Fire Performance

LEGISLATION AND GUIDANCE

Irish Building Regulations – Fire Safety

The document specifies the minimum periods of fire resistance to be achieved by building elements depending upon their classification, which vary according to the buildings size and use. Generally, the greater the designated risk within a building, the greater the defined period of fire resistance required to protect the elements within the building. The document also sets out criteria relating to the materials used to form the internal surfaces of the building to control and reduce the risk of fire spread.

Fire Protection for Structural Steel in buildings, ASFP Yellow Book
This publication which is prepared by the Association for Specialist Fire Protection (ASFP), sets out the theory and provides guidance on the methods of fire protecting structural steel to comply with the Building Regulations.

PRINCIPLES OF FIRE PERFORMANCE

Fire growth
Whilst they may not be the materials first ignited in a fire, the materials used in the construction of separating walls and ceilings can significantly affect the rate of fire spread and its growth within a building. The materials used for such building elements are of particular importance where linings constitute the boundaries of circulation spaces and means of escape.

Compartmentation
To prevent the rapid spread of fire, which could trap occupants within a building, and also reduce the chances of a fire becoming large, the spread of fire can be restricted by sub-dividing a building into compartments. Compartmentation can relate to any element of a building, typically walls and floors, that can offer fire resistance between two defined areas for a designated period of time.

The appropriate level of sub-division depends upon,
- The use and fire loading of the building
- The height and scale of the building in relation to appropriate evacuation provision

Structural fire precautions
Premature failure of a building can be prevented by ensuring loadbearing elements of the structure have a minimum period of fire resistance to failure of their loadbearing capacity.

Fire limit state
For the purposes of structural design, fire is considered to be an accidental limit state in which the structure must not collapse. Within this manual where load bearing systems are referenced, 100% loadbearing capacity may be assumed unless their loadbearing capacity is quoted with respect to a stated load ratio.

Structural members that are designed to be fully stressed under normal conditions may be subject to reduced load ratios under fire state conditions.

Structural behaviour of timber in fire
Timber has a low thermal expansion coefficient and a low thermal conductivity. The combination of these properties enables the charring that occurs around the exterior of the timber in a fire situation to provide an inherent level of self protection, with the timber below the charred layer maintaining a level of structural strength. The amount of undamaged timber can be assessed for structural stability using standard design guides in conjunction with stress modification factors.

Structural behaviour of steel in fire
Steel generally begins to start losing strength at temperatures above 300°C, eventually melting at approximately 1500°C. For the purposes of structural design, the greatest loss of strength occurs between 400°C and 600°C.

When determining the level of fire protection required to prevent steel from structural failure, a critical design temperature of 550°C is typically used unless otherwise stated. The level of protection required is assessed based on the relevant section factor A/V (Hp/A) of the steel. It is the responsibility of a qualified design engineer to specify the appropriate limiting steel temperatures. The loss of strength from cold-formed steel at elevated temperatures exceeds that of hot-rolled steel and specialist advice is recommended in determining the strength reduction factor at the limiting temperature.
FIRE TEST STANDARDS

The Irish Building Regulations and its supporting technical guidance documents require certain elements of structure and other building elements to provide minimum periods of fire resistance, which are typically expressed in minutes, and generally based on the occupancy and size of the building.

**BS fire resistance standards**

Under the British test standards (BS) the fire resistance of loadbearing and non-loadbearing elements are assessed against the procedures set out in the relevant sections of BS 476. The fire resistance of an individual building element may relate to its loadbearing capacity, fire integrity and/or fire insulation performance characteristics.

**Loadbearing capacity**

A loadbearing element must support its test load or a stated ratio of the test load. For horizontal elements i.e. floors, roof, and beams, allowable levels of vertical deflection may be permitted.

**Integrity**

A separating element must resist collapse, the occurrence of holes, gaps or fissures through which flames and hot gases could pass, and sustained flaming on the unexposed face.

**Insulation**

A separating element must restrict the temperature rise of the unexposed face to below specified levels.

**EN fire resistance standards**

When compared against British Standards, the new harmonised standards have lead to an increase in severity of the test furnaces, particularly in the first 30 minutes of a test. In addition, the new EN fire resistance classifications also impose strict rules governing the use of tests to cover specific end use scenarios.

Therefore, different specifications may be required to meet EN standards compared to those required to meet BS standards, often with additional limitations imposed on a partitions maximum recommended height.

However, under the current Irish Building Regulations, the two testing systems are operating concurrently and fire resistances may still be based on the relevant parts of BS 476. Designers therefore have the choice on the standards they adopt for their projects.

Flame spread over wall and ceiling surfaces is controlled by specifying materials that are either classified as non-combustible or of limited combustibility.

**Non-combustibility**


Glasroc F Multiboard and Glasroc F FireCase are classified as non-combustible in accordance with BS 476: Part 4.
Surface spread of flame
When tested to either BS 476: Part 7: 1997 Surface spread of flame test for materials or BS 476: Part 7: 1987 Method for the classification of the surface spread of flame of products, combustible materials (or certain materials of limited combustibility) are classified as Class 1, 2, 3, or 4 with Class 1 providing the greatest resistance to surface spread of flame.

The exposed plasterboard surfaces of Gyproc plasterboards are all designated Class 1.

Fire Propagation
In addition to a materials contribution to the surface spread of flame in a fire, consideration must also be given to the amount and rate of heat evolved by these materials when used in areas requiring maximum safety.

Within the Irish Building Regulations, circulation areas and routes of escape are typically required to be constructed using materials classified as either Class B-s3,d2 (European Class) or Class 0 (National Class).

Please note, although Class 0 is the highest performance classification for lining materials within the Building Regulations, Technical Guidance Document B (Fire Safety), it is not a classification identified in any British Standard.

A Class 0 material is defined within the Irish Building Regulations as either:
(a) composed throughout of materials of limited combustibility (including non-combustible materials) or
(b) a Class 1 material that has a fire propagation index (I) of not more than 12 and a sub-index (i_1) of not more than 6.

The surfaces of Gyproc plasterboards and the exposed plasterboard surface of Gyproc thermal laminates are designated Class 0.

European test standards
The Construction Products Directive (CPD) within European legislation is designed to enable free trade across Europe in construction products. EN test standards can be split into two main parameters; reaction to fire and fire resistance.

EN Reaction to Fire
EN reaction to fire classifications also run concurrently with the national standards which are classified under BS 476. The EN Reaction to Fire classifications, in accordance with BS IS EN 520 are the manufacturing standards by which all Gyproc board products are classified.

The Euroclass test methodology which is based around the Single Burning Item (SBI) test method (BS EN 13823: 2002), along with the non-combustibility test (BS EN ISO 1182: 2002), heat of combustion test (BS EN ISO 1716: 2002) and direct flame impingement test (BS EN ISO 11925-2: 2002), predicts the performance of building materials in a real fire more accurately than the old BS 476 standards.

Under EN standards, a materials classification is defined by BS EN 13501-7: 2002 to give a Euroclass rating. The ratings range from A1 (non-combustible) through to F. The table below compares the EN classifications with the previously used national standards.

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Plasterboard is subject to ‘classification without further test’. This assessment means that any type of plasterboard can be classified as A2 so long as the grammage of the paper liner does not exceed 220g/m². All Gypsum Industries Gyproc plasterboard products manufactured in accordance with BS IS EN S20 are designated Euroclass A2.

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<thead>
<tr>
<th>National classification</th>
<th>Euroclass category</th>
<th>Safety level</th>
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<tbody>
<tr>
<td>Non-combustible</td>
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</tr>
<tr>
<td>Material of limited combustibility</td>
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