6 Business and property protection

6.1 Introduction

Fire safety legislation is primarily concerned with the protection of people from death or injury in fire.

However, a fire that causes no physical injuries can still have potentially devastating effects on the viability of a business in terms of:

- loss of stock;
- loss of records;
- direct damage to building;
- lost production;
- lost customers;
- damage to public image;

etc.

Therefore, where a fire has the potential to have a substantial impact on the viability of a business or cause large financial losses consideration should be given to additional fire protection measures over and above those necessary to satisfy the minimum statutory requirements. Insurance premium discounts may be available where a high standard of fire protection is provided.

In some cases insurance cover may not be readily available unless fire protection measures exceed the minimum requirements of building regulations.

6.2 Risks associated with external insulated panels

Buildings have to comply with the statutory requirements for Energy Conservation. By definition this demands well insulated structures and the Amendments to the Building Regulations: L2: 2002 further extend these requirements.

The revised regulations mean thicker roof and wall systems and increasingly airtight building envelopes. The recommendations in this guide combine the requirements to achieve these regulations with the steps necessary for fire safety and performance through the securement of external insulated panels and the design detailing to provide good fire protection.

Fires involving insulated panels, which have increasingly been of concern within the insurance industry, have almost entirely been associated with polystyrene cored panels installed internally within the building. The external envelope has only become involved as a consequence of the fully developed internal fire.

Section 1 clearly identifies that insulated panels designed for use as the external roof and walls are totally different from products designed to build internal insulated boxes. The history of external panels in fire over 30 years indicates that the associated risk is relatively low. Nevertheless it is important that insulated panels are properly specified [section 10] to meet the regulations and that guidance is available on the design and installation of details especially at junctions [section 11] to ensure that any potential risk is kept to a minimum.

6.3 Insurance requirements

Sections 10 and 11 of this guide are designed to complement the published guidance and recommendations available to insurance companies and specialist fire professionals. It sets out the guidelines for design detailing of insulated panels at junctions and other points of potential vulnerability. Other published guides are briefly described below.

The Loss Prevention Council (LPC) have published a Design Guide for the Fire Protection of Buildings [13] for use by insurers when assessing the insurance premiums of premises that are considered to be of high value or risk.

The LPC Design Guide contains wide ranging recommendations for the fire protection of industrial and commercial buildings. These recommendations are aimed towards minimising the direct and indirect losses that may occur as a result of fire damage and business disruption.

As the LPC Design Guide for the Fire Protection of Buildings becomes more established, it is likely that its provisions will become more important. In some cases insurers may be unwilling to take on a specific risk. It is therefore important to establish, at an early stage, whether the insurers or the client have any specific requirements for property protection over and above building regulations requirements.

Some of the more significant recommendations of the LPC guide, relevant to the external building envelope, are summarised below. These recommendations would normally be in addition to the requirements of the relevant building regulations.

The LPC Design Guide recommends controls on the fire performance of materials used as the internal lining of a building. This includes the roofs and walls of the external envelope.

The use of insulated panels is considered acceptable if they are constructed of materials of limited combustibility. Wall and roof panels incorporating combustible materials are also deemed to be acceptable if they satisfy the requirements of the LPC test standard LPS 1181 (Requirements and tests for wall and ceiling lining materials and composite cladding materials [14]). Further information on the LPS 1181 test is given in section 8.1.2.

Compartment walls

Where a compartment wall meets with an external wall or roof it is recommended that a protected zone be formed such that the external wall or roof (and its supporting framework) has a fire resistance of at least 30 minutes integrity and 15 minutes insulation when tested from each side in accordance with BS 476: Part 22. The fire resisting section of the external cladding should extend for a minimum of 1m each side of the compartment wall or to the next structural bay whichever gives the greater distance.

