

SYDNEY | ADAPTIVE REUSE

Carbon-Sensitive and Socially-Driven Transformation: Quay Quarter Tower

Sydney's Quay Quarter Tower (QQT) is an adaptive reuse project of an existing underused 50-year-old high rise building, the 1976 AMP Centre. QQT achieved significant embodied carbon savings and reduction in construction waste, reducing overall environmental impact while elevating user experience.



Fred Holt and Dan Cruddace are Partners at 3XN Australia - a renowned architectural firm known for building projects that push the boundaries of aesthetics and functionality, connecting people with their built environment.



The Quay Quarter Tower and surrounding precinct.
Image: 3XN

The Challenge

The architecture and construction industry faces two fundamental and seemingly opposing responsibilities: the need to drastically reduce the industry's carbon footprint, while also developing healthy cities to accommodate a growing and increasingly urban global population. For 3XN/GXN, the transformation of existing buildings offers an opportunity to unite these two responsibilities, ultimately providing flexibility in our response to changing social and urban dynamics—without that need for change coming at a high cost to the environment.

Located on the edge of Sydney's bustling Circular Quay and within view of the Sydney Opera House, Quay Quarter Tower (QQT) is a 102,000 m² adaptive reuse project which radically 'transforms' the 1976-built AMP Centre tower. The original tower, like other mid and late 20th-century towers, was reaching the end of its usable lifespan, but rather than simply tearing it down and starting over, the project team set out to achieve the ambitious goal of reusing as much of the existing building as possible and set a lofty new standard for adaptive re-use in architecture. Today, the project is the world's first adaptive re-use of an existing high-rise.

Quay Quarter Tower's Regenerative Strategy

QQT retains over 65% of the original structure (beams, columns, and slabs) and 95% of the original core, resulting in an embodied carbon savings of over 12,000 metric tons or around three and a half years of operational carbon for the completed building. Working within the solar envelope and other contextual constraints, the design doubled the existing floor area, primarily on the north side of the building, by grafting on new floorplates to the existing slabs.

The QQT project provides an example of retaining and transforming existing assets as an effective regenerative strategy in tackling ageing infrastructure. With QQT, the impact of transforming the former AMP Centre can be described in three

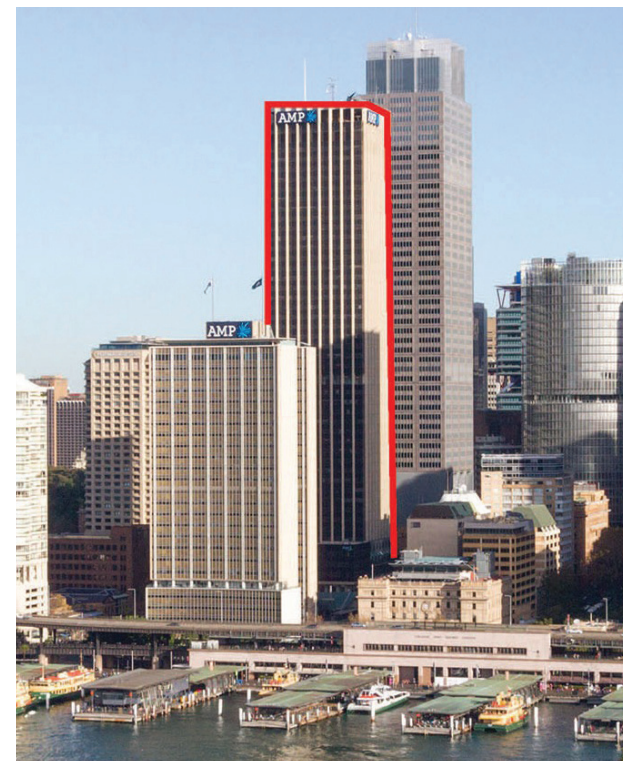
broad categories: social, urban, and environmental transformation.

Social: Avoiding the usual conventions of traditional, uniform high-rise design, QQT was developed around a 'vertical village' concept. It features a social spine and is designed from both the inside-out and the outside-in, with the user experience top of mind.

Urban: Advances in high-rise construction and changes in office/residential needs are rendering some 20th-century towers obsolete. This creates a cycle in which assets lose value, owners stop investing, districts deteriorate, and the public loses attention, ultimately encouraging new development on cities'

outer edges where infrastructure must then be extended. It is a process that is occurring the around the world, and one that emits enormous amounts of carbon. By transforming an existing asset and keeping the urban centre dense, QQT shows how to break this cycle.

Environmental: The radical re-use of the existing structure reduces QQT's embodied carbon footprint. Its more salient design feature, the façade's external sunshade hood, reduces solar gain by more than 30%. This not only gives the building its identity, but reduces its operational carbon by lowering mechanical loads needed for cooling.



Old and rejuvenated AMP Building.
Image: City of Sydney



The extended height atrium which functions as a social connector.
Image: 3XN

Social Transformation: An Architecture That Shapes Behaviour

QQT's vertical village concept places users at the centre of the design. By dividing the building into five separate volumes, an optimal balance between intimacy and connectivity is achieved, while also reducing the bulk form of the tower.

