

**Ensuring Best Practice** for passive fire protection in buildings



I am pleased to introduce to you the Guidance Document from the Department of Trade and Industry sponsored Partners in Innovation project 'Ensuring Best Practice for Passive Fire Protection'. The objectives behind this research were to determine if problems exist in the specification and installation of passive fire protection in buildings and to analyse the reasons behind any problems.

The Guidance Document generated by the project sets out the ways in which the whole process of design, installation and maintenance of passive fire protection may be handled to provide fire safe buildings for occupiers and to overcome any system failures established by the research.

I extend my congratulations to all of those involved in the production of this Guidance Document and believe that it will provide the reader with added knowledge that will help him or her to design, install and maintain passive fire protection systems to the highest standard.

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OFFICE OF THE DEPUTY PRIME MINISTER







## FOREWORD TO BEST PRACTICE GUIDANCE FOR PASSIVE FIRE PROTECTION IN BUILDINGS



It is vital that the buildings we construct help save life and reduce the risk of injury. This document is intended as a practical guide to enable all those involved in building design and construction – building owners and developers, the design and construction teams and facilities managers – to increase the quality of passive fire protection using the best practice techniques available.

Research has shown that Passive Fire Protection in many buildings is either badly installed or inadequate. As part of our Best Practice Programme this guidance fills a major gap in a vital area of construction safety and focuses the minds of the industry on a neglected area.

I therefore wholeheartedly commend this guide and in doing so would like to acknowledge the considerable support from the Passive Fire Protection Industry that has made its production possible.

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Brian Wilson Minister of State for Energy and Construction

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## **USING THIS GUIDE**

This Guidance is intended to offer architects, designers, constructors, building occupiers and others, effective and feasible recommendations and selection criteria for the use of Passive Fire Protection (PFP) systems in buildings. It is the outcome of a three year 'Partners in Innovation' project, which was partly funded by the Department of Trade and Industry (DTI) and the Office of the Deputy Prime Minister (ODPM) (formerly DTLR).

The main objective of the project was to determine if problems existed in the specification and installation of PFP systems in buildings and to analyse the reasons behind any problems, with the intention of producing effective and feasible guidance on the use of PFP. The guidance is also intended to have the additional benefit of providing Building Control Bodies and Fire Safety Officers with summarised, accessible, and meaningful information that will enable them to more accurately assess the appropriateness of the passive fire protection systems intended for the building.

The work follows the report of the Construction Task Force, chaired by Sir John Egan in 1998, and fits into the 'Rethinking Construction' initiative and its three simple principles, Client leadership, integrated teams throughout the delivery chain and respect for people. The objectives of this initiative are to achieve radical improvements in the design, quality, sustainability, and customer satisfaction of UK construction by assisting best practice and so providing improved life safety and best value.

#### The Best Practice recommendations in this Guidance are shown highlighted in this manner.

|    |   | Designers<br>(D) | Constructors<br>(C) | Manufacturers<br>(Mf) | Approvers<br>(A) | Managers<br>(Mg) |
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The following matrix is intended to help individual professionals find their way through this document.

Essential Information

## 1 INTRODUCTION

#### 1.1 OVERVIEW

PEP Section 9

This guidance document is intended to assist all involved in the design, construction, administration, management or inspection of buildings or structures to establish 'Best Practice' in the provision of Passive Fire Protection (PFP) measures.

While primarily concerned with the safety of life and reduction of injury, PFP also provides protection for the building fabric, contents, business operations, heritage, and the environment, by reducing fire severity.

This subject is too large and the range of materials and building elements too complex for all the details of their correct specification, installation and use to be included in one publication. It is intended to provide a reference document that contains basic details and direct the user to detailed sources of information on areas of concern. Only by applying due diligences at all stages of the process is it possible that these measures are likely to provide the expected performance.

### 1.2 INTRODUCTION TO FIRE PROTECTION AND PASSIVE FIRE PROTECTION (PFP)

#### 1.2.1 Introduction

PFP is vital to the stability and integrity of a building or structure in case of fire. PFP with proven fire performance properties is built into the structure to provide stability and separate the building into areas of manageable risk. These are designed to restrict the growth and spread of fire allowing the occupants to escape or the fire fighters to do their job. Such protection is either provided by the materials from which the building is constructed, or is added to the construction materials to enhance their fire resistance.

Recommendations for fire resistance are expressed in terms of time and the ability of dividing elements such as walls or floors to contain fire and/or maintain insulation values. Load bearing elements are required to maintain their capacity and/or integrity for the basic framework of the building, and include any element or service that provides an opening or passes through the walls, floors, or fire separating elements. It is vital that these protection measures are correctly designed, specified and installed if the building is to behave as expected should fire break out. By their nature they are 'passive' until there is a fire and only then will their fire performance in-situ be demonstrated. The occupants of a building will attend to their daily business, visitors will shop, be entertained, or enjoy recreation without any knowledge of the PFP measures that will protect them in fire. However, it is essential that these measures will work if an emergency occurs.

#### 1.2.2 Built-in fire protection and Passive Fire Protection (PFP)

Most construction materials have some natural resistance to fire and as such comprise built-in fire protection.

This natural fire resistance may be enhanced by the use of added materials or components that are known by the collective term PFP. These are called passive because they do not need any special energisation or command signal to operate, (although some systems such as dampers and certain types of doors may be designed to operate from such methods).

PFP includes:

- Cavity barriers
- Ceiling systems
- Compartment walls

- Fire doors and furniture (eg self-closing devices, latches etc)
- Fire fighting shafts and stairwells
- Fire-resisting air transfer grilles (mechanical or intumescent)
- Fire-resisting dampers (mechanical or intumescent) used in horizontal or vertical air distribution ducts
- Fire-resisting ductwork
- Fire-resisting glazing
- Fire-resisting service ducts and shafts
- Fire-resisting walls and partitions
- Floors
- Hinged or pivoted fire doorsets (timber or steel)
- Industrial fire shutters (rolling or folding)
- Linear gap seals
- Penetration seals for pipes, cables and other services
- Structural frame fire protection
- Suspended ceilings
- Membrane ceilings (horizontal partitions)
- The building envelope, eg fire-resisting external walls, curtain walls etc.

Other elements of the building may also have a role in PFP.

#### 1.2.3 Active fire protection

Active fire protection is the fire protection which requires special energisation or a command signal to operate. It includes:

- Detection systems
- Alarm systems
- Sprinkler systems
- Other fire suppression systems
- Smoke control systems

Active systems all need to be actuated by a signal. Detectors will operate from heat, smoke, CO,  $CO_2$  etc. The signal from a detector will be needed to operate any of the systems listed above. Alternatively, or in addition, these systems will usually be operable by manual triggering, eg from a control room.

Because active systems actually do something when a fire is detected, and fires are rare and unexpected in normal buildings, they need to be regularly tested and maintained. Apart from these comments this guidance document will only occasionally mention Active Fire Protection.

#### 1.3 WHY GUIDANCE IS NEEDED

The research undertaken under this project has shown that many buildings are constructed and operated with PFP either badly installed or missing altogether. This situation is compounded by alterations made to the building by the occupier as changes in occupancy, operations or systems take place.

Egan<sup>[1]</sup> Latham<sup>[2]</sup> The Egan report, published in 1998<sup>[1]</sup> and the earlier Latham report<sup>[2]</sup> identified the confrontational and competitive situation that exists in the construction industry and the need for improvements in training and skill levels. Research has shown that these comments have particular relevance when considering the life safety requirements that are embodied in the installation of fire protective materials. This work has been undertaken as part of the 'Best Practice Programme' of research and innovation<sup>[3]</sup> set up by Government

following these reports. The research has included reviewing manufacturers' information, fire investigation reports, inspectors' findings, extensive industry consultation and detailed examinations of buildings.

Furthermore, the move within regulatory guidance from prescriptive rules to performance-based designs and risk assessment during occupation put greater responsibility for safety onto construction companies and building owners or occupiers. These notes are intended to help all concerned understand their responsibility and fulfil the requirements.

The 'Rethinking Construction' research<sup>[1]</sup> with clients brought the following conclusion that is central to this research:

'Using price competition as the main criteria for selection encourages contractors to submit low tenders to win the contract. Once contractors have secured contracts they strive to increase profitability by applying pressure on their subcontractors to further reduce prices...'

Additionally, the initiative identified six key guidelines that are fully in line with this document and the research findings.

- 1 Traditional processes of selection should be radically changed because they do not lead to best value.
- 2 An integrated team which includes the client, should be formed before design and maintained throughout delivery.
- 3 Contracts should lead to mutual benefit for all parties and be based on a target and whole life cost approach.
- 4 Suppliers should be selected by Best Value and not by lowest price; this can be achieved within EC and central government procurement guidelines.
- 5 Performance measurement should be used to underpin continuous improvement within the working process.
- 6 Culture and processes should be changed so that collaborative rather than confrontational working is achieved.

These are considered to be particularly relevant in the context of PFP because of the life safety implications which are unseen until a fire emergency arises.

### 1.4 THE FIRE PROCESS

Egan<sup>[1]</sup>

This Section very briefly describes the way a fire develops to become a life-threatening event so that the recommendations in this Guidance can be understood in context and their importance appreciated.

A fire in a building can start in a number of ways. These include:

- careless use of matches, cigarettes and pipes
- faulty wiring or electrical equipment
- careless use of cooking equipment, especially leaving oil fryers (chip pans) unsupervised
- drying of materials (eg fabrics) that will smoulder and burn near heaters such as gas fires and electric radiant, storage and convector heaters
- poor detailing of hot flues, particularly when adjacent to combustible insulants
- hot work; inadequate compliance with hot-working procedures during construction or maintenance
- items falling into open fires or other heat sources
- children playing with matches and cigarette lighters
- old or faulty appliances

- putting portable heaters close to furniture and curtains
- failure to disconnect electrical appliances, not designed for continuous operation, at night or when unattended
- incorrect use of paraffin heaters
- covering of storage and convector heaters, thus stopping air from getting to them
- irregular or poor servicing of heating appliances
- lightning
- self-heating of specific materials
- solar heating (eg through a magnifying glass)
- electrical sparks, mechanical sparks
- arson (deliberate fires).

A fire needs three elements; heat, fuel and air. If a fuel, a combustible material, is heated enough it will give off volatile gases, which may ignite. If the heat from these burning gases is enough, it will cause more gases to be given off and so the fire will grow.

A fire starts when a source of heat is brought into contact with something ignitable. Because a material is combustible does not mean it will ignite easily. But the item ignited (eg paper) may be in contact with other combustible materials (eg furnishings). Once a fire has started, extra heat is produced by the first item and this can cause other items to burn. So a fire can grow very quickly, and this speed of growth is enhanced by being in a room which can contain the heat. Fires indoors grow more quickly than fires in the open. How the fire then develops depends on the quantity and density of combustible materials in the room or compartment.

As the fire gets bigger, a third factor becomes important; the amount of air available. In a small room, with all doors and windows closed, the fire will use up the air quite quickly and may go out. But in a larger room, or where doors or windows are open, the fire will grow. The fire gets so hot that volatiles are produced more quickly than the air can reach them. These volatiles leave through the various openings to burn outside a compartment. Once this stage is reached the fire is very dangerous since it can spread very quickly. The development of a fire depends on the source of ignition, quantity and layout of the material to burn, and the air supply.

As well as heat, the fire produces products of combustion which include smoke. This is often the first killer since it is produced in large quantities by most fires and it can spread a long way from the fire. It can be blinding, irritant and toxic. As well as being dangerous in itself, even quite dilute smoke can hinder escape. It is also thought that some toxic gases can affect the decision-making ability.

Some fires start off as smouldering hot spots. These fires do not grow very quickly and do not produce very much heat, but can produce very toxic smoke. Smouldering fires may suddenly turn into real flaming fires and grow very rapidly. They are particularly dangerous to people who are asleep.

Explosions are different from fires. Here the fuel will be mixed with air or have oxygen as part of its own chemical composition and so the growth of the fire is very rapid; so rapid that a pressure wave may be produced. Buildings are not normally designed to cope with explosions and neither are most PFP systems, unless specifically called for at the design stage.

There can be different risks in different occupancies. Not only will the content and use of the building affect how the fire starts and develops, but the function of the building will determine the type of people present. People who are familiar with a building will find the exit routes more easily than those who are new to the building, and when people are sleeping they are likely to take longer to react to an emergency than those awake. Similarly, people who are mentally confused (for whatever reason) will be at particular risk. Partially occupied buildings can present a problem to occupants if a fire breaks out in the unoccupied part.

#### 1.5 **DESIGN RESPONSE**

1.5.1

Options

The designer has a range of techniques available to protect occupants against fire and smoke. These include:

- PFP measures to physically limit the spread and effects of the fire, protect escape routes against heat and smoke and stop the building collapsing
- Detection and alarm systems, to quickly alert occupants and ensure a rapid response
- Smoke control systems to limit the spread of smoke, or contain it so that it does not hinder escape
- Extinguishing systems of various types (fixed or portable) to either put the fire out or limit its growth.

In addition, facilities can be provided to assist the fire service in their efforts to extinguish or control the fire and rescue trapped occupants.

In designing a building the designer must specify PFP materials and constructions that will limit the growth of fire and smoke in a number of ways. These specifications will usually relate to a defined test method. (See Section 6).

#### **EXTREME EVENTS** 16

Unless specified, fire safety systems, both passive and active, will not be designed or constructed to cope with a fire resulting from, or accompanying, an extreme event, such as an earthquake, an explosion or an impact from an aircraft.

The protection requirements for such events are, at the time of writing, under review. However, materials are available which, properly designed and implemented, could provide protection, or, at least, some protection, against these consequential fires. This may entail significant weight and/or cost implications.

The requirement for a PFP system that must withstand a defined extreme event needs to be defined very early in any building project.

#### 1.7 STATUTORY OBLIGATIONS, REGULATIONS, STANDARDS AND ACCREDITATION

#### 1.7.1 Construction

Regs EW<sup>[4]</sup> Building Regulations in England and Wales<sup>[4]</sup> are applicable to most building work that is undertaken. The Regulations for England and Wales are functional and deal with life safety standards for design and building work in the construction of domestic, commercial and industrial buildings. The regulatory systems in Regs Scot<sup>[5]</sup> Scotland<sup>[5]</sup> and Northern Ireland<sup>[6]</sup> differ from those in England and Wales. However the underlying principles Regs NI<sup>[6]</sup> are similar (see Section 15).

An owner or developer has a statutory duty to notify the authorities at the following stages of a development.

- Commencement
- Excavations
- Concrete Foundations
- Drains open Drains on completion
- Completion
- . . .

DPC

Approved Inspectors<sup>[7,8]</sup>

- Oversite concrete/DPM
- Occupation

The details of inspections carried out at these specific stages (as well the level of general inspections undertaken throughout the construction phase), are decided by the Building Control Surveyor. If an 'Approved Inspector' is handling the project then the approach to the regulations may be slightly different<sup>[78]</sup> and a developer must ensure that he understands these differences. Since there is no Statutory Duty for the building control body to inspect fire protection measures, other checks may be needed (see later).

Approved Documents for these Regulations set out recommended acceptance criteria for a wide range of inter-related technical provisions. The needs of one provision may sometimes conflict with the needs of another and designers must be able to satisfy each provision without contravening another by doing so. Fire protection guidance for England and Wales is contained in Approved Document B (Fire Safety) of the Building Regulations<sup>[9]</sup>, in Scotland in the Building Standards (Scotland) Regulations 1990 Technical Standards Part D<sup>[10]</sup>, and in Northern Ireland in the Northern Ireland Building Regulations, 1994 Technical Booklet E<sup>[11]</sup>, see also the AD to Regulation 7: Materials and Workmanship<sup>[12]</sup>.

See Section 8.2 Approved Document B (AD B) is broken down into building types or purpose groups and provides 'deemed to satisfy' data and sources of data on the fire performance of many common construction materials and elements of the building. Compliance with the recommendations contained within AD B will (except in unusual circumstances) satisfy the requirements of the Building Regulations. There is however a general move by designers away from the 'prescriptive' method of AD B towards performance or output-based specification. AD B makes provision for projects as a whole or in part to be 'fire safety engineered' to provide alternative solutions to those contained in the AD B. This allows the developer and his designer more freedom to innovate in both design and functional areas. BS 7974:2001 Application of fire safety engineering principles to the design of buildings – Code of practice provides guidance on the use of fire safety engineering<sup>13</sup>.

In general the fire safety specification for a building to satisfy the regulations will only be concerned with life safety. However there are other issues that may need to be addressed by the fire protection system. These include; building fabric, business interruption, contents, heritage, functionality and/or environmental protection. The building manager must be made aware where these additional criteria, if any, have been considered.

### 1.7.2 Building occupation

In addition to Building Regulations, which control building work, Fire Precautions Legislation also exists to ensure that adequate levels of safety are maintained once the building is occupied and that the precautions provided are kept under review to ensure that they are appropriate to any changes in fire risk that may occur over time. For more detailed references to fire safety legislation see Section 15.



## ENSURING BEST PRACTICE FOR PASSIVE FIRE PROTECTION IN BUILDINGS

FS (WP) Regs<sup>[14]</sup> Designers and Building managers will need to be aware of the Fire Safety (Workplace) Regulations<sup>[13]</sup>. The location and maintenance of the PFP within the building should form part of the risk assessment carried out for the building under these regulations. Managers need to be aware that there may be liability issues in the failure to comply with some regulations (eg as a criminal act). There may also be requirements imposed by insurers. Building managers need to be aware of the overall Fire Strategy for the building and the influences on the fire safety measures that are contained within it. CPD<sup>[15]</sup> These might include any Fire Safety Engineering guides or codes that apply, CE marking (see The Construction Products Directive and the classification of products<sup>[15]</sup>, applicable British Standards, Industry CDM<sup>[16]</sup> Standards or documentation appropriate to the Construction (Design and Management) Regulations<sup>[16]</sup>. FP Act<sup>[17]</sup> Where appropriate (eg to premises designated under the Fire Precautions Act<sup>[17]</sup>), the building will be issued with a Building Control completion certificate. It needs to be ensured that any future modifications to the building do not negate the effectiveness of the system to which the certificate applies. There is also a need to be aware that the fire safety systems within the building may interact with other systems, services or engineering facilities. The use or maintenance of such systems should not be allowed to affect the PFP and must be considered in the occupiers risk assessment. The design of the PFP should take account of building life cycle issues with regard to management, maintenance, suitability for repair and change of use. 1.7.3 Manufacturers and product test standards Currently, before a manufacturer can place a product on the market, the expected performance of the product has to be demonstrated. For the fire performance this is usually achieved by conducting tests against the British Standards (BS or BS EN) recommended in AD B. The performance will be shown in test reports, assessment reports or in third party product conformity certification. BS 476<sup>[18]</sup> The long established test standards called for in AD B are set down in BS476, parts 3 to 11 covering 'Reaction to Fire Tests' and parts 20 to 24 cover 'Fire Resistance Tests'<sup>[18]</sup>. The performance requirements are proven by these tests and Test Reports issued by the fire test laboratory, which must carry NAMAS approval. It is not possible to test many products in all possible uses or configurations and so Assessment Reports are prepared to show the range of performance of the product. These are usually produced by the testing laboratory concerned but may be produced by any suitable qualified fire specialist. Guidance on the contents and use of such assessments is contained in the PFPF publication 'Guide to Undertaking PFPF<sup>[19]</sup> Assessment Reports in Lieu of Fire Tests'<sup>[19]</sup>. At the completion of the above process products are not routinely issued with a 'Fire Certificate', just the test or and/or assessment reports. Fire Certification of products is purely voluntary on the part of manufacturers. (See Section 13 for details of available schemes).

Only products which can be shown to have a fire performance that satisfies the relevant test standard(s) should be put into the market-place. Relevant documents must be available to the user and enforcement authorities.

In accordance with CPD, product classifications will be expressed as Euroclasses. Fire tests will be carried out in accordance with the new European Standards, implemented as British Standards (BS EN), see Section 16 and below.

### 1.7.4 The Construction Products Directive (CPD)

CPD<sup>[15]</sup> AD B<sup>[9]</sup> TS Scot<sup>[10]</sup> TB NI<sup>[11]</sup> CPR<sup>[20]</sup>

BS EN 13501<sup>[21]</sup> BS EN 1363<sup>[22]</sup>

BS EN 1634<sup>[23]</sup> BS 476<sup>[18]</sup>

The Construction Products Directive<sup>[15]</sup> has led to the definition of new test methods which are incorporated in the 2002 amendments to AD B, for England and Wales<sup>[9]</sup>, and the Building Standards (Scotland) Regulations 1990 Technical Standards Part D (6th Amendment)<sup>[10]</sup>. Documents for Northern Ireland<sup>[11]</sup> are under development. Under the Construction Product Regulations (CPR)<sup>[20]</sup> the manufacturer is responsible for demonstrating that his/her product meets the necessary essential requirements of the CPD. These requirements cover more than just fire performance and the product characteristics designed to meet them are detailed in the relevant European Technical Specification for the product, either a harmonised product standard (EN) or a European Technical Approval Guideline (ETAG). The European Organisation for Technical Approvals (EOTA) have been mandated to prepare ETAG's (European Technical Approval Guidelines). These can be found at the EOTA website; http://www.eota.be/ (see Section 18).

