ACSE AWARDS 2019
Large buildings category

NORTHROP

Omnia, Potts Point

INTRODUCTION

Omnia Potts Point is a high-end iconic residential development located in the heart of Kings Cross. The project comprises an adaptive re-use of the existing building which was formerly known as the 'Crest Hotel'. Northrop have been engaged by the developer Greenland (Australia) Investments Pty Ltd as the project structural engineer and worked closely with the builder Probuild and the project architects Durbach Block Jaggers and SJB architects on this project.

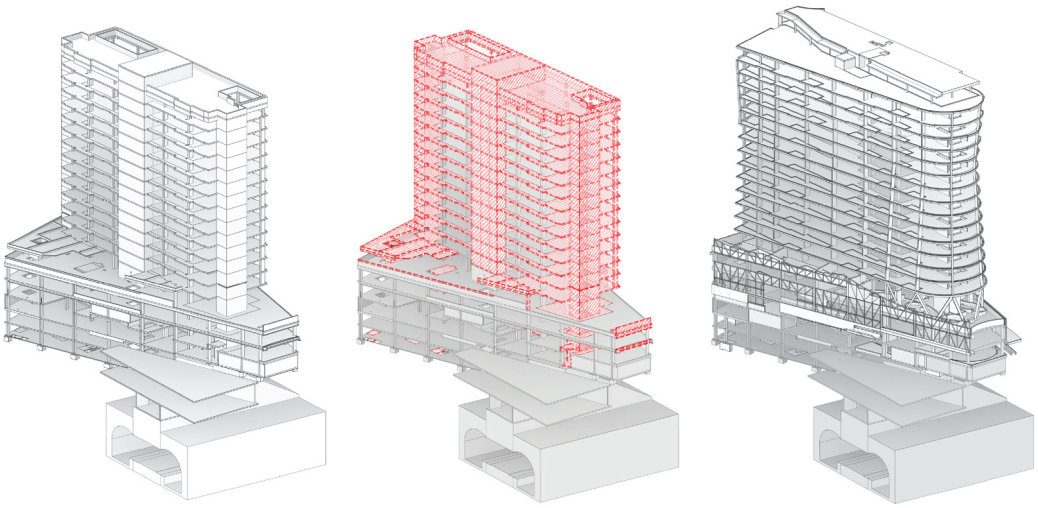
The existing building was designed in the late 1960's to the design standards of the time. The significant additions and modifications to the building required the building to be upgraded to comply with the current design standards.

Project Brief

Northrop worked within tight timeframes and site constraints to deliver a world class residential tower.

The new mixed-use development includes 135 residential units over 20 storeys with communal landscaped amenities on level 2, retail and commercial uses on ground floor and level 1, and three levels of basement parking, which is maintained from the original building.

The southern portion of the site is located over the Eastern Suburbs rail tunnels and King's Cross station.



Northrop's structural Revit model, showing the existing, demolition and new phases

DESIGN & CONSTRUCTION PROCESS

Design

This modern luxury apartment building was designed by the architects Durbach Block Jaggers to appear like an hourglass on the crown of the king residing in King's Cross. It was converted from the old Crest Hotel's structure whilst retaining 90 per cent of the existing structure. The limited floor to floor height, the complex architectural design and constructing over the Kings Cross railway station posed significant engineering challenges.

The proposed redevelopment involved stripping out all non-structural elements, partially demolishing the existing structure including the two existing stair cores and preparation to the existing slab edge to lap into the proposed floor slab. The key aspects of the development affecting the structure include:

- Extension of the tower at the Southern end of the building over the rail easement, requiring new footings;
- Alterations / reorientation of the building stair cores, including the core at the southern end of the site over the rail easement;
- A new building façade with extensions to the floor areas at each level;
- Two additional levels to the tower;
- New stair penetrations are required to the existing and new floor slabs in some double storey apartments.

Construction

Construction started in early 2016 with the complex and detailed demolition of large sections of the level 16 to 18 slabs as well as the demolition of the northern and southern concrete slabs by Dedico. The demolition was complex with the future slab design depending on the connection to the existing. In late 2016, Probuild were engaged to complete the construction of Omnia. With limited site perimeter access and working with a complex existing site, there were a number of challenging construction aspects that needed to be overcome – these are described in the sections below. Construction was completed in late 2018, and the apartments are now being occupied.

