ELEANOR SCHONELL BRIDGE

ACAA TECHNICAL CONFERENCE PAPER

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ABSTRACT

The Eleanor Schonell Bridge is a historic piece of infrastructure for Brisbane, providing the first bridge in Australia specifically designed for the enhancement of a public transport system (buses) and the promotion of other green modes of transport (pedestrians and cyclists).

Identified as a key project for the delivery of a modern transport system for the city, the bridge connects the existing public transport, pedestrian and cycle networks from the south and east with the University of Queensland, which is the second largest traffic generator after the CBD. The bridge has also been designed to make allowances for future light rail.

Although providing the greatest benefit to the University campus users who live south east of the Brisbane River, the provision of this new access also significantly benefits the environment and broader community by encouraging green modes of transport and reducing congestion on the CBD feeder roads.

Through a clear and concurrent vision the project team, made from representatives from the client, consultants and John Holland, worked together to translate the idea of a vibrant community link that reduced carbon-emitting traffic into a construction reality that represents value-for-money and be safe for all involved.

This recognition of the equal demands between the journey for the end user, the client's budget, the architect's flair and the constructor's need for safety enabled the team to successfully deliver a project well beyond the community and client's expectations.

KEY WORDS

ACAA, Green Bridge, Eleanor Schonell Bridge, Cable Stay, Innovation, Sustainability, Brisbane River

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INTRODUCTION

The construction of the Eleanor Schonell Bridge over the Brisbane River is an exemplar project, representing the industry's continual ability to achieve and exceed benchmarks previously considered to mark the high-tide.

Not only does it demonstrate what can be achieved when outstanding individuals are put together in a collaborative team environment with strong leadership, but shows how links with the community can be the start of a legacy beyond the project delivery.

The construction of the Eleanor Schonell Bridge was a complex and demanding project that pushed a highly imaginative, experienced and practical construction team to apply new ideas, new technologies and new methods to solve age-old problems regarding safety, delivery on time and within budget.

In this they succeeded – delivering ahead of time, within budget, and with safety systems and records that have been awarded by the industry, Federal Government and John Holland nationwide.

These measurable results were achieved while maintaining open and communicative working relationships with the client and stakeholders.

The construction of the Eleanor Schonell Bridge is not just an example of the excellence attainable by a construction team when they strive for the best, but it is an example of what can be achieved when people care for their community and act to help improve the life of others.

SCOPE OF WORK

The Eleanor Schonell Bridge, formerly the Green Bridge, is a dedicated two-lane bus corridor with pedestrian and cycle paths approximately one kilometre in length from Annerley Road at Dutton Park to the University of Queensland (UQ) at St Lucia.

The project specifically involved the design, construction and maintenance of:

- A cable stay harp arrangement bridge – first of its kind in Australia
- A busway from Annerley Road to UQ, with a terminus bus station with bus lay-over area on the UQ campus
- Connection of the busway to Annerley Road at the Gladstone Road intersection
- Pedestrian connection from the bridge through a combined cycleway / walkway to Dutton Park and integration of the cycleway / walkway within UQ's bicycle / pedestrian network
- Modifications to T.J. Memorial Park Drive at Dutton Park and College Rd at UQ
- Urban design, hard and soft landscaping and rehabilitation works to the Dutton Park soccer field, busway corridor and bus station environments
- Associated utility infrastructure services and relocations
- An Intelligent Traffic System (ITS)
- Solar power generation system
- Maintenance of the bridge and busway for a 10 year period, with options to extend the contract to 15 and 20 years.

TYPE OF CONTRACT

John Holland was awarded the role of Principal Contractor for the design and construction of the 'Green Bridge Project' on 19 January 2005. The financial delivery model was a lump sum base fee of $55.5 million with pain share / gain share provisions. After client initiated variations the final contract was approximately $59 million.

CONCEPT SELECTION & DESIGN

The client offered very few parameters except that the project:

- Must be a cable-stay bridge.
- Must be less than the established budget of $55.5million.

