correct quality could fail to deliver the fire safety design requirements. It is therefore important to unambiguously specify the standard of workmanship required.

Although there is currently no legal requirement for 3rd Party Certification of structural fire protection installers, Building Regulations Approved Document B states: “Since the performance of a system, product, component, or structure is dependent upon satisfactory site installation, testing and maintenance, independent schemes of certification and registration of installers and maintenance firms of such will provide confidence in the appropriate standard of workmanship being provided. Third party accreditation provides a means of ensuring that installations have been conducted by knowledgeable contractors to appropriate standards, thereby increasing the reliability of the anticipated performance in fire”.

The ‘FPA Essential Principles Design Guide’ states: “All fire protection products / systems shall be installed by adequately trained specialist installers installers shall be third party certified to install the specific product / system when an appropriate scheme is available”.

Installation contractors should hold third party certification for each type of passive fire protection they install. A sufficient level of competence and expertise with evidence of a robust Quality Assurance system is required to ensure that fire protection systems meet the required standard.

Passive fire protection is often prone to ‘out of sequence’ damage as additional services are installed. If damage to the fire separating components takes place it is very important that such damage is repaired by those who are competent to do so. As stated on page 34 of the FPA ‘Passive Fire Protection Handbook’ “never allow on-site modifications that are not approved or use an installation contractor that cannot demonstrate the appropriate level of competence and experience”.

Limitations on installers

It is necessary to understand some of the limitations to ensure that all potential workmanship issues are covered. Stakeholders should check that 3rd party certificated contractors hold certification for each & every product they install.

For example BRE/LPCB scheme LPS 1531 covers the requirements for the approval and listing of companies installing or applying the following passive fire protection products:

- Penetrations, Cavity Barriers and Linear Gap Seals
- Fire Rated Board and Cladding to Steels
- Intumescent Coatings to Structural Elements
- Fire Rated Spray Materials
- Fire Rated Ductwork Systems
- Fire Resisting Dampers
- Fire Resistant Compartment Wall Systems

Very few if any companies are in the scheme for all types of products. It should also be noted that this scheme does not apply to fire doors; these are covered by two separate schemes: LPS1271 for installing Fire and Security Doors, Doorsets, Shutters and Active

Smoke / Fire Barriers; LPS 1197 for repairing and maintaining them; some organisations will be licensed for only one or more but not all of the products within these two schemes.

It should also be noted that some schemes will allow a member of the scheme to undertake work outside of the scheme, potentially to a lower quality assurance standard. It is therefore crucial that the Responsible Person ensures that all aspects of the work being undertaken by a 3rd party accredited installer is covered by the scheme in which they claim to operate and that ALL work they are undertaking can be fully certified upon completion.

Alternative to third party certification

An alternative to 3rd party accreditation schemes to guarantee competent installations is by using inspection and auditing services to guarantee that fire safety components are being installed competently to the required standard of workmanship. Suitable organisations to undertake such inspections include British Research Establishment (BRE), Warrington Certification, BM TRADA, IFCC and the BWF.

In house quality assurance checks may be another option where a suitably competent person is employed and has access at relevant stages in the construction. Where used, proof of competence and a schedule of inspection must be provided.

Planned Preventative Maintenance

The future management of fire safety components is an important function which must be considered at design stage; a primary aim being to minimise the resources that will be required.

It will be difficult to recruit, organise and train people to carry out functions such as fire wardens, evacuation stewards, operators of evacuation equipment, extinguisher users etc.

The factors to consider include:

- Time: the duration of tasks
- Expertise: Level of knowledge required and training implications
- Access: Requirements to work at height, confined spaces etc.
- Lifespan: frequency of tasks and working life before replacement

Expected examples to reduce the management burden include:

- Service free water mist extinguishers to cover all except risk of metal fires or in high voltage electrical equipment areas
- Self-test facilities on emergency lighting systems
- Quality doors and fittings, free swing or magnetic hold open devices
- Ready access to hidden spaces and cavities within the building for inspection and maintenance of in-built fire safety components.

