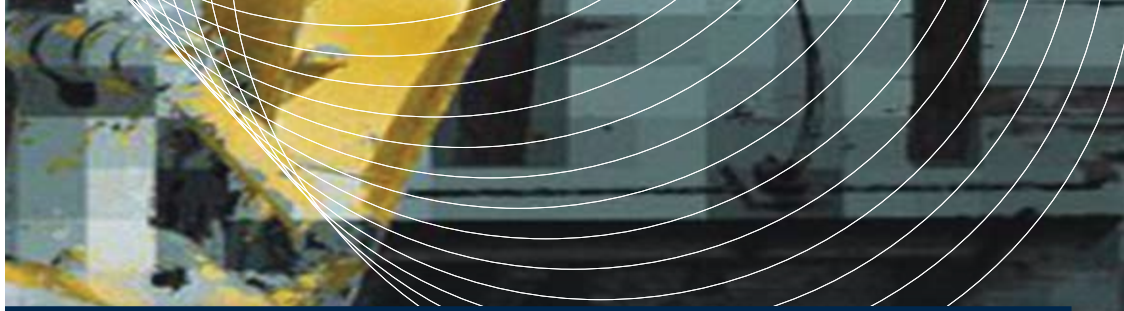
BRITE Innovation Gallery 2007

Nine examples of project-based innovation by Australian contractors

THE BRITE PROJECT

CRC Construction Innovation
BUILDING OUR FUTURE



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Businesses Consulted

The following highly innovative contractors provided material for this report:

Foreword

In 2006, the BRITE Project of the CRC for *Construction Innovation* researched the learning behaviours of twenty of Australia's most innovative contractors. The findings are published in our *Being the Best* report available for download at www.brite.crcci.info. This companion report contains nine examples of project-based innovation drawn from the activities of the twenty contractors interviewed. In combination, the two reports provide a carefully targeted resource to help contractors improve their innovation outcomes, and hence their business performance.

This publication *BRITE Innovation Gallery 2007* was prepared by the BRITE Project of the Cooperative Research Centre (CRC) for *Construction Innovation*. The BRITE Project is headed by Karen Manley from Queensland University of Technology (QUT) with a project team comprising Dale Gilbert, Wendy May-Taylor and Julia Willis (Queensland Department of Public Works), Richard Hough (Arup), Mary Hardie, Steve Kajewski and Lindy Spindler (QUT), Sam Fernando and Mike Swainston (Queensland Department of Main Roads) and Steve McFallan (CSIRO).

Construction Innovation is committed to leading the Australian property, design, construction and facility management industry in collaboration and innovation. We are dedicated to disseminating practical research outcomes to our industry – to improve business practice and enhance the competitiveness of your firm. Developing applied technology and management solutions, and delivering education and relevant industry information is what our CRC is all about.

Example 1:
Airconditioning system lifts green rating of 1980s building

The Project

Refurbishment of the 12-storey headquarters of the South Australian Health Commission, CitiCentre, aimed to lift its audited Australian Buildings Greenhouse Rating (ABGR) from a poor two stars to the desired optimum rating of five stars. The department's offices are located above a busy commercial shopping arcade in the heart of Adelaide's Central Business District and have a facade which consists of large areas of glass with some precast panelling. The initial project to refurbish two floors was completed in 2006 at a cost of $200,000.

Project Participants

Tenant: South Australian Department of Health
Client: DAIS (now DTEI)
Consultant: System Solutions Engineering
Contractor: Corporate Air
Specialist contractor: Air Con Serve Pty Ltd

Challenge Encountered

The South Australian Government encourages the use of energy rating schemes to monitor the greenhouse gas emissions of its office building stock. A five-star rating is generally considered to be difficult to attain for new buildings even if they are specifically designed for the target rating. For existing commercial buildings, which frequently have a legacy of inappropriate design and inefficient energy and water practices, it represents a considerable challenge. Many office buildings of 15 years old or more in Australian cities are rated at two stars or less. Responsible clients are looking to lift their environmental performance while maintaining high standards of thermal comfort for the building occupants.