The John Holland team developed the vertical and horizontal alignments, the bridge's architectural look and feel, urban and soft landscaping outcomes, permanent works design in tune with unique construction methods, logistical, and interface strategies.

THE TEAM

John Holland assembled a well-rounded and experienced team to work seamlessly for the right "solution" for this challenging project.

The team, comprising of industry leading experts, was carefully chosen from within Australia and internationally. The winning team required the right mix of artists and practitioners, designers and constructors, lateralists and specialists, speakers and thinkers. The design team was comprised of the following companies:

- Design Engineers **GHD** were appointed because of the previous positive experience working with John Holland on a number of high profile civil projects.
- Renowned Cable Stay Bridge Designers **International Bridge Technology (IBT)** were chosen because of their outstanding international record.
- Architects **Denton Corker Marshall (DCM)** is held in very high regard in international architectural circles and has previously undertaken many landmark projects around the world.
- Landscape Architects **Wilson Architects** were chosen because of their long history of design work at UQ.

THE PROCESS

The team's vision for the design was to create an experience, rather than a journey, by complementing and not dominating the surrounding shaggy woodlands of Dutton Park, mangrove-lined Brisbane River, and the formal Jacaranda settings of UQ.

This broad definition challenged the project team to quickly analyse the demands of the site to create a number of possible solutions for evaluation. The newly formed project team took a rigorous 'optioneering' approach during the tender phase.

Twenty-two separate options were evaluated, taking into account aesthetics, construction methodology, risk, cost, safety and the environment → a constant quest for value adding within a culture of questioning the status-quo.

Another key aspect to the concept selection process was the decision to develop the design to John Holland's extensive equipment fleet, delivering both economy and surety.

The Outcomes

As a result of the team challenging, developing, and refining the concept design, the associated construction methodologies and techniques are equal to the best in the world → supported by the fact that representatives from international companies have come to the Eleanor Schonell Bridge to gather learnings.

The Eleanor Schonell Bridge is recognised as providing incredible value-for-money for the community of Brisbane. The simple fact that cost savings were made on the initial tender price—$17million under the nearest competitor's price—demonstrates how cost effective the team was in delivering the bridge to a world-class standard.

PROJECT PROGRAM

The project was awarded on 19 January 2005 and was required to be completed ahead of the academic year commencing in February 2007.

Mobilisation on-site commenced in March 2005 with the establishment of site offices and compound in the area of the old Dutton Park soccer field. The temporary jetty was also constructed on the river bank adjacent to the location of the eastern tower.

Permanent works commenced with the first piles being constructed in the river in late April 2005, and soon after additional equipment was mobilised on the western side of the river to begin the piling operations in line with the revised construction schedule.

Through the process of developing the work methods with key members of the team, the schedule reflected realistic and achievable cycle times and activity durations. Through careful selection and monitoring of resources, and detailed procurement planning, we were able to maintain, and in many cases, make up time on the program.

Timely procurement of the key material components of the bridge was fundamental to delivering the project on schedule. This was particularly important for the larger items such as structural steel and precast concrete, where intense activity in the local market threatened to discourage interest from the more capable suppliers.

Where possible, new systems which affected critical path activities were "tried and tested" ahead of time to ensure that critical time was not lost in eliminating "bugs".

The connection of the two structures at mid span was achieved in mid-August 2006, 15 months after the first pile was driven. The remaining deck finishing works were completed along with the mechanical and electrical installations, and ITS from September through November, allowing the project to be handed over to the client in December 2006, two months ahead of the contractual date.

Program Constraints

The project was inhibited by a number of time constraints, particularly in regards to its location within a residential area and the university grounds, as well as the particular time constraints associated with cable stay cantilever bridge design and construction.

The relatively short timeframe required an aggressive construction program with extensive and detailed planning of construction methods to ensure works were completed in time.

Measures put in place included:

- Noisy construction activities were scheduled outside of UQ's exam periods.
- Construction work was only performed between the hours of 7am and 5pm to minimise disruption to the surrounding community.

- Construction work at the Annerley Road Intersection was performed under strict time constraints ensuring peak hour traffic was not impeded.