The attestation of a fire protective product against the EN product standard will usually require the involvement of a certification body which will be responsible for checking the manufacturer's factory production control and selecting samples for tests. For the fire performance new European 'reaction to fire' and 'fire resistance' classification systems have been agreed (BS EN 13501<sup>[21]</sup>). These, in turn, will call up the new European fire test methods (BS ENs eg BS EN 1363<sup>[22]</sup> – Fire resistance tests, BS EN 1634<sup>[23]</sup> Fire doors and shutters), which will replace the various parts of BS 476<sup>[18]</sup> Fire tests on building materials and constructions that are currently in use.

Once test data have been obtained against a European test method this will then be acceptable across the EU, so current systems of testing to national fire test standards will be a thing of the past. A manufacturer can demonstrate that his/her product has undergone the relevant attestation procedures by CE marking the product. (Whilst CE marking is not mandatory in the UK the expectation is that manufacturers of mandated products will want CE marking in order to provide presumption of conformity, parity with competitors and enhanced market confidence).

The fire classification (reaction to fire and/or fire resistance) will have to be clearly indicated on the CE marking label.

For each product there will be a transition period of 1 - 2 years during which time a manufacturer can demonstrate compliance by tests to either the British Standards (BS) or the European Standards (BS EN). However CE marking can only be applied to those products conforming to the appropriate BS EN or which have a European Technical Approval (ETA) issued against an ETAG. This can only be done by carrying out tests to the BS EN standards. Test results cannot be transposed from British Standard tests to European tests as the new tests and classification systems are different.

#### 1.7.5 Product quality

It is important to understand that CE marking is not a quality mark, it is just a manufacturer's claim that the product has undergone the necessary attestation procedures set out in the EN product standard. CE marking does not preclude the additional use of a European wide certification scheme, but such schemes cannot set any additional technical requirements for the product. It is anticipated that such a scheme would set a more rigorous system of surveillance.



## ENSURING BEST PRACTICE FOR PASSIVE FIRE PROTECTION IN BUILDINGS

### Wherever possible, fire protection products should carry a relevant quality marking.

### 1.7.6 Product test data

BS 476<sup>[18]</sup>

As new EU fire tests and classification methods are introduced, manufacturers will need to change over to the new classification systems. The existing BS 476<sup>[18]</sup> system allows a manufacturer to select a test laboratory and gain an assessment of the fire performance for generalised use.

All fire protection products and systems should be supported by a relevant fire test report and/or assessment. Although there is little restriction on the scope of use of the data, more reputable manufacturers or suppliers will always indicate any limitations which may apply.

There are no formalised BS test procedures for fire-stopping in a linear manner or for fire protection at service penetrations through compartment walls; only ad hoc test evidence is available under existing BS 476 methods. BS EN standards will in future provide suitable test procedures based upon European Technical Agreement guidelines (ETAGs).

### 1.7.7 Scope of application of test and assessment results

PFPF<sup>[19]</sup>

Today, unofficial 'extended application' rules are agreed within the UK's Fire Test Study Group and published by the PFPF<sup>[19]</sup>. In the future, the EU system will require the test to be made separately from the product classification together with a separate statement of the acceptable scope of application of the test result. If Extended Application is required, then EU EXAP rules through CEN standards (under preparation) will have to be applied and considered.

#### 1.7.8 Third party accreditation

Under EU legislation manufacturers of PFP are required to submit to third party certification to enable them to apply CE marking to their products. This applies where products are required to have 'Attestation of Conformity' at level 2 or above.

| System | Task for manufacturer                               | Task for notified body                                   |
|--------|---|--|
| 4      | <ul> <li>initial type testing of product</li> </ul> | None   |
|        | <ul> <li>factory production control</li> </ul>      |  |
| 3      | factory production control                          | Initial type of testing of product                       |
| 2      | initial type of testing of product                  | Certification of factory production control on basis of: |
|        | factory production control                          | <ul> <li>initial inspection</li> </ul>                   |
| 2+     | initial type testing of product                     | Certification of factory production control on basis of: |
|        | factory production control                          | initial inspection                                       |
|        | testing of samples according                        | continuous surveillance, assessment and approval         |
|        | to prescribed test plan                             | of production control                                    |
| 1      | factory production control                          | Certification of product conformity on basis of tasks of |
|        | further testing of samples                          | the notified body and the tasks assigned to the          |
|        | according to prescribed test plan                   | manufacturer   |
|        |   | <ul> <li>initial type-testing of the product</li> </ul>  |
|        |   |  |

 initial inspection of factory and of factory production control

 continuous surveillance, assessment and approval of factory production control

| System | Task for manufacturer                          | Task for notified body                                   |
|--------|--|--|
| 1+     | <ul> <li>factory production control</li> </ul> | Certification of product conformity on basis of tasks of |
|        | <ul> <li>further testing of samples</li> </ul> | the notified body and the tasks assigned to the          |
|        | according to prescribed test plan              | manufacturer   |
|        |  | initial type-testing of the product                      |
|        |  | initial inspection of factory and of factory             |
|        |  | production control                                       |
|        |  | continuous surveillance, assessment and approval         |
|        |  | of factory production control                            |
|        |  | audit-testing of samples taken at the factory            |

AD B advises that fire protection materials and systems may be more reliable if supplied and/or installed under Third Party Accreditation schemes.

Whilst European legislation does not directly cover installation, installers have an obligation to maintain the performance of products and systems incorporated into the works so as to maintain compliance with the Essential Requirements of the CPD.

Schemes are available for certification of installers (see Section 13) and an appropriate scheme should be selected by the Main Contractor unless the client has already specified a scheme. The scheme should include:

- Verification of the skills and training of management, designers and estimators
- Suitable materials to be used in accordance with approved details
- Operatives and supervisors to be trained and certificated
- Random inspection of sites to monitor the quality of work
- Provision of a 'Certificate of Conformity' for completed work
- Provision of an audit trail
- UKAS accreditation for the scheme

#### 1.8 OTHER INFLUENCERS

#### 1.8.1

LPC<sup>[24]</sup>

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Whilst not mandatory, insurance requirements should not be forgotten and may be more demanding than the life safety standards advised in AD B. They are becoming increasingly important.

Insurers may have higher requirements than Building Regulations to minimise the damage to the property and to the business itself. In addition, the compartment area may require enhanced fire resistance to the walls and roof within the 'protected zone' on each side of the compartment wall. Details are contained in the LPC Guide for the Fire Protection of Buildings, published by the Fire Protection Association, London<sup>[24]</sup>.

The insurance requirements are described in the LPC Design Guide for the Fire Protection of Buildings 2000<sup>[24]</sup> and individual insurers should be contacted for advice.

#### 1.8.2 Litigation

The use of 'best practice' guidance, can play a significant role where litigation is involved, for example following a fire. The guidance here offers the opportunity for designers, builders and managers to demonstrate, and document, their professionalism.



## 2 PROCUREMENT OPTIONS AND INTRODUCTION TO KEY PLAYERS

## 2.1 OVERVIEW OF KEY OPTIONS

### 2.1.1 Traditional designer led

The traditional process sees the client or developer appoint an architect in the early stages of the project to seek planning consent for the building and produce designs and specifications according to the regulations and the client needs.

For anything more than simple designs the architectural team will seek assistance from specialists such as structural or environmental engineers and quantity surveyors to produce a 'Bill of Quantities' and specification for the project.

The next stage in this process is for construction companies to tender for the work and be appointed as the 'Main Contractor'. Specialist sub-contractors will be sought for 'packages' of work and during construction the whole project will be supervised by the design team, led by the architect who has the overall responsibility for ensuring that the building satisfies the brief originally agreed with the client.

### 2.1.2 Management contracting

This system differs from the traditional, principally in that the management contractor/construction manager, who takes responsibility for delivering the construction of the project, is brought into the process at a much earlier stage, as are key specialists. This type of procurement is most commonly used for complex or fast track projects where risks tend to be high. Some design responsibility may be included in the arrangement.

#### 2.1.3 Design and build

Under this option a client will offer the basic concept, or a brief, to construction companies who will undertake (with their own design team) to deliver the completed building largely to performance based requirements. The design and construction will be the contractor's responsibility and he will deliver a building to meet the client's needs. Competition will have been between companies offering a variety of design solutions to meet these needs and the client will have to select the contractor whose ideas most closely fit his requirements both conceptually and financially.

This system sees the contractor responsible for designing all aspects of the project to meet the performance requirements of the client within the agreed budget.

#### 2.1.4 Public Private Partnerships and Private Finance Initiative

The Government is committed to partnerships with the private sector to deliver modern and effective public services. Partnerships are intended to enable the public sector to benefit from commercial dynamism, innovation and efficiencies, by harnessing private sector capital, skills and experience with the high standards and commitment found within the public services.

Public Private Partnerships place risks with the party best placed to manage them. The private sector partner puts its own capital at risk, encouraging innovation and the effective management of risks, which helps to deliver projects on time and on budget through the lifetime of the project. Public Private Partnerships are intended to offer better services, delivered more efficiently and thus providing better value for money for the taxpayer.

Public Private Partnerships are not a single model applied to every circumstance but rather offer a tailored approach to the particular circumstances of public services. The Private Finance Initiative (PFI) has been the main vehicle for delivering successful PPPs. PFI projects can only go ahead where they demonstrate clear value for money against a 'traditional' procurement. This involves a comparison between the PFI proposal and a Public Sector Comparator which estimates the costs of a 'traditional' procurement in which separate arrangements will exist for the construction, maintenance and operation of a service.

Within the concept of the 'Private Finance Initiative' government departments and local authorities seek companies who will provide a facility that may be a building or some other construction such as a road or a bridge at their own expense. The cost will be met by the Main Contractor drawing funds from either the users or the authority for the use of the facility over an agreed period of time.

In this way it is intended that the original design will meet the requirements of the client in functional terms but will also have to be capable of being maintained over a long period within projected income limits if the Main Contractor is to meet his cost and profit objectives from the construction and use of the facility over the agreed period.

#### 2.2 ROLES AND RESPONSIBILITIES

The final specification for the PFP within any of the above options will be a combination of the decisions on fire strategy taken by the client and the design team and the interpretation of that strategy by those who contract to provide the building. The roles for each participant in the process are set out in the following Sections of the guidance and include both the construction of new buildings and the subsequent occupation and use of those buildings.

#### 2.3 HOW IS THE PROCESS TO BE MANAGED?

The Main Contractor needs to ensure that the PFP has been correctly specified by the design team, is correctly procured and installed, and is inspected and recorded by all interested parties.

Where the fire strategy and compartmentation for the project has been designed and approved by others (architects and design consultants, building control bodies, etc) the Main Contractor should ensure this information is correctly converted into scope documents, drawings and specifications for the work. Careful attention should be paid to the interface arrangements between the trades.

For example, it may be appropriate to include, in the PFP package, the installation of Z-bars, brackets, and other attachments to the steel that are not part of the PFP system. The PFP Contractor can then pre-install these items before fire protection is applied and so minimise subsequent damage. Alternatively, a similar result may be obtained by appropriate programming of the other trades concerned.

If it is inevitable that following trades will have to remove small areas of fire protection, this should be properly addressed in the contracts of those trades to ensure that excessive damage is not caused and proper reinstatement of the PFP executed.

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## **3 THE CLIENT AND THE BUILDING DEVELOPER**

### WHO IS THE CLIENT/DEVELOPER?

3.1

The client is the person or company who will own and/or operate the facility on completion of the project. He/she is responsible for ensuring that the building meets the legal requirements and is then operated in accordance with the law.

A developer may be the client, or a person or company who develops facilities for others to operate or own. He/she will take responsibility for ensuring that the building meets the legal requirements but may not, in the long term, retain ownership of the facility.

Where a developer passes ownership on to others, then they accept the responsibility for the fire safety of the building (subject to the terms of any contract or agreement) and must ensure compliance with all regulatory requirements at handover.

### 3.2 DUTIES AND RESPONSIBILITIES

### 3.2.1 Appointing the team

In all the cases listed in Section 2, the procurement option for constructing the facility carries a responsibility for ensuring that those involved are capable of undertaking the required tasks within the law. By appointing a person or persons the client may 'sub-contract' the decision-making process since the required skills may be outside his own capability but the ultimate responsibility for meeting the legal requirements will remain with him/her.

The team must be selected from qualified persons or companies and in this particular guidance the aim is to explain how their ability to supply or install fire protection materials should be judged for best results.

#### 3.2.2 Setting the design and construction standards

The ultimate responsibility for fire safety rests with the client and/or developer; it is recommended that the basic fire strategy for any project should be agreed as early as possible in the design process so that the activities of all sectors involved in the process may be co-ordinated.

Any safety objectives that go beyond life safety (ie building fabric, contents, business interruption, heritage or environment) must be agreed with the client and specified at an early stage.

The 'Best Practice' in PFP will be achieved by setting out the requirements at the start of the project, stating that that all PFP measures should, wherever possible, be installed by third party accredited installers.

This will ensure that expert companies select these life safety measures in accordance with the design requirements whether they are laid down by the design team against the guidance contained in AD B and *Guidance*<sup>[9,10,11]</sup> its equivalent Scotland/Northern Ireland guidance<sup>[9,10,11]</sup> or to fire safety engineered designs<sup>[13]</sup>.

# BS 7974<sup>[13]</sup>

The principle construction companies will be required to seek quotations from qualified contractors who in turn will select materials from manufacturers who have adequate test evidence for their products.

At the end of the installation process Certificates of Conformity must be provided which show exactly what has been installed and provide an audit trail for the work. This will also provide valuable information to support the client's acceptance of the responsibility to assess the risks in the operation of the building.

#### 3.2.3 Commissioning and handover

CDM<sup>[16]</sup>

When the construction programme is completed the Contractor must hand over to the client/occupier the Construction Design and Management Safety File (CDM File<sup>[16]</sup>).

The specialist contractors are required to provide full details of all materials used, their location and purpose, for the CDM File. If an accredited installer has been used for the PFP work as recommended, this will include a copy of a Certificate of Conformity.

Overall this is known as the CDM Regulations Safety Plan and must be handed over on completion of the building.

The handover must also include details of the Fire Strategy that has been established for the building. This should be considered alongside the CDM File as the building is commissioned.

The occupier will install his/her own equipment and processes. If these require mechanical fixing, wiring, ductwork or any other services that pass around or through the building he must understand the impact on the fire safety measures incorporated in the structure.

During this process should any of the fire protection be affected by, eg breaches of fire separating elements or removal of structural protection, then these must be restored to their original condition.

*FS (WP) Regs*<sup>[14]</sup> A Risk Assessment is required by virtue of the Fire Safety (Workplace) Regulations<sup>[14]</sup> as soon as the building is in use. This must consider if the fire safety measures provided and the fire strategy adopted are adequate for the purposes for which the building is being used. Without the CDM File and the Strategy details this risk assessment cannot be undertaken adequately and a failure to do so is a criminal offence under the Workplace Regulations.

It must be assumed that the Fire Inspector may never visit the building. The occupier has responsibility for fire safety.

Advice on building handover can be found in BRE Digest 474 'HOBO protocol; Handover of Office Building HOBO<sup>[25]</sup> Operations<sup>[25]</sup>.

### 3.2.4 Fire safety manual

The design of large or complex buildings needs to be documented for the benefit of the management of the premises, with all relevant information included in a fire safety manual.

The fire safety manual is an essential part of any successful building operation. It is strongly recommended that a manual be compiled by the designer for the occupier.

The manual needs to set out the basis on which the means of escape were planned and the type of management organisation envisaged for running the building, also the consequential staff responsibilities. It needs to explain the operation of all the mechanical and electrical systems and to give information on routine testing and maintenance requirements. The fire safety manual must be available for inspection or tests by auditors and enforcers, and for operational purposes by the fire brigade.

CDM<sup>[16]</sup> FPA<sup>[17]</sup> Depending on circumstances the manual may need to be separate from the CDM Regulations Safety Plan<sup>[16]</sup> and/or the Fire Precautions Act<sup>[17]</sup> requirements, in which case the information from these should be duplicated in the manual. The actual form of the manual will depend on the type of occupancy involved.

#### Contents

The fire safety manual should include the following items:

- fire safety policy statement
- fire safety specification for the building
- a description of the passive fire safety measures
- a description of the active fire safety measures
- integration of active and passive fire safety measures
- planned inspection, maintenance and testing schedules
- CDM Regulations information
- copies of all certificates and licences
- maintenance requirements and records
- a log of the contractor's and/or workman's attendance
- changes to building structure
- information relating to regulatory requirements (eg Fire Prevention Certificate, Building Regulations approvals)
- detail routine inspection and maintenance activities, with frequencies and routine test measures
- contain documentation from contractors and manufacturers (including any instructions, guarantees and test certificates) and spare parts

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BS 1635 23<sup>[26]</sup>
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contain as-built drawings and specifications and equipment operating parameters and record drawings in accordance with BS 1635 23<sup>[26]</sup> for all fire protection measures, both active and passive, incorporated into the building.

The manual will form part of the information package that will contribute to the risk assessment required under the Fire Precautions (Workplace) Regulations.

#### 3.2.5 Maintenance and repair

Once the building is in use it is the responsibility of the occupier to maintain the fire protective measures in an appropriate manner. He or she must at all times review the Risk Assessment if any changes in occupation, processes, equipment or structure are made that impinge upon safety including fire safety. A 'Responsible Person' must be identified to carry out these reviews and must be trained to a suitable standard. Where work is carried out on the structure of the building it is recommended that this be done by Accredited Installers wherever possible. If this is not done the contractors or staff concerned must be able to identify such things as fire separating elements and work accordingly. Suitably marked drawings of the building should be part of the instructions for any work on the building.

The **responsible person** is the employer, where there is one, and where there is not it will be the person responsible for the activity undertaken on the premises which might give rise to a risk to those present. It includes;

- a the employer in relation to any workplace which is to any extent under his control;
- b in relation to any premises where there is no employer
  - i the person (whether the occupier or owner of the premises or not) who has the overall management of the premises; or
  - ii where there is no one with overall management responsibility, the occupier of the premises; or
  - iii where neither (i) or (ii) apply, the owner of the premises

Such work may necessitate bringing in a specialist for apparently minor jobs but this is preferable to allowing any fire incident to cause unexpected damage and possibly injury.

Where the design involved Fire Safety Engineering the structure may contain features that differ from those suggested in AD B and its equivalent Scotland/Northern Ireland guidance. Any changes in the operation or occupation of the building can therefore have a more critical impact on the Fire Safety Strategy.

#### Example

An example of the changes that can have an unexpected impact on the fire safety strategy and risk assessment is that escape distances and routes may have been calculated for the originally proposed occupancy levels or layout. Changes in the number and type of personnel in a particular location may negate the calculations used for the original design. Such changes may have an impact on the passive fire protection provided for escape routes and compartments.

The responsible person must be aware of any critical areas, particularly if Fire Safety Engineering was a part of the design process, as the calculations may limit the freedom of the occupier to make changes. This latter point is particularly critical when a building changes ownership.

Where the occupier is responsible for part of a building, eg as the tenant of premises within a shopping mall or large office complex the safety of those that work in or visit this part of the building must be considered.

This may involve them in using common parts of the complex for escape in the event of fire. The safety of these areas for access/egress should also be considered in the Risk Assessment and maintenance. Liaison with other tenants and the building management is essential in this matter. In such premises a Fire Safety Manual as recommended above should be in place and available to all occupiers.



#### 4 DESIGNERS

4.1

LPC<sup>[24]</sup>

#### WHO ARE THE DESIGNERS?

The most prominent designer in a project will be the project architect but the role and responsibilities will vary with the procurement option chosen for the project (see Section 2). The designer of the fire protection measures may be the architect or one of many specialists involved in sectors of the building.

In considering the list of PFP measures contained in the introduction to this document (see Section 2) it will be realised that the design may be the result of contributions from anyone involved in producing part of the specification of the building. Architects, structural engineers, mechanical and electrical specialists, and sub-contractors may all have a responsibility for fire protection measures, as well as fire engineers.

#### 4.2 **DESIGNERS AND THE FIRE STRATEGY**

In Section 1.7 - Regulatory Requirements - the role of AD B and its equivalent Scotland/Northern Ireland guidance is explained. The alternative to the recommendations contained in that document is to allow the designer to use fire safety engineering for either the whole of the project or selected elements.

Designers should be aware that the recommendations in AD B provide only a 'life safety' standard and they BS 5588 24<sup>[27]</sup> may need or wish to adopt a higher 'best practice' standard eg via BS 5588 24<sup>[27]</sup> series, or the LPC Design Guide for the Fire Protection of Buildings<sup>[24]</sup>.

> The fire safety objectives (life safety, building fabric, contents, business interruption, heritage or environment) must be specified at an early stage.

Many designers are not yet familiar with fire safety engineering and rely on normal (building) regulation guidance, Standards and manufacturers' claims when setting the fire rating and fire resistance for construction elements, fire compartments, travel distances and means of escape. AD B of the Building Regulations is broken down into building types or purpose groups and experience gained from previous designs will inform the designer on these issues. AD B of the Building Regulations also provides 'deemed to satisfy' data and sources of data on the fire rating of many common construction materials. With this information the designer will know whether additional protection is required.