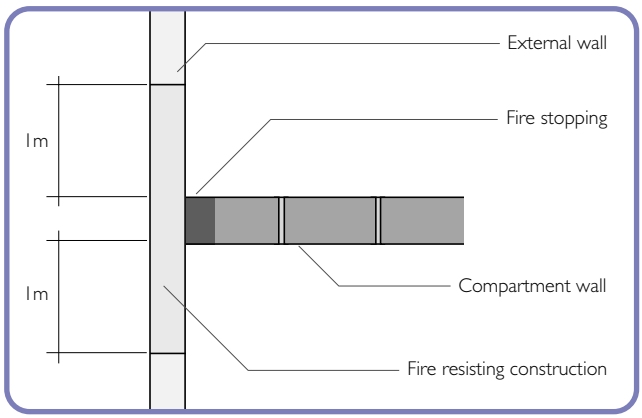

Figure 10. Illustration of protected zone on each side of fire resisting wall

In some circumstances where there is a potential threat of fire attack from the outside of a building (e.g. goods stored externally or an adjacent low roof) the external walls may be required to provide a minimum of 30 minutes fire resistance (15 minutes insulation). Dependent upon the magnitude of the potential loss this may be increased to 60 minutes for both insulation and integrity.

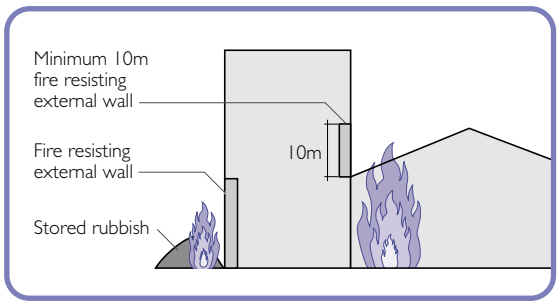

Figure 11. Illustration of fire resisting external wall to protect against effects of an external fire

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Roof coverings

The LPC guide recommends that roof coverings should be classified as AA, AB or AC when tested in accordance with BS 476: Part3: 1958 [9].

Exposure to fire from external accidental sources

The LPC Design Guide also provides guidance on the prevention of fire spread from accidental fires and specifically the creation of fire breaks, or clear areas, between buildings and storage as well as from adjacent sites.

Figure 12 [from Chapter 5 of the LPC Design Guide] illustrates that by planning at an early stage any imposed risks can be eliminated, controlled or reduced to acceptable levels capable of protection. A specific recommendation is that provision should be made to prevent the storage of combustible materials nearer than 10m from the building and at a suitable distance from surrounding property or boundary fences or walls. External cladding having a degree of fire resistance (section 8.2) may also be considered to combat threats to the buildings posed by external sources of fire.

