

TECHPORT SHIPLIFT

STRUCTURAL ENGINEERING STEEL AWARD 2010 - MINING + INFRASTRUCTURE (SA)

RPG Australia, Rolls Royce and TTS Handling Systems



Project Overview & Structural Design Concept

In December 2009, RPG Australia completed the on-site consolidation, fabrication and installation of a shiplift and transfer system for Rolls Royce Australia and Norwegian company TTS Handling Systems AS.

The shiplift is located at Osborne in South Australia and forms part of Techport Australia, a South Australian Government owned and operated facility developed to assist ASC build the Royal Australian Navy's next generation \$8 billion Air Warfare Destroyers and attract future naval shipbuilding and repair opportunities to the State.

The shiplift is the largest in the Southern Hemisphere, capable of supporting a vessel up to 9,300 tonnes. It is 156 meters long, 34 metres wide and lowers 18 metres into the water to launch and dock ships. The Hoist Lift Capacity is the largest and the first of its type manufactured for Rolls Royce, with a lift capacity capable of 625 tonnes per hoist. It has been specifically designed with the potential for future expansion of an additional 50.5 m or another seven standard modular sections, which would give the shiplift a total lifting capacity up to 22,000 tonnes.

The project comprised of the workshop fabrication and on-site consolidation and installation of three elements; a working steel sub structure platform with timber and rail decking, 40 off hoists connected to the platform via wire rope to lift and lower the platform and a trolley and trestle transfer system to allow the ships to be moved onto and off the platform.

The platform required approximately 2,700 tonnes of steel, the hoists 420 tonnes utilizing both plate and section and the transfer system consisting of trolleys and trestles requiring 440 tonnes of steel plate, all originating from Australian Steel Mills. All plate was 350 L15 and L20 XLERPLATE whilst section was 300-Plus.

Over 100 tonnes of additional steel was used in the fabrication of the temporary works system to install the platform into position which was all recycled after the platform was in place.

RPG developed and subsequently fabricated components that were utilized in a unique way for assembly and installation of the platform through the use of a trolley, rail and heavy lift jacking system. By doing so, this negated the need for barges and large heavy lift cranes which would be subjected to climatic conditions and the hazards associated with working over and on the water.

Detailing for Economy

The shiplift itself is a unique design accommodating for its specific application with the main requirement being the load carrying capacity as specified by the user of the infrastructure. The project components were designed around the basis of using standard size sections and plate sizes wherever possible. This is evidenced by the requirement for 126 no. longitudinal beams all of similar design, 550 no. intermediate transverse beams utilising standard 900 WB's as well as the 20 no. main transverse beams that again are structurally similar with only minor detailing differences. The 40 hoists, 42 trolleys and 21 trestles were all of serial manufacture, again designed to be fabricated through the use of standard plate sizing.

The design intent was not to fabricate the shiplift in one piece but to modularise it into a number of pieces for fabrication within the workshop and then consolidate these once economically transported to site into larger modules. These modules would eventually be lowered into location in the shiplift basin forming the platform through articulated joint connections located at the end of each individual module. With such a design, each module of the shiplift platform was able to be "clicked" together, assisting in maintaining the tight tolerances that were required due to the working deck structure design using a railway track as a runway for the transfer system to traverse along which required precise levelling so as to obtain smooth travel of the load once applied in a docking. Such design and fabrication reduced the need for numerous different fabrication jigs, labour to handle odd and differing size pieces, further lending itself to economies of scale via mass production opportunities.



The design has also taken into account the long term use and maintenance of the assets by incorporating easy access to greasing points for the working components of the platform such as the upper and lower sheaves. For the hoists and trolleys which contain wearing components such as bearings, shafts and hydraulics, and which are the most susceptible to attack from the environmental conditions and subsequent failure, all of these components have used materials that either protect against corrosion or have additional protection provided in the form of special seals so as to minimise the maintenance required and maximise the available operating time of the platform and transfer system given the extremely harsh corrosive environment that they operate in.

Practicality in Fabrication and Erection

The sheer size of some of the shiplift components and modules such as the 38m wide, 3.6m deep main transverse beams required detailed thought processes about the practicality of its manufacture and subsequent on-site consolidation and installation.

Globally over the entire project, this was able to be achieved by breaking the major modular sections of the project down into manageable workshop fabrication pieces ranging from 1 to 90 tonnes. By doing so, serial and repeat manufacturing was able to be achieved such as 20 no. 84 tonne beams, 550 no. 1.5 tonne beams and numerous other beams further consolidated into 20 tonne modules. By breaking into smaller components, these were then able to be consolidated on site to make up 19 no. full size modular pieces ranging from 160 to 300 tonne.

Once consolidated, these modules, most of identical design, were transported on a single temporary installation and jacking system able to be traversed down the concrete hardstand, lifted by hydraulic post jacks on fabricated skates and pushed/pulled into location with forklifts, then lowered into position on jacks. The articulated nature of the design allowed for ease of construction and alignment of one module to the next.



Innovation

The massive scale of the project presented a number of unique logistical challenges as the design of the individual modules that comprise the platform structure were too large to transport on the road as completed units.

RPG therefore split the manufacture of each module into three main components consisting of the main transverse beams, each weighing over 80 tonnes each, two smaller consolidated modules averaging 22 tonnes a piece and numerous smaller beams and sections.

RPG designed and manufactured specialised equipment for the fabrication, painting and transport to site of these beams. For fabrication, purpose built rotation rings were designed and fabricated to allow critical full strength welding to be carried out down hand rather than overhead on the main transverse beams reducing the potential risk of welding failures and allowing the work to be carried out in an ergonomic and safe manner. Transport required the design and fabrication of specialised bolsters supported on jinkers which also acted as jacking points once onsite to speed up offloading and allowed the use of hydraulic jacks in lieu of using dual crane lifting.