The very nature of bridge construction also imposed a variety of time constraints:

- During piling and pilecap construction resources had to be expertly managed to optimise productivity during low tides.
- Surveying needed to be completed at the same time every day to avoid the influence of thermal and loading affects and maintain consistent and accurate data. Subsequent construction activities could only then be performed after the predecessor activity's data was confirmed and verified by the design model.
- Final stressing and cutting of stay cables could not be performed until all superimposed dead loads were on the bridge deck, driving the development and implementation of an accelerated program to install all permanent concrete barriers and asphalt pavement on the bridge deck.

CONSTRUCTION

PLANNING AND CONTROL OF CONSTRUCTION OPERATIONS

Such was the technically complex nature of the project that John Holland made the decision to self-perform the majority of work using its ideally suited plant, equipment and expertise. This decision delivered considerable advantages in allowing a high level of flexibility, as well as enabling the team to develop significant innovations that delivered commercial, time, safety, community and stakeholder management dividends.

The project was also divided into two distinct sections – the cable stay bridge, and all other associated works, which included roadworks, busway and the viaduct. This was done to maximise the expertise of specific project team members.

Greater control of the decision-making process was also achieved by having all major representatives, such as IBT, KBR and BCC, on site at all times. This resulted in a very timely decision making process, which greatly benefited productivity.

CABLE STAY BRIDGE CONSTRUCTION

Designed to be constructed using the balanced cantilever method, the bridge involved a high level of designer and constructor interaction to ensure the structural integrity of the partially completed bridge. To address the complex nature of this balanced cantilever technique, the project team embarked on a task of extensive pre-planning and methodology development.

These systems were developed by the entire team with a high level of self-evaluation and learning in mind, resulting in continuous improvement as the detailed design and level of understanding of systems improved.

The design process involved several iterations to refine the design in coordination with the team's detailed methodology for the deck erection. In its final format, the deck erection sequence was broken down into 300 individual activities, each of which represented a change in the loadings on the partially completed structure. For each of these construction steps the design model predicted cable stay forces and deflections in the bridge deck and towers.

The design model demonstrated the extreme sensitivity of the bridge deck to changes in the loadings (in excess of 400mm of deflection), and the risks of overloading the structure. Robust systems and methods had to be developed to guarantee the structural integrity of the bridge throughout the deck erection phase, and the safety of all involved.

Fundamental to this process was the implementation of a survey monitoring regime to track and record the behaviour of the two structures and compare this against the design model's predictions.

With the bridge alignment running east to west, the northern stays and edge of the bridge deck tended to warm up more than the southern half, thus further influencing the deflections. In order to achieve consistent and meaningful results, all surveying was conducted at first light before thermal effects came into play.

These daily survey results, along with all updated load and stay force data, was consolidated and fed into the structural model for review by the bridge designer. To expedite this review process, a member of IBT's design team from San Diego was on-site for the deck erection phase. Through the use of a sophisticated electronic structural model the processing and review of data was completed within two hours for the determination of any changes to the sequence going forward.

MARINE FOUNDATIONS

The design of the river foundations was largely influenced by the vessel impact loadings on the pile caps and required that the 1.5m diameter piles be socketed a minimum of 3m into the bedrock layers, some 25m below water level. The geology of the riverbed consisted of weathered and unweathered phyllite overlaid by marine silts and clays.

In order to give the construction schedule some momentum early in the project and to mitigate potential delays due to unexpected geological conditions two barge-mounted drill rigs were used simultaneously for the piling operations.

TOWERS

To carry the large moments generated by the out-of-balance loads resulting from deck construction, very high reinforcement content was required, particularly at deck level. The interface between the towers and deck was also very complicated due to the congestion of vertical tower reinforcement, deck transverse post tensioning, and longitudinal stress bars to anchor the first of the structural steel elements.

To overcome reinforcement congestion problems the team focussed on reducing the overall bar numbers and refined the splice connection details. The tower longitudinal reinforcing bar diameter was increased to 40mm, reducing overall bar numbers, and lapped splices were replaced by screwed coupler connections.