The basic fire strategy for a project should be decided at the outset of the design process. If this recommendation is adopted, then the activities of all sectors of the process may be co-ordinated.

There is a general move by designers away from prescriptive towards performance or output-based specification. This has been driven by, amongst other issues, the need to broaden the choice of supplier and, in particular, the increasing complexity of buildings leading to the emergence of the specialist (sub) contractor and supplier. As a result the final selection of a product that satisfies the performance specification often rests with the main contractor.

Typically the supply and fix of fire protection products is by specialists. The designer will provide the specialist with the performance requirement for the product or service such as 'provide one hour fire protection to all structural steel columns'. The specialist will then select a suitable material, given the circumstances from the range of board, cementitious spray or intumescent coatings available on the market. He/she will take into account site conditions, cost requirements, aesthetic requirements, access, building operating conditions and many other variables. A total reliance on pure cost may not be the best solution for service in the long-term use of the building and there is a need for a complete 'brief' to the contractors if expensive problems are to be avoided.

The contractual relationship between the designer, main contractor and specialist will influence the process for passing the specification to the specialist. However both the designer and main contractor will anticipate the responsibility for achieving the performance being placed with the specialist best suited for this role, and so careful scrutiny of the specialist's qualifications is essential.

Not all structures will need protection in the first place. This will depend on building types, permitted use and the risk to occupants, bystanders, spread of fire beyond the boundary and fire and rescue personnel.

#### 4.3 **EXTREME EVENTS**

The fire safety systems, both passive and active, may, in certain circumstances and for certain types of building, be required to cope with a fire resulting from, or accompanying, an extreme event, such as an earthquake, a deliberate or accidental explosion or an impact from an aircraft.

The protection requirements for such events are, at the time or writing, under review. However, materials are available which, properly designed and implemented, could provide protection, or, at least, some protection, against these consequential fires. It needs to be recognised that there may be significant weight and/or cost implications from such protection.

The requirement for a passive fire protection system that must withstand a defined extreme event needs to be specified very early in any building project.

#### 4.4 **DUTIES AND RESPONSIBILITIES**

The design specification will be based on the agreed fire strategy. For the different elements of the building, this specification may show a required performance, or may identify a specific proprietary product. It is important that the design specification is adhered to during the procurement and construction of the building despite pressures of time, money and availability.

It is the duty of everyone involved in the specification or design of an element of the building to be aware of the fire strategy and to ensure that any element with which they are concerned complies with the agreed strategy. Clear instructions must be given and wherever possible fire rating requirements should be shown on drawings and in written specifications.

The consideration of fire rating or fire protection after the design of an element has otherwise been completed may add considerable extra cost. An example of this is the design of the steel framework of a building where the careful use of slightly varying steel member sizes or types can reduce the amount of added fire protection required to provide the stability times for the building.

Contractors who are bidding for specialist work will require extra payments for additional fire safety materials. Best value will not be achieved if such additions are carried out piecemeal.

All the various elements of the building must interact correctly if the maximum level of fire safety required is to be achieved. Designers that are unsure of the reaction with other elements from this standpoint should consult the fire strategy plans for guidance.



#### 4.5 RELATIONSHIP BETWEEN SPECIALISTS

Certain elements of a building are often subject to specialist sub-contracts for added fire protection, as is the case with the structural steel example mentioned above. A specialist engineering company will supply the steelwork, but the added fire protection is not always part of that contract.

Steel should be supplied prepared and painted with an appropriate priming system for selected fire protection materials and the timing of the contract for the application/fitting of this protection is then critical.

To apply the protection too soon can result in damage that has to be made good, whilst leaving the steel in primer too long could result in corrosion and/or delays to other fitting out trades.

The steel designer should consider the added protection as noted above and plans can then be made for the incorporation of the whole process in the programme.

Similarly, there will be many individual cable, pipe and ductwork penetrations within a service duct or above suspended ceilings, for example. It is wasteful to have each penetration sealed by the tradesman concerned only to have a later trade destroy the work as they fit their particular service.

These individual trades should be trained to fit fire-rated penetration sealing systems, or have sufficient experience to price the fire protection work correctly. A far better job will result, often at lower overall cost if the Mechanical and Electrical designer recognises the areas where untrained or inexperienced trades may be working and prepares the specification accordingly to allow specialist contractors to price for the work.

It should be part of the overall planning that the fire strategy is included as part of the work programme.

#### 4.6 UNDERSTANDING AND APPLYING STANDARDS

The research undertaken shows that specialist trades and even specialist designers in some cases are generally unaware of the detailed requirements for fire safety within the completed building.

The designers of all sections of any building must ensure that they are familiar with the fire safety standards that apply not only to their speciality but also to any other sectors that are likely to interact. Guidance on the various standards and codes of practice are contained in the reference section (Section 16) of this document.



## 5 CONSTRUCTORS, MAIN CONTRACTORS AND SPECIALISTS

### WHO ARE THE CONSTRUCTORS – THEIR ROLE AND RESPONSIBILITIES?

### The main contractor

5.1 5.1.1

> The main contractor is responsible for co-ordinating the work of all the Trade Contractors on the project. This includes:

- Programming activities so as to minimise clashes between the trades
- Ensuring good communications
- Control of shared facilities such as hoists, cranes, access scaffolding etc
- General site housekeeping, site safety and security

Main Contractors should select sub-contractors who carry Third Party Accreditation wherever possible (see Section 13). As a very minimum, site labour involved in activities concerned with fire protection should hold a CSCS (Construction Skills Certification Scheme) blue card in PFP installation (Section 17) for the work being undertaken.

Sub-contractor workers must be properly supervised and their work individually inspected as the CSCS card scheme does not cover supervision and inspection directly.

#### 5.1.2 Specialist installers

Specialist sub contractors will be identified for many sections of the work in a building and PFP should be one of the specialist trades with whom separate contracts are placed.

As the objective of PFP 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 principal areas where such contracts should be set up are:

- Structural fire protection
- Penetration sealing and linear gap sealing
- Sealing of service ducts
- Fire barrier installation
- Fire doors

- Fire resistant glazing
- Partitions
- Suspended ceilings
- Dampers

It may be desirable to group as much as possible of such work under one contract and the detailed sections where PFP is required are set out in Section 1.

By placing this work with specialists, and with careful programming, it is possible to ensure that the correct materials are specified and installed, and damage and rework can be avoided. Other trades will then be free to perform their own speciality.

Careful programming of the work by the main contractor should:

- Allow the specialist to work continuously with a regular supply of areas coming available for work. This
  allows the specialist PFP contractor to plan for a consistent supply of personnel and equipment, and to
  plan deliveries.
- Ensure that other trades are not required to work in the same area at the same time, or carry out PFP work for which they are not qualified

- Ensure that the PFP Contractor is not required to carry out difficult or dirty work above or adjacent to sensitive equipment or materials
- Ensure that barriers, segregated areas, screens and protection are installed correctly
- Plan work by other trades to be carried out in advance where possible to minimise subsequent damage
- Ensure hoists, cranes etc are available for the delivery of materials and to move equipment
- Allow the PFP Contractor sufficient time to complete the work before the area is handed over to other trades

### 5.1.3 Managing and Applying Standards

The work of the PFP contractors is especially prone to damage, possibly for a number of reasons:

- The materials are easier to damage than steel and concrete
- The programme usually involves the PFP Contractor working at the same time as, or just ahead of many of the other trades
- The PFP work is not perceived by other trades to be of high value or importance so they have little inhibition about poking a hole through a fire seal, or removing an area of board or spray. The assumption is that 'someone will fix it if necessary', (and/or that it will never be found out)

A final round of inspection is recommended before areas are handed over for closing up, or access is finally removed. The re-inspection will check for damage that may have occurred after the work was originally approved. If there is only a limited amount of damage it is sometimes convenient to carry out the final inspection jointly with all concerned parties, and with a repair team in attendance to carry out minor repairs on the spot.

A systematic approach to quality checks and inspection will take the following form:

- The PFP operative will carry out a self check and rectify any defects. For structural fire protection this check may not be recorded, but for fire seals the PFP operative should affix a label giving details of the seal type, date of installation and the name of the operative.
- The Contractor's supervisor (or quality checker) will check the work, using an agreed check list and record sheet. For fire seals, the supervisor will countersign the label.
- If the Contractor's supervisor finds the installation is satisfactory, the PFP Contractor will ask the inspection agency to inspect the work. This refers to an inspection agency (see Section 10.2) rather than a third party accreditation organisation as discussed in Sections 13 and 10.3.
- Following the inspection by the inspection agency the PFP Contractor will offer the work for the Main Contractor to check. Depending on project specific arrangements, the Main Contractor may invite the Architect and/or the enforcing authority (eg Building Control) to inspect.
- The formality with which this process is followed depends on the scale of the project and the working relationships. Some of the steps above can be taken simultaneously provided there is a consistently good standard of work being offered.

It must be borne in mind that the occupier must produce a risk assessment once control of the building is handed over, and should it be found that fire protection measures are inadequate or badly installed he/she will have a legal claim against the construction company. The occupier cannot assume that the building, at hand over, is safe and must not wait for a Fire Inspector to check the premises. Under the Fire Safety (Workplace) Regulations<sup>[14]</sup> full responsibility for these matters rests with the occupier and criminal sanctions apply if the duty is not fulfilled. The contractual responsibility must be accepted and due care taken to ensure compliance with the accepted design.

D C Mf A Mg

#### MANUFACTURERS AND SUPPLIERS 6

6.1

BS 476<sup>[18]</sup>

#### WHO ARE THE MANUFACTURERS - THEIR DUTIES AND RESPONSIBILITIES?

Guidance<sup>[9, 10, 11]</sup> Product manufacturers produce materials to meet the standards defined in Approved Document B<sup>[9,0,11]</sup>. These materials enhance the performance of building materials and allow constructions to achieve the levels of loadbearing capacity, stability, integrity and insulation defined in the standards. They have a duty to test materials in accordance with those Standards and a responsibility to supply in a form or manner that allows installation contractors to use the products correctly, either for factory assembly or on site. Currently materials will probably be tested to the appropriate parts of BS 476<sup>[18]</sup> and the manufacturer must supply materials that are to the same design or formulation as the test materials. Certain materials are already being tested to the appropriate BS EN Standards. (See Section 6.4 for EU legislation)

> Materials may be supplied either direct to the contractor or through distributors. In some specialist cases, eg certain types of fire doors or fire rated ductwork, the manufacturer may also be the installer. The manufacturers of materials and material systems will usually offer advice on the selection of a suitable material and methods of application.

Product literature must show the correct use of the materials and the range of their test evidence, together with any certification that may exist for the product to allow designers or contractors to select the correct product for his/her needs. Vague usage claims should be questioned as the product test evidence may limit the extended application of the product and result in an unsafe application if not made clear.

#### WHO ARE THE SUPPLIERS - THEIR DUTIES AND RESPONSIBILITIES? 6.2

Product suppliers may be distributors and/or other persons or companies that are not the manufacturers of the products, and should supply materials that meet the needs defined in the standards. They have, as with manufacturers, a duty to ensure that the materials they supply have been tested in accordance with those Standards and a responsibility to supply in a form or manner that allows installation contractors to use the products correctly, wherever required.

Suppliers may also offer advice on the selection of suitable materials and methods of application provided that they have been adequately trained by a suitable authority to do so.

Suppliers must be able to provide clients with product literature which shows the correct use of the materials and the range of their test evidence, together with any certification that may exist for the product to allow designers or contractors to select the correct product for his/her needs. It is recommended that clients contact the manufacturers direct for confirmation that the materials or systems are correctly installed. As above for manufacturers, vague usage claims from suppliers who are not the manufacturers of a product must be treated with caution and verified.

#### 6.3 **RELATIONSHIP WITH SPECIALISTS INSTALLERS**

Training in the use and application of materials is common with manufacturing companies and some may operate a scheme for licensing or recommending PFP Contractors who are recognised as being experienced and competent.

Some manufacturers will provide site advisory personnel, at no extra cost, to ensure that queries and/or inappropriate use of their materials is minimised and ultimately eradicated. The personnel may carry out checks on the materials, application, installation, thickness and all aspects of the work to ensure that this is in line with their test evidence.



This direct advice from the manufacturing company is commended since it should provide both designer and contractors with reassurance concerning the correct use of the products.

#### 6.4 EUROPEAN REQUIREMENTS

CPR<sup>[20]</sup>

The Construction Products Regulations<sup>[20]</sup> which transpose the CPD into UK legislation are incorporated in the guidance for England and Wales<sup>[9]</sup> and Scotland<sup>[10]</sup>. Guidance for Northern Ireland<sup>[11]</sup> is under development. Under the CPR the manufacturer is responsible for demonstrating that his/her product meets the necessary essential requirements of the CPD. These requirements cover more than just fire performance and the product characteristics designed to meet them are detailed in the relevant European Technical Specification for the product, either a Harmonised Product Standard (EN) or a European Technical Approval Guideline (ETAG) (see Section 18).

The attestation of a fire protective product against the Technical Specification (Harmonised European Product Standard or European Technical Approval Guideline,) for critical, regulated products such as PFP, will require the involvement of a certification body which will be responsible for inspecting and auditing the manufacturer's factory production control, selecting samples and conducting type tests. For the fire performance new European reaction to fire and fire resistance classification systems have been agreed (BS EN 13501 Parts 1 and 2<sup>[20]</sup>). These, in turn, will call up the new European fire test methods which will replace the various parts of BS 476<sup>[18]</sup>. A full list of BS ENs is given in Section 16.

BS EN 13501<sup>[21]</sup> BS 476<sup>[18]</sup>

Once test data classification and attestation has been obtained against a European test method, providing all the requirements of the technical specification have been followed, they will then be acceptable across the EU, so current systems of testing to individual national fire test standards will be a thing of the past.

#### 6.4.1 Manufacturers' information

A manufacturer can demonstrate that his product has undergone the relevant attestation procedures by CE marking the product. (Whilst CE marking is not mandatory in the UK the expectation is that all products will have CE marking in order to provide presumption of conformity, parity with competitors and enhanced market confidence).

CE marking, or at least compliance with Construction Product Regulations, is applicable to products and systems which are the subject of Regulation. For PFP the method of attesting conformity involves certification of products by an independent third party certification body. The fire classification (reaction to fire and/or fire resistance) will have to be clearly indicated on the CE marking label.

For each product there will be a transition period of 1–2 years during which a manufacturer can demonstrate compliance by either the BS route or BS EN route. But after the end of this transitional period, compliance can only be demonstrated against the BS ENs, and this can only be done by carrying out tests. Test results cannot be transposed from BS to BS EN as the new tests are substantially different. (See Section 1.7.4).

### 6.4.2 Product quality

It is important to understand that CE marking is not a quality mark; it is just a manufacturer's claim that his product has undergone the necessary attestation procedures set out in the product standard. CE marking does not preclude the additional use of a European wide certification scheme, but such a scheme cannot set any additional technical requirements for the product. It is anticipated that such a scheme would set a more rigorous system of surveillance and factory production control.



#### 6.4.3 Product test data

As new EU fire tests and classification methods are introduced, manufacturers will need to change over to the new classification systems having tested products to the new BS EN standards. The existing system allows a manufacturer to select a test laboratory and gain an assessment of the fire performance for generalised use. These assessments may also come from a suitably qualified expert. There is little restriction on the scope of use of the data, although more reputable suppliers will always indicate any limitation that applies. There are no formalised test procedures under BS 476 for fire-stopping in a linear manner or for fire protection at service penetrations through compartment walls - only ad hoc test evidence is available. European Standards will define requirements for such areas through ETAGs. (See below for scope of applicability).

#### 6.4.4 Scope of application of test and assessment results

PFPF<sup>[18]</sup>

At the time of writing, unofficial 'extended application' rules are agreed within the UK's Fire Test Study Group<sup>18]</sup>and for situations that vary from the test report an independent assessment report is provided for the particular application. In the future, the EU system will require the test to be made separately from the product classification and a separate statement of the acceptable scope of application of the test result will be required. If Extended Application is required, then EU EXAP rules through CEN standards (under preparation) will have to be applied and considered.

### 6.4.5 Managing and Applying Standards

ISO 9000<sup>[28]</sup>

Whatever Standards are used when a product is tested, the manufacturer is responsible for producing and supplying the materials to the same specification used for the test. Failure to supply materials that match the original test is fraudulent and in breach of the Trades Descriptions Act. Most manufacturers will have a suitable QA system, possibly in the ISO 9000<sup>[28]</sup> series and will supply materials with a certificate of conformity.

As stated in AD B (Use of Guidance; Materials and Workmanship - Independent certification schemes and Appendix A), the membership of a Third Party Certification scheme will give the user reassurance that this requirement is being met even before the EU system is in regular use in the UK.

#### From AD B

'Use of Guidance; Materials and Workmanship – Independent certification schemes: There are many UK product certification schemes. Such schemes certify compliance with the requirements of a recognised document which is appropriate to the purpose for which the material is to be used. Materials which are not so certified may still conform to a relevant standard. Many certification bodies which approve such schemes are accredited by UKAS. Since the fire performance of a product, component or structure is dependent upon satisfactory site installation 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.'

The manufacturer will make the classification documents for the product available to specifiers, users and any appropriate authority. Product data sheets and product safety information are available to assist the user in complying with the requirements of CDM regulations.

It is essential to ensure that all advice given is accurate and practical. It is recommended that the manufacturer be encouraged to provide as much information as possible to ensure that the materials are correctly used.

## 7 REGULATORS AND ENFORCERS

7.1

### WHO ARE THE REGULATORS AND ENFORCERS - DUTIES AND RESPONSIBILITIES?

The regulatory requirements have been raised in Section 1.7 where the Building Regulations and the use *Guidance*<sup>(9,10,11)</sup> of Approved Document B<sup>[9,10,11]</sup> are discussed. During the construction stage, the Building Regulations are overseen by either a Building Control Surveyor who will work for the Local Authority or in some instances by an independent Approved Inspector. In either case, the developer must agree plans, designs and construction details with the selected authority until a Completion Certificate is issued. The Building Control Surveyor or Approved Inspector has a duty to ensure that the agreed designs comply with the regulations and that the construction follows the design specification.

Also with authority to enforce regulations, during the occupation stage, is the Fire Authority for the geographical location and in certain buildings (at the time of writing this guidance document) a Fire Certificate will be required for designated premises. Even where this is the case the occupier should note that this does not negate the responsibility to produce a risk assessment under the Fire Precautions *FS (WP) Regs*<sup>[14]</sup> (Workplace) Regulations<sup>[14]</sup>. The enforcement responsibility passes to the Fire Authority who are responsible for ensuring compliance with the Fire Protection Regulations once the building is handed over.

It is recognised that, other than during construction and major change, inspections by the building control bodies or enforcers may be infrequent and/or superficial. But there is always the possibility that an inspector may probe further. The potential is therefore present for an unforeseen loss of use of a building, or an element of a building, if deemed unsafe. Additionally, in an ever more protective culture, the risk of prosecution for breaches of regulation is a real prospect.

Through the development or adoption of maintenance strategies for passive fire protection building owners and users can mitigate all manner of such tangible risks.

## 8 PASSIVE FIRE PROTECTION (PFP) REQUIREMENTS

### WHAT IS BUILT-IN FIRE PROTECTION?

'Built-in' fire protection or 'Passive Fire Protection' is the overall terminology used to describe the inherent reaction to fire performance and/or the comparative period of resistance to fire available, from:

- 1 The basic elements of the structure without any further treatment; eg steelwork, concrete, brickwork
- 2 The same elements of structure with specialist additional treatment to enhance the fire performance, when the additional treatment has been tested and classified to standardised methods; eg steelwork treated with intumescent paint or boxed/profiled specialist board materials
- 3 Non-structural systems or materials added between/into elements of structure to ensure that the spread of fire cannot pass around/through the elements of structure described in 1 and 2; eg insulated fire-resisting partitions, cavity barriers, specialist fire-stopping of gaps in structure or those gaps or holes created when installing building services
- 4 Materials of construction where the spread of fire over their surfaces is minimal and which exhibit little heat release in fire. These materials do not exhibit sustained burning from direct ignition or from exposure to radiation from adjacent fires; eg the use of wall lining materials which will not add fuel to the fire, and which will therefore limit the fire growth
- 5 Doors
- 6 Purpose-designed ancillary systems, for example to ensure that fire doors or dampers in ductwork close effectively to prevent the passage of fire

#### 8.2 APPROVED DOCUMENT B (AD B)

AD B<sup>[9]</sup>

8.1

Approved Document B<sup>[9]</sup> contains detailed guidance on fire safety set out in time periods of stability, integrity and insulation for the various elements of the building. The document is divided into sections:

- B1 Means of Warning and Escape
- B2 Internal Fire Spread (Linings)
- B3 Internal Fire Spread (Structure)
- B4 External Fire Spread
- B5 Access and Facilities for the Fire Service

Within the document, buildings are split according to type with the following main sectors:

- Residential (Domestic), Flats or Dwelling Houses
- Residential, Institution or Other
- Office
- Shop and Commercial

- Assembly and Recreation
- Industrial
- Storage and Other Non-residential including Car Parks

By demonstrating compliance with AD B a developer is 'deemed to have satisfied' the Building Regulations although alternatives are available through Fire Safety Engineering of the whole or parts of the construction. The periods of loadbearing capacity, integrity and/or insulation may be provided by using materials that themselves have the required characteristics, or comply by the addition of 'Built-in fire protection' using PFP materials.