Each volume is arranged around a central atrium that faces the iconic Sydney Harbour. This atrium accommodates informal meeting and social spaces, thereby activating the workspace and bringing it in alignment with 3XN's design philosophy of "Architecture Shapes Behaviour". At the base of each of the stacked

blocks, the atrium volume opens northwards towards generous terraces, extending the workspace and creating spaces that focus on collaboration and well-being.

Each of the tower's five volumes are a hub unto themselves, with floors threaded together by a spiral staircase and arranged around stacked atria that bring daylight deep into the 2,000-2,200 m² floorplates. The transparency of the open atrium spaces distributed within each block allows for easy visual access to the surrounding floorplate departments and colleagues—thus, encouraging

knowledge sharing and social interactions.

Along the northern zone of the floorplate and visible from the surrounding precinct is the social spine consisting of a stack of 3- to 4-level atria, which are connected by spiral staircases for enhanced movement flow. To enable future adaptive re-use and flexibility, the structure in these floors can be dismantled, or assembled easily. Designed-for-disassembly, these floor systems allow spaces to be curated to match tenants' future growth or workplace requirements.

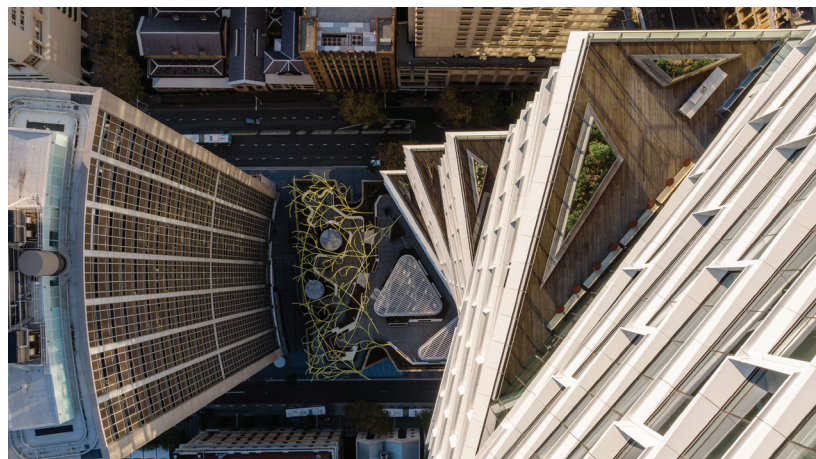


The 11m sloped terrain that Quay Quarter Tower sits on.
Image: 3XN

The separation of vehicular traffic from pedestrian pathways ensures clear spaces that are open and safe.

The social spine starts at various points at the base of the tower: the open space, the publicly accessible podium market hall, and the hospitality-focused lobby. There are multiple entry points located across different levels, which is a result of the building's circular design, intended to take advantage of the sloped terrain across the site. The building is strategically designed to make wayfinding easier as users can constantly orientate themselves with visual connections at each level of the podium as well as the tower's surrounding context.

The separation of vehicular traffic from pedestrian pathways ensures clear spaces that are open and safe. The creation of spaces for collaboration and well-being are represented by "Third Space" co-working lounges, retail offerings, bicycle parking, gymnasiums, and a fully accessible rooftop garden that comprises an open-air event space and a public art piece by world renowned artist, Olafur Eliasson.



A bird's eye view of QQT's multiple rooftop gardens.
Image: 3XN

Urban Transformation: The Quay Quarter Precinct & City Context

The success of the user experience for any high-rise starts at arrival. QQT's podium design creates a pedestrian-friendly environment, while creating a "moment of arrival" with the large, voluminous tower lobby visible from the multiple entrances.

The podium's visual and physical permeability encourages an active public domain. This plays out in the internal, market hall tenancies that connect to external terraces, where users can enjoy the favourable Sydney climate. Extending from the tower lobby, atop the two-level market hall's podium rooftop is a publicly accessible parkscape that features a roof top café and bar. Due to the site topography, which drops 11-m from the southern lobby

entry to the northern end of the podium, the rooftop garden can also be accessed directly from the ground level lobby. QQT's rooftop garden creates a place destination and a much-needed green space for Sydneysiders and visitors to enjoy the revitalised and reinvigorated precinct.

Connectivity was carefully considered with the integration of narrow laneways, new streets, and entrances across the entire Quay Quarter precinct and beyond. Furthermore, while Circular Quay's supporting infrastructure (e.g., ferry, train, and light rail, etc.) was good, the building was approaching its end-of-life and partially vacant. The Quay Quarter development was thus a catalyst for the regeneration

of the eastern end of Circular Quay. This involved many stakeholders as well as the City of Sydney which worked together with the developer to unlock the precinct's potential through innovative implementation of planning policy and pragmatic development controls.

At a city level, the visible expressive form, informed by the site solar access constraints and passive sustainability, is highly unique to QQT. The podium scale, form, and materiality are a nod to the Australian vernacular of the Sydney terrace house with protective verandas, while also sitting comfortably in the sandstone heritage context of Bridge Street and the adjacent Quay Quarter Lanes.