These congestion difficulties continued at higher levels in the tower around the stay anchorages. This was overcome to some extent by prefabricating the tower cages at ground level and by integrating the support frame for the stay guide tubes in the reinforcement cage. This helped to eliminate complex work at height and demand on craneage time. A high degree of accuracy was required in installing these guide tubes in the tower pours to guarantee the geometry of the future stay cables.

COMPOSITE DECK

The composite bridge deck presented a number of highly complex issues for the team.

The bridge deck is made up of 875 tonnes of structural steel and 492 precast concrete panels (from which 164 unique types were identified).

Each panel was approximately 5m x 3.5m and weighed around 10 tonnes, and was designed for a specific location on the deck. Furthermore, they incorporated the sleeves and ducting required for the mechanical / electrical services and deck furniture.

Due to the high compressive forces encountered in the deck during the construction phase, the reinforcement content in these panels was “solid” at an average of 380 kg/m^3. The panels were carefully placed on the grillage with the reinforcing overlapping with that of the adjacent panels, and the shear studs on the top flanges of the grillage members. These “stitch joints” required an extraordinary planning effort to ensure that there were no clashes between the panel reinforcement and the shear studs on the grillage surface.

Installation of the cable stays formed an integral part of the deck erection process. The stays were installed in several stages and required the stressing team to work closely with the rigging and precast concrete crews. Strand reeving commenced immediately after the bolted splice connection into the structure was completed. Initially only eight of the 31 strands in each stay were stressed. Only when these initial strands were installed and nominally stressed could the precast concrete be installed on the grillage.

The traditional lifting frames used on other projects around the world were simplified to the ‘beam and winch’ method because it was recognised that it could be effectively used in conjunction with a rough terrain crane for precast placement.

CABLE STAYS

The cable stays featured state-of-the-art cable technology, and consisted of cables with 31 or 37 strands, enclosed in a UV-resistant stay pipe in a selected architectural silver colour.

The strands were a die formed seven wire configuration that were galvanized, waxed and individually sheathed with a continuous and wear-resistant coating, providing each strand with a triple protection system.

The strand material is manufactured only by a select few companies overseas, and such was the worldwide demand for it, that all stock for the project had to be procured 10 months ahead of time to secure supply for the project.

Anchorages were first installed in the tower and the deck. The HDPE stay pipe was then hung between the two anchorages using two master strands, and used as a guide for subsequent strand installation. The strand was positioned at deck level and pulled up through the stay pipe to the upper anchorage, using a stay cable strand puller, positioned behind the upper anchorage.

Each strand was tensioned immediately after installation, using the BBR isostress tensioning method, which ensured an equal force distribution among the strands of an individual cable. Compact multi-strand jacks were used for the final adjustment.

INNOVATION

Given the relatively short construction period the project team was challenged to seek innovative solutions in the construction methodologies to improve overall productivity, control potential safety hazards, make use of available John Holland resources and expertise, and to adhere to budgetary constraints.

Throughout the project numerous hours were spent by key members of the team workshopping the methodologies to achieve the best possible outcomes. Among the highlights of these innovations were:

TOWER CONSTRUCTION

The construction of the cable stay towers presented several significant challenges.

The formwork system needed to be highly efficient to meet the rapid cycle times demanded by the construction schedule, be serviceable using the John Holland crawler cranes, and required safe and efficient accessibility to deal with the hazards that come from working at height.

Traditional self-climbing form systems were carefully studied but found to require too many complex operations while working 'unprotected' at heights of up to 55m above the river. These systems would also place a high demand on the attending crane because each face of the jump form had to be individually handled.

To this end, John Holland engaged and worked with a specialist consultant (Cantilever) in the development of the "Donut" access system.

Unique to its design was the use of a crane lifted, fully enclosed, birdcage which could be progressed up the tower following each concrete stage. This system ensured that at no stages were there any live edges or access restrictions, and the entire jumping process could be completed in a single crane lift.

A cantilevered walkway provided access between each pair of donuts and ensured easy access between towers, thus requiring only a single Alimak man / material hoist.

