STEEL DELIVERS EARTHQUAKE RESILIENCE

KiwiRail's maintenance facilities are a crucial part of the national rail network. Its Woburn site in Lower Hutt is home to several expansive warehouses. KiwiRail is progressively improving the safety and efficiency of these assets, which include workshop building upgrades and seismic strengthening.

All of the buildings feature 'kitset' structural steel frames from the UK and were originally hot riveted together. Built approximately 90 years ago, the structures were designed without consideration for seismic loading. A seismic assessment of the structures returned a score of just 30 percent of the new building standard (NBS). Rather than demolish and rebuild, KiwiRail took a reuse approach, which could only be achieved with steel. So a pivotal focus for the team was to strengthen the structures. Plant 1 was upgraded first, followed more recently by work on Plant 2 and Plant 3. The latter two buildings have now been strengthened to 67 percent of the NBS.

Plant 2 is a massive warehouse – 164m long by 50m wide, with a 15m-high roof 'knuckle'. Used to maintain locomotives, wagons and passenger carriages, the building features five gantry cranes up to a 100t capacity, which lift and move whole locomotives.

Central to the upgrade project was the requirement that the site remain operational throughout. Success demanded high levels of collaboration and flexibility between the client and the design and construction teams. Impressively, the project was delivered two months ahead of schedule, despite the added challenges of the COVID pandemic.

THE FACTS

- 1.6km of steel girts (DHS 200 18) to support the cladding
- 5 gantry cranes
- 164m-long x 50m-wide warehouse

ENGINEER BECA **STEEL CONTRACTOR** ATCO STEEL DEVELOPMENTS **BUILDER** MAYCROFT CONSTRUCTION **DEVELOPER/OWNER** KIWIRAIL

ENGINEER

Beca performed the initial seismic assessment then delivered the concept and detailed designs required to upgrade the building's earthquake resilience in line with today's standards.

One of the challenges was determining what the team would find in such an old building once the cladding was stripped away. There were, at most, six structural drawings to work with so on-site investigations and 3D scanning techniques were used to create a picture. Even so, some unexpected steelwork was uncovered; it wasn't captured in the design phase so the team had to alter how the connections worked on the fly. The condition of the existing steelwork also couldn't be determined until the cladding had been removed.

While Beca completed the design, Atco, the structural steel contractor, painstakingly site measured every piece of steel – nothing was plumb, no beam nor column was the same. The information was relayed to the engineers in the form of shop drawings and RFIs (requests for information), which Beca then reviewed to ensure the team was on the same page.

There were 27 roller doors along the length of one face for the trains to enter and exit for maintenance purposes. A more conventional cross-bracing solution extending down to floor level was completely incompatible with the use of the building as it would block the doorways that trains have to pass through. Instead, the solution involved installing large custom-welded beam portals to carry the load – a good example of steel's intrinsic design flexibility. In all, there were six moment-resisting frames consisting of four columns each with a beam in between.

When construction started, Beca monitored activity on site to ensure it married up with the design intent. It was a highly collaborative process made easier by being able to discuss any issues on site with main contractor Maycroft and Atco.

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BEN HENDRY, STRUCTURAL ENGINEER, BECA

BUILDER

Once the cladding was removed, the steel was wet blasted to allow the engineer to easily inspect all of the steelwork and identify what remediation may be required. The majority of the steel structure was in very good condition but column base plates along one grid line that had been exposed to weather were rusting. To address this localised area of corrosion, the base plates were encased in concrete.

For main contractor Maycroft, the Plant 2 upgrade was a complex supervision job. The need to ensure KiwiRail remained operational throughout the project meant that programming and coordination were its biggest challenges.

The plan was to break up the job into four stages. Twenty-eight six-by-six-metre grids along the length of the building were divided into four. Working on one zone at a time, the team aimed to bunny hop down the length. The theory worked well in practice until KiwiRail, when under pressure to deliver a job, needed a zone to be released.

Flexibility was key and the team would shift to a new grid to keep the project rolling. This occurred frequently but it was when work got underway in the third zone that things got particularly tight. The team continued to switch from one area to another as required – it was always on site and the job never stopped.

The project's fast pace also warranted having Atco involved in Maycroft's meetings with KiwiRail – not a typical practice. The drive to do things faster or differently meant it was invaluable having Atco's specialist steel construction knowledge on tap.

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"I CAN'T FAULT ATCO, THEY PUT THE EXTRA EFFORT IN, WORKING OUT OF HOURS IF WE NEEDED TO BECAUSE WE HAD TO WORK AROUND KIWIRAIL."

ANDREW SMITH, CONSTRUCTION MANAGER, MAYCROFT CONSTRUCTION

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FABRICATOR

At its height, Atco had 12 staff on site running multiple work zones. The erection crew would also do 'split days' – when KiwiRail downed tools at the end of the day, Atco would work till 10pm so it could quietly access areas it couldn't on a live site. When KiwiRail needed a zone back, the team would pull 12-15-hour days and work weekends to get it across the line in time. When the plan changed and Atco had to drop a zone to focus on another, there was a big scramble because the steelwork hadn't yet been fabricated.

Being local made a difference. All of the 'raw' steel for the job was stored at the Woburn site. Atco would progressively pick up the steel to manufacture it at its workshop then have it painted and return the completed product back to site. Every bit of steel had to be site measured, and every beam and every plate had to be made individually so drafting was very labour intensive. Even so, turnaround was fast.

As COVID was first sweeping the globe, the team 'read the tea leaves' and quickly worked to procure all of the steel for the job before its effects were fully felt in New Zealand. All the welded beams were sourced from Jakarta. The order was placed in early January 2020 and it arrived as the first lockdown hit in April but the port had no transporter available to remove the container. Struggling with space, and due to the steel's non-essential designation, the port advised that it would charge for the material's storage if it remained. Atco worked with the steel merchant to engage an external transporter.

A change of scope coupled with supply chain issues meant that halfway through the project the paint ran out. While the west and east walls were part of the original scope, the south wall was not. A change of specification led to the work being completed by an arc-spray process instead.

"COLLABORATION BETWEEN EVERYONE INVOLVED WAS IMPORTANT – FABRICATOR, ENGINEER, BUILDER, CLIENT. IT BROUGHT EVERYONE TOGETHER; WE COULDN'T DO IT WITHOUT EACH OTHER."

DAVE OLSEN, GENERAL MANAGER, ATCO STEEL DEVELOPMENTS