Innovative Response

The specialist contractor on CitiCentre used the patented Shaw Method of Air Conditioning (SMAC) to dehumidify and cool the outside air intake before merging it with the inside air. The system eliminates the need to use energy twice to overcool and reheat air in order to maintain humidity in the occupied space. Along with tighter design of the system's set points, this allows much greater performance efficiency while improving the level of climate control provided. A more traditional airconditioning approach had previously been considered by the project's originators but the specialist contractor was able to convince the client by pointing to existing installations and their performance data. A change in the consulting engineers for the project helped in the delivery of the innovation. Complementary energy-efficiency strategies were adopted in other areas.

Outcome

The preliminary energy data on the partly occupied building shows that its emissions of carbon dioxide will be about 20 per cent lower than that required to achieve five stars. Greenhouse gas emissions overall have been reduced by greater than 50 percent, and peak electrical demand has been lowered by more than 30 per cent. Along with other performance measures, this ensures that the building will comfortably meet its sustainability target while improving the quality of the indoor environment for its occupants. This result far exceeds the improvement expected when the refurbishment was initially considered. This unprecedented outcome for a refurbished commercial building will establish new benchmarks for energy efficiency in Australian office buildings and help demonstrate Australia's capability for meeting the worldwide greenhouse challenge.

Example 2:
Prefabrication of townhouse upper storeys eliminates OH&S risks

The Project

Four two-storey townhouses were constructed on a small site in a largely built-out area in Warrnambool, Victoria, in 2006. Tight time scheduling and the need to limit OH&S risks led the builder to devise an innovative partial prefabrication approach. The budget for the project was $1.8m.

Project Participants

Client: prospective townhouse buyers
Head contractor: Dwyer Building Services
Consultants: Bayview Design
Subcontractor: Keppel Prince Cranes

Challenge Encountered

Restricted site space and the very close proximity to the boundaries of neighbouring buildings meant that it was difficult to find anywhere appropriate and safe to place scaffolding for the second storey of the townhouses or for roofing. Work was to be carried out at height close to the boundaries, and standard scaffolding placement would have created a risk of disputes with the neighbours as well as OH&S problems for the workforce.

In addition, there was a tight finish deadline as bank interest was accruing and fast completion and sales were needed to beat a forecast market downturn.

Innovative Response

As is often the case in residential construction, the response needed to be relatively 'low tech' as well as low cost. The head contractor modified the structural designs and construction procedures to allow the upper storey of each townhouse to be built on the ground. Additional bracing panels were added for rigidity. The prefabrication was accomplished through careful site management. The completed upper storey module, including steel and timber floor framing, braced wall frames, trussed roof and Colorbond steel roof sheeting, was craned into position, eliminating the need for tradespeople to work on second-storey roofs. The upper storeys were built on site over the garage floor slabs, then lifted, turned 90 degrees and cantilevered over the garages, supported by temporary steel Acrow props to hold upper storeys in place while the garage wall frames below were completed to support the upper-level structure. The lower storey was constructed of traditional brick veneer but the upper-storey walls were lightweight slate tile cladding, which did not require heavy full-height scaffolding.

Outcome

To ensure the prefabricated module had sufficient structural strength and rigidity to cope with being lifted into place by crane, the original engineering design specifications for bracing and tie downs were exceeded. The result is a building which is structurally stronger than the minimum building code requirements, and therefore better able to withstand extreme storm or strong wind events in the future. The building program was streamlined, saving four weeks project time and bank interest. Although the crane hire cost $1500, scaffold costs were reduced by $8000, upper-level safety risks eliminated, and $20,000 saved in labour and site administration costs. Construction team morale was boosted and marketing exposure for the builder was enhanced as the local press covered the installation of the upper storeys.

Example 3:
Bridge fabricated with modular precast sections reaps time savings

The Project

A 6 X 12m-span dual carriageway bridge was upgraded using a precast modular system, with minimal use of in-situ concrete, saving labour costs and construction time. The bridge crosses the Castlereagh River at Deringalla south of Coonabarabran in NSW. It was completed in February 2006 for a total cost of $0.75m.

