EXTENDING THE LIFE OF MARINE STRUCTURES

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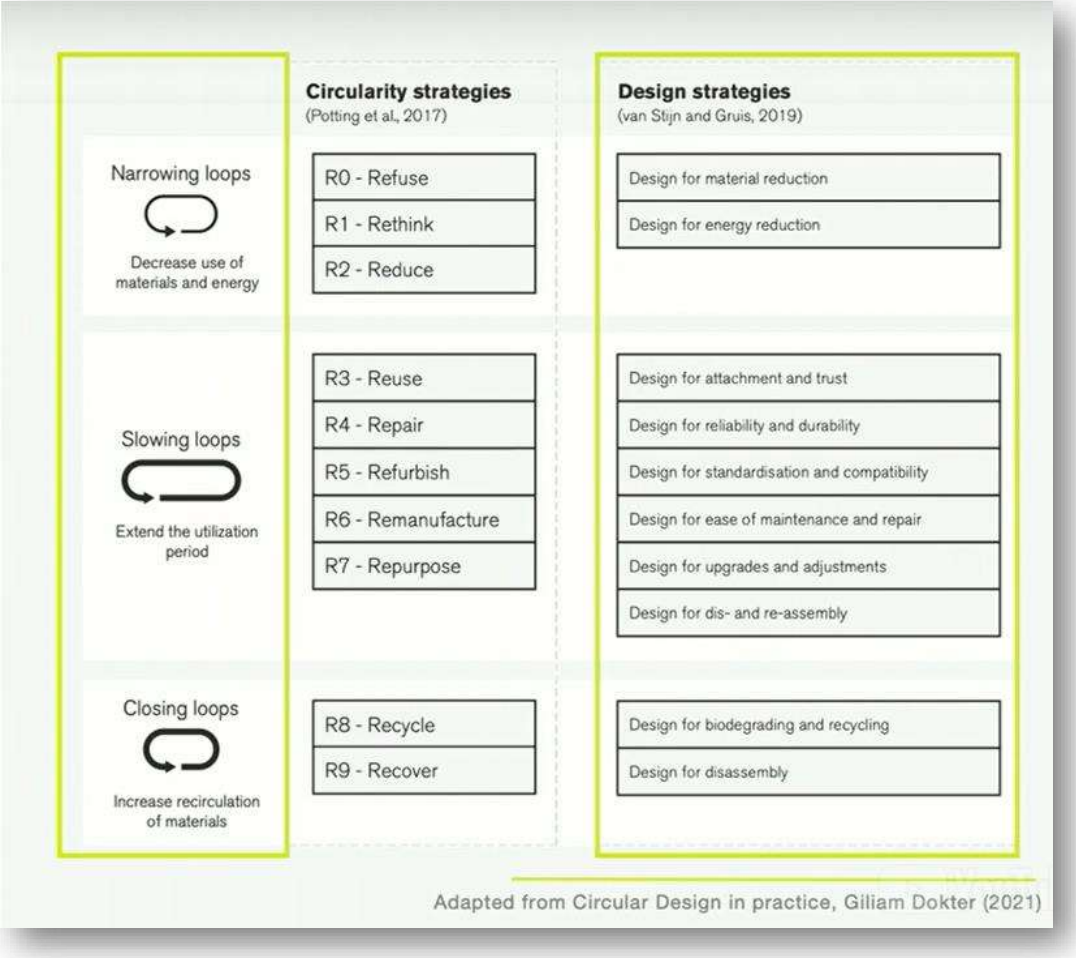
How do we bring Circular Economy thinking to Port Infrastructure

Shifting to a circular economy involves promoting sustainable thinking, design and construction patterns, by following a hierarchy of circular actions:

- **reducing waste** significantly by beginning upstream with circular design (including modularity and designing for adaptable operations) and circular sourcing (for instance, renewable or on island materials and recycled materials),
- **keeping materials** within the economy through:
  - reuse,
  - repair,
  - refurbishing,
  - and repurposing, thus reducing the embodied carbon of buildings
- at **end of a life**, recovering and recycling resources to feed them back into the same or different purposes and capturing and creating further value.



