PR9-230306

General Comparison Of Competing Fire Protection Systems

1) Concrete filled circular columns to assist fire protection

Concrete filling can be used for fire protection but it is not just a case of filling the steel tube with concrete. Structural engineers need to be involved to determine the stress and load on the beam. It is always necessary to add reinforcing bars within the tube and a calculation is required to determine if the bars need to be stressed or if they can just be placed in the tube

The concrete must be vibrated to release the air to achieve the correct density. This limits the size at which concrete filling can be used as the vibration unit needs to be placed all the way down the centre of the column. Corus have produced a software package for this application.

The minimum diameter of circular hollow section is 170mm (Corus)

The purpose of the concrete is to replace the steel section when it has lost its structural strength through heat. Corus advise that serious consideration be made to any construction less than 219.

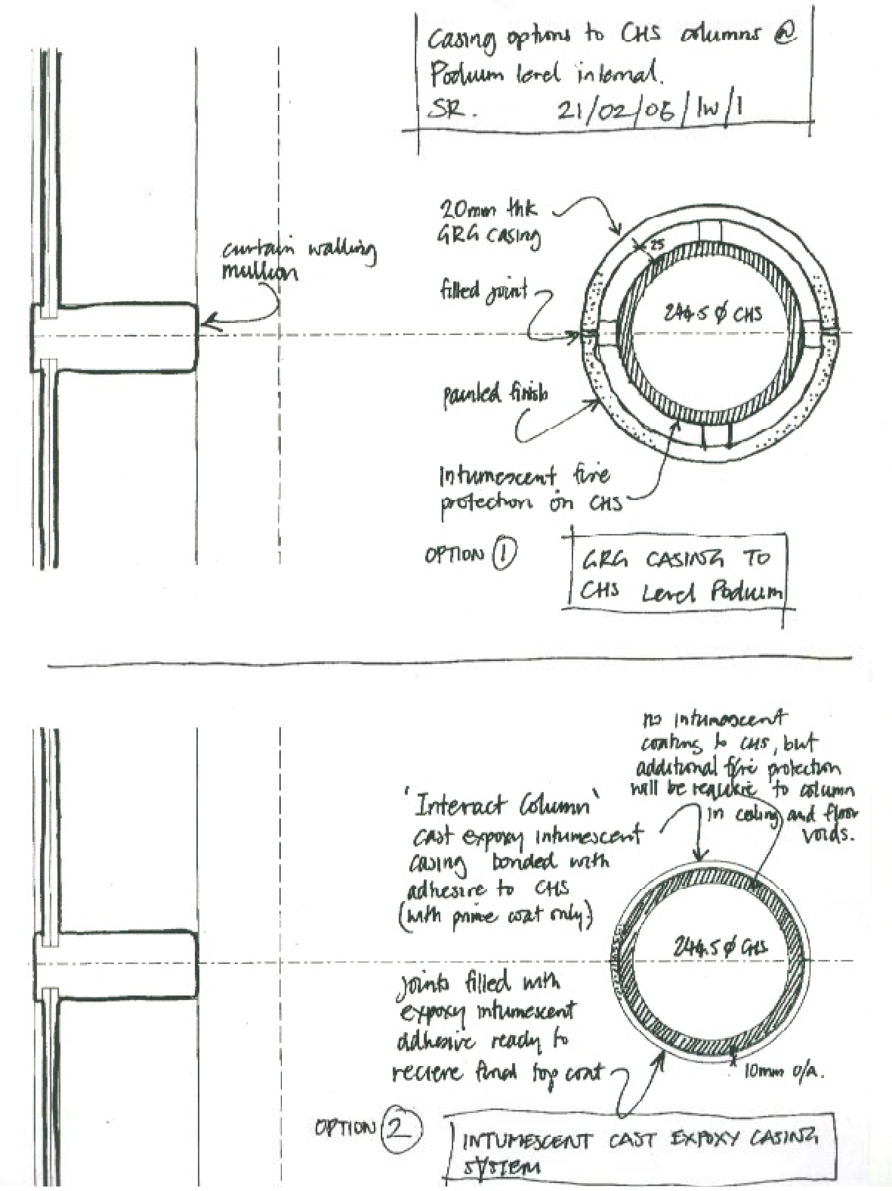
A 12mm hole, drilled through the steel into the hollow section is required at the base and just underneath the start of the floor above or at 4m intervals whichever is the least distance. The bottom hole is to allow the drainage of excess water. The upper hole is to allow steam to escape during the heating process in a fire creating steam which is quite capable of rupturing the steel section prematurely.

2) Slurry filled circular columns to assist fire protection

There is no test data to support slurry filling. This method is only assumed to work. Questions must be asked as to how the column will survive bearing in mind that concrete filling is compacted to achieve a specific density. Another question should be asked is the validity of a system that has not been tested. All fire protection systems should be tested to BS476 part 20&21 and data for load testing is given in BS490. Either way slurry filling does not negate the need for reinforcing bars in the system.

3) Secondary cladding

A recent design was presented for cost analysis (see below). It shows two competitive methods of fire protection.



The bottom design is a complete fire protected system which incorporates epoxy intumescent in its cast form, bonded to the structural hollow section providing two hours fire protection. The system is fully fire tested.