Structural Steel Protection Systems

Fire protection systems to structural steelwork come in a variety of materials. All systems need to be installed within the parameters of the manufacturer's fire test/assessment data or third party certification, otherwise they are unlikely to provide the fire resistance that was specified:

- Board materials; normally applied to form a box around the steel sections. It is relatively easy to check if they have been correctly installed, or rectified if necessary, paying particular attention to joints and fixing details.
- Sprays and renders; such non-combustible cementitious or gypsum based products, sprayed or troweled around the section to provide an insulating layer, tend to be installed by specialist contractors to the required standard.
- Intumescent paints; react to heat by swelling up to form an insulating char. Base coats must be applied evenly onto a compatible primer in good condition to specified loadings within the right time frame and within certain ambient temperature and humidity limits. It is neither easy to check, nor rectify if incorrectly applied.

Fire Wall Systems

Fire walls may be loadbearing or non-loadbearing and are made from a variety of materials including masonry, plasterboard, calcium silicate board and sandwich panels for larger buildings.

Buildings will move in the event of a fire and floor slab deflection can cause stress in partitions. The partition's structural soffit junction detail must be designed to accommodate anticipated movement. The deflection head detail must be correctly installed. A robust method of quality assurance for the fire compliance of dry-lined walls must be in place prior to installation. There are many systems that can accommodate this, for example the British Gypsum 'White Book' which can be readily accessed and downloaded from their website.

Fire Resisting Glazing Systems

Fire resistant glass should always be marked with a stamp to advise exactly what type and properties of fire performance the glass provides. If such a symbol is not clearly displayed then it will be assumed that the glass is not fire resistant.

The commonest fire resistant glass types provide integrity but no significant level of insulation protection; this cannot be used, for example, to protect a refuge area. Other types are available that provide either full insulation (same period of insulation as integrity) or partial insulation, e.g. the insulation value is approximately half the integrity value. Security or safety glass cannot be expected to provide any tested fire performance unless expressly stated.

Fire resistant glazing systems have to be installed as tested, assessed or certificated, using the correct, supplier specified, compatible components. Any site application that deviates from the test, especially those involving the installation of larger panes, must be re-tested or assessed by a competent person.

Expert advice and more detailed information on glazing systems can be sought from the Glass and Glazing Federation: www.ggf.org.uk

Fire Doors

A fire door 'assembly' is a system where all or several items (door leaf or blank, frame, glazing, hinges and other hardware) are sourced separately and typically assembled on site. Research suggests that a significant proportion of fire doors in the UK created in this way will

not achieve the fire rating to which they were tested due to a combination of poor procurement, installation, maintenance and management procedures.

A fire 'doorset' is a door system where everything has been supplied from one source (typically a 3rd party certified door manufacturer), partly or completely pre-assembled where all of the components are fire tested as a unit. Pre-assembled doorsets are generally preferred as they are the best method of attaining fire compliant installations and can be more cost effective as they reduce installation time.

All fire doors must be fully 3rd party certified, identified by being plugged in accordance with the BM TRADA Q Mark Assurance scheme or carry the BWF Certifire label, backed by the Manufacturers Primary Fire test evidence in accordance with BS476: Part 22.

Fire door frames must be kiln dried to prevent non-compliant gaps through warping. The minimum density for FD30 frames is 500KG/m³, either softwood or hardwood; for FD60 doorsets the minimum is 650gk/m³ and the timber must be hardwood.

10mm lippings and bushed bearing hinges should be specified for high usage doors to reduce the likelihood of defects and maintenance burden.

Fire doors to a refuge area must have adequate seals to the threshold to ensure that the refuge area will perform as intended.

The Fire Door Inspection Scheme (fdis.co.uk) is a useful source of information on all aspects of fire door compliance.