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Ravensbourne Wharf Port Otago NZ

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Originally built in the 1930s, the Wharf has undergone various cosmetic changes over the years including an extension in 1968 and a new concrete deck and berthing beam in 1994.

The issues:

A relatively remote facility which had reached end of life.

Business Requirement to bring materials into processing facility next to the wharf.

The business required the wharf to be economically functional and environmentally compliant

Important but potentially short-term business outlook, the operator required a further 10 years life.

Options using road transport costly and environmentally not acceptable to local community.

Access issues for land and marine plant and material supply.

The wharf had remaining limited axial but no lateral capacity

The conveyor and hopper systems still had residual life.

Typical Condition

Photograph 1 – End of Wharf looking South.

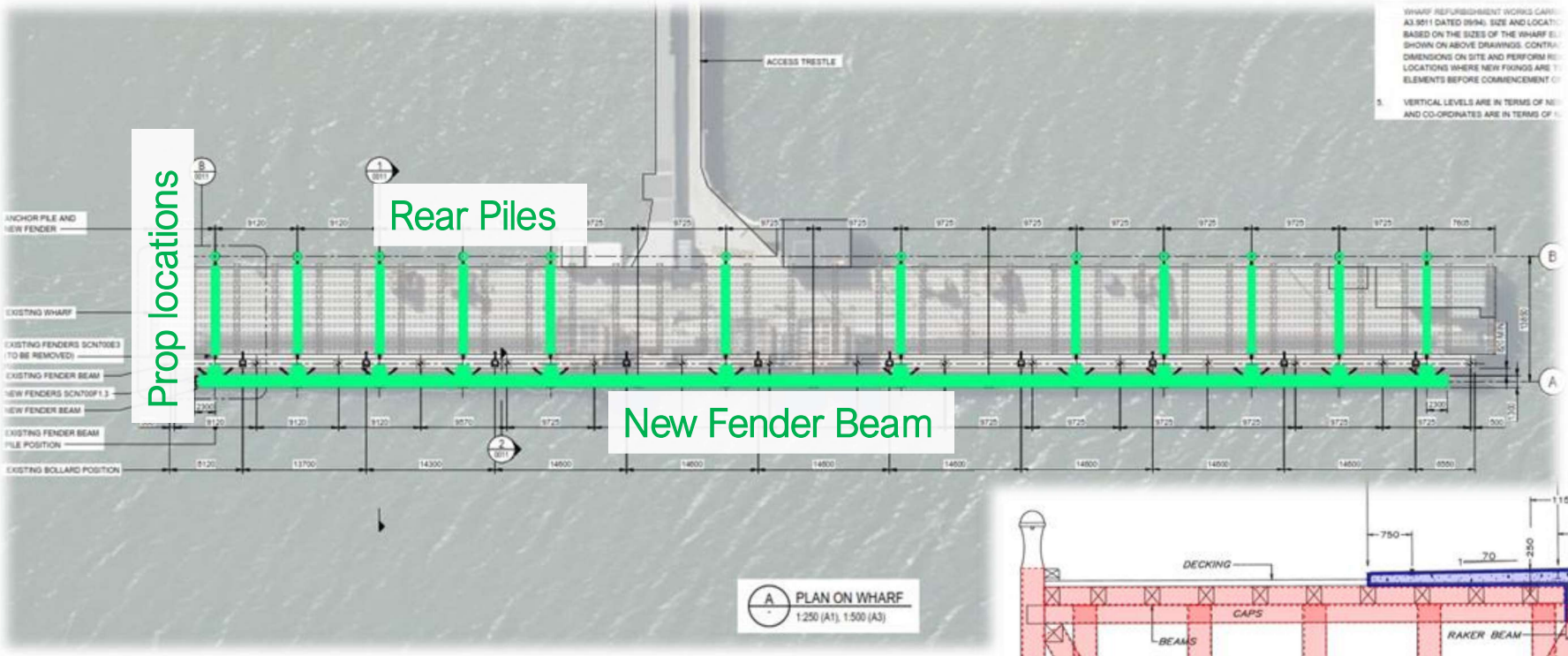
Photograph 2 – Underside of Wharf, note broken raker pile.