Project Participants

Client: Warrumbungle Shire Council
Consultant, designer and supplier: Sudholz Bridge and Precast Pty Ltd

Challenge Encountered

The road system in much of regional Australia contains many narrow and deteriorating steel and timber bridges which are unable to support the loads of modern trucks and semi-trailers. The challenge for the rural road network is to design a modular system which can be efficiently constructed in non-metropolitan areas quickly and with a small, skilled labour force. The narrow two-lane bridge at Deringulla needed upgrading to cope with freight from the various rural enterprises in the area including abattoirs, saleyards and grain silos. Without the upgrade, heavy vehicles such as B-doubles had to make an 82km detour between the towns of Coonabarabran and Coolah. A system which could prefabricate the greater part of the bridge structure, transport the modular sections to the site and enable speedy assembly was needed to make the bridge replacement an economical proposition.

Innovative Response

The precast supplier was able to design bored concrete piers to suit the geotechnical characteristics of the site. The remainder of the bridge structures, including columns, headstocks, prestressed deck units and abutments, were fabricated in modular segments in a manufacturing yard and shipped to the site. The connecting system allowed rapid site erection with minimum construction risk and environmental impact. The heavy-duty prestressed deck units require no correctional topping layer, which means that construction can occur quickly even in remote and isolated areas. The modular and systematised nature of the structure makes the design solution repeatable in different locations, provided the local foundation conditions are assessed by a geotechnical engineer. The system can cope with reactive and cohesionless soils.

Outcomes

The prestressed concrete deck to the six spans of the Deringulla Bridge was erected in four working days. This is up to three times faster than a traditionally formed and poured concrete bridge deck, with less likelihood of environmental damage to the river being spanned. The new bridge can carry heavy traffic as specified under AS 5100-2004 SM1600 HLP 320 loading code. The design has delivered a durable, clean-lined and modern structure which is an asset to the local economy and to the community in the surrounding district.

Example 4:
Strong human resource investment pays off for mid-sized contractor

The Project

A mid-sized commercial construction company in Queensland has made very significant human resource investments over the past five years, as part of an internal upgrade project, providing considerable benefits.

Project Participants

Contractor: McNab Constructions
Consultants: Open Up

Challenge Encountered

Many construction companies, especially those active in regional areas, have difficulty finding new team members to support growth. There can also be a problem retaining skilled staff who have family and social commitments that make regional work difficult. This skill shortage is a significant barrier to the maintenance of prosperity, continued competitiveness and overall viability of the industry in many parts of Australia. If this skill shortage is not overcome, growth in regional areas in particular will continue to be constrained, reinforcing population drift to the capital cities and reducing the capacity and sustainability of regional areas.

Innovative Response

The contractor decided to tackle these issues by exploring new approaches to finding and retaining staff, including:

- a profit-share program for all employees who have been with the firm more than twelve months
- mature-age apprenticeships for selected former labourers, who are paid more than normal apprentice rates (to maintain pay consistency with their former positions)
- training investment equivalent to 10 per cent average staff time per annum, including in non-traditional areas, such as cultural awareness
- personal development programs such as 'Open Up', involving deep emotional work to support development of robust team relationships
- providing support of female staff with ongoing responsibility for young children, to help them return to work (for example, female project managers are encouraged to bring their babies to meetings and breastfeeding is supported – female staff who have babies are also allowed to work from home and internet access is provided)
- two days family leave per year to cover things such as caring for sick children
- up to four hours flexible time off allowed for other appointments and contingencies
- workplace agreements negotiated under a no-disadvantage test even though this is now not compulsory
- incentive payments for existing staff who help recruit new workers who pass their probation period
- a financial and psychological counselling for team members and their immediate family.

These initiatives are backed up by policies encouraging recruitment of under-represented groups of staff, including:

- affirmative action for women, who now hold half of the senior management positions in the company
- active pursuit of staff with diverse cultural backgrounds, with employees being sourced from China, India, Ireland, New Zealand, Serbia, South Africa, Sri Lanka and Uruguay.

The Outcomes

The HR investment has assisted in the continued profitability and sustainability of the company, which has doubled in size on average for each of the past four years. Additionally, the annual staff turnover rate is low, currently at seven per cent. These achievements would not have been possible without a strong people orientation.