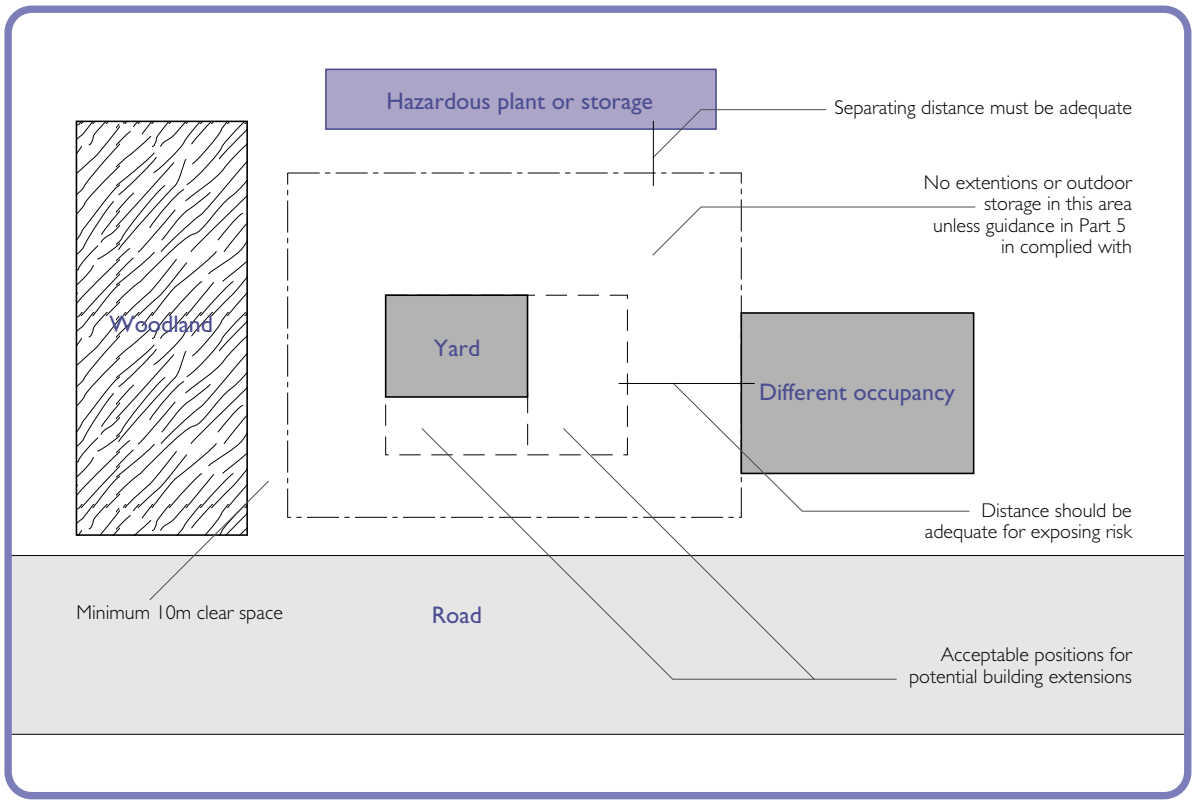

Figure 12. Outdoor exposure and arson risk – plan view

Factory Mutual

Factory Mutual like LPC is an insurance approval company which proactively supports good building design by means of a number of written documents and the approval testing of materials and services through the Factory Mutual Research Corporation.

FMRC approvals procedures encompass the testing of specific physical characteristics, e.g. wind uplift; foot traffic, in addition to fire characteristics.

In the case of insulated panels the principal test is the Room Fire test – UBC Standard No. 17-5 [FMRC 4880 / 4471 – Class1]. The list of fire issues tested as part of the approval procedure is:

- Room fire test – UBC Standard No 17-5
- Flammability characterisation
- Surface burning characteristic (ASTM E84-94)
- Heat of combustion (ASTM E711-87)
- Ignition properties (ASTM D1929-91)
- Ignition residue (ASTM D482-91)
- External fire resistance/spread of flame (ASTM E108).

Quality Management Systems

A key area of the LPC and FMRC approvals is the continued surveillance and audit checking of the Quality Management Systems for any approved insulated panel products to ensure that full compliance with product specification is maintained.

6.4 Loss prevention

The LPC design guide is essentially a prescriptive document that provides a series of standard solutions that may or may not be applied by insurers.

In many cases when considering property protection issues it may be more appropriate to utilise fire engineering and risk assessment techniques (see section 7) to determine appropriate fire protection measures and to establish the most cost effective means of reducing business risk.

For instance for a large manufacturing organisation it may prove to be more cost effective to divide operations between several dispersed locations rather than provide a very high level of fire protection to a single large operational centre.

7 Fire safety engineering

Historically an acceptable standard of fire safety in buildings has been achieved by reference to prescriptive codes that provide standard solutions for a given set of building parameters. For many buildings that are of simple and straightforward design, layout and use, prescriptive codes and standards will probably provide the designer with an acceptable solution.

The Technical Standards for Scotland and Approved Document B in England and Wales are examples of prescriptive guidance.

However, unlike the Technical Standards the recommendations of Approved Document B and Technical Booklet E (Northern Ireland) are not mandatory and designers are not required to adopt any particular solution contained in them providing that it is explicitly demonstrated that the functional requirements of the regulations can be met in some other way.

Fire safety engineering techniques can be adopted as a means of demonstrating compliance with functional requirements of the Building Regulations in England and Wales and specific relaxations of the Scottish Technical Standards can be achieved. In many large and complex buildings fire safety engineering may be the only practical way of achieving and demonstrating a satisfactory standard of fire safety.