The new stair core coming up through the existing floors

Installed temporary steel bracing

Creativity & Innovation

The existing stair cores at each end of the building which formed the main structural elements that supported the building laterally were demolished for the full height of the structure to optimise the apartment layouts.

A detailed lateral analysis was required to determine the design of a temporary steel bracing which could be removed as the new stair cores and shear walls worked their way up the building. Detailing was key to allowing a quick transition from steel bracing to concrete shear wall as the steel needed to be removed to install the wall reinforcement.

Sustainability

This project was an adaptive re-use build, and the main intent of the project team from the very beginning was to minimise the extent of demolition to the existing structure and to minimise waste.

This allowed for a substantial amount of concrete to be saved from landfill and for even more saved from being batched. Retaining the existing structure related to challenges such as:

- Creating moment connections at existing slab edges for continuity between the new and old and to achieve minimised structural depths within the very tight floor to floor heights
- Upgrade the existing building to comply with current Australian standards to ensure that the existing concrete structure could be saved from demolition:
- An extensive amount of concrete testing was undertaken to determine increases to the existing compressive strength from the design documentation. This reduced the amount of strengthening required to existing columns to support the additional two levels above

BUILT ENVIRONMENT AND HERITAGE

The building has been built at a time when Sydney's notorious King's Cross was going through a transition stage. This building is going to be first of many high-end residential towers built along Darlinghurst Road. Omnia will change the local demographic whilst preserving the existing building structure that was built in circa 1960's of the old Crest Hotel.

The podium façade tiles were selected to match the Woolworths building, now known as Kings Cross Library which was opened in 1939. These tiles were selected as they maintained the original heritage appeal and feel of the building while honouring the existing heritage buildings in the area.

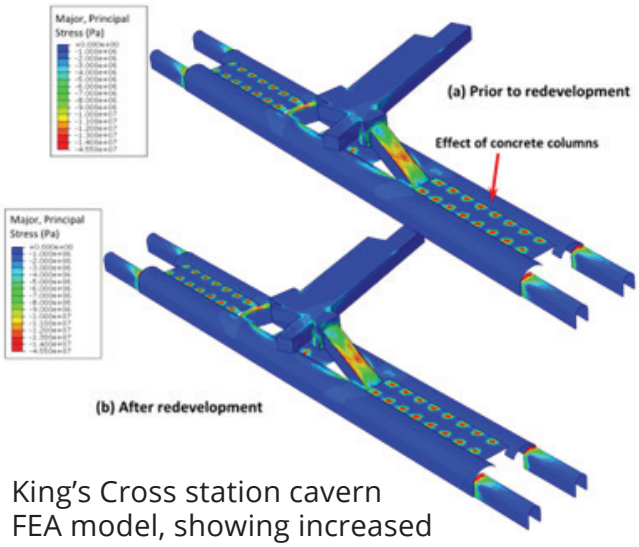
The original concept sketch from DBJ

Existing slab edges, prepared for a full moment connection with the existing reinforcement

THE CHALLENGES & RESOLUTIONS

Building over rail tunnels

The south portion of the building was built directly over existing railway tunnels. Some existing footings were constructed within the RailCorp protection zone. New building loads need to be bridged over the tunnel and distributed to both sides of the tunnel. The tunnel structure was modelled and analysed by Coffey Geotechnics, and Northrop provided input into the capacity of the existing tunnel structure to withstand this additional loading without cracking.



King's Cross station cavern FEA model, showing increased stresses due to new loads

Steel transfer beams

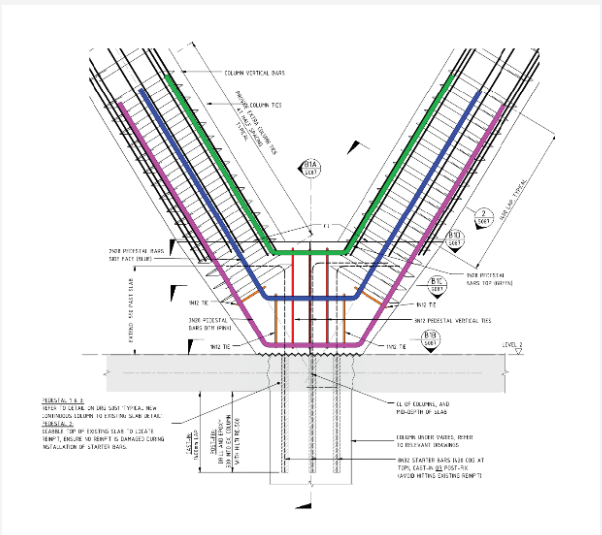
New steel transfer beams were required to support new proposed columns within the residential tower. Due to the limited head height imposed by the existing building there was only 600mm structural depth allowed for an approximately 8m simply supported span. Many workshops were help with the steel fabricator and a steel transfer beam was developed. The steel transfer beam consisted on 2/500WC280 sandwiched together with 40mm thick steel plates.

