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.

A Road through time

Melbourne's eye-catching new headquarters for fashion retailer Country Road has won major awards for its architects, and the former 19th century power station presented unique challenges for structural engineers Burns Hamilton & Partners.

The biggest challenge was to add basement parking after the ground floor had already been poured - a variation made possible when site drainage proved more effective than initially expected. For the engineers it meant a complete re-think of the floor's supporting structures.

Leigh Burns, of Burns Hamilton & Partners, had expected the greatest problem to be a lack of existing drawings and specifications, and made a major time allocation for an arduous survey of the entire building before other work could progress. By contrast, he had expected no trouble supporting a new concrete slab floor because of a forest of steel columns which had once supported the assorted machinery of the power station.

The reality turned out quite differently. Whereas good luck intervened to cut short the survey, the addition of underground parking made designing the floor structure the biggest single task of the project. The engineers' other interesting task was to create a planar glass interior wall entirely suspended from the roof.

Project Background

Located in a precinct of upmarket office and commercial premises which were once industrial buildings, the building had served for more than a century as a power station. It was built progressivley between 1878 and 1952 and was sold off in the early 1990s by the State Electricity Commission of Victoria (SECV). Walker Corporation took on the redevelopment of the site and engaged Metier3 as the architect and Qanstruct as the project manager.

An unusual aspect of the job was the appointment of project managers and structural engineers to work together on what would be an evolving project to meet Metier3's design.

Rather than tendering on the entire job up front, the agreement was to work within an agreed total budget - an arrangement which Leigh Burns found very workable. "Doing it this way, we could concentrate on designing what was needed first, and getting that work started while we moved to the next design stage - a true critical path," he said.

Before serious work could start, he and his team began the time-consuming task of drawing the entire existing building. Then they made a chance discovery that saved enormous amounts of time. Through personal contacts Leigh Burns became aware that the SECV had surveyed the entire site in the previous decade, and he was able to track down these survey drawings.

With the drawings to hand, the focus moved to assessing the condition of the structural steel after a century of survival in a hostile environment. Coal dust, dirt and moisture had taken their toll of the existing steel, although structurally, things were promising.

Steel throughout the building had come from several different sources. "Some of the columns in the main turbine hall were from England, some from Scotland, others from Whyalla."

BHP Steel, having helped to trace a little of the history of the original steels, also facilitated analysis of samples. Of most interest was their suitability for welding, because of the tendancy for some older steels to become brittle when welded. Although the tests indicated that this should not be a problem, it was decided to go with bolting for all but a few connections, where welding was the only real option.

In assessing the suitability of existing steel to support new structures, some of the answers were self-evident. For instance, in the main turbine hall, the load rating was proved by a 50 tonne overhead crane traversing the length of the hall. As the crane's load rating was well above that required for the new structure, little more was needed than to confirm that the steel structure was still in sound condition. The crane itself is now fixed in position partway along the building, albeit without the tracks it once traversed.

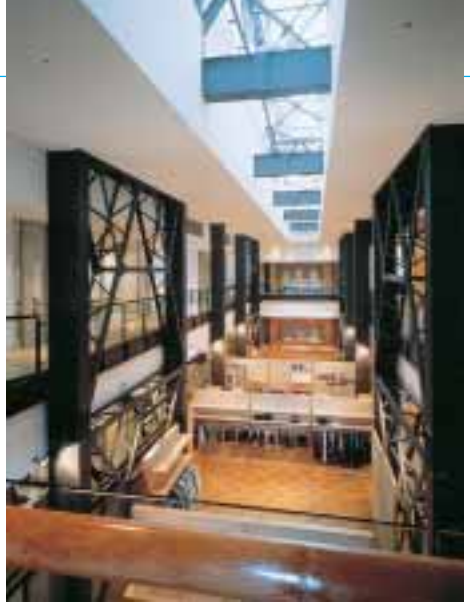
Similarly, many of the Victorian-era structural elements were so clearly over-engineered for their original purpose, and still in good condition, that there could be no doubt of their suitability to the new structure. To transform the vast open hall into a multi-level office complex, the engineers bolted steel 'collars' to the steel columns to support the beams carrying the reinforced concrete floor.