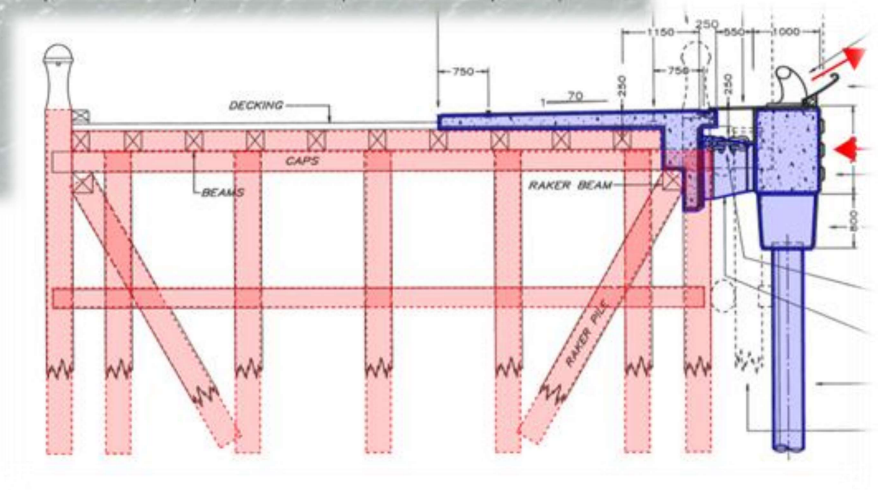
Typical Condition

Photograph 3 – Bent 5, note broken raker pile and waisted vertical piles.

Photograph 4 – Underside of Wharf showing corrosion of the steel form.

Separation of old and new





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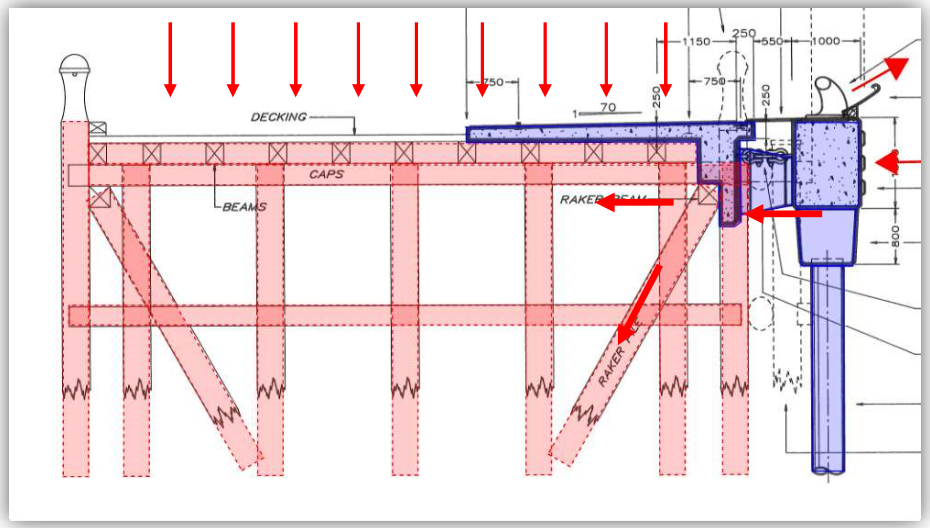