Fire Safety Engineering is the application of scientific and engineering principles, rules (Codes), and expert judgement, based on an understanding of the phenomena and effects of fire and of the reaction and behaviour of people to fire, to protect people, property and the environment from the destructive effects of fire.

Built-in fire protection is also important to ensure that the fire resistance of purpose-made shafts is provided and usefully maintained. These shafts may contain building services or fuel lines within buildings.

A protected shaft is defined as 'a shaft which enables persons, air or objects to pass from one compartment to another, and which is enclosed in fire-resisting construction'.

#### 9 **DESIGNING FOR PASSIVE FIRE PROTECTION (PFP)**

### INTRODUCTION

Having identified the regulatory requirements and developed and agreed a fire safety strategy with the enforcement authorities this has to be translated into physical fire protection by designing and specifying the products and systems, together with their correct installation. A number of parties may have reasonable claim to influence the specification including the building owner, occupier, architect, insurers, fire safety engineer, main contractor and/or fire protection contractor. The number of interested parties can give rise to problems not least because they are rarely involved at the same time. Consequently a specification drawn up by the architect implementing the fire safety strategy may subsequently be changed by others. This is a necessary part of the process but there is potential for specifications to be inadequate or to compromise the requirements of the original fire safety strategy

It is therefore recommended that only a limited and controlled number of parties be authorised to change the specification and that any changes to the specification be carefully monitored and recorded.

#### STRUCTURAL FRAME FIRE PROTECTION SYSTEMS 9.2

ASFP<sup>[29]</sup>

9.1

Structural frames are usually constructed from concrete, steelwork or timber. The fire protection of steel framed structures is covered in detail in the ASFP publication 'Fire Protection for Structural Steel in Buildings'<sup>[29]</sup>. This publication describes the principles of PFP on steelwork and the testing of materials in line Guidance<sup>[9, 10, 11}</sup> with the standards given in AD B<sup>[9,10,11]</sup>. It also provides a wide range of comparable data for independently assessed fire protection systems from ASFP Member Companies for fire protection from 30 minutes to 4 hours exposure. The book is a reference document quoted in AD B and guidance produced by the ASFP should be used by designers. See Section 17 for contact details.

The fire protection systems available to the designer include:

- a wide variety of board materials, and metal cased systems
- intumescent paint coatings
- various cementitious based spray-on systems.

#### Alternative Fire Safety Engineered design solutions may be found in BS 5950 Part 8<sup>[30]</sup>. BS 5950<sup>[30]</sup>

Invariably, paint or spray on systems will need to ensure that the steel surface is suitably prepared and primed for the material being applied, the steel temperature at the time of the PFP application should be 3°C above the Dew Point to assist good adhesion and avoid surface moisture which could adversely affect the adhesion of the applied coat. Such systems will usually follow the profile of the steel member, but 'boxed' systems are available for some cementitious sprays reinforced by wire mesh.

Intumescent systems are thin by comparison with other sprayed protection systems. The film thickness required will be advised by the manufacturer and will vary with the material, function and size of the steel section requiring treatment. Accurate definition and measurement of the required thickness is vital to provide the performance specified. A top coat may be required either for long term protection or for a decorative finish.

By contrast most board protection systems are usually applied in a 'boxed' form and use less surface area as a result.

Only approved and tested fixing systems are acceptable for boards. The form of the joints needs particular attention to avoid gaps. Some joints require fire-resisting glues/adhesives to achieve the required fire performance.

Where these fire protection systems abutt profiled decking used in the floor construction the fire protection period/system type will dictate whether the re-entrant profiles need fire stopping or not. Where such profiles are used above a fire rated partition or wall they will require fire stopping

Good practice developed by the Steel Construction Institute and the ASFP has offered the designer a choice of solutions to this problem and details are contained in 'Fire Protection for Structural Steel in Buildings' from the ASFP<sup>[29]</sup>.

Concrete frames generally do not require PFP because they are designed to achieve a specified fire resistance period. In certain circumstances spalling may be an issue and PFP required. Only products intended for this application, and which have been demonstrated to provide the necessary protection should be used.

For timber frame buildings, the structural frame fire protection, if needed, will often be provided by a board system, for example, plaster board. Most manufacturers of these products provide guidance on their installation and use. See Section 17.

#### 9.3 FIRE-RESISTING DOORSETS AND FIRE DOOR FURNITURE

DSMA<sup>[31]</sup> ASDMA<sup>[32]</sup> IFSA<sup>[33]</sup> BHIF<sup>[34]</sup> BWF<sup>[35]</sup>

ASFP<sup>[29]</sup>

Fire-resisting doorsets are specially designed to resist the spread of fire and products of combustion through walls or along corridors containing escape or access routes. Fire-resisting doorsets are doors tested and (hence) installed in conjunction with specified door frames and door hardware as a matched set of components. See contact details Section 17 and references [31], [32], [33], [34] and [35]

Fire-resisting doorsets may be of timber or metal construction and hinged, pivoted, sliding or mechanised including roller shutters. They must be installed in accordance with the details contained in the test report provided by the manufacturer or as required by Third Party Certification. All installations must be properly maintained.

In order that fire-resisting doors fulfil their mechanical and movement functions, movement gaps in the 'fit' with the door frame are essential. These gaps have specially selected sealing strips fitted adjacent to the movement spaces which will expand in fire conditions to seal the movement gap.

BS 4787<sup>[36]</sup> BS 8214<sup>[37]</sup> It is important that the doors and hardware are maintained in good condition including sealing strips, hinges, latches and vision panels if fitted. Each product should be tested to the appropriate BS or BS EN Standard, with timber doorsets complying with the door-to-frame gap tolerances of BS 4787-1:1980<sup>[36]</sup>. For maintenance requirements refer to BS 8214:1990<sup>[37]</sup>.

Fire-resisting doors are not effective unless they are closed. Self-closing devices ensure that fire-resisting doors re-close each time they are opened.

BS EN 1154<sup>[38]</sup>

When the door relies only on the self-closing device, it is important to ensure that the closing force is set to the value at which it was tested, during the fire resistance test, with the minimum closing force, power size 3 as required in BS EN 1154:1997<sup>[38]</sup>. Fire-resisting doors may also incorporate latch systems, which enable the door to be held closed in lieu of the door closing device.

Fire-resisting doors, frames, self-closing devices and latch systems are all fire tested as a specified set to achieve the stated fire performance - the matched set of components is essential to the fire performance. Substitute components must be avoided, unless permitted as alternatives by means of assessments. or within the third party certification of the product. It should be noted that hardware does not carry its own fire test report but is recorded in the fire test report as contributing to the successful performance of the doorset in the fire resistance test.

| DSMA <sup>[31]</sup>  | For further information on industrial and metal doors, consult the Door and Shutter Manufacturers' Association                          |
|-----------------------|---|
| ASDMA <sup>[32]</sup> | (DSMA) code of practice <sup>[31]</sup> or the ASDMA <sup>[32]</sup> . Information on timber fire-resisting doors is available from the |
| IFSA <sup>[33]</sup>  | British Woodworking Federation (BWF) <sup>[38]</sup> . For information on intumescent seals, contact the Intumescent Fire               |
| BWF <sup>[38]</sup>   | Seals Association (IFSA) <sup>[33]</sup> and for timber doors, contact TRADA <sup>[39]</sup> . See Section 17 for all contact details.  |
| TRADA <sup>[39]</sup> |   |
|                       | For further information on the selection of door fittings reference should be made to the Building Hardware                             |

BHIF<sup>[34]</sup> Industry Federation (BHIF) Code of practice – Hardware for timber fire and escape doors<sup>[34]</sup>.

BS 5499<sup>[40]</sup> Attention is drawn to the revision of BS 5499 safety signs including fire safety signs. Part 5:2002 Graphical symbols and signs<sup>[40]</sup> – Safety signs including fire safety signs – Signs with specific safety meanings for signage required on fire-resisting doorsets and emergency/panic exit doors.

#### **FIRE SHUTTERS** 9.4

These can be collectively defined with fire-resisting doors as 'a door, or shutter, provided for the passage of persons, air or objects, which together with its frame and furniture as installed in a building, is intended (when closed) to resist the passage of fire and/or gaseous products of combustion, and is capable of meeting specified performance criteria to those ends'.

It may have one or more leaves, and the term includes a cover or other form of protection to an opening in a fire-resisting wall or floor, or in a structure surrounding a protected shaft.

Rolling shutters across means of escape should only be released by a heat sensor in the immediate vicinity of the door, and not initiated by smoke detectors or a fire alarm system, unless the shutter is also intended to partially descend to form part of a smoke reservoir.

# LPC<sup>[24]</sup> DSMA<sup>[31]</sup>

9.5

## COMPARTMENT WALLS AND COMPARTMENT FLOORS

Compartment walls and floors are specifically intended to ensure that fire is contained in the compartment of origin, and is not allowed to spread horizontally or vertically through a building. The objectives are:

[a] To prevent rapid spread of fire and products of combustion which may endanger occupants.

(See 'LPC Design Guide for Fire Protection of Buildings, 2000'<sup>[24]</sup> and DSMA guidance<sup>[31]</sup>.)

[b] To prevent a small fire growing to threaten occupants, people in the vicinity of the building, and firefighters who may have to enter a building to extinguish the fire. The compartmented structure provides demarcated lines of safety for fire-fighters and occupants.

The allowable size of a compartment will vary with the height and use of a building, the fire load contained in the building, and the ability of fire-fighters to intervene effectively. In some cases, the availability of a dependable sprinkler system may allow larger compartment sizes, but it should be recognised that sprinkler systems require adequate water pressures and regular maintenance practices to ensure reliable performance.
Any compartment wall below a service void should run continuously up through the void to prevent the spread of fire through the void. Where the void is a roof void, the wall should reach roof level or pass through the roof to a specified height to prevent spread of fire across the roof. The junctions of compartment walls or floors with each other, with external walls or roofs must provide continuity of the expected fire-resisting performance.

Any element (including structural elements) passing through compartment walls or floors should have associated fire-stopping at the point of penetration and the aperture should be kept as small as practicable. The design should ensure that the failure of a penetrating structure because of fire in one compartment will not cause failure in the adjacent compartment. The same comment applies to the passage of building services, and special provisions are required for protected shafts.

Most guidance documents to building regulations provide recommendations for allowable compartment sizes and guidance on junctions with other walls and roofs. It should be noted that resilient fire-stopping systems are recommended where compartment walls meet roofs, and double skinned roof sheeting should incorporate bands of material of limited combustibility centred over each compartment wall.

Insurers may have higher requirements than building regulations to minimise the damage to the property and to the business itself. In addition, the compartment wall may require enhanced fire resistance to the walls and roof within the 'protected zone' on each side of the compartment wall. Details are contained in the LPC Guide for the Fire Protection of Buildings, published by the Fire Protection Association, London.

### 9.6 FIRE WALLS OR FIRE SEPARATING ELEMENTS

Fire walls or fire separating elements can be defined not only as compartment walls and floors as above, but also as cavity barriers and construction enclosing a protected escape route and/or place of special fire hazard eg subdivision of concealed roof space; escape corridors; enclosures to cooking machines in a food factory; or enclosure of fuel storage space. Such elements may be load-bearing or non-load-bearing according to the design requirements and must perform accordingly in case of fire.

The junctions of fire walls or fire separating elements with each other, with external walls or roofs must provide continuity of the expected fire-resisting performance. Any element passing through a fire wall or fire separating element should have associated fire-stopping at the point of penetration and the aperture should be kept as small as practicable. The design should ensure that the failure of a penetrating element will not cause failure of the fire wall or fire separating element or vice versa.

#### 9.7 FLOORS

Floors may be formed of timber, concrete, steel or composite steel/concrete systems. The fire resistance of a floor will depend on the material from which it is formed, the properties of that material in fire, on the materials essential to the stability of the floor, and on the means by which these materials or products are fixed together.

Timber floors will char, the wood will be progressively but predictably consumed by fire. The timber thickness is critical to the performance in fire and therefore must be correctly specified.

Concrete floors contain entrapped moisture. They may well be reinforced with steel. In fire, the entrapped moisture will heat up and turn to steam. The steam pressure will increase and try to find relief by escaping from



D C Mf A Mg

the concrete. The escape mechanism can be violent and large pieces of concrete can be removed – 'explosive spalling'. Any steel reinforcement in the concrete will be initially protected by the concrete, until spalling exposes the steel and it will substantially expand to threaten the viability of use as a floor. The extent of concrete cover over reinforcement is therefore critical to the fire resistance available and must be correctly specified.

Composite floors perform differently in fire, because the metal base will conduct heat from fire laterally. The metal face will attempt to expand. The rate of temperature increase in the critical parts of the floor may be lessened compared to concrete alone. The composite floor will also be fixed through shear connectors to the supporting steel structure. Steam formed in the concrete may force out the metal decking to distort it and cause gaps and subsequent failure. The steel reinforcement will transfer the load and the heat from fire. The composite structure may ultimately deform under the heat and sag under the load of the concrete.

The fire performance of all floors can be enhanced through the use of added passive fire protection systems. These PFP systems act to insulate the timber, concrete, or steel from the effects of fire for given periods of time. The protecting mechanism depends on the characteristics of the PFP system and careful design based on fire test evidence is essential.

Manufacturer's test evidence must be understood and incorporated into the specification to ensure that the anticipated performance is achieved.

The choice of PFP can also be important if the performance is not to be negated by deformation of the floor system. Some PFP materials will deform better than others, which may fracture under deformation in fire.

### 9.8 CEILINGS

Fire-resisting ceilings can form a critical component of the fire resistance of a building and should be specified to fully satisfy the manufacturers' instructions. See Section 12.

### 9.9 CAVITY BARRIERS

Cavity barriers are defined as a construction, other than a smoke curtain, provided to close a concealed space, such as in a cavity wall or ceiling void, against penetration of smoke or flame, or provided to restrict the movement of smoke or flame within such a space.

Cavity barriers require special attention from the designer. By their very nature they are often hidden once installed and are therefore difficult to inspect after installation, handover and subsequently through the life of the building. However the barrier will not become effective until it has been covered up and later inspection, by re-opening the work, could affect its integrity.

The designer should indicate where there is a need for a cavity barrier. Because it is an important element that is often accidentally missed out during construction, the responsibility for its installation and performance must be clearly identified. This is all the more important as the cavity barrier may well be hidden after its installation.

Unless clearly defined, it is possible for an in-appropriate sub-contractor to be given the task of installing cavity barriers.

# Guidance<sup>[9,10,11]</sup>

The requirements and responsibilities for the provision of cavity barriers must be clearly stated in the contract(s). Proprietary systems must be designed in accordance with manufacturers instructions. Recommendations on the provision of cavity barriers are given in AD B and its equivalent Scotland/Northern Ireland guidance. Co-ordination between different trades and contractors is essential particularly when aligning or joining one cavity barrier system with another.

The insulation and integrity requirements may be different from those required by the compartment walls and floors of the building. Care should be taken therefore with their use, particularly for large barriers. It should be noted that barriers in a roof space for example, which are located above the fire separating divisions must provide the same level of insulation and integrity as the division. The recommended positioning and spacing of Cavity Barriers is given in regulatory guidance documents.

#### 9.10 FIRE STOPPING

Fire-stopping materials are sealing products that take up imperfections of fit or design tolerance between the fire-resisting fixed elements of a building to restrict the passage of fire and smoke. They continue to take up the imperfections of fit at all times and have the same fire rating as the fixed elements of which they form a part. In reaction to a fire condition they swell, spread or deform to achieve their performance.

Like cavity barriers, fire stopping requires special attention from the designer. They are frequently hidden once installed and are therefore difficult to inspect after installation, handover and subsequently through the life of the building. The designer may not be able to indicate where there is a need for fire stopping since it should be fitted wherever needed. Because it is an important element that is often accidentally missed out during construction, the responsibility for its installation and performance must be clearly identified. This is all the more important as fire stopping is often hidden after its installation.

Unless clearly defined, it is possible for an inappropriate sub-contractor to be given the task of installing fire-stopping. For example, where fire-stopping is needed behind a cladding system at floor level, the responsibility may fall to the floor installer or the cladding contractor. Those who carry out the task must have the necessary expertise. The requirements and responsibilities for the provision of fire stopping must be clearly stated in the contract(s). Proprietary systems must be designed in accordance with manufacturer's instructions. Recommendations on the provision of fire stopping are given in AD B and the ASFP 'Red Book'<sup>[29]</sup>.

AD B<sup>[9]</sup> ASFP<sup>[29]</sup>

#### From AD B

### 'Fire-stopping

- 11.12 In addition to any other provisions in this document for fire-stopping:
  - a. joints between fire separating elements should be fire-stopped; and
  - b. all openings for pipes, ducts, conduits or cables to pass through any part of a fire separating element should be:
    - i. kept as few in number as possible, and
    - ii. kept as small as practicable, and
    - iii. fire-stopped (which in the case of a pipe or duct, should allow thermal movement)."

### Co-ordination between different trades and contractors is essential.

BRE DAS<sup>(41)</sup> Advice on preventing fire spread between buildings at roof level is given in BRE Defect Action Sheets 7 and 8<sup>(41)</sup>.

#### 9.11 FIRE CURTAINS

Fire curtains are not defined, as such, in guidance. They should not be confused with cavity barriers, which may have specific lower fire resistance criteria. It is suggested that fire curtains are considered as flexible materials used to extend a fire-resisting wall in a normally hidden void, often above ceiling level. The fire performance of the division is dependent on the fire performance of the support, top and edge fixings as well as jointing systems. Services penetrating the fire curtain should be protected to maintain the fire performance of the entire fire division.

If smoke barriers are used, these will not have the same high fire resistance criteria as fire barriers/curtains. They can only be expected to provide fire integrity, not insulation, and will not provide continuity of the fire-resisting division. They may be helpful to provide a smoke reservoir as part of a different and separate fire strategy. Again edge and joint fixing and sealing must be correctly specified.

Fire curtains should be installed in accordance with the manufacturers' instructions.

### 9.12 AIR DISTRIBUTION SYSTEMS

The detailed design of ducts for air movement (ventilation, air conditioning, heating) is frequently left to the services contractor. The consultant services engineer will define the performance required of the duct - eg how many air changes are required from a given space - and the services contractor is left to develop the most economical combination of duct size, route and fan power. Both the consultant and services contractor may find that the use of dampers is a more expedient way to control of the spread of fire via ductwork in preference to using fire resistant duct material. Such dampers must be correctly positioned where the ductwork passes through a fire-resisting element. However their inspection, testing during occupation and subsequent resetting can be costly and disruptive over the life of the building and many will be hidden in ceiling voids.

The use of ductwork to distribute air around a building may threaten the overall expected fire performance, unless the possibility of fire entering the duct, and/or breaking out of a duct is considered. This is covered in BS 5588:Part 9<sup>[27]</sup>. Three alternative methods are outlined.

- Fire dampers
- Fire-resisting ducts
- Enclosing in fire-resisting shaft

The possibility of fire entering the duct, and/or breaking out of a duct must be considered. Suitable test standards are defined in BS 476 Part 24<sup>[18]</sup>, see below.

### 9.13 FIRE-RESISTING DUCTWORK

Ductwork can be designed and constructed to resist the passage of fire arising from either inside or outside the ductwork. However ducts carrying air are often left unprotected and designers anticipate that fire will penetrate the duct. This is not a problem when the building is fire-compartmented except where the duct passes through a compartment wall or floor. The fire should be either arrested at the wall or floor or contained within the ductwork to prevent it spreading to the adjacent compartment. This is often achieved by installing a fire damper with a fusible link within the duct positioned at the point where the duct penetrates the compartment wall or floor unless a damper is deemed to be unsuitable. In this case the ductwork system must be fire-resisting.

BS 5588<sup>[27]</sup>

BS 476<sup>[18]</sup>

BS 5588<sup>[27]</sup> BS 476<sup>[18]</sup> BS EN 1366<sup>[42]</sup>

The design of fire-resisting ductwork of all types is described in BS 5588 Part 9<sup>[27]</sup> and this in turn requires the duct and materials to be tested according to the requirements of BS 476 Part 24<sup>[18]</sup>. This test Standard will be replaced by BS EN 1366-1<sup>[42]</sup> as the EN fire test standards become available.

The duct should be constructed according to the same fire rating as the fire separating element through which it originally passes. This is especially important when the duct is intended to remove smoke from a compartment exposed to fire, or a kitchen extract system where the duct may become lined with ignitable fatty deposits if poor filtration or maintenance persists. (for this last application, additional insulation criteria are specified in the test standard).

ASFP<sup>[29]</sup>

Design guidance may be found in the ASFP publication 'Fire-resisting Ductwork and Dampers'<sup>[29]</sup>.

Where a fire-resisting duct system has been specified, it must be fully tested or independently assessed to the requirements of BS 476:Part 24 (or BS EN 1366-1). This must include the method of support and the type of seal used around the ducts where it penetrates a wall or floor whose fire resistance must be maintained. Also, it should have been tested for both fire outside (duct A) and fire inside (duct B), both in horizontal and vertical orientations unless the end use conditions are to be restricted.