Due to the strength and adaptability of the existing steel structure, Leigh Burns initially harboured doubts about how much work there would be for his team, but it turned out that their skills were in high demand. For instance, the existing steel truss roof in the main turbine hall could not be proved adequate to withstand current wind load criteria, so was therefore modified by the addition of ties to restrain the bottom chord. A substantial number of steel beams were installed to replace the loadbearing brick walls in the multi-level structure in the northern section of the building. Sprinklers were used throughout and fire spray was not required.

It was one of the self-evidently adequate structures that ultimately led to the biggest single engineering task: creating basement parking for almost 50 cars. The story of the basement car park illustrates the unexpected developments which can arise in an old building with an incomplete history.

Addition of Basement Carpark

Metier3's original concept did not allow for parking beneath the building, but rather for a low-profile parking building on the adjacent open ground facing the Yarra River. The existing basement, six metres deep and fully flooded, held no promise of a parking level. With a labyrinth of tunnels carrying water in and out of the basement, there seemed no prospect that it could be rendered dry and stable. Instead, after it was drained, it was filled with earth from a neighbouring site which was



The engineers had to then find a way of supporting the entire ground floor while removing all but a handful of the steel columns to create manoeuvring space for the cars. The challenge was to redesign the supporting structure while the floor remained in place. A labyrinth of transfer floor beams had to be individually designed due to the varying combinations of load and span. Sizes ranged from 700WB130 down to 250UB31. These beams were framed under and used to support existing floor beams by transferring loads to the main through columns upon removal of the old equipment support columns. Temporary props were installed to enable column removal and

Top: Reminders of the building's past are retained in the exposed steel framework

Above: The planar glass wall separating office and showroom spaces presented a major engineering challenge

Left: The showroom areas enjoy natural light from the vast original front windows

also under development by Walker Corporation – an added touch of efficiency for both projects.

Meanwhile, the composite slab floor was poured on unpropped Bondek steel decking which was amply supported by the basement's many existing columns and beams. It was one of the features of the old building which simplified the engineering task.

Then, with three metres of fill in the basement, it was completely dry and in no danger of flooding. Quite unexpectedly, there was a clear, three-metre space which could be used to eliminate the need for a separate parking building.

the transfer beams were then jacked into position with stubs and packers being used to pick up the load from the supported beams over. Connections were all bolted and the transfer beams were simply supported.

"The architect came up with a design that assumed the main structural columns of the building would stay, and pretty well every other column – those that had previously supported the machines – would come out," said Leigh Burns. "We had to look at each column individually and ensure that it was strong enough to support the additional beams, which in turn would support the slab."

Suspended Wall

The decision to include a planar glass wall, made late in the project, to separate the office area from a large display and presentation space, presented an interesting challenge; to design a fully suspended structure which could be erected without removing large parts of the new roof. It also had to have the minimum of visual impact, as its purpose was to be an acoustic barrier. The solution was to install a portal frame which matched the traditional clerestory roof profile of the building, and to tie it laterally with cables in tension behind the glass. The structure was fabricated in sections off site and lowered through a small roof opening for assembly inside the building.

The cross section of the beams supporting the glass typifies the sort of detail design required to marry both form and function. Whereas the structural requirement was for a boxed section, the aesthetics called for an I-beam. The solution was to weld two I-beams together, which gave the appearance sought by the architects and provided the necessary torsional strength of a boxed section which was required to support the heavy offset load from the suspended internal glass curtain wall. These beams spanned 17 metres, and comprised 2 x 360UB45 beams welded toe-to-toe. They were installed inside the existing building by removing a portion of the roof and lowering them through the hole. The frame was then assembled on the floor and raised into position.

Conclusion

With the project now successfully completed, and the winner of an award from the Royal Australian Institute of Architects, Leigh Burns believes the project could never have been successfully completed using the usual up-front tendering system.

"We were lucky in working so closely with the project manager, matching the architect's concept to the available budget and meeting the challenges of the building as we discovered them. I think we will see more of this approach to major projects, with the budget and the overall parameters driving it along a critical path, rather than working to tenders which have been fully developed in advance. Where the history of the building is not fully known, it is really the only way."

Developer:	Walker Corporation
Architect:	Metier3
Project Manager:	QANSTRUCT
Civil & Structural Engineer:	Burns Hamilton & Partners
Building Surveyor:	M&K & Assoc Building Consultants
Fabricator:	Fairbairn Steel (Fabricator member of AISC)
Occupier:	Country Road Clothing