Installation of these large beams was a major challenge, requiring a substantial amount of site welding and a system of temporary props and lifting beams

V Columns

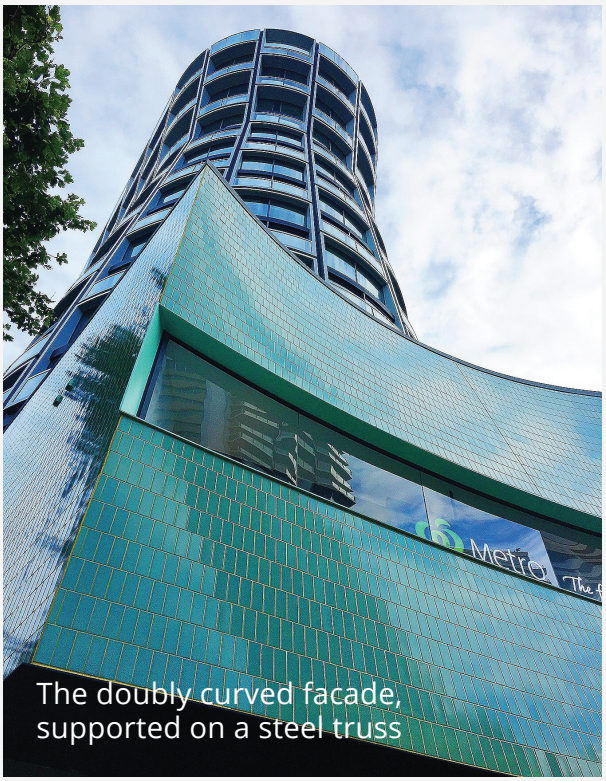
A new residential public garden space was proposed on level 2 at the south end of the tower. Tying together the tower structure and the podium structure are a colonnade of raking V columns.

As these V-columns were raked in two planes, horizontal tie forces were induced into the existing slab, it was critical that the existing slabs was checked, scanned and measured on site for the existing reinforcement was enough to resist the newly induced slab tensile force. Due to their geometry they also participate in the earthquake and wind load resisting systems and had to be designed and detailed to suit.



Complex geometry

Dealing with the complex geometry imposed by the architecture was another challenge of the project. The building facades are curved in 3 directions with the podium façade also following the curves of the building waving in and out as they travel around the podium. A doubly curved steel truss was designed to suit this complex geometry. Northrop worked in collaboration with Probuild, the steel shop detailer and DBJ to ensure that construction tolerances, thermal and building movement tolerances were considered in the design while maintaining the tight defection criteria and lightweight materials.



The doubly curved facade, supported on a steel truss

Complex Site Restrictions and Challenges

Due to the complex nature of the job - interfacing with the existing structure and working with limited site access - there were a number of challenges during construction.

- Installing a new crane on a suspended slab between level 1 and level 2. Temporary structural steel strengthening was required for several columns to ensure that the forces associated with the crane could be resolved.
- Existing and new footings were required due to the increase of load and limited residual capacity in the existing structure. Geotechnical advice sought in regards to the interaction between the old and new foundations.
- It was discovered after removing the cladding around the existing core that a number of undocumented penetrations had turned the concrete walls into swiss cheese. These penetrations were measured and analysed to determine what residual capacity we could rely on for the lateral stability.
- Due to limited access in some areas on site and specific sequence requirements, several columns around the perimeter were left as “catch-up columns”. Propping specifications and temporary supports were designed to allow the builder to maintain their tight program without affecting the overall structural design.


Strengthening of the existing column footings


New transfer steelwork designed to support the tower crane