Fire stopping and linear gap sealing

When fire stopping around services a number of factors must be considered:

- required period of fire resistance
- type, number and size of services contained within the aperture
- how the fabric of the building will react in a fire
- later addition or removal of services
- load bearing or impact resistance requirements
- thermal movement or other ambient conditions
- acoustic or other non-fire issues

Products should only be installed as fire tested/assessed/certified and systems should not be mixed and matched as products from one manufacturer may not work with complementary products from another. Similarly seals damaged by the introduction of additional services should be repaired with the same product.

Linear gaps occur where different components of a building interface. Fire stopping requirements must be expertly determined to guarantee compliance, taking into account a number of factors such as the level of fire resistance required and how the interfacing components might behave in a fire in terms of expansion and deflection. The attainment of fire compliant linear gap seals can be problematic if the passive fire protection of a building has been fragmented into different sub-contractor's work's packages. The responsibility for the linear gaps is unambiguously allocated by the Principal Contractor.

The correct type of intumescent mastic must be specified for each application:

- Urethane foams are rarely tested or suitable for sealing service penetrations. They must not be used unless evidence is provided to confirm they are tested and certified as suitable for each application.
- Acrylic mastics are the most basic in terms of fire performance. 3rd Party certification is a key requirement.
- Silicone mastics are waterproof and generally more flexible– they should to be used in cavity voids and other areas where thermal movement of the structure and moisture may occur.
- Graphite mastics generally have both a high expansion capability and the ability to exert pressure. They should be used around cables and small plastic pipes as they will displace and dam penetrations as such services melt.

Within a roof void, in addition to the installation of vertical barriers, fire stopping should be carried over the full thickness of the wall and the roof covering is to be designated for penetration by fire and spread of flame. If roof support members pass through the wall, fire protection to these members for a distance of 1500mm either side of the wall may be needed.

Cavity Barriers

Any voids within a building need to be effectively separated at determined locations with cavity barriers to limit the unseen spread of fire and smoke. Barriers for fire and smoke should provide at least 30 minutes fire resistance including insulation and integrity; those just for smoke require integrity only.

Where vertical fire separation is specified between floors, a cavity barrier to the required fire rating is necessary between floors and curtain walls or other adjoining substrates. They must be installed to the manufacturer's fire tested detail to ensure that wall deflection due to thermal movement and other factors, will not compromise effectiveness.

Suspended ceiling cavity barriers not forming structural fire separation are typically created by flexible 'curtain' products made from mineral wool or woven glass fibre fabric.

Cavity barriers to extend a fire wall to the soffit or to fill a gap between a door set and the soffit must provide both integrity and insulation and are typically made from a 'coated batt' system.

Raised floor cavity barriers can also be used to provide acoustic barriers and/or an air seal, especially if forming an integral part of a building's air plenum. They are typically made of foil faced mineral wool systems where they are not likely to be disturbed or breached by services. Where they may be breached, coated batt systems or similar, fire tested for this detail must be specified, potentially inclusive of cable transit sleeves.

Ducts and dampers

In some situations, particularly in escape routes, there can be a requirement to fire rate ductwork to prevent fire from breaking out of or entering ducts in order to maintain compartmentation. Dampers should be fixed either within or directly adjacent to fire barriers and be robustly supported, independently of the connecting ductwork, such that in a fire

situation they will not distort or collapse but remain as an integral part of the barrier. Where they are installed within a penetration seal, the seal should be as per the damper manufacturer's detail.

Where ducts penetrate drywalls they must be framed with the studwork, lined with plasterboard and effectively sealed as per the duct manufacturer's detail.

All dampers must be accessible for future maintenance.

Electrical / computer cables etc.

There is a tendency for cables to be run and installed throughout buildings in densities that cannot be effectively fire sealed. The use of fire tested transit sleeves, pre-installed to cater for such runs, should be seriously considered.

It should also be noted that BS 5839 precludes the use of plastic tie clips, cable ties or trunking where these products are the sole means of cable support. Electrical trunking boxes almost invariably have no external fire rating and should be fire stopped.