The system proved to be extremely safe throughout the tower construction and removed the need for tower cranes on the job, which were originally planned during the Tender phase.

The formwork system was also unique in that the design was a 'no wet tie' construction and all bracing was external to the finished product. The design also used horizontal waler beams designed as bowstrings.

During assembly of the forms they were constructed with shims to install a pre-camber in the beams and forms, which counteracts the expected deflection of the forms resulting from the concrete pressures.

TOWER ACCESS

The question of access to the main bridge towers for the purposes of installing the stay cables was the subject of much discussion. The concept at the time of tender was to provide scaffold and stair access to all anchorage points on the tower.

As other methodologies evolved, and with the appointment of a cable stay supplier / installer, it became clear that the scaffold and stair solution would be inadequate and inefficient. In particular the amount of crane hook time required to install and remove the large amounts of scaffold was prohibitive, and it was calculated that 4000 manhours would be lost over the project in simply scaling and descending the stairs.

Also unique to the bridge design was that the stay cables actually passed through the tower and were anchored on the outer opposing face of the tower.

Unlike many larger cable stay structures, where the stay anchorage is formed inside a hollow tower structure, access for the stressing equipment was required on the outer faces of the tower. This rendered any fixed scaffold and stair solution ineffective as they created a crane shadow over the underlying anchorages.

To overcome these and a number of other problems, a solution using mastclimbers was developed. The mastclimber chosen was similar to that used in many high rise building developments, though a number of features were added to make it suitable to the task of installing stay cables.

The design and geometry of the bridge required that the stay cables always be installed as a pair, meaning that simultaneous access was required to both the north and south towers. The climbing platform spanned the gap between the respective north and south towers, thereby allowing easy passage for the crews and equipment between stay anchorage pairs.

The climber could also travel relatively quickly to any anchorage pair, and a fold-down deck extended out to form a safe work area immediately underneath each anchorage point. This vastly improved efficiency by eliminating the lost time travelling up and down the towers offered by the stair solution, and allowed a single stressing crew to carry the installation of each stay cable pair without the need to move vertically between towers.

Above all, safety issues associated with crews moving equipment up and down stair towers were eliminated. The crews were able to work safely within the confines of the platform railings at all times, and in most cases were able to leave their equipment at the work face.

The use of the mastclimber also allowed unfettered access to the stay anchorages by the rough terrain cranes. This was particularly important in the latter stages of the project when the crawler cranes were no longer available and access to the anchorages required using heavy multi-strand jacking equipment.

Deck Erection Sequence

Early in the methodology studies, John Holland chose to modify the construction sequence to that proposed during the tender phase. The original concept was to complete the bridge in two halves – the eastern half first and then the western using two 100 tonne crawler cranes mounted on the deck

As the methodologies and detailed construction program for the cable stay structure developed however, a careful study of the required resources determined that constructing the two towers and decks concurrently would not necessitate the need for additional staff or workforce though required fundamental changes to the plant required

By running the two bridge decks concurrently, with approximately eight days in each cycle at a given work front, 'specialist' teams could be formed to carry out activities such as erection and bolting, cable stay installation, precast panel installation, and concrete pouring.

With these four key activities running in parallel over four work fronts, with specialised crews for each task, a high degree of efficiency was achieved and significant program savings delivered.

Whilst the change in the construction program did require a greater investment in plant for the piling operations and temporary works for the pier table and tower construction, it proved far more effective in focussing the team on the required tasks and attaining optimum performance.

This innovative approach to 'rethinking' the program in conjunction with the methodologies was a key contributor to the team's ability to deliver the project two months ahead of schedule.

ECOLOGICALLY SUSTAINABLE DESIGN (ESD)

The Eleanor Schonell Bridge was originally called the "Green Bridge", with the expectation that the delivery of this project would have a positive effective on the environment by reducing carbon-producing and greenhouse gases through the removal of significant car based traffic to the university—the second largest generator of traffic next to the Brisbane CBD, and the encouragement of pedestrian and cyclist green modes of transport.