As the traditional prescriptive codes have to account for an almost infinite range of building designs they will rarely provide the optimum solution in terms of:

- life safety;
- property protection;
- cost effective fire protection;
- operational requirements.

The prescriptive approach will often not meet the needs of building owners, designers or approvals bodies, particularly for more complex buildings or processes, or in instances where there is a potential for substantial financial loss arising from a relatively small fire.

A particular weakness in the prescriptive approach was recognised in the conclusions of the Cullen report into the Piper Alpha offshore platform disaster, which stated that:

> "Many regulations are unduly restrictive in that they are of a type that impose 'solutions' rather than 'objectives' and are out of date in relation to technological advances. There is a danger that compliance takes precedence over wider safety considerations..."

This conclusion is equally applicable to building design and BS 7974 (Application of fire safety engineering principles to the design of buildings [15])has been developed to provide an objectives based approach to the achievement of fire safety in buildings (Note. BS 7974 was originally issued as a draft for development BS DD 240).

The main objectives of BS 7974 are to:

a) provide a structured framework for assessing the interaction between buildings, people and fire.

b) enable an objective assessment of the fire safety measures required to achieve defined objectives.

c) assist in developing alternatives to prescriptive codes and enable the effect of these to be evaluated.

The British Standard divides the fire safety engineering design process into three main stages:

- Qualitative design review
- Quantitative analysis
- Assessment against criteria

The general approach adopted in the standard is illustrated in figure 13.