Example 5:
Project alliance facilitates efficient delivery of complex bridge with zero lost-time injuries

The Project

A new bridge was opened at the end of 2005 to replace the old coastal road between Coalcliff and Clifton in the northern Illawarra district of NSW. The old road had been made unsafe by frequent rock falls. The new structure comprises a balanced cantilever bridge at the southern end meeting up with an incrementally launched bridge at the northern end. Total project cost was $50.2m.

Project Participants

Infrastructure manager: Roads and Traffic Authority of NSW (RTA)
Public interest issue manager: NSW State Government
Principal construction partner and project manager: Laing O'Rourke (formerly Barclay Mowlem)
Design partner: Maunsell Australia
Geotechnical partner: Coffey Geosciences
Community Stakeholders: Communities of Coalcliff, Clifton and other northern suburbs of the Illawarra, from Thirroul to Scarborough.

Challenge Encountered

In August 2003, RTA received advice that a 900m section of road between Clifton and Coalcliff had the highest slope-risk assessment of any road in NSW. Deemed an intolerable public safety risk, the government was forced to close this section of Lawrence Hargrave Drive. This severely disrupted the lives of the people of the northern Illawarra, forcing former neighbours to take a 45-minute detour to get from Clifton to Coalcliff. It disrupted the natural egress from the northern Illawarra suburbs to Sydney, the route followed by those commuting, and by those coming south to holiday in the coastal villages. The community and local politicians demanded a solution be found and the road reopened – as soon as possible.

Innovative Response

Given a deadline by the State government of 24 months to find and construct a solution, RTA chose an innovative approach – an alliance contract. It was the first for RTA and has become for them a benchmark for successful alliance contracting. Initial expressions of interest highlighted a broad range of possible solutions, so a series of workshops were held in which the potential contractors, in conjunction with RTA, narrowed down the possibilities to the eventual solution.

An alliance was formed between the RTA, Laing O'Rourke (then Barclay Mowlem), Maunsell Australia, and Coffey Geosciences. The principal benefits of an alliance contract are a no-blame culture and a pain–gain share regime, which can achieve much higher standards in all aspects of projects. Flowing from the 'alliance culture' is a desire for 'best-for-project' outcomes, rather than the more usual and adversarial 'best-for-us' approach of traditional contracts. One result of this was the Innovation Register, to record and measure performance of innovations during the project.

With the harsh marine environment and a design requirement of a 100-year lifespan, strict management of concrete batching and delivery achieved a remarkable coefficient of variation of the mix constituents of less than 6 (normal is 10–12 and excellent is 8–10). This helped achieve a volume of permeable voids of less than 12, against the contract's minimum operating standard of 13.5. The lower the value, the less permeable the concrete and the longer it can resist chloride attack in a marine environment.

Other innovations saw the incrementally launched bridge achieve a radius curve of 150°, much tighter than any previous curved bridge of this type. This required modification to the launch nosing. This

bridge also had to align accurately with the balanced cantilever bridge at the other end of the project. The traveller formwork on the balanced cantilever bridge was modified to provide a shorter 'drop' for the concrete, preventing aggregate separation, and this produces stronger, better-quality concrete.

Outcomes

The best-for-project approach resulted in many additional innovations, rewarded by the pain–gain share program, itself independently assessed. Innovations to the formwork traveller and a constant emphasis on consistency in concrete production saw exceptionally high levels of concrete quality achieved.

The community was consulted during the 'multi criteria analysis' to select the preferred solution, resulting in the inclusion of a shared pedestrian/cycleway on the seaward side of the bridge which was not part of the original project brief. The additional cost was justified through the best-for-project outlook because it provided a significant benefit, both for the community and tourist access.

The alliance culture also set very high standards for the quality of workmanship and raised the bar on OH&S, attaining quality of finishes rare in bridge construction, and achieving a lost time injury score of zero, after 285,000 worker-hours and 19 months construction. That the alliance team was also able to bring the project to completion two months before its targeted opening — itself a challenging 24 months from closure to reopening — demonstrates the possibilities of the alliance contract delivery method and an innovation-focussed approach.

The centrepiece of the works is now known as the Sea Cliff Bridge. The project has been embraced by the local community and has contributed significantly to the economy of the north Illawarra area.