Fire curtains and shutters

Care must be taken in ensuring that what is specified and installed provides the fire resistance required; for example if it is intended to create a 30 minute escape route then fire curtains must possess 30 minute insulation from excessive heat together with hot and cold smoke protection and not just 30 minutes fire integrity. Fire shutters provide a similar function and are often used to provide 120min fire separation. Both types of products should only be installed and maintained by 3rd Party certified installers.

Suitable arrangements must be in place to ensure that the escape of building users is not impaired.

Timber Frame Buildings

Timber frame buildings are unforgiving of poor passive fire protection. Softwood framework has very little fire resistance and mainly relies on plasterboard for protection. Unless expertly clad and sealed, adhering strictly to the board manufacturer's instructions, there can be a risk of fire entering wall cavities where it can be extremely difficult to locate and fight. Any actions or changes to the building that might breach the internal cladding must be strictly managed.

H. APPENDICES

Fire Strategy content

The Fire Strategy document shall:

- Provide a full description of the assumptions and philosophies that led to the fire safety design, including explicit assumptions regarding the management level and designated use of the building, housekeeping and other management functions;
- Explain the nature of the fire safety planning, construction and systems designed into the building, and their relationship to overall safety, evacuation and management;
- Describe the basic fire precaution measures;
- Provide information, etc., relating to other reasons for protecting the building – property, contents, fabric, heritage, environment and insurer's requirements.

Fire Safety Manual Requirement

Content shall be provided to the University during the early design stages, completed and revised during the project. The completed content shall be confirmed 'as built' before hand-over where practical and within 3 months where not.

Manuals may consist of links to IT documents rather than copy and pasted information. Any paper information may be scanned in and treated the same way.

Content:

- The Fire Strategy.
- Design imposed restrictions not shown on the plan drawing i.e. fire loading etc.
- Any pre-planned procedures agreed with the fire and rescue service
- Documentation to describe the use, test, servicing and maintenance schedule and instructions of the fire safety features and equipment.
- Documentation relating to the fire related features of products, installation and commissioning.
- Detail of the fire prevention and security measures (including measures for the prevention of arson).
- Details of interactions with security, building management, other safety systems, etc.
- Cause and effects of fire alarm systems and interlinked devices.
- Fire safety plan drawings showing all fire safety related features. Where content cannot be reasonably be displayed on one set, two may be required, one featuring all items which may be useful for firefighting purposes.

Plan drawing content:

- Escape routes indicating maximum as built capacity, minimum widths and any not suitable for disabled persons or specifically provided for them.
- Fire refuges and specialist disabled equipment.
- Room use and maximum as built occupancy numbers.
- High fire risk or hazardous areas.
- Compartmentation including fire resistance of partitions, floors, fire shutters etc. All passive fire protection components and elements must be shown.

- Fire and final exit doors indicating securing, hold open or self-closing devices.
- Detection and alarm equipment including zones, ancillary and interfaced items.
- Emergency lighting units
- Electricity and gas supply cut-offs.
- Ventilation systems controls, ductwork and dampers.
- Fire related signage.
- Smoke control zones and equipment.
- Firefighting and evacuation lifts and Fire Service controls
- Control points for any other fire related equipment (ventilation, curtains etc).
- Access (exterior and interior) for the fire and rescue service and hazards to fire-fighters (e.g. some types of sandwich panels)
- Firefighting equipment including hydrants, dry risers and items for Fire Service use.
- Assembly points and/or muster stations.

Construction Phase

Non-Notifiable Works.

The Project Manager is responsible for providing all relevant information to the contractors & design team as part of the pre-construction information required under CDM. Pre-Tender Safety Information Pack. They will consult with the University of Essex Fire Safety Officers at an early stage to assure the safety of University of Essex staff and students.

Notifiable Works.

The Principal Designer¹ and the University's Project Manager will consult with the University of Essex Fire Safety Officers at an early stage to assure the safety of University of Essex staff and students. The University's Project Manager will provide all relevant information to the Principal Designer as soon as they have been appointed. The appointed Principal Designer shall provide all relevant information to the Principal Contractor and design team as part of the pre-construction information required under CDM.