Types of product used to make steel ductwork fully fire resistant typically include:

- Fire protection boards, typically calcium silicate and vermiculite boards
- Rock fibre mineral wool (not glass fibre mineral wool)
- Sprayed fire protection coatings
- Intumescent coatings
- Hybrid systems, comprising at least two of the above

Care should be taken when utilising any of the above to make steel ducts fire resistant, that adequate test evidence is available for the particular circumstances, or a valid independent assessment has been obtained. Materials typically used for self supporting ducts include fire protection boards, typically calcium silicate and vermiculite boards.

### 9.14 SERVICE DUCTS AND SHAFTS

prEN 1366–5 (see page 61) Built-in fire protection is also important to ensure that the fire resistance of purpose made shafts is provided and usefully maintained. These shafts may contain building services or fuel lines within buildings. A protected shaft is defined as 'a shaft which enables persons, air or objects to pass from one compartment to another, and which is enclosed in fire-resisting construction'. There is currently no British Standard covering this, but prEN 1366-5, soon to be published, describes a suitable method (see page 61).

The designer must consider the possibility of fire spread through such a space and specify adequate fire stopping and fire sealing at all penetration points and possibly fire barriers at floor levels.

### 9.15 PIPE, CABLE AND SERVICE PENETRATIONS (INCLUDING LINEAR GAP SEALS)

Wherever services penetrate elements of structure, any fire resistance criteria of the element of structure must be maintained. Any apertures must be kept as small as possible and fire-stopped in such a way that differential movement of the service and the element of structure will not disturb the fire-stopping (see Section 9.10). It may be required to extend the fire-stopping along the service to ensure that high temperatures are not conducted along the service to the side isolated from the fire, to ensure that fire

spread is prevented. The exact solution will depend on the system provided and manufacturer's advice is essential for compliance with the available test data.

Note - Currently the UK does not have a formal test standard for such service penetrations. Specifiers and users should scrutinise test data carefully to ensure the relevance of the intended fire protection system. The European Union is preparing a new standard as prEN 1366-3 for the fire performance of service penetrations, and prEN 1366-4 for linear fire stopping systems in the gaps between building elements (see page 61).

In certain cases, the vertical penetration of compartment floors may necessitate large apertures to be formed for the passage of the services. This introduces an additional hazard if the aperture could permit maintenance staff to fall through it.

Any fire-stopping used to block the aperture should be either capable of maintaining the expected load, be reinforced or supported adequately, or covered with a load bearing steel plate.

### 9.16 FIRE-RESISTING GLAZING SYSTEMS

5.10

AD B<sup>[9]</sup>

Whilst the limitations in use of uninsulated glazed elements on escape routes, stairways, walls and door leaves is provided by Table A4 of AD B<sup>(9)</sup>, the use of insulated glazing, which reduces thermal transmittance of fire by radiation is less familiar to much of the construction industry. The choices and formulations of different types of insulated glazing are increasing rapidly, so that the available performance needs improved understanding. In addition effective glazing demands mounting in an appropriate frame. There are wired glass, glass bricks, profiled glass, using reinforcing wires or mortars. Laminated glasses may use toughened glass, foils or intermediate intumescent layers. The choice may critically affect the level of radiation of heat from fire. There is Integrity resisting glass and Integrity + Insulation glass available which can be selected to reduce the radiation intensity through glazed screens to acceptable or reduced levels of radiation along escape routes. Fire-resisting glazing systems must be suitable for the required application and designed in accordance with the manufacturer's instructions.

 $GGF^{[43]}$ Advice on the latest options available to the designer may be obtained from the Glass and Glazing $LPC^{[24]}$ Federation<sup>[43]</sup>. See Section 17 and the LPC Guide<sup>[24]</sup>.

### 9.17 THE BUILDING ENVELOPE

A wide variety of cladding systems are used in the construction industry today. The cladding system can be of a variety of types, eg masonry, mixed masonry or brick /cladding systems, externally rendered thermal insulation systems on new and refurbished structures, built-up cladding systems where the metal and insulation components are brought together on site to afford unlimited geometrical options, or prefabricated composite sandwich panels using an insulation material between the two metallic outer leaves. Some high rise residential buildings have been refurbished using decorative panel systems for aesthetic appeal.

BR 135<sup>[44]</sup>

BS 8414<sup>[45]</sup>

Recommendations for the construction of external walls are given in guidance to Building Regulations. Specific design principles are given in the recently revised BR 135<sup>[44]</sup>, Fire Performance of external thermal insulation for walls of multi-storey buildings, which also provides a method of assessing the fire performance of these systems using the BS 8414-1:2002<sup>[45]</sup> test method for external cladding systems.

Built-in fire protection may be formed from a wide range of ordinary (but mostly low-combustibility) construction products (ie materials not specifically marketed as passive fire protection). Such products

include brick and block, concrete, cement, plaster board and timber. Such products are used, for example, to form fire-resisting compartment walls and floors, or to provide cavity barriers, cavity closures or fire stopping. Cavity barriers in cavity walls, or in roof constructions, may need to be installed as part of the construction process. Others, such as cavity barriers in roof spaces, may be fitted later.

It is essential that those elements of construction that comprise the built-in fire protection are properly designed, installed, inspected and maintained. This is particularly important for ordinary (non-specialist) products since their role as passive fire protection can be overlooked and difficult to inspect.

### 9.18 CHECKING DESIGNS

It is good practice, and especially when a building has had its fire safety system designed using fire safety engineering, for the fire safety design to be properly checked. This might be done by an in-house colleague of the designer, or a third party fire safety engineer. In any case the design should be checked by the Building Control Surveyor and the Fire Safety Officer.

*Guidance*<sup>(9,10,11)</sup> For most buildings, designed using AD B and its equivalent Scotland/Northern Ireland guidance, it is only necessary to check that the passive fire protection proposed for the building corresponds in both location and value to that recommended in AD B. However, insurers requirements may also need to be considered.

Where a building has had its fire safety system designed using fire safety engineering then more detailed analysis may be needed, since, for example, the fire resistance specified might be reduced because sprinklers are fitted. It is vitally important that where a Fire Engineer is used, he or she is involved in the project at the earliest possible stage, preferably when the Fire Strategy is being agreed so that all aspects of his/her proposals are considered before any work is implemented.

It is important for the checker to be satisfied that the PFP offered does meet the recommendations or can otherwise be justified, and that it is of a type that is appropriate for the actual use of the building, eg a soft coating may not be appropriate if trolleys are going to impact it.

It is recommended that the checker should be satisfied that

- The passive fire protection is located properly
- The fire resistance periods proposed are appropriate
- The product specified is appropriate for its end-use
- The product specified has appropriate test reports showing it to be fit for purpose
- Adequate documentation (for CDM purposes and on maintenance, testing etc) is available for the building managers
- The person or body confirming the suitability of the design should record his/her acceptance of the proposal.

It is essential that where designs or proposals do not follow the guidance document recommendations the enforcers should have access to suitably gualified persons to verify the proposals.

### 10 CONSTRUCTING, SUPPLYING AND INSTALLING PFP

### 10.1 MAIN CONTRACTOR

The Main Contractor should seek to ensure that the PFP is correctly specified and designated in all contract documents. The Main Contractor is responsible for ensuring the material is properly procured and installed, and is inspected and recorded by all interested parties.

Assuming the fire strategy and compartmentation for the project has been designed and approved by others (architects and design consultants, building control bodies, etc) the Main Contractor should ensure this information is correctly converted into scope documents, drawings and specifications for the work. Careful attention should be paid to the interface arrangements between the trades.

Note: see Relationships between specialists (Section 4.5) and Specialist Installers (Section 5.1.2).

If it is inevitable that following trades will have to remove small areas of fire protection. This should be properly addressed in the contracts of those trades to ensure that excessive damage is not caused.

### 10.2 ORDERING BY MAIN CONTRACTOR

The placing of sub-contracts is a vital element in the process and the Main Contractor should have in mind his/her legal responsibility to ensure that all such work is correctly undertaken. It should not be assumed that responsibility in the event of failure can automatically be passed to a sub-contractor. The Main Contractor should be totally satisfied as to the competence of sub-contractors where life-safety, as is the case with PFP, is involved.

The Main Contractor should identify competent contractors for the work concerned. Advice can be obtained from recognised industry accreditation schemes. See Section 10.3. If a manufacturer's product has been specified, advice should be obtained on approved or recommended installers. The scope of work should include a requirement that the PFP Contractor carry out inspection of work in progress and when completed. This may include a requirement that the PFP Contractor employs an approved third party independent inspector, whose reports will be issued to the Main Contractor. The contract should be awarded only to a contractor whose submittal complies with these tender requirements.

For the work of installing fire seals around penetrations in compartment walls and slabs, traditionally this has been included in the scope of work for each of the service trade contractors. This traditional approach can raise problems because of interface problems, and sometimes the seal installation has been left to untrained personnel.

An alternative approach, which has proved successful, is to remove the penetration and fire seals from the scope of work of the service trades, and appoint a competent specialist contractor to carry out all this work throughout the project.

### 10.3 THIRD PARTY ACCREDITATION

Various accreditation schemes are available. The Main Contractor should select an appropriate scheme if the client has not already specified one.

Approved Document B recognises the benefits in confidence and reliability obtained by the use of Accredited Installers. All Contractor members of the ASFP are Third Party Accredited.

The scheme should include:

- Verification of the skills and training of management, designers and estimators
- Suitable materials to be used in accordance with approved details
- Operatives and supervisors to be trained and certificated
- Random inspection of sites to monitor the quality of work
- Provision of a 'Certificate of Conformity' for completed work
- Provision of an audit trail
- UKAS accreditation for the scheme

For most effective use of this system the Main Contractor can ask the PFP Contractor to provide a list of names of operatives and supervisors, with copies of their certificates. The overall majority should be certified but a small number in training can be allowed to work under supervision. (See Section 17 for the available Third Party Accreditation (TPA) schemes).

### 10.4 STRUCTURAL PROTECTION

The fire protection system chosen will be dictated by a combination of the level of fire rating required, appearance (unless hidden), environmental conditions such as humidity and temperature during application, prior to occupation and during use, robustness (impact damage), consideration of future adaptations, fitting out (partitions), capital and maintenance costs. Some of these considerations may influence the selection of materials.

The designer will usually provide a full specification if masonry or in-situ concrete is chosen as the fire protecting media. In cases where proprietary spray or panel systems including pre-cast concrete are to be used, the designer will indicate the required fire rating to the specialist installer who will select the materials and specification accordingly.

Where steel protection is required the steel must be supplied to site with appropriate and compatible priming systems applied. This is another example of the need to co-ordinate the activities of all contractors where PFP is required.

Accredited contractors are trained in the specialist installation to steelwork and the methods required and will minimise the risk of additional expense that may be incurred when unsatisfactory work is found. The protection thickness required will vary for the specific steel mass, and the perimeter of steel which could be exposed to fire, as well as the duration of the protection. Specialist contractors will understand the requirements and ensure that the correct thickness of material is used.

Invariably, it will be necessary to ensure that for paint or spray on systems, the steel surface is suitable for the material being applied, the steel temperature at the time of application should be 3°C above the Dew Point to assist good adhesion and avoid surface moisture. Such systems will usually follow the profile of the steel member, but 'boxed' systems are available for some cementitious sprays reinforced by wire mesh.

Intumescent systems are thin by comparison with other sprayed protection systems. The dry film thickness required will be advised by the manufacturer and will vary with the material and steel section requiring treatment. Accurate dry film thickness measurement during inspection is vital. A top coat may be required either for long term protection or for a decorative finish.

By contrast most board protection systems are usually applied in a 'boxed' form and use less surface area as a result. Only tested and approved fixing systems are acceptable. The form of the joints needs particular attention to avoid gaps. Some joints require fire-resisting glues/adhesives to achieve the required fire performance.

The interfaces between different elements of structure need careful planning for the expected performance in fire. The ASFP suggests that sample situations are agreed before general work commences, so that all parties are aware of the issues. Simple steel protection may well be the norm, but more complex areas will always occur, especially where different trade packages interface – eg Protection of perimeter steel adjacent to prefabricated cladding, and interfaced by internal fire walls, storey decks and services. The practice of fire protection of cladding supports varies according to local Bye-Laws, and special solutions may well be required.

Where these fire protection systems abutt profiled decking the fire protection period/ system type will dictate whether the re-entrant profiles need fire stopping or not, according to good practice developed by the Steel Construction Institute and the ASFP (See ASFP 'Fire Protection for Structural Steel in Buildings')<sup>[29]</sup>.

### 10.5 FIRE-RESISTING DOORSETS

ASFP<sup>[29]</sup>

The designer will specify the fire resistance for fire-resisting doorsets and leave it to the contractor to select an appropriate supplier. The rating will be dictated by the rating of the compartment wall or corridor it is in. If the designer is looking for additional features, not necessarily related to the fire rating, he/she may identify a number of acceptable suppliers and include details of glazed panels, finishes and building hardware (ironmongery).

It is recommended that only doors covered by Third Party Certification which includes factory production control should be used. Suitable schemes are operated by CERTIFIRE, TRADA Q Mark and LPCB. See Section 17 for contact details. Doorsets should be included on a schedule that will describe the swing, the size of opening, appearance and required building hardware (ironmongery).

Current practice is that the building hardware (ironmongery) will often be selected by a member of the project design team and included as a Prime Cost (PC) sum. Certain procedures may follow the alternative route of selecting catalogue items, usually covered with the caveat of 'equal and approved' to preserve the ideals of fair competition and choice. This route can lead to incompatible specifications which are further down-graded by the Main Contractor or the purchaser (doorset supplier, sub-contract installer etc). Confirmation of the fire performance compatibility must be obtained from the door manufacturer and/or the hardware supplier for all components.

To achieve Best Practice the final building hardware schedule should be prepared by an architectural ironmonger who has specialist knowledge regarding the overall requirements for functionality and performance, This route is more likely to result in the desired performance - aesthetics, functional etc.

AD M<sup>[46]</sup> BS 8300<sup>[47]</sup> Attention should be paid to the use of auxiliary items such as electro-magnetic hold-open and swing-free door closing devices for use where doorsets are required for fire compartmentation but where the door otherwise creates an inconvenience in day-to-day use, viz under the new DDA requirements with particular reference to AD M<sup>[46]</sup> and BS 8300:2001<sup>[47]</sup> Design of buildings and their approaches to meet the needs of disabled people - Code of practice where there are possibilities of conflict between user friendliness and function in case of fire.

It should be remembered that from all the PFP products included in any building the doorset with its hardware is the item which withstands the greatest use and abuse. The door is required to function correctly at all times, being the most handled product in the circulation area of any building. It is expected to play a dual role of conventional door for security, privacy, separation, sound reduction and/or air movement control BUT in the event of a fire it has to perform 100% as a fire barrier.

This can only be achieved if the correct items are fitted at the time of construction and maintained throughout its whole working life. Any replacement MUST be on a 'like-for-like' basis.

 BS 8214<sup>[37]</sup>
 For maintenance and replacement refer to BS 8214:1990<sup>[37]</sup> and BHIF Code of practice - Hardware for fire and escape doors<sup>[34]</sup> and ASDMA guidance<sup>[32]</sup>.

ADSMA<sup>[32]</sup>

DSMA<sup>[31]</sup>

Where specialist metal and/or mechanical fire-resisting doors are used they will usually be fitted by the manufacturer since specialist skills are required to ensure long term performance and compliance with the test evidence for the installation, using the Code of Practice for Fire Resistant Metal Doorsets, etc <sup>[31]</sup>

### 10.6 FIRE-RESISTING SHUTTERS

Fire-resisting shutters can be used to protect openings in compartment walls ranging in size from serving hatchways upwards and usually are operated on a fusible or smoke activated link basis or connected to the fire alarm system.

As such, they will require regular testing; apart from this aspect, they will be designed or specified in the same way as fire doors.

### 10.7 COMPARTMENT WALLS AND FLOORS

Designers will usually specify in some detail the construction of compartment walls and floors. Floors in particular will have functions other than fire separation, such as structural load carrying capabilities and stiffening of the general structure of the building. Concrete floors will normally be designed to provide a required fire rating. Supporting beams that are in concrete will usually be designed with adequate concrete cover for most fire compartment requirements. Steel beams and some composite flooring such as the use of permanent corrugated steel shuttering will usually require additional (bolt on or sprayed) fire protection and this will be the subject of a performance specification prepared by the designer and supplied and fixed by a specialist.

The designer will fully specify the structural performance of load bearing compartment walls. The fire resistance may be covered by the structural specification, but a specialist will provide details if additional protection is needed. Partition or non-load bearing walls may also be fully specified, although if a stud system has been specified, the supplier will be expected to certify that the required performance has been achieved.

Installation contractors can only provide meaningful certification through independent Third Party Accreditation.

#### 10.8 CEILINGS

Fire-resisting ceilings should be constructed to fully satisfy the manufacturers' instructions and allow for parts of the ceiling to be removed for maintenance. Light fittings, and other penetrations through the ceiling, must be appropriate for the type of ceiling. See Section 12.



#### 10.9 **CAVITY BARRIERS**

The successful installation and maintenance of cavity barriers is dependent on the supports, top fixing, edge fixing and jointing systems. Cavity barriers are usually tested in fire conditions for a maximum of 3 m vertical drops. Higher drops are viable provided the barrier and support/fixing systems can accept the higher load of the extended drop. In many cases this may require additional support elements and manufacturers can provide the necessary detail. Some will offer site advice free of charge. Unless clearly defined, it is possible for an in-appropriate sub-contractor to be given the task of installing cavity barriers.

The requirements and responsibilities for the provision of cavity barriers must be clearly stated in the contract(s). Proprietary systems must be installed in accordance with manufacturers instructions. Guidance<sup>[9,10,11]</sup> Recommendations on the provision of cavity barriers are given in AD B and its equivalent Scotland/Northern Ireland guidance. Advice on preventing fire spread between buildings at roof level is given in BRE Defect Action Sheets 7 and 8<sup>[41]</sup>.

#### 10.10 **FIRE STOPPING**

BRE DAS<sup>[41]</sup>

Fire-stopping materials are sealing products that take up imperfections of fit or design tolerance between the fire-resisting fixed elements of a building to restrict the passage of fire and smoke. They continue to take up the imperfections of fit at all times and have the same fire rating as the fixed elements of which they form a part. In reaction to a fire condition they swell, spread or deform to achieve their performance.

Like cavity barriers, fire stopping requires special attention from the installer. They are frequently hidden once installed and are therefore difficult to inspect after installation, handover and subsequently through the life of the building.

The designer may not have been able to indicate where there is a need for fire stopping but it should be fitted wherever needed. Because it is an important element that is often accidentally missed out during construction, the responsibility for its installation and performance must be clearly identified. This is all the more important as fire stopping is often hidden after its installation.

Unless clearly defined, it is possible for an in-appropriate sub-contractor to be given the task of installing fire-stopping. For example, where fire-stopping is needed behind a cladding system at floor level, the responsibility may fall to the floor installer or the cladding contractor. Who ever carries out the task must have the necessary expertise.

Guidance<sup>(9,10,11)</sup> The requirements and responsibilities for the provision of fire stopping must be clearly stated in the contract(s). Proprietary systems must be designed in accordance with manufacturers instructions. Recommendations on the provision of fire stopping are given in AD B and its equivalent Scotland/Northern ASFP<sup>[29]</sup> Ireland guidance and The ASFP Red Book<sup>[29]</sup>.

#### Co-ordination between different trades and contractors is essential.

## 10.11 BS 476<sup>[18]</sup>

# FIRE-RESISTING DUCTWORK AND DAMPERS

EN 1366<sup>[42]</sup>

It is important that when a fire-resisting ductwork system has been specified, it has been fully tested to the requirements of BS 476:Part 24<sup>[18]</sup> (or BS EN 1366-1<sup>[42]</sup>).This must include the method of support and the type of seal used around the ducts where it penetrates a wall or floor whose fire resistance must be maintained. Also, it should be tested for both fire outside (duct A) and fire inside (duct B), both in horizontal and vertical orientations unless the end use conditions are to be restricted.



Typically, there are two types of fire-resisting ducts.

- Steel ducts protected with a fire protection system, which typically includes:
  - Fire protection boards, eg calcium silicate and vermiculite boards
  - Rock fibre mineral wool (not glass fibre mineral wool)
  - Sprayed fire protection coatings
  - Intumescent coatings
  - Hybrid systems, comprising at least two of the above

Where any of these materials are included, the complete assembly must be tested, as noted above, to BS 476 Part 24, or BS EN 1366-1.

2 Self-supporting duct systems constructed entirely from fire protection boards eg calcium silicate and vermiculite boards.

Fire dampers with fusible links (or those designed to be operated when smoke is detected) are designed to be installed in the line of the cavity barrier, fire wall or compartment wall/floor through which the ductwork passes. If they are not in the line of the fire division, then fire can by-pass the damper system.

The damper assembly should be independently supported so that failure of the duct will not cause failure/ collapse or disturbance of the damper mechanism in the line of the wall. Ducts also need to be adequately supported so that no undue load is applied to the damper due to distortion of the duct. This can prevent the damper from closing properly or not at all. It is also important that the damper has been tested (or assessed) for the particular type of wall or floor in which it is to be installed.