Project innovations:

- alliance contract delivery method
- 150° radius, curved, incrementally launched bridge
- use of linked balanced cantilever and incrementally launched bridges
- addition of pedestrian walkway/cycleway
- exceptional concrete quality control
- zero lost-time injuries.

↗ Example 6:
Infrastructure project completed six months ahead of schedule thanks to project alliance

The Project

An alliance was formed in February 2003 to design and construct a dam spillway upgrade at Wivenhoe in south-east Queensland, by the best available method. The upgrade also had to include a road traffic system. Environmental licensing and controls were managed along with ongoing community involvement and consultation. This infrastructure project was completed six months ahead of schedule in September 2005 at a total cost of $70m, which was $11.5m below the target construction cost.

Project Participants

Client: SEQWater
Contractor: Leighton Contractors
Consultants: Coffey Geosciences, MWH Australia Ltd, and NSW Department of Commerce

Challenge Encountered

The Environmental Protection Agency's conditions for the project provided strict limits for noise, dust and air pollution, and sediment and erosion control. As the works were

being constructed directly adjacent to south-east Queensland's major domestic water supply, water quality and the control of any sediment-laden runoff from the site was of utmost importance. In addition, the spillway construction and dam upgrade works needed to be completed with minimal disruption to a nearby major highway. The upgrade needed to be delivered promptly while at the same time providing community and environmental legacies that would have long-lasting benefits for the local area.

Innovative Response

The alliance implemented a number of initiatives to ensure innovation was a key focus on the project. All innovative ideas were recorded in an innovations register and were tracked from inception to delivery. Project innovations resulted in the client saving about $30 million prior to the final sign-off of the target cost estimate, when compared to solutions developed in feasibility studies carried out before the alliance was formed.

A series of technical innovations were delivered as a result of the alliance, challenging assumptions made at the feasibility stage of the project. An new spillway location improved the management of releases while minimising downstream impact. The adoption of a three-metre-high S-shaped crest within the new spillway dramatically reduced the spillway width by providing an increase in discharge per unit length of crest. This successful innovation provided a more efficient spillway structure and an initial saving of $4m. Concrete wall linings were applied to the excavated rock face to cope with high velocity flows during operation. Anchor bars were progressively installed in the rock face and accurately located so that reinforcing mesh could be welded to the grouted anchor bars. Shotcrete was then sprayed onto the rock face and the wall given a steel trowel finish from two-metre-high lifts. This resulted in a saving of approximately $1m compared to a formed and poured concrete wall slab and minimised the time required for working at height. A baffle plate structure was constructed adjacent to the existing spillway, and this diverts the flow under the gates when fully raised. As an additional legacy, it also provides a safe work platform for SEQWater to use when they conduct regular maintenance of the gates. A cobble beach made of locally sourced river cobbles and coarse sand-filled voids was designed as a filter zone for all runoff from the spillway entry. This prevented any turbidity reaching the dam as well as improving the aesthetics of the dam's margins. A zero-discharge sediment pond system captured all runoff from the 17-hectare construction site. It was controlled by a valve release system which enabled the site runoff water to be used for dust suppression and irrigation of the rehabilitated areas so that no turbid water was released from the construction site.

Outcome

In addition to the time and cost savings noted earlier, the alliance was also able to successfully implement a work–life balance initiative to increase employee satisfaction. The challenge for the alliance was to create better balance in employees' lives without jeopardising the project's program. After full consultation with site and management personnel, union representatives, engineering teams and designers, the alliance opted to challenge the industry norm of a 5.5-day working week by condensing the project's working week to five days. Employees were encouraged to think smarter and harder about activities and, as a result, the project moved forward with exceptional pace. Additionally, procurement and construction activities were scrutinised by the main contractor from conception to delivery to ensure that work methods were effective and in line with safety and environmental best practice.