Fire risk assessment

Fire safety legislation requires a fire risk assessment with suitable control measures prior to any works being undertaken. Note: the documentation must be provided to any authorised Fire Brigade Officer attending site or any other person who may be affected on request. The Principal Contractor (or Project Manager where one is not appointed) will be responsible for the assessment and the implementation, supervision and monitoring of suitable control measures prior to and for the duration of the project.

Those projects where the building is occupied at the same time as construction works are being undertaken are of particular concern. The extent that the building's fire safety arrangements could be affected by the works must be established in consultation with the University Fire Safety Officers. The University's Project Manager will be responsible for the implementation, supervision and monitoring of any necessary changes to the buildings existing control measures prior to and for the duration of the project. The Permit to Work scheme will prove invaluable for obvious risks such as disabling fire alarms and impeding means of escape.

¹ As required by CDM 2015

The aim shall be to protect the occupants, buildings and equipment from fire commensurate to the risks and size of the project or undertaking. The risk assessment must include consideration of the impact of the proposed works on the following areas:

- Prevention of fire and control of ignition sources.
- The means of escape for occupants to a place of safety; this includes the physical protection of routes, floor surfaces, locks & door furniture and emergency & safety lighting for escape routes etc.
- The building's fire compartmentation to protect occupants and escape routes; this includes fire door management, demolitions, fabric removals, penetrations of fire compartment walls & floors by services, pipe work and electrical & data cabling etc. The provision of passive fire protection element of structure and to maintain fire compartmentation.
- The storage and use of hazardous goods by contractors that increases the fire loading or introduces hazardous materials to the site; which includes combustible waste removal, storage and use of hazardous materials such as gas cylinders & flammable liquids and hot works etc.
- The elimination of unwanted fire alarms caused by automatic fire detection being contaminated due to dust, construction activities or works to the fire alarm system within the site or the immediate project site boundaries.

The assessment should generate suitable control measures and documented arrangements to protect all 'relevant persons'. These control measures must be in place prior to works starting. The following fire prevention and fire safety guidance documents (or equivalent) may be used as a basis:

- Fire Prevention on Construction Sites (Joint Code of Practice on the Protection from Fire of Construction Site & Buildings Undergoing Renovation - Seventh Edition)
- Construction Site Fire Prevention Checklist (A Guide for Insurers, Surveyors and Construction Industry Professionals - Seventh Edition)

The arrangements shall be recorded in the Safety Plan which will include:

- The Fire Risk Assessment
- Procedures for Serious & Imminent Danger
- Records of monitoring, training, tests and checks etc.
- Method statements, permits to work etc.

The plan must be kept up to date and revised as appropriate.

Recommended 3rd Party approval schemes

FIRAS is a third party certification scheme for installation contractors of both passive and active fire protection systems, accredited by UKAS to EN45011, operated by Warrington Certification www.warringtoncertification.com

LPCB (The Loss Prevention Certification Board) is part of BRE (Building Research Establishment) Certification www.bre.co.uk and runs many passive and active fire safety schemes to Loss Prevention Standards (LPS), developed by various stakeholder groups over many years.

Both schemes provide:

- Technical assessment of the installer's competence
- Approval of the installer's quality management system to ISO 9001 (or assessment against the requirements of the relevant Loss Prevention Standard (LPS) where ISO 9001 is not appropriate)
- Regular surveillance inspections of on-going installations
- Surveillance of the installer's quality management system
- Certificates of Conformity which are issued for each installation to demonstrate compliance with the specification
- Listing of the approved installers on their websites.
- LPS schemes additionally require the installer to complete an inspection checklist defining the frequency of inspection as a quality test sign off, completed by an experienced or qualified nominated person in the installation company.

Other schemes for the installation and inspection of fire doorsets are provided by UKAS Accredited body BM TRADA and the British Woodworking Federation (BWF)