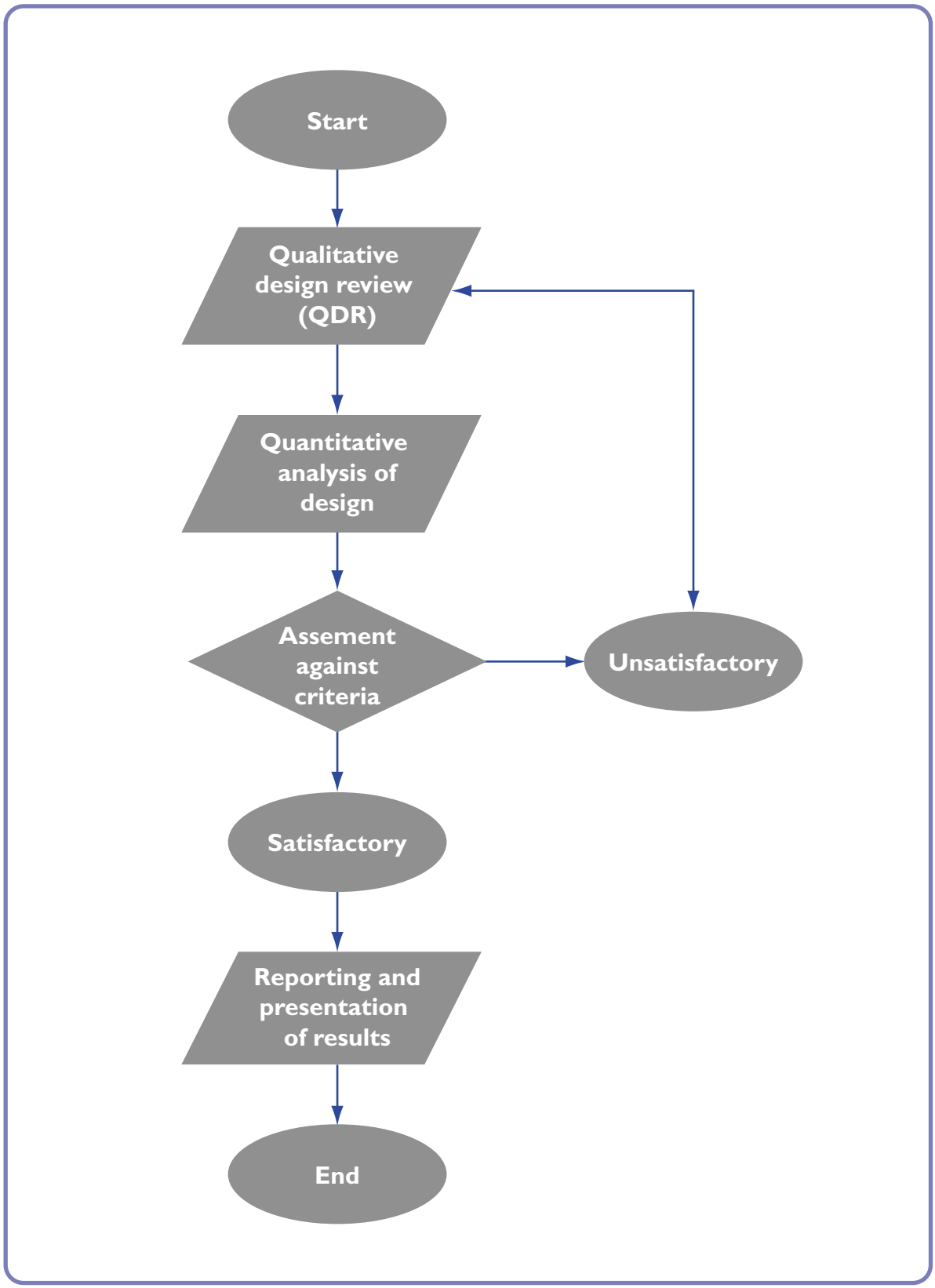

Figure 13. Structure of fire engineering methodology given in BS 7974

7 Fire safety engineering

7.1 Qualitative Design Review (QDR)

The first stage in a fire engineering design is to establish the basic parameters of the project. This process should include a review of the scheme, identification of any overriding constraints and definition of the design objectives. This initial stage should draw on the expertise and experience of the engineer and design team.

Any necessary calculations will normally only follow when the design parameters have been established. For the purposes of fire safety engineering (FSE) this preliminary stage is described in BS 7974 as the Qualitative Design Review (QDR).

During the QDR process the scope and objectives of the fire safety design are defined, performance criteria established and one or more potential design solutions (trial designs) proposed. Key information is also gathered to enable detailed evaluation of the possible design solutions in the quantitative analysis.

7.2 Quantitative analysis

Following the QDR a quantified analysis can be carried out if necessary. It has been found convenient to split information on various aspects of FSE into a number of separate parts, referred to as sub-systems in BS 7974. Guidance on each of the subsystems is published in the supporting series of Published Documents (PD's).

The PD's provide selected guidance on the underlying principles and the type of calculations that may form part of a fire engineering study. However, it should be noted that the use of data and calculation procedures from other sources is not precluded and may often be essential to reach a solution.

One or two of the sub-systems may be used when analysing a particular aspect of design or they may all be used in combination as part of an overall fire engineering evaluation of fire safety in a building.

The quantitative analysis may use probabilistic or deterministic calculation procedures or a combination of both.

The sub-systems are as follows:

sub-system 1: Initiation and development of fire within the enclosure of origin;

sub-system 2: Spread of smoke and toxic gases within and beyond the enclosure of origin;

sub-system 3: Fire spread beyond the enclosure of fire origin and structural response;

sub-system 4: Detection, activation and suppression;

sub-system 5: Fire service intervention;

sub-system 6: Human Factors;

sub-system 7: Probabilistic risk assessment.

7.3 Assessment against criteria

Following the fire engineering analysis the results need to be compared with the acceptance criteria identified during the QDR.

If none of the trial designs satisfies the specified acceptance criteria, the QDR and quantification process should be repeated until a fire safety strategy has been found that satisfies the design criteria.

7.4 Reporting and presentation

A fire safety engineering study will generally need to be reviewed and accepted by the relevant approval bodies and it is essential that full details of the study are documented in a clear and understandable form.

7.5 Qualifications of fire safety engineer

The detailed application fire safety engineering techniques is beyond the scope of this document and any fire engineering study should be carried out by a suitably qualified and experienced fire safety engineer. In assessing the suitability of fire safety engineering design personnel professional qualifications (e.g. Chartered Membership of the Institution of Fire Engineers) and experience of fire safety engineering on projects of similar scale and complexity should be taken into account.

