InfraBuild

MLC Building Perth

July 1999

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

Sophisticated Steel Transformation

Kingsgate Apartments.

Another unprotected steel-frame building accepted by Regulators, through a Fire Engineering approach.

The twelve storey, forty year old MLC building at the King Street end of St George's Terrace, Perth, was stripped to its steel frame and floor deck before being extended and transformed into sophisticated luxury apartments.

Renamed Kingsgate Apartments, the floor plan of the original building was extended at the front and back, for its entire height. The refurbished building envelope is 20 metres wide by 32 metres long, and houses 38 luxury apartments, 2 self-contained office suites and basement carparking. There are typically four spacious apartments per floor on levels 2–9 and 2 penthouses on level 10, with their own open roof-deck levels, above.

Design

The lateral stability of the original building was provided in both directions by a structural steel system and the floor comprised beams supporting inverted metal floor pans (1.6 mm thick, 100 mm deep ribs and 250 mm wide panels) which in turn supported a 65 mm thick topping slab.

To support the additional floor area of approximately 2,000 square metres, the existing steel columns adjoining the new floor areas had to be strengthened, with the steel beams remaining unmodified. The columns were upgraded to cater for the additional loads by simply thickening the flanges with flat bar steel sections ranging in thicknesses from 20 mm to 10 mm. The flats were stitch welded on site with 6 mm fillet welds.

The new floor system incorporated beams designed in accordance with AS2327.1 Composite Structures Code. Generally 1.00 mm BMT Bondek II™ was used with an overall slab thickness of 115 mm. Typically secondary beams were OneSteel 300PLUS 310UB40 spanning 6.1 metres and primary beams were 410UB60 spanning 7.7 metres. Lateral stability of the extended building was principally achieved with moment end plate connections between primary beams and columns. To enhance this lateral stability, some additional 'K' bracing

Structural steel frame under construction.

with 125x6 SHS members was added at the bottom two levels, at locations where they did not interfere with the carparking layout.

The additional columns were designed in accordance with AS4100 Steel Structures code and comprised spliced sections at every third level starting from the ground upwards utilising OneSteel 300PLUS, 310UC137, 310UC97, 250UC73 and 200UC60 at the top level. Engineer Paul Santillo of Terpkos & Santillo found the three-storey-high columns provided efficiencies by minimising fabrication and saving erection time on site.

New balconies were constructed on the existing north and south facades by 'threading' prefabricated steel beams and Bondek balcony units through existing penetrations in the edge beams. The floor-to-floor height for all levels is generally 3.5 metres, matching that required for the previous use of the building. The more-than-required floor-to-floor height enabled a built-up floor to be constructed in the wet areas, thus creating a space to run new services to designated ducts. This will avoid having to possibly access services for one apartment from the apartment below it.

The steelwork on the roof-deck level is very expressive. Wing-like members comprising 10 mm thick plate have been profile cut to form curved sections. These in turn support Lysaght Z200 purlins and Lysaght Custom Orb roof deck in a Colorbond finish, to provide a protective canopy.

Fire Safety

Fire protection to steel floor members was originally virtually non-existent as the intended fire protection element, a thick gyprock ceiling, had many penetrations which were used for air distribution. With the upgrade, the client was faced with a decision of whether it would be necessary to apply fire protection material to the steelwork or have unprotected steel members. OneSteel was approached by project architect Peter Hodge of Hodge & Collard Pty Ltd who requested advice on how to achieve the necessary fire safety requirements of the Building Code of Australia (BCA) without having to apply passive fire protection to steel beams.

Two options were examined.

1. **BCA deemed-to-satisfy requirements:**

Upgrading the building to current BCA deemed-to-satisfy requirements would require protection of the steel floor beams to ensure a fire resistance level of 90 minutes could be achieved.

In addition the building would be required to be sprinklered. Such a building would represent a situation which satisfied the minimum requirements of the BCA.

2. **Rational Fire Engineering:**

It was found that provided the refurbished building incorporated a sprinkler system with an improved level of reliability, the building with unprotected steel beams would offer a higher level of fire safety than a building which met the minimum deemed-to-satisfy requirements of the BCA. The improved, refurbished building would require monitored subsidiary sprinkler valves for each floor. The reason being, should the sprinklers on one floor need to be isolated, the remainder of the building could still be sprinkler-protected. It should be noted that isolation of sprinklers to allow tenancy upgrades is the factor which has the greatest impact on reducing sprinkler reliability. In the case of residential buildings, because major tenancy modifications are generally rare, the sprinkler system can be assumed to be almost 100% reliable provided subsidiary sprinkler valves have been incorporated for each floor, and an associated management protocol for sprinkler isolation exists. These controlled conditions also ensure that the likelihood of fire spread between levels during a major fire on one level, is very much lessened by adopting a Fire Engineering approach, than if minimum BCA requirements were adopted.

Typical floor plan

Preferred option:

The approach adopted for fire safety for the Kingsgate Apartments was similar to that described in the Rational Fire Engineering option, and incorporated the installation of an improved sprinkler system coupled with improved management protocol. The steel beams therefore remained unprotected.

Wing-like roof canopy.

The architect submitted OneSteel's recommendations to Perth City Council (PCC) for permission to use unprotected steel beams, adopting the Fire Engineering approach. PCC accepted that all recommendations contained in OneSteel's report met the fire safety objectives of the BCA.

It should also be noted that at each level from the ground floor upwards, the steel columns were protected with thermolite blocks up to the underside of the beams, since a 12 mm standard plasterboard ceiling, screw fixed to steel runners, provided some additional insulation. However, in the basement carpark level steel beams and columns were exposed, as a sprinkler system was used to make the facility equivalent to an open-deck carpark.

Construction

All steelwork was erected with mobile cranes. A 50 tonne P&H mobile crane was used for erection of the lower half of the structure. An 80 tonne Demag mobile crane was used for the upper levels and this was further extended with a fly jib to an overall boom length of 68 metres, enabling it to reach the winged roof structure at the top of the building.

Surface Treatment

All internal structural steel members were shop wire brushed to Class 1 and coated with a 50 µm ROZP. The external roof wing members were given an abrasive blast cleaning to Class $2^{1}/_{2}$ finish followed by a 0.75 µm inorganic zinc silicate and a 2-pack epoxy acrylic coating. The galvanized purlins were etch primed and top coated with a 2-pack epoxy acrylic.

Conclusion

It was concluded that the use of unprotected steel beams for Kingsgate Apartments, in association with an improved sprinkler system and related management protocol, would give a level of safety well in excess of the existing building and greater than that achieved if the building had been refurbished in accordance with the minimum requirements of the BCA. This conclusion was accepted by the relevant authorities (Perth City Council and West Australian Fire Brigades) and the building was refurbished accordingly. This approach offered significant cost savings by eliminating fire spray protection to steel beams.

Client:	Florin Pty Ltd
Project Architect:	Hodge & Collard Pty Ltd
Design Architect:	Archetype Design Studio
Structural Engineer:	Terpkos & Santillo Pty Ltd
Mechanical Engineer:	Steens Gray & Kelly Pty Ltd
Builder:	Primo Constructrion
Fabricator:	Allcon Steel Construction
Steel Erector:	Perth Rigging Company
Steel Distributor:	Steelmark Eagle & Globe