Multiple entrances converge at QQT's podium.
Image: 3XN

Environmental Transformation: The World's First Adaptive Reuse Skyscraper

The challenges of adaptive re-use of an existing tower or structural upcycling, comes down to three things:

- Does the existing structural strength capacity match or exceed its original design?
- Does it have the capacity for more load, vertical or horizontal?
- Does the existing floor-to-floor height match with the new use?

A comprehensive survey and concrete sampling need to be done to assess the exact location of the existing structure and its load bearing capacity. These assessments inform the design of the retrofit structure, carefully ensuring that it does not deteriorate the existing structure.

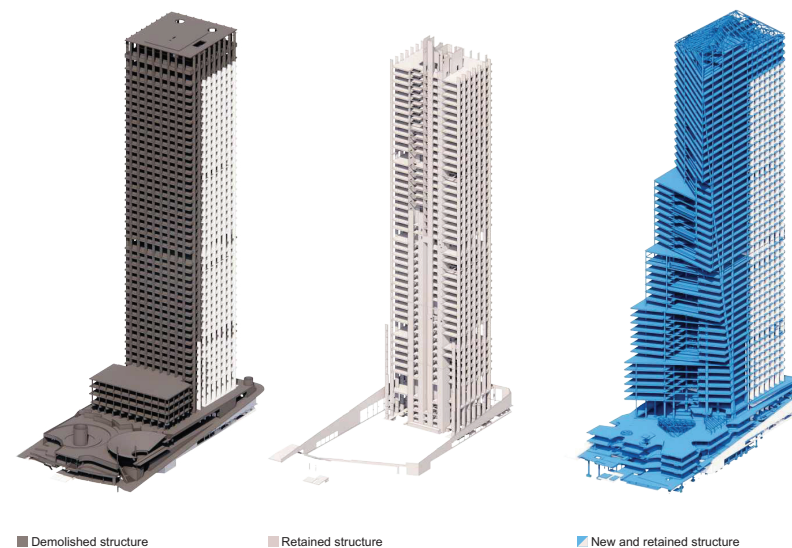
In the case of QQT, this was done by using concrete-filled tubular steel columns for the new structure, as this results in less shortening than a concrete-only structure would.

QQT also incorporated data from a “digital twin” simulation model during construction. This digital structural twin was continuously updated with results from core and concrete strength samples taken from the existing structure, as well as movement sensors on the building. This significantly reduced the risk associated with re-using the existing structure, as the computational testing of the structure and movements were compared with actual movements, allowing the new structure to be designed or altered prior to structure install. Where required, some areas of the existing structure were

strengthened using carbon fibre strips or steel-plates, particularly where the new program required additional space.

By retaining more than 65% of the existing structural frame and 95% of the existing core, significant carbon savings have been achieved. Furthermore, passive shading of the building has reduced solar radiance on the facades, which in turn lowers reliance on internal cooling and related operational costs and carbon.

Process Diagram
Transformation



Transformation process of Quay Quarter Tower.
Image: 3XN



Quay Quarter Tower.
Image: 3XN

The Future

QQT sets a new global benchmark as a sustainable and social example of how to radically re-use an existing high-rise in cities. 3XN/GXN believes that this approach can be adopted more widely, which is why currently more than 30% of our work is within the “transformation” space at various scales and typologies and with different levels of intervention.

In the typology of adaptively re-using high rise buildings, corporate firms will focus more on Collaboration and Well-Being, resulting in a need for larger space and floorplates in towers to handle the open environments and flexibility that tenants demand. There is a lot of tower stock globally from the 1970's to the 1990's, that due to their limited floorplate size, façade visibility, aspect, or performance, see a diminishing return on value. Moreover, because tenants are not seeking out large, long-term leases in these buildings, the asset's financial return is not as high. If, however, city planning

officials and developers work together to revise the allowable floor area of existing assets, either vertically or horizontally, then the value in the existing asset and the precinct in which it is located, can be retained. It is ultimately about leveraging what is already in place—transformation rather than demolition. After all, the most sustainable building is the one that already exists.

A more circular economy needs to benefit the economy. As the concept of “retain/partially retain” versus “demolish” becomes more globally applied, upfront carbon can be reduced, and construction time and cost can be saved. In the case of QQT, over A\$150 million was saved over 13 months. The asset was also able to take tenants earlier, and therefore, generate revenue faster than a full demo and rebuild.

Adaptive re-use is a great sustainability approach, which capital investors are starting to

tie to the price of investment. It is an interesting economic dynamic that extends beyond the embodied carbon number alone.

As one of the biggest contributors to carbon, the architecture and the construction industry has a responsibility to tackle climate change and social infrastructure issues. The radical re-use of existing high-rises will revitalise urban precincts and improve the socio-economic condition of their surroundings and do so with minimal environmental impact.

With QQT showing what is possible, it is no stretch to imagine mid- and late-20th century buildings around the world being upcycled in the years to come. Transformation of existing buildings has the potential to help tackle the global issue of ageing infrastructure, while revitalising urban precincts and surrounding social infrastructure—all at minimal environmental cost. 📍