



Graham Ellicott, chief executive officer,
Association for Specialist Fire
Protection

Structural steel fire protection



1 Types of product

Structural steel fire protection is required to preserve the stability of the building in the event of a fire. Section B3, Internal fire spread (structure), of the 1991 Building Regulations, states that: '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, 2000 edition, which provides guidance to meeting the requirements of the Building Regulations, states that the requirements of Section B3 will be met in part 'if the loadbearing elements of structure of the building are capable of withstanding the effects of fire for an appropriate period without loss of stability'.

There are three generic types of fire protection for structural steel:

- cementitious products
- board and casing systems
- intumescent coatings

a) Cementitious products

Cementitious products based on gypsum or portland cement binders are normally applied by low pressure spray techniques to the profile of the steel section to be protected. These materials contain low density aggregates and rheological aids to help the application characteristics. Fire protection is provided to the steel by these materials in two ways, the first being the 'cooling effect' as the trapped moisture (physically and chemically bound) evaporates as the temperature of the surrounding fire increases. Once all the moisture has turned to steam the product then behaves as a thermal insulation material. Low density mineral and synthetic aggregates are used in these products since they are efficient in allowing the steam to escape, while denser materials might impede its progress and cause the product to spall.



b) Board and casing systems

Board and casing systems use materials such as ceramic wool, mineral wool, fire resistant plasterboard, calcium silicate and vermiculite to provide fire protection to steel. These products provide fire protection in much the same way as the cementitious products and are dry fixed around the steel using clip, pin, noggin and screw systems.

c) Intumescent coatings

Intumescent coatings derive their name from the Latin verb *tumescere*, which means to begin to swell. In a fire situation, these thin film products swell up to form a char which protects the steel, thanks to its insulating properties. Using various types of industrial coating equipment, these materials are applied as a thin film and are often available with a range of topcoats in different colours so that the designer can achieve his or her aesthetic needs as well as those of fire protection on visible steel. Intumescent coatings are particularly effective for steel that requires up to 90 minutes' protection.

2 Design and installation issues

The use of any product can be undermined by poor application. Any work that is not of the correct quality could lead to premature collapse of a building in a fire situation. This in turn could threaten the lives of the occupants and firefighters. Thus it is imperative that contractors who have the appropriate credentials for the work install passive fire protection products for steel fully in accordance with the manufacturers' instructions.

Third-party accreditation schemes are in operation for installers of passive fire protection. These ensure that the installing companies and their operatives have the required level of expertise to properly carry out the job. These are recognised in Approved Document B to the Building Regulations 1991, 2000 Edition, which states: 'Since the performance of a system, product, component, structure is dependent upon satisfactory site installation, testing and maintenance, independent schemes of certification and registration of installers and maintenance firms of such will provide confidence in the appropriate standard of workmanship being provided.'

'Third-party accreditation and registration of installers of systems, materials, products or structures provide a means of ensuring that installations have been conducted by

knowledgeable contractors to appropriate standards, thereby increasing the reliability of the anticipated performance in fire.'

Each type of product is susceptible to particular problems, which should be checked during installation:

a) Cementitious products

Spray-applied cementitious products should be checked for thickness, sagging and recoat time. If the installed product has a high pH – such as, materials based on portland cement – any primer on the steel should be considered for compatibility, since some primers will undergo saponification to form a soap, which in turn will lead to a lack of bond between the fire protection product and the substrate. Cementitious fire protection products are particularly suitable for large jobs with good access – thus allowing high production rates – and where the steel needs to be protected for two hours or more.

b) Board and casing systems

Board systems for structural steel may have different fixing systems for different ratings and the inspector should make sure that the appropriate one is being used. In particular, it should be ensured that all fixings are installed at the appropriate centres and, if noggins are required, determine if they need

adhesive, or if friction fitting is sufficient. Noggins are generally required to be cut to size from the board material and will need to be of a certain thickness, and the inspector should ascertain that this requirement has been adhered to. In addition, the inspector should make sure that any adhesive used is of the correct grade as specified by the board manufacturer. Dense board systems lend themselves to areas where moderate levels of abuse may be expected, whereas the lower density products may be reserved for beam protection only. Being dry systems, boards can be applied to the steel in all temperatures.

c) Intumescent coatings

For intumescent coatings, the wet and dry film thicknesses should be checked. The recoat times should also be monitored to see that they conform to the manufacturer's application instructions. Some intumescent coatings require special primers and topcoats and the inspector should make sure that the correct ones are being used. Any substitutions should be compatible with the intumescent. Much intumescent coating is now applied to steel off-site. The same inspection regime would apply for steel coated off-site as for that installed at the construction site.