7.6 Fire safety engineering and the external building envelope

At the start of the fire engineering process it is essential to clearly establish the fire safety design objectives. Typical fire safety objectives may include:

- protection of life (including firefighters);
- limitation of direct damage to property;
- minimisation of business disruption.

When the fire safety objectives have been agreed, specific performance criteria need to be established.

In the context of materials used in the external building envelope the achievement of these objectives may be influenced by:

a) flame spread characteristics of internal and external faces;

b) through fixing of cladding and detailing of panel joints;

c) detailing of the junction between construction elements (e.g. roof/wall)

d) material heat release rate and potential contribution to a developed fire;

e) smoke production and potential for smoke spread;

f) potential for fire spread around compartment walls or floors;

g) fire resistance of the cladding system and the supporting structure;

h) general building fire protection measures (e.g. sprinklers).

The extent to which the above factors may influence the specification in any particular building needs to be considered in the context of the specific case.

The detailed application of fire safety engineering techniques is beyond the scope of this design guide the general approach to fire safety engineering is illustrated by the following examples.

7.6.1. Single storey warehouse

Occupant safety

Experience suggests that fires in single storey warehouses and industrial buildings do not present a high risk to life. This is largely because the number of occupants in this type of building is relatively small and they are generally familiar with their surroundings and should participate in regular fire drills. Consequently once warning of fire is given evacuation can be quickly achieved.

The main life safety concern in this type of building is to ensure that early warning of a fire is provided and that the rate of fire and smoke spread in the early stages of fire does not impede escape.

In the context of external cladding the main aim is to ensure that exposed internal surfaces do not accelerate the rate of fire spread in such a manner that escape could be impeded. The smoke production, fire resistance and the ultimate rate of heat release are unlikely to be significant when compared to the effects of a fire involving combustible warehouse contents.

Therefore if the building is located well away from adjacent buildings (or site boundaries) it may only be necessary to consider the surface flame spread properties of the faces of an external cladding system.

In the early (evacuation) stages of a warehouse fire the combustible core of an insulated panel is unlikely to contribute to the rate of flame spread if:

a) steel facings are provided and these are fixed through to the structure using steel fixings;

b) inter-panel joints remain tight.

7 Fire safety engineering

Fire fighting

Whilst the occupants should be able to quickly escape fire fighters may be put at risk if fire spread or structural collapse occurs more quickly than might be expected in other buildings. It is therefore desirable to ensure that all facings of composite panels are well secured and jointed to avoid the falling of facings and exposure of any underlying combustible material. Additionally if a thermosetting core materials are utilised (e.g. PUR, PIR or Phenolic) the danger of molten flaming droplets being released is avoided.

Loss control

Where the objective is to protect the contents of the building and reduce the potential for business disruption the most effective fire protection measures are likely to be the sub-division of the building into fire resisting compartments and/or the provision of sprinklers.

In an unsprinklered warehouse building the main influence on the speed of development of a fire will be the stored combustible materials.

However, it is important to ensure that the internal linings do not accelerate the spread of fire and that combustible core materials do not enable fire to by-pass compartment boundaries.

At junctions with compartment walls or floors consideration should be given to the incorporation of non-combustible materials. In all cases and especially where combustible core materials are utilised the design of detailing and the use of metal closures should ensure that the core material does not promote fire spread around the edges of compartment walls, floors or penetrations.

7.6.2. Hospital

At the other extreme of the spectrum is the design for fire safety in multi storey hospitals. Hospitals pose particular evacuation problems because of the difficulties in evacuating patients who may be confined to bed.

Consequently the design for fire safety in hospital buildings is based upon the principle of progressive horizontal evacuation. This process involves the movement of patients away from the fire-affected area to separate fire compartments. Bed patients outside of the fire-affected compartment are expected to remain where they are and be safe from the effects of fire. It is therefore imperative to ensure that fire and smoke will not spread from one compartment to another.

In this situation it is essential to consider all of the factors affecting the fire performance of the external cladding (7.6a to 7.6g on previous page) including the potential for fire spread, smoke production and smoke spread between compartments.