The Wivenhoe Dam upgrade resulted in a legacy project known as the Fernvale Futures Partnership Project (FFPP). This partnership, comprising the alliance, Esk Shire Council, SEQWater, Fernvale Chamber of Commerce and members of the local business and residential communities, developed a master plan which included extensive streetscaping and traffic safety initiatives, and improvements to the central parkland. Another key element of this legacy project was the construction of a community information and training centre in the local town, called the Fernvale Futures Complex. The complex now provides tourist information, an Esk Shire Council shopfront, and rooms for the local community, to hold meetings and training sessions (through TAFE). The partnership raised approximately $2m to fund the FFPP, including money pledged by the alliance and SEQWater, as well as the Australian Government which, under its Regional Partnerships Program, contributed $500,000. The FFPP will produce tangible community benefits for many years to come, providing Fernvale with a more cohesive sense of identity, improved regional significance and increased tourism and business opportunities.

The alliance enlisted Queensland University of Technology to independently conduct an assessment of its activities against world's best practice sustainability benchmarks. This study showed the alliance to be at the forefront of the industry and provided key learnings for the participants to implement on future projects or within their current corporate business practices.

Example 7:
Materials innovation and relationship management improve project outcomes

The Project

An integrated processing facility plus transport and logistics operation was constructed for Blackswan/Bluescope Steel, a subsidiary of BHP. The development comprises 670m² of office space, 12,600m² of factory and 59,000m² of hardstand, access roads and carpark. Three private railway lines and sidings are incorporated in the development site. The project was completed in July 2005 at a cost of $17m.

Project Participants

Client: Hyde Park Management
Head contractor: Doric Constructions
Project manager: Incoll Management
Architect: BCM Architects
Structural/Civil engineer: Pritchard Francis
Hydraulic engineer: Hydraulics Designs Australia
Electrical engineer: E Electrical Design
Fire engineer: Schwanke Consulting
Mechanical engineer: D&D Consulting Engineers

Challenge Encountered

The loading requirements for the concrete floors were generally high but also quite variable across the site. The labour involved in placing and tying conventional steel reinforcement in differential sections over large areas of the complex would have been very expensive. Further, the local authority had asked for a high concrete tilt panel around the exterior of the factory, but the client wanted the factory to showcase their own materials. Challenging issues also arose from the integration of the active railway lines into a working factory, while meeting safety standards.

Innovative Response

The builder showed that cost and time efficiencies could be gained by using fibre reinforcement, which can be used for larger area pours (such as 30m x 30m as opposed to 17m x 17m), rather than conventional reinforcing steel. In addition, downstand edges were removed completely as the fibre reinforced slabs can be laid in varying thicknesses to achieve the loading requirements. The concrete panel for the lower part of the external wall was replaced by Colorbond wall panelling which satisfied the local council's aesthetic standards, while providing a product display to passing traffic. Planning software was used for a two week 'look ahead' construction program which closely monitored labour and machinery requirements. Regular subcontractor meetings enabled close tracking of project performance against planned cost and time benchmarks. A flashing light and audio alarm system was used to signal the impending arrival of a train once a beam of light at the siding was broken. The alarm system had an emergency power supply.

Outcome

The builder's materials innovation and emphasis on relationship management ensured that changing client requirements could be accommodated during the construction phase with minimal disruption. The project also incurred no safety infringement notices and only one time loss injury in 60,000 hours of exposure. A strong teamwork approach was able to integrate the work of the diverse and complex service and structural requirements, avoiding the chances of discrepancies in the project planning of the different consultant areas.

Example 8:
Patented technology produces quality reinforcement cages for civil construction

The Project

Patented steel reinforcement cages were manufactured and delivered efficiently for a transmission line project at Millmerran – Middle Ridge which was completed in 2004, with the steel contract being valued at $360,000.

Project Participants

Client: Powerlink Queensland
Contractor: John Holland Group
Cage fabricator: Cagemaker

Challenge Encountered

The most common uses for steel reinforcement cages include roads, bridges, marinas, pylons, foundations and power transmission lines. The fabrication of steel reinforcement cages on site leaves builders and their workforce exposed to the risk of significant injury and lost time due to back problems, strains and cuts, as well as work position fatigue from constant bending. On-site fabrication can also be difficult because of the space required and the degree of quality control needed to produce a consistent, identical product. On remote projects far from the fabrication workshop, transport costs are high and scheduling problems can occur. Any failure to provide the cages to a construction site in good quality and on time can result in expensive cost overruns.