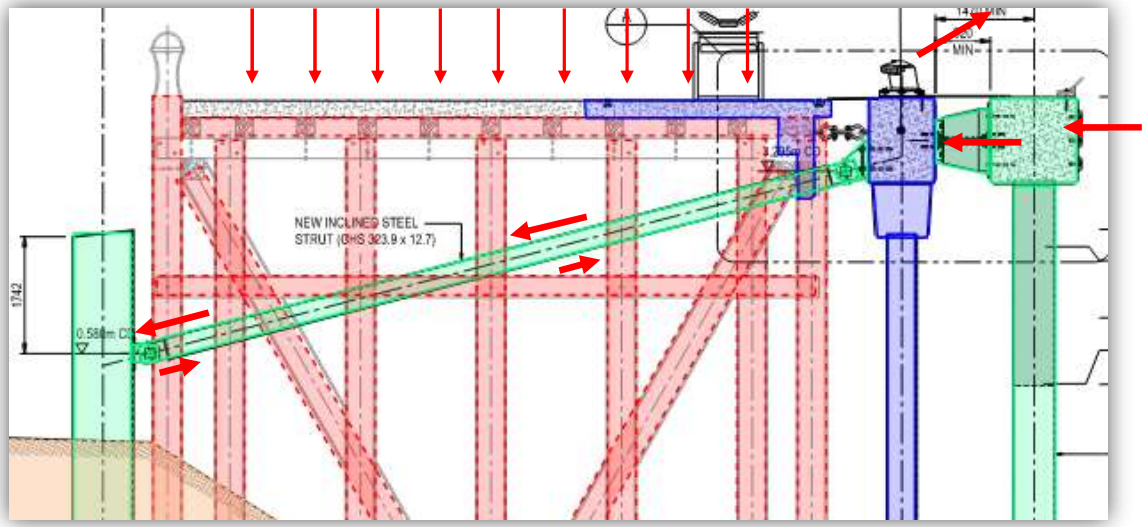

Resolving the issues efficiently

Existing Structure

- Mooring, Berthing and Axial loadings pass into the timber deck structure.
- Raker piles were mostly end of life and vertical piles have only limited axial capacity, no lateral capacity
- The existing fender beam (blue) and supporting piles did have limited lateral capacity.

Revised Structure

- Large Diameter pile driven at rear of structure to provide lateral stiffness
- Rear pile connected to existing fender beam via pinned props.
- Existing fender beam disconnected from timber structure.
- New fender beam and supporting piles driven and constructed in front of wharf.
- Lateral loads now dissipated through fender absorption, flexure of front pile and stiffness of the prop and rear pile.
- Only minimal axial loads from deck remain on existing structure.

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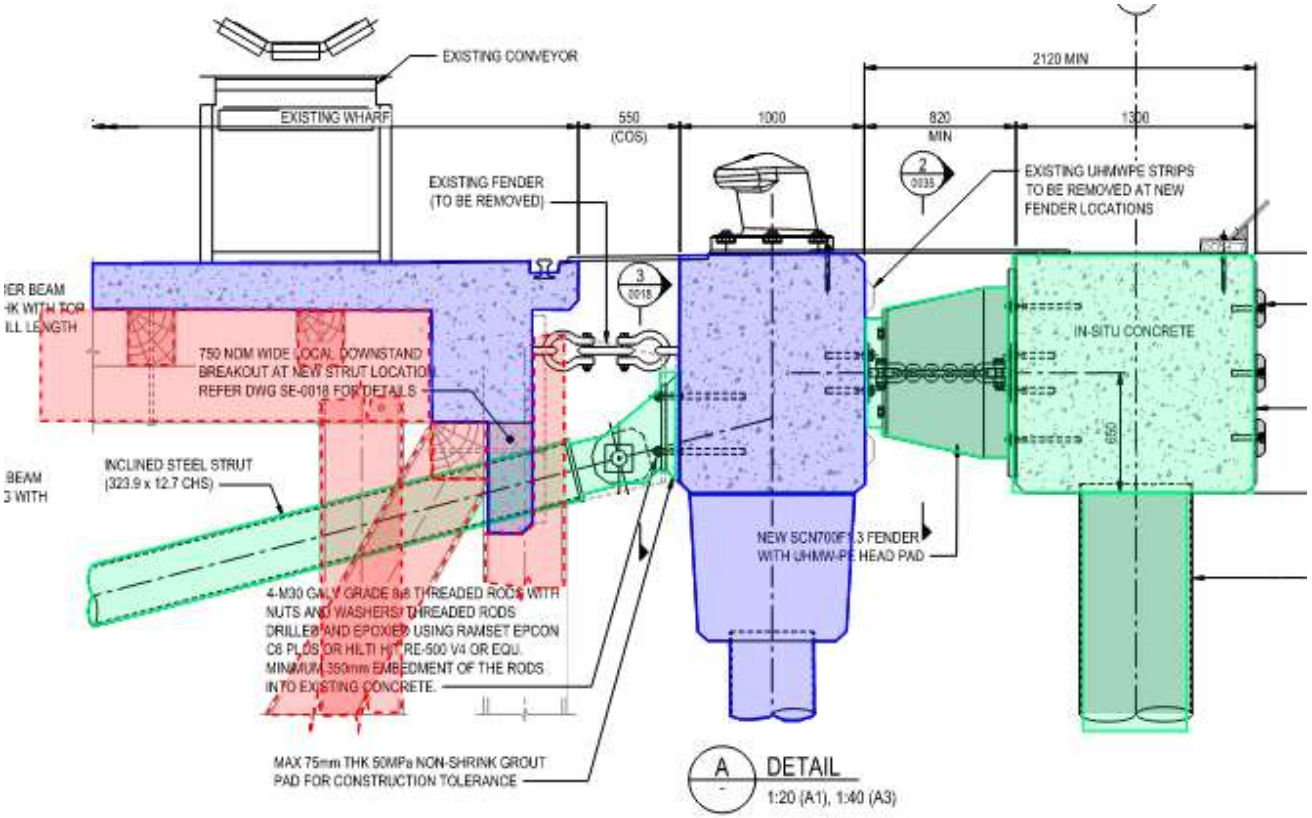
Resolving the issues efficiently



