PFP Condition Survey and Fire Engineering Assessment

Key words: *unknown fire protection material, cementitious, fire resistance, fire engineering, regulatory approvals*

PFP Specialists (PFPS) were contacted by a leading consultancy company in the building and infrastructure market in connection with a London building which was being refurbished with a change of use plan which required that the existing fire protection be assessed in its ability to provide the required level of fire resistance protection.

The building had previous structural alterations dating back to the 1980s and at that time steelwork had been installed and apparently fire protected. The key questions were "*What product was used and what level of fire protection was afforded by what appeared to be a cement-based fire protection material?*". There were no specific records available from the time of the structural alterations and initial investigations by individuals involved in fire protection could not identify the product installed.

PFPS were contacted to ask what could be done to assist in a situation where the lack of information was potentially leading to a situation where £multi-million costs were likely to be incurred to gain access to the steelwork to strip and replace the existing product with a material of known fire protection capability. There was also the prospect of serious delays in the project due to the time that would be required to conduct this work. The outlook was not good.

It became clear that the results of any investigation would need to be scrutinised by several stakeholders responsible for acceptance of the fire protection in meeting a 60-minute fire resistance requirement for the building's new purpose.

With this background, a PFP Specialists Associate with over thirty years of experience in building fire protection, made an initial visit to site in the hope that a visual inspection would begin to help in identification of the material installed on the steelwork, the objective was to identify a proprietary product for which it was hoped the published fire protection performance data would be available.

The initial visit failed to identify the product type visually, so samples were removed for further investigation, see Figure 1. Laboratory investigation revealed the material type and general constituents along with a density of product far greater than typical proprietary fire protection materials that would be used in buildings. This factor threw more confusion into an already difficult situation.

It was determined that a more detailed analysis of material samples was required using Fourier Transform Infrared (FTIR) Spectroscopy to obtain a chemical and physical profile of the product. During a second site visit to remove further samples for analysis, the general condition of the installed material was reviewed thoroughly along with thickness of product installed so that a picture of capability could be built up if product identity and performance was established.

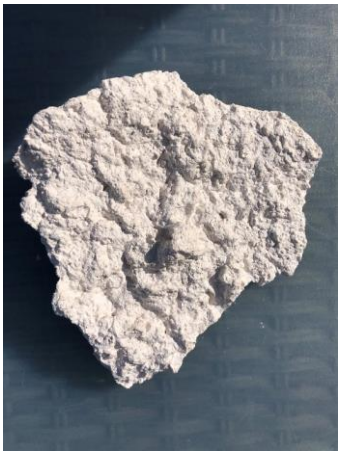

Figure 1: Sample of the cementitious material, showing a rough texture and an off-white colour

At the same time, industry investigation work was conducted with a good number of experienced individuals in the passive fire protection industry to see if there was any record or recollection of the work carried out in the 1980s on this building. Unfortunately, this investigation produced no result.

By now the new tenant for the building and the consulting company PFPS were engaged by were becoming increasingly concerned with the prospect of a £multi-million expenditure for removal and reinstatement becoming ever more real, it became a really challenging environment for all concerned.

Results of the FTIR analysis on the chemical composition of the material put it even further away from being a known proprietary fire protection product and more into the probability of being an infrequently used product qualified at the time of the refurbishment work as being acceptable.

With time running out and the apparent options for finding a solution to the problem reducing PFPS proposed a 'last shot' at demonstrating the fire performance capability of the installed material which involved conducting thermal property testing of material samples and 'mapping' the results into an analysis of the response of the structure to fire.

This required determination of the material's density, thermal conductivity, and specific heat properties, which included the effect of moisture content. Several representative structural members were selected from the project. For each member, its in-situ measured protection thickness was used together with the thermal material properties to undertake a heat transfer assessment to ascertain the temperature of the protected steelwork following exposure to the standard cellulosic fire. The resulting steel temperatures after 60 minutes were all shown to be lower than the structural member's default critical temperature.

The fire engineering heat transfer study and associated independent report was undertaken by PFPS' in-house Chartered Engineer. The outcome showed that the unknown fire protection material exhibited performance of a fire-resisting material which could be quantified against specific structural performance criteria to provide at least 60-minutes fire resistance as required by the project, see Figure 2.

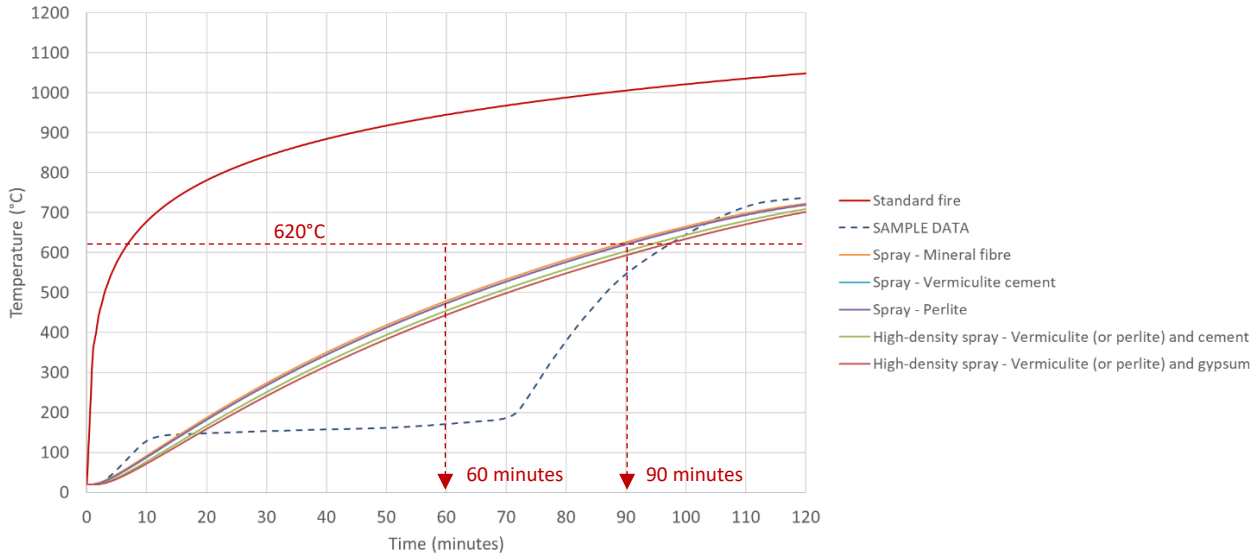

Figure 2: Temperature history of a representative protected floor beam (the plateau represents the latent heat of vaporization of moisture). Temperature histories of the same beam with generic industry properties for cementitious-type coatings are also shown for indicative comparison.

The same study also considered the adhesion and bond of the product to the underlying steel which was found to be sound.

The project team's stakeholders, which included fire engineering consultants, agreed with the approach adopted and the conclusions of PFPS's work. The Approving Authority also accepted the content of the report as independent verification of the fire resistance afford to the structure.

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Dr. Allan Jowsey
PhD MEng CEng FIFireE PMSFPE MASCE
Director

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John Dunk
Director

Chartered Engineer