ASFP<sup>(29)</sup> Readers are referred to the ASFP publication 'Fire-resisting Ductwork and Dampers'<sup>[29]</sup>.

### 10.12 SERVICE DUCTS AND SHAFTS

Protected shafts should be restricted to stairs, lifts, escalators, chutes, ducts and pipes, which are invariably vertical and pass through compartment floors. Protected shafts are therefore normally constructed to provide the same degree of fire resistance as the compartment floor through which they are passing - indeed the shaft may be an integral part of the structure in which case the structural engineer will provide a detailed design solution.

If the shaft is independent of the structure, eg non-load-bearing, the designer, probably the architect - will provide a performance based specification, tempered by aesthetics or other non-fire related issues.

#### 10.13 PIPE, CABLE AND SERVICES PENETRATIONS

Approved Document B provides guidance on the maximum pipe size, depending on its type, which may penetrate a compartment wall or floor. More combustible larger diameter pipes are permitted if they are sleeved with a non-combustible material. The designer may specify the material for pipework generally, eg steel which is considered non-combustible in buildings such as schools because they will be subject to harsh treatment. The designer may not be aware of the services which will penetrate fire walls and floors because the use of performance specification will leave the detailed design of the service routes to the specialist services sub-contractor. The performance specification will state that penetrations should meet the provisions of the building regulations, ie putting the responsibility for compliance on the contractor.

It is essential that both the designer and the specialist contractor are fully conversant with the fire protection requirements. It is recommended that suitably accredited contractors are used for such work.

#### 10.14 FIRE RATED GLAZING SYSTEMS

Modern interior designers favour lightness and airiness – particularly for places of work, retail and entertainment. Accommodation stairs that connect one or two floors to aid and encourage staff or movement and communication, need to be as open as possible so as not to obscure internal views on office floors. The accommodation stair is not included in the Building Control calculations for escape purposes. Designers prefer to use screens glazed in something more elegant than wired glass and the new fire resistant glasses are now becoming popular. Designers will need to provide full architectural details of such screens but will expect the installer to warrant the fire performance. This can only be done after reference to manufacturer's fire test information. Accredited installers should be used.

Fire-resisting glazing systems must be suitable for the required application and installed in accordance with the manufacturer's instructions.

### 10.15 THE BUILDING ENVELOPE (WALLS AND ROOFS)

Wall cladding and structural walling need to fulfil a number of performance criteria - resist rain, wind, temperature, noise, pollution, spread of fire between floors and to and from beyond the boundary, provide light, views, ventilation and comfort, support for the structure and services, plus aesthetics. Roofs will also need to fulfil most of these criteria and may form part of an escape route. Roofs and external walls will contribute to the overall thermal insulation and air tightness of the building.

Providing a balance for these criteria involves co-ordination of all the design disciplines and many subcontractors. Because of this wide ranging criteria that the building envelope has to satisfy, the lead designer will usually need to take on the role of co-ordinator and provide detailed designs and prescriptive specifications for most of the system although applied fire protection will be subject to a performance specification.

Design consultants and contractors need to appreciate the implications of selecting materials that increase the fire load. The amount of combustible material that is permitted will depend on building height, size, use and distance from the boundary.

Built-in fire protection may be formed from a wide range of ordinary (but mostly low-combustibility) construction products (ie materials not specifically marketed as passive fire protection). Such products include brick and block, concrete, cement, plaster board and timber. Such products are used, for example, to form fire-resisting compartment walls and floors, or to provide cavity barriers, cavity closures or fire stopping. Cavity barriers, in cavity walls, or in roof constructions, may need to be installed as part of the construction process. Others, such as cavity barriers in roof spaces, may be fitted later.

It is essential that those elements of construction that comprise the built-in fire protection are properly designed, installed, inspected and maintained. This is particularly important for ordinary (non-specialist) products since their role as passive fire protection can be overlooked and difficult to inspect.



### 10.16 OTHER CONSIDERATIONS

Selection of fire protection systems by designers, and contractors will need to include consideration of a number of criteria common to all elements:

- Life cycle cost considerations and how frequently the system or its components will need to be replaced
- Maintenance requirements to ensure that the specified fire rating is not compromised
- Access for periodic inspection and replacements during life
- Durability issues wetting, freeze-thaw, movement and aggressive environments may reduce performance over a period of time.

All the design disciplines and key personnel in the supply chain involved in the project should be properly informed of the PFP philosophy so that they avoid compromising agreed principles. Co-ordination of designers and suppliers along with supervision of the works is essential. Procurement routes – design led, design and build or PFI and responsibilities for the performance of the fire protection systems – need to be established at the outset of the project.

### 10.17 SUPPLIERS ROLE

The PFP measures will usually be supplied to a building through the specialist contractor appointed by the main contractor, who must install the fire protection in line with the manufacturers tested or recommended details. The requirement will be shown in either a detailed specification or often a performance specification as highlighted in 10.16 above, whereby the choice of materials may be left with the specialist contractor.

Therefore the manufacturer and the distributor, who are often relied upon by the specialist contractor for technical advice, play a significant role in the procurement chain.

Both the manufacturer and the distributor have a duty to ensure that the materials supplied conform to the specified requirements and have the required test evidence to demonstrate this compliance.

This document has stressed the importance of using accredited specialists throughout and such specialists will understand the test and certification requirements for products in their field of expertise. The placing of contracts that include PFP in the scope with contractors inexperienced in such matters places a greater burden on the suppliers. Ordering by untrained staff will be vague and lack detail and suppliers must accept responsibility for the materials that are provided as the life safety of the occupants and users of the building may be put at risk by the use of the wrong materials, probably wrongly installed. Documentation giving the scope of test evidence and full installation information in an unambiguous manner is essential with all limitations of application clearly defined.

This latter supply problem is most prevalent when the PFP element is a minor part of work that may be of a skilled nature in another field and it is recommended grouping all PFP work into specialist contracts to avoid such problems.

### 10.18 ON-SITE QUALITY CHECKS AND AUDITS

Each specialist contractor should undertake their own quality assurance checks to ensure that the work meets the specification. This is often complimented by checks or audits that manufacturers undertake to ensure that their products are being installed correctly.



Approved Document B recognises the benefits in confidence and reliability obtained by the use of Accredited Installers for such materials and all ASFP Contractor members are Third Party Accredited.

Contractors who are trained in the specialist installation methods required, should be used to minimise the risk of additional expense that may be incurred when unsatisfactory work is found.

The interfaces between different elements of structure need careful planning for the expected performance in fire. The ASFP suggests that sample situations are agreed before general work commences, so that all parties are aware of the issues. Simple steel protection may well be the norm, but more complex areas will always occur, especially where different trade packages interface, eg protection of perimeter steel adjacent to prefabricated cladding, and interfaced by internal fire walls, storey decks and services. The practice of fire protection of cladding supports varies according to local Bye-Laws, and special solutions may be required.

Quality checks and inspections are mentioned in other sections of this document.

To summarise this topic specifically in terms of procurement for ASFP related services, (see Section 17) the Main Contractor should include in the PFP Contract:

- Suitable scope of work and specification, which should define the type and frequency of checks required
- Contractor to provide a Quality Plan or other documents describing the procedures and resources for quality assurance including site testing and inspection
- For PFP to structural steel, contractor to employ an approved independent inspection agency to carry out tests and inspections to verify the work is complete and in accordance with the specification
- For fire seals, contractor shall affix a suitable permanent label to every seal giving a reference number, type of seal, name of the operative who installed it, date of installation, name of supervisor who subsequently inspected, and date of supervisor's inspection. The contractor shall also maintain a summary record of this information in the form of marked-up drawing or similar. The Main Contractor retains the right to inspect all work. PFP contractor to provide access when requested for inspection by the Main Contractor and building control bodies.

Wherever products are specified by name for a contract it is the usual practice to include the option of 'or other approved' in some form in the specification. The subsequent substitution of alternatives requires careful control, as the primary reason for such a change will almost certainly be a reduction of cost. Where alternatives are being offered expert knowledge of such matters as test evidence, scope of application, installation skill requirements, ease of maintenance and other related points is required to approve the alternative being offered.

When such products are accepted within the contracting chain the responsibility for the 'in use' performance rests with those accepting the substitution and the decision should not be taken lightly where life safety matters such as PFP are concerned. This responsibility for changes to the design specification starts with the Main Contractor and applies down the contractual chain through sub-contractors and suppliers of materials in all sectors of PFP work.



### 11 MAINTAINING PASSIVE FIRE PROTECTION (PFP)

### 11.1 GENERAL

One of the first requirements for adequate maintenance of fire protection measures in a building is a full understanding of the Fire Strategy that was used during the design and construction process. Reference was made to this earlier in this guidance and the need for the provision of a Fire Safety Manual for the building. Any relevant documents should be given to the responsible person at the hand over of the building. (See Section 3.2.4)

### FS (WP) Regs<sup>[14]</sup>

Building managers will need to be aware of the Fire Safety (Workplace) Regulations<sup>[14]</sup>. The provision and maintenance of the PFP within the building should form part of the risk assessment carried out under these regulations for the building. Managers need to be aware that there may be liability issues in the failure to comply with regulations (eg as a criminal act). Where PFP systems have to be removed or have become damaged for other purposes, they must be made-good as soon as possible.

Where appropriate (eg to premises designated under the Fire Precautions Act), the building will be issued with a Building Control completion certificate.

It is essential to ensure that future modifications to the building do not negate the effectiveness of the system to which the certificate applies. Managers also need to be aware of the other regulations and guidance that may have influenced the design of the building.

*BS 5950*<sup>[30]</sup> adaptability in use, for example if BS 5950 Part 8<sup>[30]</sup> had been used in the structural design.

*CDM*<sup>(16)</sup> The Construction Design and Management Regulations (CDM)<sup>[16]</sup> require all concerned in the process from design inception to completion of the building to prepare a file (the CDM file) containing details of all the work done and materials used where safety is concerned. The CDM file can be an invaluable source of information on all aspects of fire safety work in the construction of the building that may be used by the occupant when preparing maintenance plans, modifications to the building or Fire Risk Assessments as required by the Fire Precautions (Workplace) Regulations.

In general the fire safety specification for a building will primarily be concerned with life safety. However there are other issues that may need to be addressed by the fire strategy and these include; business interruption, contents, heritage, functionality and/or environmental protection.

The building manager must be aware where these additional criteria have been considered. Ideally, where the operation and maintenance data for a building is available and the 'as-built' products can readily be procured, any changes and repairs should be carried out with the materials originally specified. Suitably skilled, experienced and accredited personnel must carry out such works in accordance with the manufacturer's recommendations.

Again it is important to emphasise the role played by basic construction materials and systems in PFP. Maintenance of PFP cannot be achieved without the integrity of the building construction being included. Best practice in the construction, use and maintenance of walls, floors and the building envelope must be the goal to optimise the life cycle of the asset.



### 11.2 BUILDING LIFE ISSUES

The selection of PFP products at the construction stage and the quality of installation will have a direct impact on the longevity of the Fire Protection.

The use of materials that are susceptible to damage, eg through impact and/or dampness in inappropriate locations, will greatly reduce the life of the PFP. Worse still, whilst the evidence of damage may be quite obvious when impact has occurred, the detrimental effects of moisture on some types of unsealed intumescent products may not become apparent until they fail under fire conditions.

Materials that are subject to deterioration during the life of the building must be identified and be subject to a suitable maintenance procedure to extend the life of the PFP.

Notwithstanding these reservations, most modern passive fire protection materials are durable and, if properly maintained, are more than capable of delivering a sustained level of fire resistance throughout the life of a building (say 40 years).

The primary concern in the maintenance of PFP should be focussed on the control of change (alterations/breaches) and the quality and efficacy of repair.

### 11.3 BUILDING SERVICES

The interfaces between fire-resisting elements of construction and building services are commonly described as penetrations.

It is a requirement of building regulations and Insurers' Rules as well as good practice, that breaches created by the penetration of services be made good to the extent that the fire-resisting performance of the penetrated element is fully restored in terms of their load-bearing capacity, integrity and insulation.

Modern commercial and public buildings are dynamic environments in which change may be endemic. Building services are the principal cause of breaches in this scenario and because of their frequency and obscure locations often give rise to the greatest uncontrolled risk of fire spread.

Therefore, planning of breaches and their recovery are of prime importance in controlling the risk. The planned duration of new service installations or modifications should also be assessed for risk and consideration given to the deployment of temporary penetration seals.

Care must be taken in selecting an appropriately rated penetration repair solution, compatible with the original installation and substrate and suited to the type, configuration and number of penetrating services. This care should be extended to the delivery and verification of the solution by an accredited specialist. If the labelling system recommended in Section 10.18 above is used repair and maintenance of penetrations will be facilitated.

### 11.4

# PERMITS

The need for control of hot work processes is widely recognised and it is common practice to forbid such activities without the deployment of controlling 'hot work' procedures and permit systems.



Often these permits will be highly restrictive, limiting activities, and durations and stipulating protective measures to be taken before, during and even for some time after the activity. Contrast this with the introduction of new services, facilitated by the creation of multiple breaches in fire-resisting elements or the removal of structural protection within the construction. Whilst there is apparently much less immediate risk of starting a fire, there is potential for the circumvention of fire-resisting elements in such a way as to greatly increase the risk to both life and property through the spread of fire and smoke or the premature weakening of the structural frame.

Accordingly, where it is impractical to plan and control such work through conventional methods, consideration should be given to the operation of 'cold work' procedures and permit systems to control and record access to, and activity within, areas of a building.

### 11.5 FACILITIES MANAGERS

Facilities managers have a key role to play in the management of breaches. They are often empowered to plan and supervise the installation of new services and to fulfil certain duties, in respect of fire safety compliance, on behalf of building owners and occupiers. The facilities manager can have a fundamental impact on the protection of the passive measures through careful planning and control.

Understanding the design concept of fire-resisting compartmentation as well as the contradictory nature of our need for more open and highly serviced buildings gives experienced facilities management professionals the ability to recognise the inherent risks. Thus they can successfully plan and control change without placing occupants and buildings at risk. Having access to the fire strategy documents and the CDM file will materially assist in the performance of this function.

### 11.6 FIRE SAFETY MANAGERS

Fire safety managers, where appointed, have a primary role in the compliance management and monitoring of passive fire protection in buildings and must base their work on the agreed fire strategy and have knowledge of the fire safety design principles that were used in the construction of the building.

Trained in the behaviour of fire, smoke and people they will often have a superior understanding of the nature of the risk from uncontrolled breaches in fire-resisting elements. They are a powerful force in auditing the condition of the building and can provide early warning of unplanned activity and breaches and, as with Facility managers they should have access to the CDM file<sup>[16]</sup>.

CDM<sup>[16]</sup>

Additionally, they will have a role in the provision of training and guidance to personnel, building management and contractors. They will probably ensure that both active and passive fire protection measures in the building design are delivered at hand-over and are maintained to the required standard throughout the life of the building.

It is strongly recommended that a 'fire safety manager' be appointed for the building. The Fire Safety Manager should have overall responsibility (and powers and resources) for all issues relating to fire safety, and liaise with the other engineering professionals looking after the building.

### 11.7 FIRE SAFETY POLICY STATEMENT

In order to develop and maintain the safety of the building, the building management team should formulate a policy statement appropriate to the building configuration, location, occupation, and if relevant, to the building users.



This policy statement should contain a description of the levels of passive fire protection required throughout the building including recommendations for structural protection, compartmentation, protected shafts, firefighting shafts, cavities/voids and their respective protective barriers, and fire-resisting doorsets, etc.

An important aspect of the fire safety specification is the link between active and passive fire safety measures employed throughout the building. The extent to which this linkage applies should be taken into account within the fire safety specification.

**Location and access:** The fire safety manual should be kept in a secure and fireproof container on the site (but preferably not within the building), readily accessible to fire officers attending an incident.

Maintenance, review and testing of fire safety manual: The fire safety manual needs to be reviewed and its procedures tested annually, or whenever alterations are made to the building, in accordance with a documented procedure. The review should include the following:

- All plant and equipment interface controls, to ensure that all equipment is in working order and that maintenance procedures are being followed
- Record documents, as-built drawings and specifications of the fire protection measures; and records should be kept of reviews and of the changes made
- Managers will need to be aware of the changes that create a need to review the risk assessment under the Workplace Regulations<sup>[14]</sup>, which will include reference to the PFP.

### 11.8 MAINTENANCE PROGRAMMES

FS (WP) Regs<sup>[14]</sup>

The ideal risk solution to unplanned breaches in fire-resisting elements or damage to structural protection is to plan and control every activity to include the creation and restoration of such matters. 'Ownership' of the work is clearly established and completion/close-out cannot be achieved until verified. All costs associated with the planning and repair are borne by the instigating activity or project. However, it must be recognised that such a level of planning and control may be difficult or impractical to implement and sustain. In such circumstances the use of maintenance/monitoring systems offers a reasonably practicable means of checking the integrity of the fire-resisting elements and effecting repairs as required. These systems can provide a level of verification in support of control systems (planning, permits etc) or can stand alone as a means of identifying andrepairing unplanned breaches. Such systems can never provide the level of control inherent in the proactive/planned methods but are effective in providing and verifying compliance at periodic intervals. Failure to provide such a system allows unplanned activity to continue and for the perpetrators of such activity to escape the consequences. All costs associated with the monitoring and repair are borne by the maintenance budget. Fire-resisting ceilings must be restored to its original condition when any parts of the ceiling system are removed for maintenance, etc. Penetrations through the ceiling, including replacement light fittings, must have the same standard of fire resistance, and be appropriate for the type of ceiling. See Section 12.

#### MONITORING

The regular review and measurement of breach activity must be carried out. This can produce beneficial information in respect of ownership, planned and unplanned activity, frequency, type, periodicity, cost and other statistical data. It can potentially demonstrate compliance in the control and management of the passive fire protection element of fire safety in the work place. The frequency of monitoring activity will be dictated by the building's risk profile. Buildings with hazardous contents, high occupancy levels or high rates of change are examples of a higher risk category. The period between monitoring activities should not, of course, be allowed to exceed any Statutory or Health and Safety Executive guidance minimum.

11.9

It is important to ensure that all activities within the building that might affect the PFP are monitored and, responded to, where necessary.

### 11.10 RECORDING

Information as to identity, location, design, performance, installation, type, age, etc, is also highly beneficial in repairing and maintaining passive fire protection. The creation of maintenance records can range from simple identification tags to more elaborate databases of information tailored to both client and regulatory requirements. These records should be created and maintained in addition to the 'as built' records which form part of the building's Health and Safety File and Fire Safety Manual. Additionally, records of monitoring activities must be maintained in order to demonstrate compliance.

### 11.11 OTHER MANAGEMENT IMPLICATIONS

The successful deployment of planned activity, maintenance, monitoring and record-keeping has a number of effects.

- Life is protected users, visitors and fire fighters
- Capital assets are protected
- Business continuity can be optimised
- Unplanned and uncontrolled activity is reduced/eliminated
- Ownership of breaches is established
- Patterns of activity can be identified to aid future planning
- Risks to the business/enterprise are reduced/controlled
- High risk locations and types can be identified
- Trends can be detected (eg loss of control)
- Costs of unplanned breaches can be reduced
- Compliance can be demonstrated
- Non compliance can be detected

Management need to be aware of the importance of PFP on a range of factors that affect the successful operation of the building.

### 11.12 ENFORCER'S INSPECTIONS

Whilst it is recognised that, other than during construction and major change, inspections by the building control bodies or enforcers may be infrequent and/or superficial. But there is always the possibility that an inspector may probe further. The potential is therefore present for an unforeseen loss of use of a building, or an element of a building, deemed unsafe. Additionally, in an ever more protective culture, the risk of prosecution for breaches of regulation or third party claims is a real prospect.

Through the development or adoption of maintenance strategies for passive fire protection building owners and users can mitigate all manner of such tangible risks.

### 11.13 AUDIT TRAILS AND RECORD KEEPING

It is essential that full records and an audit trail is provided of all the passive fire protection in the building. Some of this information will be required for the CDM Safety File.

D C Mf A Mg

# 12 CEILINGS

Fire-resisting ceilings can form a critical component of the fire resistance of a building. Ceilings are generally constructed of gypsum, mineral wool or calcium silicate-based products supported on a steel framework. Three of their more common uses is a) to protect a structure above, such as a timber floor or structural steelwork, b) to separate building services from the space below, or c) to form one side of a smoke plenum.

Whatever type is selected, it should have documented test evidence to show that it meets the appropriate level of fire resistance for the relevant application, and should be designed, specified and constructed to fully satisfy the manufacturers' instructions. Light fittings, and other penetrations through the ceiling, must also have the same demonstrated standard of fire resistance, and be appropriate for the type of ceiling.

The ceiling design and fitting must allow for those occasions when any parts of the ceiling system need to be removed for maintenance, access, etc. Management procedures should be put in place for those occasions when any parts of the ceiling system is removed for maintenance, access, etc and the ceiling must be restored to its original condition.

# 13 THIRD PARTY ACCREDITATION

Frequent reference has been made to Product Certification and Accredited Installers and this process is summarised here. Suitable UKAS accredited schemes are run by FIRAS/CERTIFIRE, LPCB and BMTRADA, see Section 17 for full contact details.