The top section is made up of a number of components, one of which has been fire tested. The problem is that the system has not been fire tested. Consider the following:

Thin film intumescent coating to the steel; the thickness to achieve two hours fire protection to this section is 3.24mm Dry Film thickness(DFT) (Leigh's FX8000). The expansion of intumescent is nominally 50xDFT. Therefore the material is expected to expand 3.24x50=162mm. The actual expansion rate of intumescent is not published by the manufacturers. If the correct data is not provided to the manufacturer it is likely that they will quote a 25mm space is required between the surface of the intumescent and the inside of the secondary cladding. The manufacturer may not be aware of the exact requirements of the fire protection or the configuration. In order for the intumescent to work it must be able to expand without resistance. Clearly the secondary cladding is going to obstruct the expansion as will the battens which are fastened directly to the steel. Once the intumescent has reached its expansion temperature it will react. However if the material is obstructed it will not expand to its design thickness and therefore will not offer the insulation required to protect the steel. Once the timber and secondary cladding has fallen away the material will not expand as the thermally reactive chemistry will by then have been exhausted leaving the coating ineffective. "We have been using this design for years. Are telling me that it is not an acceptable method of fire protection?" (Quote from a renowned architect). Answer; YES. Unless the secondary cladding which is GRG has been tested by a manufacturer the casing is not fit for purpose i.e fire protection. The system underneath is already proven to be suspect. Now while the system as a whole may work for a short period of time, it is unlikely that it will work for two hours. There is no evidence of a fire test and no assessment.

Domestic environments are unlike commercial buildings. Once constructed the maintenance and repair is left largely to the occupant. Unlike commercial buildings where professional maintenance crews are expected to be aware of the requirements for maintaining fire protection, it would be asking a bit much for domestic occupants to have the same knowledge and skill.

Example one

On a prestigious apartment complex in Aberdeen epoxy intumescent was rejected on the grounds of cost. The construction incorporated a feature column in the living room, a feature becoming more and more common as large open space areas are popular aesthetically. The developer and the main contractor rejected the architect's recommendation to use epoxy in place of a board system.

It is inevitable that, at some stage, the board fire protection will be damaged. This could be by hanging a picture frame, having a domestic row or when moving. The board is quite robust but having been damaged the integrity of the fire protection is lost. What does a domestic occupant know about repairing the system ? Do the occupants know that once damaged the whole of the board needs to be replaced ? Failure to repair the system will leave the column open to premature failure in the event of a fire. And what of the insurance liability of the building ?

Example two

Visiting an architect to provide a RIBA Continuing Professional Development (CPD) seminar, the client was impressed with cast epoxy intumescent. The architect has an inclination to include a CHS in the kitchen, again because clients like big open spaces in this area. The usual method of fire protection is to use thin film intumescent on the column to provide the required protection.

Once handed over to the occupant the maintenance and repair is their responsibility. But what do the occupants know about thin film intumescent ? Do the occupants know that the system is dependant on maintaining the top seal (decorative coating) in good order ? Failure to do so will open the system to gradual breakdown of the intumescent below. Do they know that the warranty of the system is dependant on regular (every 3-5 year) maintenance checks and possible recoating ? Do they know that if substantial areas of intumescent are missing the system is not only invalid but is liable to result in premature failure of the system in the event of a fire ? What of the insurance cover on the building?

None of these concerns apply to epoxy intumescent, as the material is durable enough to withstand the rigours of the domestic environment. Any surface damage would be purely cosmetic and not part of the fire protection.

The architect was delighted with the system and intends to make use of epoxy castings on all future schemes where the structural column is vulnerable.

Example Three

Visiting a well known yoghurt manufacturer it was found that the company had a budget of £10k per year to repair the thin film intumescent to the supporting beams and columns. Even this repair was superficial and made no allowance for the replacement of the intumescent which had degraded due to the environmental conditions in the manufacturing of the food. Repair is carried out every 3-4 months. Aware of the failure of the system the client looked on the web for a solution. Epoxy intumescent has been selected as the preferred and in truth the only realistic solution to this problem which will not go away unless it is properly addressed. The cost of retrofitting epoxy fire protection is high. However this cost should be put against the cost to lost production and continual repair. Once installed epoxy intumescent will last the life of the building with only minor repair and aesthetic maintenance. Epoxy intumescent is not reliant on the top coat for fire protection integrity. Thin film and especially water based thin film is not suitable for Class C4 buildings with varying temperatures ranging from normal to 35 degrees C and humidity level in excess of 85%. In this case with steam evacuation close by. An industrial spray application, back rolled to make smooth would sustain the requirements of the building in conjunction with a polysiloxane topcoat for a very durable and cleanable surface which is easy to maintain.

4) External fire protection

The same applies to external fire protection to buildings, leisure areas and hospital requiring the most robust cleaning regime. Once the top seal has been broken the thin film fire protection underneath will breakdown quite rapidly leaving the building open to premature failure in a fire.

5) Epoxy Intumescent

Epoxy intumescent is not dependant on the top coat to maintain the integrity of the system. It can be cast for high decoration back rolled for less aesthetically demanding areas and sprayed for industrial use.
It is robust impact resistant and provides fire protection for up to 3 hours and more, dependant on the thickness.

There are many applications where the material exceeds the expectations of other systems. Just look at the website!!!

Yes, the material is expensive. So is glass. Would you replace this with Perspex ? Why not ? It is cheaper, you can see through it, it stops drafts, you can double glaze it. What? Not fit for purpose ? Exactly. Thin film has its use in construction as do most of the building products on the market but it is not the panacea that is expected of it !

My research while carrying out CPD under the RIBA CPD Nework has revealed that 99% of architects know nothing of this superb epoxy intumescent material. That is until four years ago. At only 35 seminars a year it is going to take a long time to get the message across to more than 4000 architects..!