These problems were recognised by the client who opted to use a patented cage system.

Innovative Response

The cage manufacturer chosen for the job has developed a patented method of making cages, which eliminates most typical workplace health and safety problems. One operator is required, working in an ergonomically safe position to manufacture all types of cages.

Off-site fabrication allows the production of cages in large volumes and stockpiling for scheduled call-up without occupying potentially strained site space. This gives contractors more flexibility on the installation schedule, which is especially of value for infrastructure projects located in high-density CBD areas. Mobile fabrication units can be used on projects requiring over 500 tonnes of cage fabrication in extreme and remote locations. Cages can also be fabricated on empty floors in skyscraper construction projects. This production flexibility can give options to resolve long-distance transport cost and delivery problems.

On-site fabrication normally uses a lot of labour and space, and can create safety problems. The patented processes and machines allow a dramatic reduction in the number of staff and amount of space required when used on or off site. In the Milmerran to Middle Ridge project, fabrication was done off site. In both site situations, the ergonomic design of the system reduces the likelihood of accidents and enables a high level of quality control. If the client had attempted to fabricate the cages manually, they might have used 10 workers to produce 10 large cages per day. The patented method resulted in the production of 10 cages per day using only two workers and the space requirements were only 25 per cent of that needed by a traditional fabricator.

Outcome

The fabrication process produced identical, high-quality cages to suit the client's project requirements. The project manager has reported a nil rejection rate for the cages supplied. This was achieved along with a large improvement in occupational health and safety standards and with much less labour, which generated significant savings to the client.

Example 9:
Tight construction scheduling enables bridge replacement with minimum disruption

The Project

A new road bridge was constructed over four tracks of the main western railway from central Sydney. The project was delivered through a design and construct contract for the local council, which included the demolition and replacement of the old concrete and masonry, three-span, two-lane traffic signalised road bridge over the railway, with a new wider and raised single-span five-lane bridge in the same location. The project was completed in December 2004 for a total cost of $10m.

Project Participants

Client: Auburn City Council
Head contractor: Reed Constructions Australia
Client's project manager: Teal Management Services
Design consultant: CW-DC Pty Ltd
Independent verifier: Tierney Opus Pty Ltd

Challenge Encountered

The bulk of the work had to be completed in three weekend shutdowns as the site is in one of the busiest rail corridors in metropolitan Sydney for both freight and passenger traffic. The track also provides access to the Clyde rail yards and there are crossovers and turnouts involved in the track run. The demolition of the massive concrete bridge required a diamond-tipped concrete saw which had to be designed and commissioned specially for the project. The 1500-volt traction power overhead wiring had to be removed from the old bridge and attached to the new bridge with increased clearance from the track rails to the underside of the new bridge. The short time available for complex construction processes meant that scheduling had to be very tightly controlled ensuring that the target completions were achieved in each of the three 48-hour rail shutdowns.

Innovative Response

Good advance planning and preparation were key to overcoming the strict time constraints. A plan of attack was established and checked several times over to ensure maximum productivity during the shutdown periods. The existing concrete arches were partially precut into 'orange-peel' segments of liftable 50-tonne weight during the first two shutdowns, and in the third shutdown the segments were cracked and lifted out of place. The prefabricated steel 'dinosaur' beams of the new bridge plus their concrete plank lids were then slid into place on the same weekend. Two cranes, of 400 and 800 tonnes, were used for the operation. The sequencing of the lifts had to be planned with great care as there was little margin for error.

Outcomes

Preplanning and project liaison enabled the operations to run so smoothly that the final shutdown was completed six hours ahead of program. The new bridge has the structural integrity to cope with today's B-double and semi-trailer trucks, which the old bridge could not safely manage. The higher clearance over the railway track provides improved safety for rail traffic. The original bridge is of a similar age and a short distance from the one which collapsed in the Granville rail disaster of 1977, leading to much loss of life. Safety concerns were paramount throughout the demolition and construction process. Traditional methods of demolition and rebuilding on site would have required lengthy track shutdowns that would have made the whole project unfeasible. The project team was able to deliver a higher-performing bridge using the quickest and safest procedures available at the time.

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