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Epoxy Intumescent - The Future Of Fire Safety In Steel Buildings

Steel is fast becoming the material of choice for buildings as diverse as high-rise super towers to medium- and low-rise office buildings, shopping centres and residential units. The popularity of steel is based on a number of factors including its fast and accurate build capabilities, superior strength to weight ratio and its curving and bending characteristics, which allow designers to achieve truly outstanding designs too costly or difficult to build with other materials. However, like all building materials, steel is at risk from fire and it is vital to ensure that all steelwork and in particular the supporting steel columns have the correct level of fire protection. Tony Tiernan, Managing Director, of Interact Fire Solutions discusses a new method of passive fire protection available for steel columns.

Approved Document B of the UK Building Regulations 2000 (Fire Safety) is the key document for fire protection requirements throughout the UK. Scotland and Ireland have slightly different standards but are based on the same principles in respect of the structure. However, the main consideration for all fire regulations is for the safety of a building's inhabitants and the fire crew sent to tackle any blaze. In broad terms the taller the building the greater the degree of fire protection required. This is obviously to allow more time for people to exit the building and to bring the fire under control.

For steel frame buildings it is vital to prevent the metal structure from weakening under intense heat. The standard for fire protection under BS476 part 20 and 21 is to protect the structure – for a specified amount of time – from reaching the critical failure temperature of 550oC. This is the temperature at which general construction steel will start to lose its structural strength – possibly causing the building to collapse.

Table B3 of the Approved Document gives different options for the recommended fire protection system for different types of buildings. However, these are only recommendations and highly sophisticated computer generated simulations can be used to reduce the period of fire protection significantly. This reduction is allowed because of a clause inserted in the Approved Document B3 Guidance which allows a fire engineer to assess the likely damage that a particular fire temperature curve would provide over time.

There are two types of "fire curve" that a fire engineer can base assumptions on with regard to fire performance for a building. A Cellulosic Fire Curve is the measure of temperature and uses cellulosic (wood-based) materials to achieve the data. In this type of fire the curve levels off at 1,110oC and the building must maintain stability at this temperature for a set period of time. The Hydrocarbon Fire Curve was developed more recently. In a hydrocarbon fire the curve increases more quickly and temperatures will reach a maximum of 1,300oC. This curve was originally used in the petrochemical industry to set standards of fire protection to chemical plants and

offshore oil platforms. However, many materials such as floor coverings and furniture used within today's buildings contain a substantial amount of hydrocarbon materials. Recent live testing of a furnished office showed that the fire produced a temperature curve similar to a hydrocarbon curve in the initial stages, reaching temperatures of 1,300oC before dropping down to follow the cellulosic curve more closely. In this type of fire the initial intense heat may damage or weaken the structure of some fire protection products at an early stage, making it unable to withstand the temperature of a celluosic fire.

Whilst there are a number of options for passive fire protection materials to insulate steel structures from the effects of high temperatures during the past 10 years thin-film intumescent coatings have come to dominate the passive fire protection market in the UK. These have largely taken over from the traditional methods such as concrete filling – a complicated procedure involving the input of structural engineers and on-site pouring that raised problems in terms of site access and workmanship – and boards and cement based sprays.

Intumescent coatings are paint like and inert at low temperatures but swell up to produce an insulating charred layer (known as a char) some 50-75 times thicker than the original coating at temperatures between 200-250oC. This type of system will typically offer fire protection for up to 90 minutes and in special circumstances 2 hours. The coating can be applied direct to the steel and over painted with a proprietary paint, leaving the shape of the underlying steel visible, or as is more common, over-clad with a conventional board system.

Cladding is usually the designer's preferred option to provide a clean, boxed appearance which can be pre-finished or decorated to complement the surrounding décor. However, where over-cladding is used, workmanship is vital to the success of the protection offered - too often insufficient space is allowed between the surface of the intumescent and the inside of the secondary cladding.

This is important as failure to leave the correct thickness between coating and cladding can leave a building vulnerable to for a number of reasons. The thickness of the activated intumescent material is crucial to its protection capabilities in the event of a fire and therefore a cladding system fixed too close to the coated steel will inhibit the swelling process and reduce its protective properties. Likewise, when the cladding system is designed to fall away in the event of fire, if this does not happen before the commencement of the intumescent swelling process, performance may again be reduced. Finally, where the cladding requires fixings to be fastened to the steel these fixings may again limit the expansion process and render the protection inadequate.

Whilst the correct application is vital to a thin-film intumescent coating's success on-going maintenance is also vital if its integrity is to be maintained over the life of the building. Failure to keep the top seal in good order will mean the intumenscent beneath the decorative coating may break down over time, leaving the system severely compromised. Often the occupier is unaware that the intumescent needs to be reinstated properly. Failure to maintain the coating properly can mean that the steel is not properly protected and

insurance cover could be jeopardized in the event of a fire.

With thin coating intumescents presenting these problems one of the newest and best ways of offering protection for structural steelwork is with an epoxy intumescent, a material originally developed for the protection of oil rigs. In this environment, the material proved capable of withstanding chemical attacks, abrasion, corrosion and major impact as well as fire.

The benefits of epoxy intumescents from both the designer's and fire officer's view point are numerous. For the designer the material is factory made and can be cast or moulded into any particular shape – making it ideal for high profile installations where the supporting steel columns and structural steelwork form part of the architecture and where the end finish is vital to the overall aesthetic of the building. The mouldings are pre-fabricated to exacting conditions ensuring that the level of protection is not reliant on site-based practices. Additionally, the material's inherent robustness allows it to be installed at any point in the construction process – from initial development to just prior to commissioning. Finally because the installation is overseen by approved subcontractors finishing is to the highest standard.

For the fire officer, an expoxy intumescent offers fire protection for up to 3 hours and the material does not depend on the top decorative coating to work effectively. This reduces the risks that can occur as a result of any damage, and, vitally for the safety of the building and its inhabitants, ensures that the level of fire protection is not diminished over time.

With existing fire protection methods presenting problems in terms of workmanship and degradation as the building ages, epoxy intumescent offers superior levels of protection without compromising the architectural finish. As a result epoxy intumescent should be the first choice for fire protection in steel buildings. With other methods the variables to ensure a successful installation are too many and the risks too great.