The project team built upon this very positive 'philosophy' and, having researched numerous "green" issues relating to construction, produced a design that has also delivered energy neutrality and allowed for the harvest and re-use of stormwater run-off.

Green Power

To conserve energy consumption energy efficient and low wattage lights were used. Feature lighting was also minimised to reduce both power requirements and the impact of the bridge on the surrounding area. Cut-off timers and remote operation features were also incorporated to reduce the amount of unnecessary lighting while still maintaining a safe environment for users.

The energy requirement of the bridge is generated by a high profile solar roof, containing 108 x 175W panels.

The solar roof feeds electricity back into the supply authority grid thereby offsetting the mains power electricity used by the bridge at night.

Water Harvesting

Water runoff from the busway and the entire bridge is captured and channelled through a triple interceptor and bio-retention basin at UQ before flowing into the UQ lake system, where it is ultimately used for irrigation of the UQ grounds.

Lifespan

The materials used in the construction of the bridge were also chosen with long-term sustainability in mind. The net volume of the project was reduced during the design phase to the bare minimum to limit the amount of materials used, and consequently wasted during construction and after the design life has expired.

The materials used on the project have also contributed to the longevity of the bridge. Through the use of predominantly high durable materials and through the implementation of a detailed asset management program, it is intended that the bridge life will be extended from 100 to 150 years and beyond.

SAFETY ⇨ ELIMINATING THE RISKS

Safety was a motivating driver behind all decisions on the project, with planning and prevention the two key areas the Project excelled in regards to safety and eliminating hazards.

This approach achieved outstanding safety results, with the project involving more than 300,000 manhours with only one Lost Time Injury.

The inherent safety message of the Project was **Zero Harm**, worn on the sleeve by all those involved both literally and metaphorically. From the very outset safety was seen as the number one priority and this safety philosophy was endorsed at induction and driven through all levels of management, giving ownership and responsibility to each individual.

The Eleanor Schonell Bridge Project had nearly every high-risk activity in the book. The technical complexity and location of the project presented considerable hazards and challenges, including:

- Vehicles, pedestrians & cyclists, and marine traffic passing through site.
- Overhead and underground power, and inground services.
- Contaminated land (heavy metals, asbestos etc).
- Heavy gradient of natural terrain.
- Deep bored pier foundations.
- Working at heights (highest point 70m above water).
- Heavy lifts.
- Marine operations, including working over water.
- Confined space (in piles and marine plant).
- Complexity of works and maintaining quality access and egress.
- Limited structural capacity in an incomplete state – use of methods paramount.

With the high level of risk associated with the project and the complex nature of the works, the team identified early in the project the need to set in place strategies to mitigate, if not eliminate potential safety threats.

Planning was the critical element to the Project Team's success towards safety. The team's 'Fundamental Operational Philosophy' was to identify hazards as early as possible and drive their management solution up the 'Hierarchy of Control' model, being Elimination, Substitution, Engineering, Isolation, Administration and finally Personal Protective Equipment. Using this principle during the design phase the team eliminated from the outset as many safety risks as possible.

An example of eliminating a high-risk activity was in the original process for the installation and erection of the grillages for the bridge deck, which identified unacceptable risks with height and working over water issues. Rather than rely on PPE equipment such as fall arrest and floatation devices, management took the initiative to eliminate these risks through devices such as:

- Modular design so to allow the maximisation of on ground steel and under deck services preassembly, subsequently reducing the amount of working at heights.
- The design and manufacture of fully self-contained work platforms and cage systems, which allowed access to these potentially hazardous areas in complete safety.

One of a number of the project's initiatives was the introduction of a 'Safety Day'. This day involved the entire project team, including all staff, supervisors, plant operators, tradesmen, labourers, and subcontractors, participating in tasks, learnings, and reviews focused on a 'My Workplace, My Safety' philosophy.

The day was entirely dedicated to safety, with no project work performed. The idea of the day was to reinforce to the entire team not to be complacent about safety and to continually review and improve upon safety initiatives and systems.

So successful was the first Safety Day that took place on the 26 August 2005 that the project team took the initiative to organise a second Safety Day on Friday 19 May 2006. The agenda for this day incorporated the learnings from the first so to ensure an even greater understanding of the importance of safety on the project was gained by all.