Leigh's Paints

3 Maintenance

Building managers will need to be aware of the Fire Precautions (Workplace) Regulations 1997 (as amended) and the ramifications of the impending Regulatory Reform (Fire Safety) Order. The provision and maintenance of the structural steel fire protection within a building should form part of the risk assessment carried out under the Workplace Regulations (and, in future, the Reform Order) for the building. Managers need to be aware that there may be liability issues related to a failure to comply with regulations.

Where structural steel products have to be removed or have become damaged, they must be made good as soon as possible. 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.

4 Relevant standards and other documents

In the UK, fire tests on elements of building construction are typically carried out in accordance with the methods of BS 476: *Fire tests on building materials and structures*. It is likely that eventually the new European fire testing standards will replace the BS 476 series. The two standards are generally similar but differ in a number of details. Results from one standard may sometimes be able to be interpreted in terms of the other. The adoption of the European standard is intended to remove technical barriers to trade within Europe.

The general procedures used for determining the fire resistance of loadbearing elements of structure are specified in BS 476: Part 20: 1987: *Fire tests on building materials and structures. Method for determination of the fire resistance of elements of construction (general principles)* and Part 21: 1987: *Fire tests on building materials and structures. Methods for determination of the fire resistance of loadbearing elements of construction*. Part 20 is concerned with general principles and covers requirements which are common to the other Parts. Part 21 covers the testing of beams, columns, floors and loadbearing walls.

Some European fire testing standards have been published. In assessing the performance of fire protection materials, the relevant part is ENV 13381: *Test methods for determining the contribution to the fire resistance of structural members: Part 4: Applied protection to steel members*. This standard makes reference to the EN 1363: *Fire resistance tests* series of standards, which contain general information about conducting fire resistance tests

In conjunction with the Fire Test Study Group and the Steel Construction Institute, the Association for Specialist Fire Protection (ASFP) publishes *Fire Protection for Structural Steel in Buildings*. This publication, available as a book or CD-ROM, is known as the 'Yellow Book' and is recognised as the industry guide to both testing and product approval. The 'Yellow Book' contains third-party reviews of test reports and assessments for passive fire protection products. The 'Yellow Book' is referenced in Approved Document B of the Building Regulations 1991 for England and Wales, 2000 Edition as a source of information.

5 Other issues

If the product has not been fire tested, or offers test data that is not appropriate to the application – for instance, where it is not possible to subject a construction or a product to a fire test because of its size, or where the test data applies to a similar but not identical system – an assessment carried out by a competent fire engineer will be required. Guidance is available from the Passive Fire Protection Federation, which has published a booklet, *Guide to Undertaking Assessments in Lieu of Fire Tests*, available as a free download from the ASFP's website (www.asfp.org.uk) or by calling tel: +44 (0)1252 739 142. This document classifies assessments into three levels: simple, intermediate and complex. It also discusses the requirements of assessors and identifies four levels of experience. These levels are then related to the complexity of the required assessment.

Published by *Fire Prevention & Fire Engineers Journal*
Bastille Court, 2 Paris Garden, London SE1 8ND



Passive Fire Protection Federation
Association House
99 West Street
Farnham
Surrey GU9 7EN
Tel: 01252 739142
www.associationhouse.org.uk

Building safety by design

'Passive fire protection is the primary measure integrated within the constructional fabric of a building to provide inherent fire safety and protection by responding against flame, heat and smoke to maintain the fundamental requirements of building compartmentation, structural stability, fire separation, and safe means of escape.'

► Comprehensive stocks of safety, anti-bandit and ballistic resistant glasses for immediate delivery.

► Non-insulated, partially insulated & fully insulated fire resistant glasses in large panel sizes if required. Suitable for internal and external applications.

Specialist Glass
from C35 Securiglass

C35 Securiglass Ltd.
Canal Mills, Elland Bridge, Elland,
West Yorkshire IX5 0SQ

For more information, please contact:
T: +44 (0) 1422 376181
F: +44 (0) 1422 310070
E: info@c35securiglass.com
W: www.c35securiglass.com