Utilise the remaining strengths of the existing Structure

- The existing deck still has sufficient (limited) axial capacity
- The existing fender beam and supporting piles can provide some lateral restraint

Plant and Materials

- Pile sizing and driving designed to meet the lift and reach constraints of plant that is locally available.
- Suppliers contacted determine readily available steel sizes.

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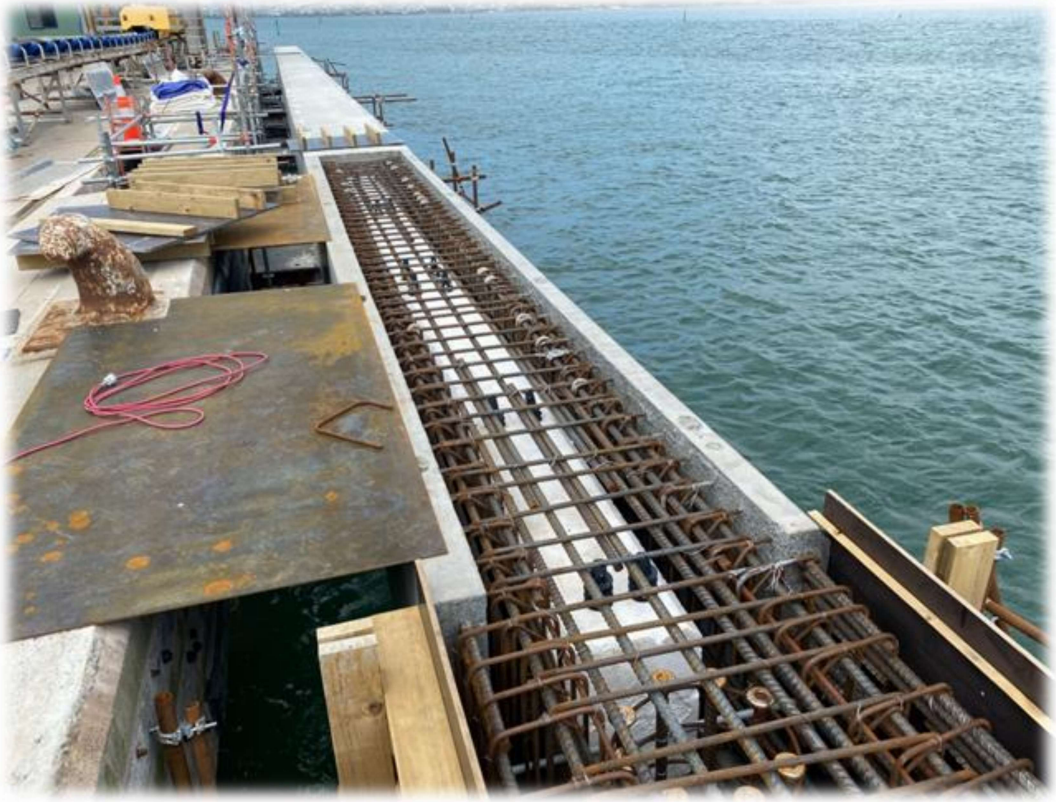
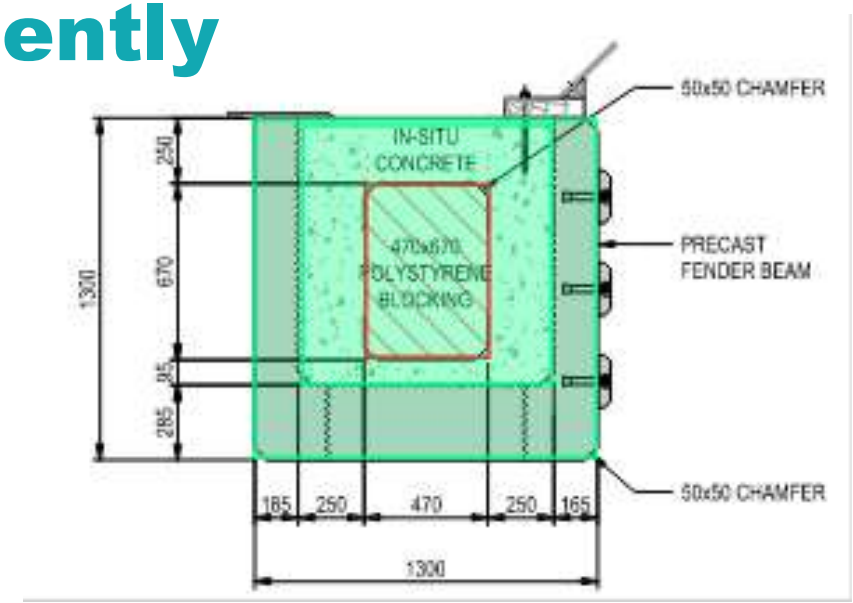
Resolving the issues efficiently