A key component of the Green Bridge Project's Zero Harm approach, a message symbolically embroided on everyone's shirt sleeve, was the Three R's model of **Refreshing, Reinforcing,** and **Recognition.**

The team continually looked at new initiatives to get the message across, **Refreshing** the focus.

Reinforcing the philosophy on site was a dynamic and ongoing activity.

Recognition of outstanding safety achievements let the project team know the hard work and effort put in to consciously making a difference to safety was being recognised and encouraged more excellent results.

By the end of the project 2055 safety orientated events had been undertaken, including Toolbox talks and Prestart meetings. This number is staggering and clearly emphasised the team's commitment to creating a positive culture of safety.

THE LOCAL ENVIRONMENT AND CULTURAL HERITAGE

The project was undertaken in an area with sensitive environmental, cultural and historic values for the community of Brisbane.

Fig trees of high cultural significance were only metres from the construction site, the heritage-listed Gair Park Anzac Memorial is adjacent to major roadworks, and the heritage listed Brisbane Cemetery bordered the entire southern boundary of the site, were known restrictions to project alignment and ongoing work.

ENVIRONMENTAL MANAGEMENT

With the project situated within highly sensitive marine and parkland environments containing a wide range of flora and fauna, including heritage listed trees, the project team's performance was exceptional, achieving the Zero Harm goal of no environmental incidents.

Dutton Park and the Busway represented a very large catchment area for stormwater and as such required a number of stormwater management measures to ensure sediment flow did not reach the river.

Because of the sensitive marine environment, strict river controls were enforced to minimise the risk of environmental incidents occurring over and in the Brisbane River.

Works on the bridge deck and towers were carried out without incident through the implementation of barrier systems, bunding of fuel and other chemicals stored on deck, absorption mats under all hydraulic equipment, and through general good housekeeping practices.

Special care was also taken with the placement of the temporary jetty, ensuring minimal impact on the fragile inter tidal zone of river.

This environmentally responsible planning was noted and commended on numerous occasions by a range of authorities. The end result is that it is very difficult to identify any impact of construction work.

The project team also adopted a policy of tree retention wherever possible. The alignment route of the busway was changed from the preliminary design to the final design. This new alignment not only protected the heritage listed trees but also enabled the team to retain numerous other trees that were originally marked for clearing.

While the transplanting of 12 trees within the UQ grounds was a contract requirement, the Project Team initiated a transplanting operation at Dutton Park as well, removing and retaining a number of large trees, and ultimately planting five times more trees than were removed.

CULTURAL HERITAGE - YESTERDAY

The project contained numerous European, Indigenous and Environmental Cultural Heritage aspects.

The project team, through detailed planning and a desire to restrict the impact of construction activities, maintained the cultural heritage integrity of the Brisbane Cemetery, Gair Park, and Dutton Park, including numerous heritage listed trees.

Of particular significance were the strong ties developed with the native title claimants, the Turribul and Jagera Associations, and the extensive collection and preservation of European artefacts which were discovered in an early-century landfill found within the construction site.

Realising the significance of the find the project team engaged UQ's archaeological department and organised a dig, where students were on site to retrieve and record items such as bottles and other ceramics which dated back to the early 1900s. The work program was adjusted to allow time for the dig before construction activities continued.

It is a credit to the whole team that the archaeological dig has become a significant insight into early life in Brisbane, with pockets of contamination also discovered within the landfill being meticulously managed so to ensure they did not leach into or affect any adjacent areas of cultural and environmental significance.

The process of retrieving and recording these artefacts was used as a real-life learning experience opportunity for many students within the UQs archaeological studies program.

CULTURAL HERITAGE - TOMORROW

The project team also delivered an engaging cultural heritage process. Realising the legacy that the Bridge would leave, a number of cultural literacy initiatives were implemented. Outcomes included the installation of touch screens at pedestrian nodes and on the bridge, poetry engraved into the concrete and handrails, and the landscape interpreting solar roof.