Third Part Accreditation for products varies according to the terms of individual schemes, but essentially includes verification of the test evidence and scope of application or use of the product, and a regular audit of the factory QA system to ensure that the product as supplied to the contractor is to the same design or formulation as the original test samples.

Third Party Accreditation for installers is a process whereby the contracting company is seen to employ appropriately trained staff to design and install the required PFP system. Their work is independently audited by site inspections from the 3rd party organisation and a full record system is required as part of the scheme. The use of such accreditation is recognised in the Building Regulations, Approved Document B (Use of Guidance; Independent certification schemes). The use of accredited installers will reduce the incidence of PFP materials being installed by unskilled or unscrupulous contractors and/or the use of unsuitable materials and reduce essential work and re-work considerably. Upon completion, a Certificate of Conformity is issued to the main contractor for each contract. These autonomous schemes raise the perceived profile of the supply and installation chain and provide the client with a new level of comfort regarding the quality of the PFP.

Where the designer has elected to use Fire Safety Engineering techniques for all or part of the works, quality of installation may be more important, because prescriptive requirements tend to be all encompassing and slightly conservative, whereas fire safety engineering calculations or recommendations may be more exact in their requirements, and any deficiency then becomes critical. Some clients will no longer accept the use of non-accredited installers. This is to be applauded and endorses the suggested use of accredited agencies in government guidance.

In July 2001, the ASFP endorsed the requirement for all contractor/installer members to be third party accredited as a formal requirement for membership of the Association, in order that Manufacturing members can rely on fair use and representation of their products as intended.

## 14 RIBA PLAN OF WORK

14.1

### **RIBA PLAN OF WORK STAGES 1999**

Most building designs are developed in line with the Royal Institute of British Architects (RIBA) Plan of Work, a process protocol which describes the activities from appraising client requirements through to post construction. All the design professionals will usually adopt this process, although they may not all be appointed at the outset. The architect may be the only designer to be employed before the end of Stage D in order to obtain planning permission. In this case many design decisions will have had to be settled with only limited or no input from other design disciplines - for example the structural, services and fire engineers.

Fire compartment sizes and overall fire resistance of the structure and other key elements and travel distances will therefore probably have been decided by the architect with reference to AD B, past experience and discussions with the local Building Inspector. This often means that the opportunities for effective fire engineering may have been lost. At Stage D, details of the materials for the structure, external cladding and roofing may only be developed by the designer in sufficient detail to satisfy the planning authorities. Design and specifications of fire stopping, actual passive and active fire protection systems etc will generally be left until some way through Stage F.

| Stage | Task                                    | Activity  |
|-------|---|---|
| A     | Appraisal                               | Identification of client requirements and possible constraints on development.<br>Preparation of studies to enable the Client to decide whether to proceed and to select<br>probable procurement method.  |
| В     | Strategic Briefing                      | Preparation of Strategic Brief by, or on behalf of, the Client confirming key<br>requirements and constraints. Identification of procedures, organisational structure and<br>range of Consultants and others to be engaged for the Project                          |
| С     | Outline proposals                       | Commence development of Strategic Brief into full Project Brief. Preparation of Outline<br>Proposals and estimate of cost. Review of procurement route.   |
| D     | Detailed proposals                      | Complete development of the Project Brief. Preparation of Detailed Proposals.<br>Application for full Development Control approval.   |
| E     | Final proposals                         | Preparation of final proposals for the Project sufficient for co-ordination of all components and elements of the Project.  |
| F     | Production information                  | <ul><li>F1: Preparation of production information in sufficient detail to enable a tender or tenders to be obtained. Application for statutory approvals.</li><li>F2: Preparation of further production information required under the building contract.</li></ul> |
| G     | Tender documentation                    | Preparation and collation of tender documentation in sufficient detail to enable a tender or tenders to be obtained for the construction of the Project.  |
| Н     | Tender action                           | Identification and evaluation of potential Contractors and/or Specialists for the construction of the Project. Obtaining and appraising tenders and submission of recommendations to the Client.  |
| J     | Mobilisation                            | Letting the building contract, appointing the contractor. Issuing of production information to the contractor. Arranging site handover to the contractor.   |
| К     | Construction to Practical<br>Completion | Administration of the building contract up to and including practical completion.<br>Provision to the Contractor of further Information as and when reasonably required.  |
| L     | After Practical<br>Completion           | Administration of the building contract after practical completion.<br>Making final inspections and settling the final account.   |

### **TABLE 1 RIBA PLAN OF WORK**

# 15 OUTLINE TO THE BUILDING REGULATIONS AND STRUCTURAL FIRE RESISTANCE

## 15.1 STATUTORY REQUIREMENTS

| Guidance <sup>[9, 10, 11]</sup> | Building Regulations         | In England and Wales   | The Building Regulations 2000<br>(SI 2000/2531)   |
|---------------------------------|------------------------------|--|---|
|                                 |                              | In Scotland  | The Building Standards (Scotland)<br>Regulations 1990   |
|                                 |                              | In Northern Ireland  | Northern Ireland Building<br>Regulations, 1994  |
|                                 | Acceptance Criteria          | In England and Wales   | Approved Document B   |
|                                 |                              | In Scotland  | Technical Standards Part D  |
|                                 |                              | In Northern Ireland  | Technical Booklet E   |
|                                 | Fire Precautions Legislation | In designated buildings<br>Hotels, Factories, Offices,<br>Shops, Railway Premises. | The Fire Precautions Act 1971   |
|                                 |                              | In all workplaces  | The Workplace (Fire Safety)<br>Regulations 1997 (as amended)<br>(SI 1997/1840)  |
|                                 |                              | In buildings used for public<br>entertainment etc                                  | Licensing:<br>Cinemas Act 1985<br>Gaming Act 1968<br>Licensing Act 1964 (as amended<br>by the Licensing Act 1988)<br>Local Government (Miscellaneous<br>Provisions) Act 1982<br>Theatres Act 1968 |
|                                 |                              | For special risk buildings such<br>as explosives works                             | Special Premises<br>Regulations   |

### 15.2 ENGLAND AND WALES

Provision for structural fire resistance of buildings is embodied in Part B of Schedule 1 of the Building Regulations 1991 as follows: 'The building shall be designed and constructed so that, in the event of fire, its stability will be maintained for a reasonable period'.

Approved Document B interprets the requirements of the Building Regulations and states that the stability criterion will be satisfied if 'the load bearing elements of the structure of the building are capable of withstanding the effects of fire for an appropriate period without loss of stability'.

The Approved Document contains detailed provisions for the maintenance of structural stability in fire. These are intended to provide guidance for some of the most common building situations. Guidance on 'appropriate periods' for different building occupancies are given. However these fire resistance periods are not mandatory. The Approved Document also states that: 'There is no obligation to adopt any particular solution contained in an Approved Document if you prefer to meet the relevant requirement in some other way. However, should a contravention of a requirement be alleged then, if you have followed the guidance in the relevant Approved Documents, that will be evidence tending to show that you have complied with the regulations. If you have not followed the guidance then that will be evidence tending to show that you have not complied. It will then be for you to demonstrate by other means that you have satisfied the requirement'.

The Approved Document goes on to suggest 'other means' to demonstrate compliance by stating that: 'A fire safety engineering approach that takes into account the total fire safety package can provide an alternative approach to fire safety. It may be the only viable way to achieve a satisfactory standard of fire safety in some large and complex buildings'.

The Approved Document lists the parameters that should be included in such a fire safety study. Reference [9].

### 15.3 SCOTLAND

In Scotland approval must be gained before building. In Scotland compliance is required with the Technical Standards of the Building Regulations; one cannot build at risk.

Fire resistance requirements are contained in Regulation 12 to the Building Standard (Scotland) Regulations which state that 'every building shall be so constructed that, for a reasonable period, in the event of a fire,. its stability is maintained.'

The measures which should be followed to ensure that this regulation is met are contained in Part D2 of the Technical Standards: Structural Fire Precautions. Many of the provisions outlined in Part D are designated as functional standards, which contain references to deemed to satisfy standards. These may be descriptive or refer to documents such as British Standards. Alternative design strategies can be adopted.

The introduction to the Technical Standards contains the following statement:

'Compliance with the Regulations: Regulation 9 sets out three ways by which the requirements of the Regulations can be satisfied:

- by compliance with the relevant standards set out in the supporting Technical Standards; or
- by conforming with provisions which are stated in the Technical Standards to be deemed to satisfy the relevant standards; or
- by any other means which can be shown to satisfy the relevant standards.'

The third of these statements is taken to mean that it is not necessary to follow the requirements of the technical standard if it can be proven that an alternative method meets the provision of the functional standard.

A relaxation of the requirements given in Technical Standard D is possible where alternative methods of fire protection can be shown to give equivalent levels of safety to those required in the standard. In such situations the local Building Control Officer, often assisted by the Scottish Development Office, may request compensatory features. Reference [10].

### 15.4 NORTHERN IRELAND

Technical Booklet E for Northern Ireland closely follows Approved Document B.

In Northern Ireland new Building Regulations came into force in November 1994. The fire safety requirements for these regulations are supported by Technical Booklet E which contains provisions regarding structural fire resistance, compartmentation, etc. similar to those in the Approved Document for England and Wales.

Unlike the provisions of the Approved Document which are for guidance, the use of which is regarded as evidence tending to show that the requirements of the Building Regulations have been met, the provisions of Technical Booklet E are deemed to satisfy those requirements. Where the provisions of the Technical Booklet are not followed then the onus falls on the designer to show that the requirements of the regulations can be met by other means. Reference [11].

Extracts from http://www.corusconstruction.com/fire/fr001.htm

### 16 REFERENCES, STANDARDS AND BIBLIOGRAPHY

Note: The compilers of this document makes no claim for the validity or accuracy of the various guidance documents referenced herein.

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- 3 Best Practice Programme. Website: http://www.dti.gov.uk/construction/research/
- 4 The Building Regulations 1991, S.I. 1991 No. 2768 plus amendments. (SI 2000/2531)
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- 6 Northern Ireland Building Regulations, 1994
- 7 Statutory Instrument 2000 No. 2532 The Building (Approved Inspectors etc.) Regulations 2000
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- 9 The Building Regulations 1991 Approved Document B Fire Safety. HMSO 2000 (including the Building Regulations 2000 Amendments to Approved Document B (Fire Safety) coming into effect March 2003)
- 10 The Building Standards (Scotland) Regulations 1990 Technical Standards Part D (as amended September 2001)
- 11 Northern Ireland Building Regulations, 1994 Technical Booklet E
- 12 The Building Regulations 2000: Materials and Workmanship. Approved Document to support Regulation 7, 1999 edition, amended 2000
- 13 BS 7974, Code of Practice on the Application of Fire Safety Engineering Principles to the Design of Buildings Draft for Public Comment, BSI 2000. (Note: partially supersedes Fire safety engineering in buildings, British Standard Draft for Development, DD 240, 1997).
- 14 SI 1997/1840 The Workplace (Fire Safety) Regulations 1997 (as amended)
- 15 The Construction Products Directive 89/106/EEC. 21 December 1988
- 16 Statutory Instrument 1994 No. 3140: Construction (Design and Management) Regulations 1994
- 17 The Fire Precautions Act 1971
- 18 BS 476 Fire tests on building materials and constructions

BS 476-3:1975 Fire tests on building materials and structures. External fire exposure roof test BS 476-4:1970 Fire tests on building materials and structures. Non-combustibility test for materials BS 476-6:1989 Fire tests on building materials and structures. Method of test for fire propagation for products

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BS 476-12:1991 Fire tests on building materials and structures. Method of test for ignitability of products by direct flame impingement

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BS 476-31.1:1983 Fire tests on building materials and structures. Methods for measuring smoke penetration through doorsets and shutter assemblies. Method of measurement under ambient temperature conditions

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- 20 Statutory Instrument 1991 No. 1620: The Construction Products Regulations 1991
- BS EN 13501-1:2002 Fire classification of construction products and building elements. Classification using test data from reaction to fire tests
   prEN 13501-2. Fire classification of construction products and building elements. Part 2.
   Classification using data from fire resistance tests (excluding products for use in ventilation systems)
   BS EN 13501-3. Fire classification of construction products and building elements. Classification using data from fire resistance tests (excluding products for use in ventilation systems)
   BS EN 13501-3. Fire classification of construction products and building elements. Classification using data from fire resistance tests systems and services
   EN 13501-5. Fire classification of construction products and building elements. Part 5.
   Classification using data from external fire exposure to roof test
- BS EN 1363-1:1999 Fire resistance tests. General requirements
   BS EN 1363-2:1999 Fire resistance tests. Alternative and additional procedures
   DD ENV 1363-3:2000 Fire resistance tests. Verification of furnace performance
- 23 BS EN 1634-1:2000 Fire resistance tests for door and shutter assemblies. Fire doors and shutters BS EN 1634-3:2001 Fire resistance tests for door and shutter assemblies. Smoke control doors and shutters
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- 27 BS 5588-1:1990 Fire precautions in the design, construction and use of buildings. Code of practice for residential buildings

BS 5588-4:1998 Fire precautions in the design, construction and use of buildings. Code of practice for smoke control using pressure differentials

BS 5588-5:1991 Fire precautions in the design, construction and use of buildings. Code of practice for firefighting stairs and lifts

BS 5588-6:1991 Fire precautions in the design, construction and use of buildings. Code of practice for places of assembly

BS 5588-7:1997 Fire precautions in the design, construction and use of buildings. Code of practice for the incorporation of atria in buildings

BS 5588-8:1999 Fire precautions in the design, construction and use of buildings. Code of practice for means of escape for disabled people

BS 5588-9:1999 Fire precautions in the design, construction and use of buildings. Code of practice for ventilation and air conditioning ductwork

BS 5588-10:1991 Fire precautions in the design, construction and use of buildings. Code of practice for shopping complexes

BS 5588-11:1997 Fire precautions in the design, construction and use of buildings. Code of practice for shops, offices, industrial, storage and other similar buildings

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- 29 ASFP guidance documents
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- 30 BS 5950-8;1990 Structural use of steelwork in building. Code of practice for fire resistant design
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   Best Practice Guide to Timber Fire Doors
   Custom Made Timber Doorsets: Pre-installation, Preparation, Site Reception, Handling,
   Storage and Installation
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- 33 The Intumescent Fire Seals Association (IFSA) Information Sheet 1: The Role of Intumescent Materials in the Design and Manufacture of Timber Based Fire-resisting Doorsets Information Sheet 2: The Role of Intumescent Materials in the Timber and Metal Based Fire-resisting Glazing systems Information Sheet 3: Guide to the Use of Smoke Seals in Doorsets Information Sheet 4: The Ageing Performance of Intumescent Seals Information Sheet 5: Guide to the Selection of Smoke Seals for Doorsets The IFSA Code: Sealing apertures and service penetrations to maintain fire resistance

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- 36 BS 4847: Pt 1: 1980 Internal and external wood doorsets, door leaves and frames. Pt 1 specification for dimensional requirements
- 37 BS 8214:1990 Code of practice for fire door assemblies with non-metallic leaves
- 38 BS EN 1154:1997 Building hardware. Controlled door closing devices. Requirements and test methods
- 39 TRADA: Timber Fire-resisting Doorsets: maintaining performance under the new European test standard
- 40 BS 5499-1:2002 Graphical symbols and signs. Safety signs, including fire safety signs. Specification for geometric shapes, colours and layout

BS 5499-2:1986 Fire safety signs, notices and graphic symbols. Specification for self-luminous fire safety signs

BS 5499-3:1990 Fire safety signs, notices and graphic symbols. Specification for internally-illuminated fire safety signs

BS 5499-4:2000 Safety signs, including fire safety signs. Code of practice for escape route signing BS 5499-5:2002 Graphical symbols and signs. Safety signs, including fire safety signs. Signs with specific safety meanings

BS 5499-6:2002 Graphical symbols and signs. Safety signs, including fire safety signs. Creation and design of graphical symbols for use in safety signs. Requirements

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- BRE Defect Action Sheets (BRE DAS) BR7 and BR8
   Advice on preventing fire spread between building at roof level. Quote BR 419 BRE 2001 for the complete set of BRE DAS
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- 44 BR 135 Cladding

BRE Report Fire performance of external thermal insulation for walls of multi-storey buildings (BR 135, 1988, revised 2003)

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- 46 Building Regulations Part M Access to and use of buildings
- 47 BS 8300:2001 Design of buildings and their approaches to meet the needs of disabled people. Code of practice

### EUROPEAN TEST METHODS AND CLASSIFICATIONS (REACTION TO FIRE)

| BS EN ISO 1182:2002    | Reaction to fire tests for building products – Non-combustibility test              |
|------------------------|---|
| BS EN ISO 1716:2002    | Reaction to fire tests for building products – Determination of the gross calorific |
|                        | value   |
| BS EN 13823:2002       | Reaction to fire tests for building products – Building products excluding          |
|                        | floorings exposed to the thermal attack by a single burning item                    |
| BS EN ISO 11925-2:2002 | Reaction to fire tests for building Products, Part 2 – Ignitability when subjected  |
|                        | to direct impingement of a flame  |
| BS EN 13238:2001       | Reaction to fire tests for building products-conditioning procedures and general    |
|                        | rules for selection of substrates   |
| BS EN 13501-1:2002     | Fire classification of construction products and building elements, Part 1 –        |
|                        | Classification using data from reaction to fire tests                               |

### EUROPEAN TEST METHODS AND CLASSIFICATIONS (FIRE RESISTANCE)

| BS EN 1363-1:1999  | Fire resistance tests, Part 1 – General requirements                                 |
|--------------------|--|
| BS EN 1363-2:1999  | Fire resistance tests, Part 2 – Alternative and additional procedures                |
| DD ENV 1363-3:1999 | Fire resistance tests, Part 3 – Verification of furnace performance                  |
| BS EN 1364-1:1999  | Fire resistance tests for non-loadbearing elements, Part 1 – Walls                   |
| BS EN 1364-2:1999  | Fire resistance tests for non-loadbearing elements, Part 2 – Ceilings                |
| BS EN 1364-3:xxxx  | Fire resistance tests for non-loadbearing elements, Part 3 – Curtain wallsfull       |
|                    | configuration  |
| BS EN 1364-4:xxxx  | Fire resistance tests for non-loadbearing elements, Part 4 – Curtain wallspart       |
|                    | configuration  |
| BS EN 1364-5:xxxx  | Fire resistance tests for non-loadbearing elements, Part 5-Semi – natural fire test  |
|                    | for facades and curtain walls  |
| BS EN 1364-6:xxxx  | Fire resistance tests for non-loadbearing elements, Part 6 – External wall systems   |
| BS EN 1365-1:1999  | Fire resistance tests for loadbearing elements, Part 1 – Walls                       |
| BS EN 1365-2:1999  | Fire resistance tests for loadbearing elements, Part 2 – Floors and roofs            |
| BS EN 1365-3:1999  | Fire resistance tests for loadbearing elements, Part 3 – Beams                       |
| BS EN 1365-4:xxxx  | Fire resistance tests for loadbearing elements, Part 4 – Columns                     |
| BS EN 1365-5:xxxx  | Fire resistance tests for loadbearing elements, Part 5 – Balconies                   |
| BS EN 1365-6:xxxx  | Fire resistance tests for loadbearing elements, Part 6 – Stairs and walkways         |
| BS EN 1366-1:1999  | Fire resistance tests for service installations, Part 1 – Ducts                      |
| BS EN 1366-2:1999  | Fire resistance tests for service installations, Part 2 – Fire dampers               |
| BS EN 1366-3:xxxx  | Fire resistance tests for service installations, Part 3 – Penetration seals          |
| BS EN 1366-4:xxxx  | Fire resistance tests for service installations, Part 4 – Linear joint seals         |
| BS EN 1366-5:xxxx  | Fire resistance tests for service installations, Part 5 – Service ducts and shafts   |
| BS EN 1366-6:xxxx  | Fire resistance tests for service installations, Part 6 – Raised floors              |
| BS EN 1366-7:xxxx  | Fire resistance tests for service installations, Part 7 – Closures for conveyors and |
|                    | trackbound transportation systems  |
| BS EN 1366-8:xxxx  | Fire resistance tests for service installations, Part 8 – Smoke extraction ducts     |
| BS EN 1366-9:xxxx  | Fire resistance tests for service installations, Part 9 – Single compartment smoke   |
|                    | extraction ducts   |
| BS EN 1366-10:xxxx | Fire resistance tests for service installations, Part 10 – Smoke control dampers     |
|                    |  |

| BS EN 13501-2:xxxx  | Fire classification of construction products and building elements, Part 2 –        |  |  |  |  |
|---------------------|---|--|--|--|--|
|                     | Classification using data from fire resistance tests (excluding products for use in |  |  |  |  |
|                     | ventilation systems)  |  |  |  |  |
| BS EN 13501-3:xxxx  | Fire classification of construction products and building elements, Part 3 –        |  |  |  |  |
|                     | Classification using data from fire resistance tests on components of normal        |  |  |  |  |
|                     | building service installations (other than smoke control systems) 30                |  |  |  |  |
| BS EN 13501-4:xxxx  | Fire classification of construction products and building elements, Part 4 –        |  |  |  |  |
|                     | Classification using data from fire resistance tests on smoke control systems.      |  |  |  |  |
| DD ENV 13381-1:xxxx | Test methods for determining the contribution to the fire resistance of structural  |  |  |  |  |
|                     | members, Part 1 – Horizontal protective membranes                                   |  |  |  |  |
| DD ENV 13381-2:2002 | Test methods for determining the contribution to the fire resistance of structural  |  |  |  |  |
|                     | members, Part 2 – Vertical protective membranes                                     |  |  |  |  |
| DD ENV 13381-3:2002 | Test methods for determining the contribution to the fire resistance of structural  |  |  |  |  |
|                     | members, Part 3 – Applied protection to concrete members                            |  |  |  |  |
| DD ENV 13381-4:2002 | Test methods for determining the contribution to the fire resistance of structural  |  |  |  |  |
|                     | members, Part 4 – Applied protection to steel members                               |  |  |  |  |
| DD ENV 13381-5:2002 | Test methods for determining the contribution to the fire resistance of structural  |  |  |  |  |
|                     | members, Part 5 – Applied protection to concrete/profiled sheet steel composite     |  |  |  |  |
|                     | members   |  |  |  |  |
| DD ENV 13381-6:2002 | Test methods for determining the contribution to the fire resistance of structural  |  |  |  |  |
|                     | members, Part 6 – Applied protection to concrete filled hollow steel columns        |  |  |  |  |
| DD ENV 13381-7:2002 | Test methods for determining the contribution to the fire resistance of structural  |  |  |  |  |
|                     | members, Part 7 – Applied protection to timber members                              |  |  |  |  |