Onsite installation of the completed modules also presented a major challenge. Typically, shiplift installation has utilised methods such as constructing the entire shiplift on a barge, floating it in at high tide and lowering it onto temporary supports as the tide drops or utilizing large cranes to install each module. Neither of these options was feasible due to the size of the platform, tides and available resources. This was overcome by designing and building equipment to move each module on specially made bogies from the dry berth to the basin utilizing existing rail tracks installed for use by the transfer system. From here the modules were transferred to a hydraulic jacking system incorporating a temporary works system attached to the ends of each module.

The hydraulic jacks used are most commonly used for silo tank installation, this being a first use in such an application. These

were mounted on a second set of bogies that ran along a temporary rail system set up on the concrete hoist pedestals. A wire rope, dead man and pulley system was then commissioned such that the modules ranging from 160 to 300 tonne could be pulled into location with the use of only two four-tonne forklifts. Modules were then lowered into position using the hydraulic jacks and the temporary works steel system. This method was not only extremely successful but very safe and allowed the installation to be carried out without the use of major cranes and barges that would have been susceptible to fluctuations in environmental conditions such as wind and tides.

Efficient Design of Structure to suit Application

The shiplift has been designed to the specifications of Defence SA, but is able to be adapted to many different situations through the adjustability of trestles and blocking configurations which can be placed to accommodate the varying ranges of shapes of ship hulls. On the working deck of the shiplift, there are six rails allowing the transfer system to be accommodated for such a range of crafts.

Although a typical docking would involve the craft being brought to land via the use of the transfer system, should the Shiplift only be lifting a craft out for a few hours, the platform has utilised Blackbutt and Spotted Gum timber for the working deck due to their hardness and crushing strength. By choosing such materials this allows equipment such as cranes, forklifts and other vehicles access onto the platform to carry out works and de-dock the craft in a timely manner. Should an extension be required, new modules are able to be fabricated and installed onto the existing structure with no significant modifications to the structure required.



Attention to Corrosion Protection

Given that the Shiplift and transfer system operate in the harsh salt water marine environment, significant consultation, design and material selection was made to ensure successful long term operation without the need for significant maintenance. Hempel Marine Paints were chosen for their expertise in supplying paints in this environment and given the task of ensuring the paint selection met the specified criteria. The main platform itself was

Painted in a three coat system with a final minimum dry film thickness (DFT) of 300micron. The system is a combination of a zinc primer with two coats of polyamide epoxy specifically because of its submersion in the salt water environment.

Due to the marine environment, the hoists also required careful corrosion protection. The hoist paint system consisted of a three coat system with a final minimum dry film thickness (DFT) of 300micron. The system is a combination of a zinc primer, one coat of polyamide epoxy and a top coat of polyurethane.

The transfer system of trolleys and trestles has the identical system to that used for the hoists. The polyamide epoxy was applied in thinner coats but still had a 300micron dry film thickness.

Specific wire rope lubrication was chosen to lubricate to the core of each wire rope to prevent the harsh salt environment from corroding them.

Given the importance of the structure, the harsh environment and the importance of maintaining the integrity of the corrosion system, RPG designed and manufactured two large relocatable paint booths so that full enclosure of the each consolidated module could occur, allowing onsite blasting and painting.

On-site consolidation of the modules required significant welding, which destroyed some areas of the already painted sections. So as not to compromise the corrosion protection of the structure these areas were re-blasted and a full paint system re-applied. These covers allowed works to progress throughout adverse weather conditions as well as providing a barrier against the harsh environmental conditions encountered. This also helped prevent potential salt contamination to the freshly blasted steel and allowed the encapsulation of all blasting medium and paint fumes so as not to impact the adjacent aquatic environment.



Sustainability

The shiplift and transfer system have been designed, fabricated and installed with sustainability of development at the forefront of its endeavours, delivering long term economic growth

opportunities to the maritime industry allowing for a greater volume of this type of work to occur. It will provide the base for launching and docking of both new and existing craft as well as supporting the maintenance and repairs of such vessels throughout their service life.

The shiplift has been designed for sustainable maintenance and eventually at the end of its useful life, the steel platform, hoists, trolleys, trestles and timber decking can all be reused or recycled, contributing to the sustainability of our society and the environment.

The timber selected for the platform working deck was a combination of Blackbutt and Spotted Gum, chosen not only for its ability to meet the design loads but also due to the sustainability of the timbers, which are commercially farmed resources.

The sensitivity of the Port River eco system was also taken into account during the construction phase to ensure material selection that does not impact the bio-diversity of the sensitive eco system in the Port River, especially the Port River dolphins that live in the estuary. Ecologically friendly products such as the grease used on the wire ropes and the bituminous material used to fill the 35 000 countersunk holes in the timber decking were carefully considered and analysed before being chosen, to ensure no leaching or contamination into the environment to preserve the sustainability of such a fragile system.

Summary

The Techport Shiplift was engineered to provide a flexible solution, in terms of use, construction and potential for future expansion, to the requirement for a piece of major infrastructure located in an ecologically and operationally complex site. The use of prefabrication, close consideration of corrosion resistance and protection from the marine environment allowed for the efficient construction and on-going use of the shiplift.



Project team

- Client:** South Australian Government
- Structural Engineers:** Rolls Royce Naval Marine and TTS Handling Systems AS
- Head Building Contractor:** Rolls Royce Naval Marine
- ASI Distributor/Manufacturer:** BlueScope Steel and OneSteel
- Steel Fabricator:** RPG Australia
- Steel Detailer:** RPG Australia
- Coatings Supplier:** Hempel (Australia)
- Metal Building Contractor:** RPG Australia