Plant and Materials

- Concrete transport to site was a logistical challenge and incurred high costs. Solutions:
  - Pre-cast shell units designed for fender beam to increase quality control & reduce formwork & working over water.
  - Polystyrene void former utilised in centre of beam to reduce insitu concrete by over 30%

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Ravensbourne Wharf Port Otago NZ

The $6 million project was a collaboration involving **Ravensdown**, **Port Otago**, **HEB Construction** and consulting engineers **BECA**.

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Ravensbourne Wharf Port Otago NZ

Wednesday, 22 March 2023

Ravensbourne Wharf upgrade completed

It was cause for celebration when the first vessel – the Magpie SW – recently berthed at the refurbished Ravensbourne Wharf in Port Otago.

Completed on time, the upgrade involved building a new 145-metre-long berthing beam and carrying out significant maintenance work on the existing timber path of the Wharf.

Around 7,000 truck movements will be removed from the road each year, as a result of the upgrade, which will be good news for the environment and surrounding community.

Originally built in the 1930s, the Wharf has undergone various cosmetic changes over the years including an extension in 1968 and a new concrete deck and berthing beam in 1994. This latest refurbishment now extends the life of the Wharf for at least another 10 years.

The $6 million project was a collaboration involving Ravensdown, Port Otago, HEB Construction and consulting engineers BECA.

Port Otago Civil Engineer Andy Pullar was full of praise for the Ravensdown team saying that they had the right approach and provided some great support to the site team.

“All in all, it was a very smooth and satisfying project.”

Key Facts

- The new 145-metre-long berthing beam along the Ravensbourne Wharf length connects to new anchor piles on the rear of the wharf.
- Loads imposed by berthing vessels will now bypass the existing timber wharf structure transferring them to 900mm diameter anchor piles.
- A total of 27 new piles were driven with 12 steel struts securing the new piles to the anchor piles.
- Significant maintenance work was also carried out on the existing timber part of the wharf to prolong the life of the 90-year-old timber structure.
- The wharf has over 300 hardwood timber piles holding it up.

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