This case study was written at the time when OneSteel was part of BHP. In that context, in some instances within this case study, reference may be made to BHP.

Fire engineering

By employing specialised fire engineering techniques on a Sydney CBD high-rise office refurbishment, the design team on 151 Clarence Street were able to save their Client, AMP, more than $1.6 million, making the refurbishment economically feasible. The refurbished building did not require passive fire protection material to be re-applied to the steel floor beams, which also shortened the time required for the refurbishment.

Built in three stages during the 1960's and 1970's, 151 Clarence Street is a 12 level office building which was the NRMA's head office until early 1999. When the NRMA relocated, the building owner, AMP, decided to undertake a major refurbishment of the building's interior to take the building into the next century.

With part of the building constructed in structural steel, the floor beams had been protected by an asbestos based passive fire protection material to achieve the required fire rating of the day. The steel columns were encased in concrete to both increase the load bearing capacity of the columns and also provide them with a fire rating. The original building also had no active sprinkler system or smoke control system installed.

Refurbishment of 151 Clarence Street involved the complete removal and replacement of all internal partitions, ceilings and floor coverings. From a fire safety viewpoint, such a refurbishment also meant that a major upgrade of the fire and smoke safety systems was required. AMP set a refurbishment life on 151 Clarence Street of ten years, which meant that all costs involved with the refurbishment had to allow a suitable return over a rental period of ten years.

Fire Safety Considerations

Resolve Engineering, as the Client's representative, prepared a list of measures required to ensure the refurbished building complied with the Building Code of Australia (BCA). These included a sprinkler system, smoke handling, the replacement of passive fire protection materials to the floor beams and stair pressurisation. Consultant Fire Engineers, Holmes Fire & Safety discussed the option of meeting the fire safety requirements of the BCA without the need for passive fire protection on the steel floor beams with BHP Steel.

Their approach considered two options for upgrading the fire safety systems on 151 Clarence Street. The first option followed the BCA deemed-to-satisfy provisions, while the second involved a fire engineering design that could offer the building a level of fire safety that met the performance requirements of the BCA, but without passive fire protection on the steel beams.

1. BCA Deemed-To-Satisfy Provisions

It was determined that a full upgrade of 151 Clarence Street to meet the current BCA deemed-to-satisfy provisions would require:

- Installation of a Sprinkler system
- Application of 120 minute passive fire protection to floor beams
- Installation of a zoned smoke control system
- A smoke detection system linked to above
- Upgrade of the existing Emergency Warning Information System
- Remodelling and pressurisation of the fire stairs

Costs prepared by Resolve Engineering

aids AMP's refurbishment

AMP's refurbished offices in Clarence Street, Sydney.

estimated that the sprinkler system alone would cost $600,000, the passive fire protection $800,000 and the smoke handling system in the order of $700,000. With a total refurbishment budget in the vicinity of $13 million, it was found that an upgrade that met all BCA deemed-to-satisfy requirements would make the refurbishment unfeasible over the proposed ten year return life.

2. Fire Engineering Approach

Holmes Fire & Safety drew on previous project experience to investigate whether installing a sprinkler system would allow the client to avoid reapplying the passive fire protection to the steel floor beams, saving an estimated $800,000. This determination involved examining the effect of both a design fire and a fully developed fire on the structure.

The design fire was an office fire controlled by a sprinkler system, as this is the most likely design scenario for an outbreak of fire in the building. Results from the fire modelling for this building showed that maximum temperatures reached for the design fire would be less than 150°C. This is much lower than the lowest limiting temperature for any of the steel floor beams (640°C), so clearly the structure would meet the performance requirements of the BCA for the design fire scenario, without re-instatement of any passive fire protection.

The likelihood of a fire starting in the building and not being controlled by the automatic sprinkler system is very low. To enhance the reliability of the sprinkler system to an even greater level than usual, the fire safety design required that a sprinkler isolation valve be provided at each floor. In this way, if the system needs to be temporarily isolated for whatever reason it can be done on a single floor, leaving the remainder of the floors with full sprinkler protection.

Even though the chance of a fully developed fire occurring without the active sprinkler system being available was very small, it was still necessary to determine that if it should happen, the entire building would not undergo total catastrophic collapse. In other words, it was necessary to demonstrate that the stability of the overall structure was maintained, even for the extreme event of a fully developed fire occurring in this sprinkler protected building.

Steel primary beams, stripped of their old asbestos coating, with typical ductwork penetrations.

As the steel columns are encased in concrete, they are effectively insulated from the effects of fire and able to resist vertical loads during a fully developed fire on a single floor. Any deformation of the unprotected steel floor beams during a fully developed fire were demonstrated to able to be resisted by the columns and/or resisted by surrounding structure unaffected by the fire.

Thus the structure was shown to be able to resist the effect of both a design sprinklered fire and a fully developed unsprinklered fire, even if the steel floor beams had no passive fire protection material reapplied during the refurbishment.

By analysing the egress paths and determining the escape times for the occupants in a variety of situations, it was also possible to prove that there was no requirement for a zoned smoke control system, which would have cost $700,000.

Holmes Fire & Safety also proved that, due to the influence of the sprinkler system, smoke detectors were only required in the return air ducts and outside the fire stairs, which saved around $130,000 on the total cost of the smoke detection system.

Fire Engineering Provides Significant Savings

Overall, the fire engineering approach offered a system that saved in the order of $1.6 million, with the installation of a sprinkler system, no passive fire protection on the steel floor beams, no zoned smoke control system and a reduced smoke detection system.

AMP and the design team agreed to adopt the engineered fire safety system described in the Fire Engineering Design Report prepared by Holmes Fire & Safety. This proposal was presented to Sydney City Council and the NSW Fire Brigade who after discussions with both Holmes Fire & Safety and BHP Steel, approved the fire safety design.

FIRE SAFE

Project Participants

Owner / Client:	AMP
Architect:	Cox Richardson
Project Manager:	Incoll Management
Structural Engineer:	Connell Wagner
Fire Engineer:	Holmes Fire & Safety Group
Services Engineer:	Norman Disney Young
Asbestos Removal:	Douglas Partners