### EUROPEAN TEST METHODS AND CLASSIFICATIONS (EXTERNAL FIRE EXPOSURE OF ROOFS)

| DD ENV 1187:2002  | Test methods for external fire exposure to roofs.             |
|-------------------|---|
| BS EN 1634-1:2000 | Fire resistance tests for door and shutter assemblies, Part 1 |
|                   | <ul> <li>Fire doors and shutters</li> </ul>                   |
| BS EN 1634-2:xxxx | Fire resistance tests for door and shutter assemblies, Part 2 |
|                   | – Fire door hardware  |
| BS EN 1634-3:xxxx | Fire resistance tests for door and shutter assemblies, Part 3 |
|                   | – Smoke control doors   |

# 17 WHERE TO GET ADVICE/HELP

| BUI  | LDING HARDWARE (IRONMO          | ONG              | ERY)                          |      |                          |
|------|---------------------------------|------------------|-------------------------------|------|--------------------------|
| Bui  | lders Hardware Industry Fed     | erati            | on                            |      |                          |
| 42 I | Heath Street, Tamworth, Staffs  | B79 <sup>-</sup> | 7JH                           |      |                          |
| The  | Guild of Architectural Ironn    | nong             | ers                           |      |                          |
| 8 St | epney Green, London E1 3JU      |                  |                               |      |                          |
| T:   | 020 7790 3431                   | F:               | 020 7790 8517                 | W:   | www.gai.org.uk           |
| E:   | info@gai.org.uk                 |                  |                               |      |                          |
| EM   | ERGENCY LIGHTING SYSTEM         | S                |                               |      |                          |
| Ind  | ustry Committee for Emerge      | ncy              | Lighting Limited              |      |                          |
| Swa  | an House, 207 Balham High Ro    | ad, L            | ondon SW17 7BQ                |      |                          |
| T:   | 020 8675 5432                   | F:               | 020 8673 5880                 | W:   | www.icel.co.uk           |
| FIR  | E-RESISTING DOORS IN META       | AL AI            | ND MECHANICAL DOORS OR S      | ынит | TERS                     |
| Doo  | or and Shutter Manufacturer     | 's' As           | sociation                     |      |                          |
| 42 I | Heath Street, Tamworth, Staffor | rdshir           | re B79 7JH                    |      |                          |
| T:   | 01827 52337                     | F:               | 01827 310827                  | W:   | www.dsma.org.uk          |
| E:   | info@dsma.org.uk                |                  |                               |      |                          |
| FIR  | E-RESISTING HARDWARE FOI        | r co             | NSTRUCTION USE                |      |                          |
| Ass  | ociation of Building Hardwa     | re M             | anufacturers                  |      |                          |
| 42 I | Heath Street, Tamworth, Staffor | rdshir           | re B79 7JH                    |      |                          |
| T:   | 01827 52337                     | F:               | 01827 310827                  | W:   | www.abhm.org.uk          |
| E:   | info@abhm.org.uk                |                  |                               |      |                          |
| FIR  | E-RESISTING PARTITIONS AN       | D CE             | ILINGS                        |      |                          |
| Ass  | ociation of Interior Specialis  | ts               |                               |      |                          |
| Olto | on Bridge, 245 Warwick Road, S  | Solihı           | ull, West Midlands B91 3DX    |      |                          |
| T:   | 0121 707 0077                   | F:               | 0121 706 1949                 | W:   | www.ais-interiors.org.uk |
| FIR  | E-RESISTING DOORSETS IN TI      | MBE              | R                             |      |                          |
| Brit | ish Woodworking Federatio       | n                |                               |      |                          |
| 56-0 | 54 Leonard Street, London EC2   | A 4J)            | X                             |      |                          |
| T:   | 020 7608 5050                   | F:               | 020 7608 5051                 | W:   | www.bwf.org.uk           |
| E:   | info@bwf.org.uk                 |                  |                               |      |                          |
| The  | Architectural and Specialist    | Doo              | r Manufacturers Association   |      |                          |
| Buri | nside House, 3 Coates Lane, Hi  | gh W             | /ycombe, Buckinghamshire HP13 | 5EY  |                          |
| T:   | 01494 447370                    | F:               | 01494 462094                  | W:   | www.asdma.com            |
| E:   | info@asdma.com                  |                  |                               |      |                          |
| FIR  | E SEALING PRODUCTS AND L        | INFA             | AR GAP SEALS                  |      |                          |
| Inti | imescent Fire Seals Associati   | ion              |                               |      |                          |
| 201  | Park Street Princes Rishorough  | Ruc              | KS HP27 9AH                   |      |                          |
| T.   | 01844 275500                    | Fax              | 01844 274002                  | W    | www.ifsafire.com         |
| F.   | ifsa@intfire.com                | i un.            | 5.511 <i>27</i> 1002          | •••  |                          |
|      |                                 |                  |                               |      |                          |

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| GL/  | ASS AND GLAZING SYSTEMS   |   |  |  |   |  |
|--|---|---|--|--|---|--|
| Gla  | ss and Glazing Federation   |   |  |  |   |  |
| 44-4   | 18 Borough High Street, Londo   | on SE   | 1 1XB  |  |   |  |
| T:   | 020 7403 7177   | F:  | 020 7357 7458  | W:   | www.ggf.org.uk  |  |
| E:   | info@ggf.org.uk   |   |  |  |   |  |
|  |   |   |  |  |   |  |
| IMF  | REGNATION AND OTHER TI  | MBE   | R TREATMENTS   |  |   |  |
| Brit   | ish Wood Preserving & Dan   | וף-Pr   | oofing Association   |  |   |  |
| 1 G  | leneagles House, Vernon Gate  | , Sou   | th Street, Derby DE1 1UP   |  |   |  |
| T:   | 01332 225100  | F:  | 01232 225101   | W:   | www.bwpda.co.uk   |  |
| E:   | crc@bwpda.co.uk   |   |  |  |   |  |
| PAI  | NTS AND COATINGS  |   |  |  |   |  |
| Brit   | ish Coatings Federation   |   |  |  |   |  |
| Jam  | es House, Bridge Street, Leath  | erhea   | id, Surrey KT22 7EP  |  |   |  |
| T:   | 01372 360660  | F:  | 01372 376069   | W:   | www.bcf.co.uk   |  |
| E:   | hughwilliams@   |   |  |  |   |  |
|  |   |   |  |  |   |  |
| PLA  | STERBOARD AND GYPSUM  | PRO   | DUCTS  |  |   |  |
| Gvp  | sum Products Development  | t Ass   | ociation   |  |   |  |
| 165  | Queen Victoria Street, Londor   | n EC4   | IV 4DD   |  |   |  |
| T:   | 020 7311 2942   | F:  | 020 7311 2913  | W:   | www.gpda.com  |  |
|  |   |   |  |  | 51  |  |
| PRC  | DUCT TESTING, RESEARCH,   | PRO   | DUCT AND INSTALLER CERTIFI   | CATI   | ION AND FIRE SAFETY   |  |
| ENG  | GINEERING   |   |  |  |   |  |
| BM   | TRADA Ltd (for Trada Q Ma   | rk)   |  |  |   |  |
| Chil   | tern International Fire Ltd.  |   |  |  |   |  |
| Stocking Lane, Hughenden Valley, High Wycombe, Buckinghamshire HP14 4ND              |   |   |  |  |   |  |
| Stoc   | king Lane, Hughenden Valley,  | High  | Wycombe, Buckinghamshire HP  | 14 4   | ND  |  |
| Stoc<br>T:   | king Lane, Hughenden Valley,<br>01494 563091  | High<br>F:  | Wycombe, Buckinghamshire HP<br>01494 565487  | 14 4<br>W:                                   | ND<br>www.chilternfire.co.uk  |  |
| Stoc<br>T:<br>E:   | king Lane, Hughenden Valley,<br>01494 563091<br>info@chilternfire.co.uk   | High<br>F:  | Wycombe, Buckinghamshire HP<br>01494 565487  | 14 4<br>W:                                   | ND<br>www.chilternfire.co.uk  |  |
| Stoc<br>T:<br>E:   | king Lane, Hughenden Valley,<br>01494 563091<br>info@chilternfire.co.uk   | High<br>F:  | Wycombe, Buckinghamshire HP<br>01494 565487  | 14 4<br>W:                                   | ND<br>www.chilternfire.co.uk  |  |
| Stoc<br>T:<br>E:<br>BRE  | king Lane, Hughenden Valley,<br>01494 563091<br>info@chilternfire.co.uk   | High<br>F:<br>g the   | Wycombe, Buckinghamshire HP<br>01494 565487<br>Loss Prevention Council (LPC)   | 14 41<br>W:<br>for                           | ND<br>www.chilternfire.co.uk<br>LPCB Certification) FRS   |  |
| Stoc<br>T:<br>E:<br>BRE<br>Build   | king Lane, Hughenden Valley,<br>01494 563091<br>info@chilternfire.co.uk<br><b>Certification (Incorporating</b><br>ding Research Establishment, G  | High<br>F:<br>g the<br>Garsto   | Wycombe, Buckinghamshire HP<br>01494 565487<br>Loss Prevention Council (LPC)<br>on, Watford, WD25 9XX UK   | 14 4<br>W:<br>for                            | ND<br>www.chilternfire.co.uk<br>LPCB Certification) FRS   |  |
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### **OTHER USEFUL CONTACTS:**

| As   | sociation of British Insurers (  | ABI)    |                           |    |                             |
|------|----------------------------------|---------|---------------------------|----|-----------------------------|
| 51   | Gresham Street, London, EC2V     | ′ 7HÇ   | )                         |    |                             |
| T:   | 0207 7600 3333                   | F:      | 0207 696 8999             | W: | www.abi.org.uk              |
| E:   | info@abi.org.uk                  |         |                           |    |                             |
| Co   | nstruction Skill Certification   | Sche    | me (CSCS)                 |    |                             |
| CS   | CS, Bircham Newton, Newton,      | King    | s Lynn, Norfolk, PE31 6RH |    |                             |
| T:   | 01485 578777                     | F:      | 01485 577427              | W: | www.cscs.uk.com             |
| Pas  | ssive Fire Protection Federati   | on      |                           |    |                             |
| Ass  | ociation House, 99 West Street   | :, Farı | nham                      |    |                             |
| Sur  | rey GU9 7EN                      |         |                           |    |                             |
| T:   | 01252 739141                     | F:      | 01252 739140              | W: | www.associationhouse.org.uk |
| E:   | info@associationhouse.org.uk     | <       |                           |    |                             |
| The  | e Fire Protection Association    |         |                           |    |                             |
| Bas  | tille Court, 2 Paris Gardens, Lo | ndon    | SE1 8ND                   |    |                             |
| T:   | 0207 902 5300                    | F:      | 0207 902 5301             | W: | www.thefpa.co.uk            |
| E:   | fpa@thefpa.co.uk                 |         |                           |    |                             |
| The  | e Steel Construction Institute   | 3       |                           |    |                             |
| Silv | vood Park, Ascot, Berkshire SL5  | 7QN     | I                         |    |                             |
| T:   | 01344 872 775                    | F:      | 01344 622 944             | W: | www.steel-sci.org           |
| E:   | publications@steel-sci.com       |         |                           |    |                             |
|      |                                  |         |                           |    |                             |

Some of the organisations listed above have a number of interests. This listing is only a guide and full details can be found on the appropriate website.

| The Association for Specialist Fire Protection  |      |             |                    |  |  |  |
|---|------|-------------|--------------------|--|--|--|
| Association House, 99 West Street, Farnham, Surrey GU9 7EN  |      |             |                    |  |  |  |
| T: 01252 739142   | F: 0 | 1252 739140 | W: www.asfp.org.uk |  |  |  |
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| CD versions and further copies are available on request at the address above.                               |      |             |                    |  |  |  |
|   |      |             |                    |  |  |  |

### 18 GLOSSARY

**Air transfer grille**: A device which allows the passage of ventilation air in normal conditions through a fire door, wall or partition; but, closes automatically to prevent the passage of fire in a fire condition for a stipulated time period.

Automatic fire and smoke damper: A device which allows the passage of ventilation air in normal conditions through a duct, fire wall or partition; but closes automatically to prevent the passage of smoke and fire in a fire condition for a stipulated period of time. Response to smoke is typically achieved by linking to the automatic fire detection system.

**Building hardware (ironmongery)**: Fittings designed for incorporation in a fire-resisting doorset and which contribute to ensure that the fire-resisting door (when closed) resists the passage of fire and/or gaseous products of combustion. Such fittings include hinges, pivots, door closing devices, latches, locks, and door furniture (lever handles, knobs).

**Cavity barrier**: A construction provided to close a concealed space against the penetration of smoke and flame or to restrict the movement of smoke or flame within such a space, for a stipulated time period.

**Combustibility (BS 476-4)**: This assesses whether a material will burn and add to a fire when subjected to an existing fire. Spread of flame (BS 476-7) this assesses whether the fire will spread over the surface of the material (especially wall linings).

**Compartment (fire)**: A building or part of a building, comprising one or more rooms, spaces or storeys, constructed to prevent the spread of fire to or from another part of the same building, or an adjoining building. The basis of compartmentation is to subdivide buildings into areas of manageable risk, to provide adequate means of escape, and to provide fire separation for adjoining buildings.

**Drywall**: A generic term used to describe a range of metal and timber framed assemblies clad with gypsum plasterboard and other board materials for standard dry lining, partitions and ceilings which involve little or no wet operations.

**European Technical Approval (ETA)**: Favourable technical assessment of the fitness for use of a product for an intended use, based on the fulfilment of the Essential Requirements for building works for which the product is used (article 8, 9 and 4.2 of the CPD). An ETA can be issued on the basis of a Guideline (article 9.1 of the CPD) or without guideline (article 9.2 of the CPD)

**European Technical Approval Guideline (ETAG)**: Document used as the basis for preparing ETAs, which contains specific requirements for the products within the meaning of the Essential Requirements, the test procedures, the methods of assessing and judging the results of the tests, the inspection and conformity procedures, written by EOTA (the European Organisation for Technical Approvals) on the base of a mandate received from the Commission (article 9.1 and 11 of the CPD)

**Fire damper**: A device which allows the passage of ventilation air in normal conditions through a duct, wall or partition; but, closes automatically to prevent the passage of fire in a fire condition for a stipulated time period.

**Fire door (assembly)**: A door or shutter, provided for the passage of persons, air or objects, which together with its frame and furniture as installed in a building, is intended, when closed, to resist the passage of fire and/or gaseous products of combustion, and is capable of meeting specified performance criteria to those ends. (BS 5599-11 and AD B)
**Fire-resisting (fire resistance)**: The ability of a component or construction of a building to satisfy for a stated period of time some or all of the appropriate criteria specified in the relevant part of BS 476 (AD B and BS 5588-11)

**Fire-resisting composite panel**: A fully bonded steel faced panel with mineral fibre or other non combustible core which is used for cladding external walls of steel building structures to form a separating element from one building to another; and, for high risk areas within buildings to form a separating element. It is designed to restrict the spread of fire from the compartment or building of origin for a stipulated period of time.

**Fire-resisting doorset**: A complete installed door assembly comprising door frame, door leaves, other panels, building hardware, seals and any glazing that, when closed, is intended to resist the passage of fire and smoke in accordance with specified performance criteria. (ASDMA guide)

**Fire-resisting ductwork**: Ventilation or extraction ductwork designed to contain fire and the products of combustion in a manner that does not allow passage to other parts of the building from the compartment of origin for a stipulated time period.

**Fire-resisting glass**: A glass that demonstrates its ability to meet the defined heating and pressure conditions specified in EN 1363-1 Fire resistance Test (or any other National or International fire resistance test method). Typically, the glass will be clear, textured, toughened, laminated or wired and may incorporate special features such as coatings or laminations that enable the glass to achieve a particular fire performance in terms of integrity and insulation. Each glass may have a unique chemical composition and its fire test performance may be dependent on or affected by the pane size, aspect ratio, edge cover, glazing method and type of frame and its fixing. Other fire performance parameters may be requested by the test sponsor to classify the glass according to EN 13501-2, such as the measurement of radiation as defined in EN 1363-2.

**Fire-resisting glazed screen**: Glazed structure or window incorporating fire-resisting glass and designed to resist the spread of fire and the gaseous products of combustion for a stipulated period of time.

**Fire-resisting luminaire**: Lighting structure or fitting for suspended ceilings designed to resist the spread of fire and the products of combustion for a stipulated period of time. It is required to be tested for integrity when fitted to an individual manufacturer's suspended ceiling.

**Fire-resisting partition**: An internal non load bearing vertical dividing structure designed to resist the spread of fire, heat, and the products of combustion for a stipulated period of time. Such a partition can include a glazed section or a fire door.

**Fire-resisting suspended ceiling**: A suspended ceiling designed to contribute to the overall fire resistance of a floor assembly or to prevent the collapse of steel beams supporting a floor or roof, for a stipulated period of time. It may also provide fire resistance as a membrane in the same way as a partition.

**Fire Safety Engineering** is the application of scientific and engineering principles, rules [Codes], and expert judgement, based on an understanding of the phenomena and effects of fire and of the reaction and behaviour of people to fire, to protect people, property and the environment from the destructive effects of fire.

**Fire separating element**: A compartment wall, compartment floor, cavity barrier and construction enclosing a protected escape route and/or a place of special fire hazard. (AD B).

**Fire Shutters.** These can be collectively defined with fire-resisting doors as 'a door, or shutter, provided for the passage of persons, air or objects, which together with its frame and furniture as installed in a building, is intended (when closed) to resist the passage of fire and/or gaseous products of combustion, and is capable of meeting specified performance criteria to those ends'. A door or shutter across means of escape should only be released by a heat sensor in the immediate vicinity of the door, and not initiated by smoke detectors or a fire alarm system, unless the shutter is also intended to partially descend to form part of a smoke reservoir.

**Fire-stopping**: Sealing products that take up imperfections of fit or design tolerance between the fire-resisting fixed elements of a building to restrict the passage of fire and smoke. They continue to take up the imperfections of fit at all times and have the same fire rating as the fixed elements of which they form a part. In reaction to a fire condition they swell, spread or deform to achieve their performance.

**Fusible link**: Device installed local to the door or shutter which will fracture at a specified temperature to release a door closing mechanism. (This originates from prEN 14600 for fire doors)

**Penetration seal**: Products that maintain the integrity and insulation of fire-resisting separating elements where services pass through the element. They are designed to allow for any movement and to close any opening that may be expected to occur in a fire situation. For the purpose of this study penetration seals have been included under fire-stopping products.

**Protected Shaft.** A protected shaft is defined as ' a shaft which enables persons, air or objects to pass from one compartment to another, and which is enclosed in fire-resisting construction'.

**Reaction to fire tests assess a number of properties and materials**: Ignitability (BS 476-5, 12, 13) this assesses whether a material is likely to catch fire.

Reaction to fire: This is the extent to which a product burns and contributes to the development of a fire.

**Resistance to Fire**: The ability of a product to prevent the spread of flame and/or smoke, and, where relevant to maintain mechanical stability. Resistance to fire tests to assess the ability of a product when used in specific circumstances to perform in a particular manner are defined in BS 576 parts 20 to 24.

**Responsible person** is the employer, where there is one, and where there is not it will be the person responsible for the activity undertaken on the premises which might give rise to a risk to those present. It includes;

- a the employer in relation to any workplace which is to any extent under his control;
- b in relation to any premises where there is no employer
  - i the person (whether the occupier or owner of the premises or not) who has the overall management of the premises; or
  - ii where there is no one with overall management responsibility, the occupier of the premises; or
  - iii where neither (i) or (ii) apply, the owner of the premises

**Structural fire protection**: Products used to insulate the structural frame of a building or other construction to allow it to retain its required load bearing strength or limit the core temperature for a stipulated period of time. The time periods may be stipulated in Building Regulations, IMO Regulations, Safety Case studies or Safety designs according to the type of structure involved.

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