These screens display a range of features including 'Singing Bridges', which are sounds drawn from the vibration of the bridge cables and amplified through speakers.

COMMUNITY INTERACTION

As a high profile project with a large public interface it was critical to the project's success to manage these interfaces well. During the tender phase some discontented local residents formed a protest group called CRAB (Community Residents Against Bridge).

Through extensive community consultation and a genuine desire to respond to concerns the project team established and maintained excellent relationships with local community groups. This included the employment of a full-time communications officer, regular meetings with community liaison groups, and the adoption of a charity partner.

BEING PART OF THE COMMUNITY AS OPPOSED TO AN IMPOST ON IT

High levels of stakeholder interaction have delivered equally high levels of satisfaction from all concerned parties. What started as a community and politically sensitive project has become a real success story, with the Brisbane City Council, local community groups, and UQ extremely satisfied with the project and the way in which it was constructed.

The effectiveness of the engagement process was demonstrated by the extremely low levels of issues raised via the project's 1800 number info line, which was established at the start of project works.

In particular the Project Team's relationship with its charity of choice, MS Australia, was a standout feature of its dedication and commitment to leaving a positive legacy within the community.

At the start of construction management identified the opportunity to contribute to the community by adopting the neighbouring Queensland branch of the MS Society as its charity of choice. Funds raised through monthly raffles and profits from drink machine sales went directly to the MS Society and delivered immediate benefits to people with MS. The team also donated expertise labour and plant to help the MS Society clean and fence part of its premises, which was in serious disrepair.

The culmination of the relationship came in the form of a gala cocktail and charity auction night at the conclusion of the project. This event proved a highlight for all involved in the project, including stakeholders, employees and the client, with a massive $60,000 raised and donated directly to the MS Society.

The benefits of this relationship will last far beyond the life of the project. The foundation stone for the relationship has been laid between John Holland and MS, but also between UQ and MS. There has been further agreement now put in place involving research into Multiple Sclerosis by the University's Brain Institute

CONCLUSION

The Eleanor Schonell Bridge Project achieved excellent results in regards to time, cost, quality, safety, community interaction, and a range of other objectives.

As a result of a solid investment upfront in resources and the development of methodologies, as well as all stakeholders adopting a best-for-project approach, the project achieved practical completion two months ahead of the original 24 month schedule.

The project was also delivered within the Target Cost Estimate, a price which was 15% more economic than our nearest competitor.

Through rigorous quality control measures and the pride taken by the workforce for doing the job well, an outstanding quality result was achieved, with a Quality Frequency Rating (QFR) of 19, some six points less than the QFR target of 25.

The project has become a benchmark project in Australia in regards to safety, winning the 2005 John Holland Safety Award and the 2006 Queensland Major Contractors Association (QMCA) Safety Award. Only one Lost Time Injury (LTI) was recorded, with this being the secondary infection of a finger cut.

The project was also the first civil construction site in Australia audited personally by the Office of the Federal Safety Commissioner, Mr Tom Fisher, who subsequently granted John Holland accreditation under the new Australian Government Building and Construction OHS Accreditation Scheme.

This project and its success will make it memorable and a talking point for all those involved for years to come.

LESSONS LEARNT

- Make an effort to really understand what your client wants, as opposed to focusing on what you think they need.
- When determining "best for project solutions" ensure the appropriate team is fully engaged within an environment of value adding, leaving dominant egos and opinions out of the equation.
- Innovation is a state of mind encouraged to be creative.
- You can be challenging without being confrontational.
- Elimination of safety hazards is most effective when focused upon during the design and planning phases.
- The success of a project is directly related to the success of the collective as opposed to the individual.
- Becoming "part of the community" as opposed to focusing on how to manage the community is a critical ingredient to an outstanding outcome.
- It is amazing what can be achieved when a team believes in, and strives to deliver, a vision.
- No one has a mortgage on good ideas, the skill in capturing these ideas is in the listening.
- The strength of, and commitment to, a relationship is determined when things aren't going to plan. It is at these points in time when you must walk the walk without changing step.
- Planning is paramount to success.

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