

# **AUSTRALIAN CONSTRUCTION ACHIEVEMENT AWARD 2007**

## **CONFERENCE PAPER**

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### **M7 MOTORWAY – SYDNEY**

**Presented by**

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#### **ABSTRACT**

The 40km M7 Motorway is a two lane dual-carriageway traversing the western suburbs of Sydney. It is Australia's largest operational urban road project and it connects the existing M5 tollroad at Prestons to the existing M2 tollroad at Baulkham Hills.

The project was developed by the Roads & Traffic Authority who called for tenders for this build, own, operate and transfer (BOOT) project in 2001. The Abigroup Leighton Joint Venture (ALJV), comprising Abigroup and Leighton Contractors, was contracted in February 2003 by Westlink Motorway Limited (the Concessionaire) to design and construct the M7. The ALJV subsequently engaged the Maunsell/SMEC Joint Venture as lead consultants for the engineering design.

Major construction commenced in 2003 and the motorway was opened in December 2005, eight months ahead of schedule. As part of the construction works, some 20km of the heavily trafficked local road network connecting with the motorway was also upgraded.

The project also incorporates a 40km off-road shared cycle/pedestrian pathway located adjacent to the motorway which also serves as a services route.

Tolling is entirely electronic with no toll booths or boom gates. Motorists pay only for the distance travelled.

There are 16 interchanges along the motorway. The most complex of these, the Light Horse M7/M4 interchange at Eastern Creek, has four levels including the M4 motorway with three levels of M7 motorway bridges and ramps. It is Australia's first full motorway to motorway interchange.

**Keywords:** M7 Motorway, Abigroup Contractors, Leighton Contractors, 40km motorway, 40km shared path, 20km local roads, tolling entirely electronic, eight months ahead of schedule.

## **1. SCOPE OF PROJECT WORKS**

### **1.1 Project Specification**

The 40km M7 Motorway is a two lane dual-carriageway traversing the western suburbs of Sydney. It is Australia's largest operational urban road project and it connects the existing M5 tollroad at Prestons to the existing M2 tollroad at Baulkham Hills.

The Abigroup Leighton Joint Venture (ALJV) was responsible for delivery of the project under a PPP arrangement with the NSW Roads and Traffic Authority (RTA).

Not surprisingly a number of issues were identified during the Environmental Impact Study (EIS) process which impacted on the technical specification for the Project and which contributed greatly to many of the technical solutions adopted.

In particular, the form of the major interchanges, the quantity and type of bridges required on the Project, the significant hydraulic modelling required to ensure minimum impact of the Project on adjacent areas and the extent of ancillary works such as the shared path and local road work, were all influenced significantly by the Department of Infrastructure, Planning and Natural Resources' (DIPNR) Conditions of Approval and by the RTA's Scope of Work and Technical Criteria.

Following contract award, the ALJV partners undertook major reanalysis of tender designs to ensure that the Project did achieve the required outcomes and also maintained the aims of all stakeholders.

### **1.2 Scale of Project**

The M7 is Australia's largest operating urban road project.

The 40kms of motorway, with a similar length of shared path (4m wide and constructed to Austroads cycleway standard) and 20kms of associated local road works, meant that there were always going to be very big numbers associated with every aspect of the work.

Every quantitative aspect of the Project seemed to be measured on an unprecedented scale – hundreds and thousands rather than ones and twos or tens and twenties.

It seemed to those taking part in the Project that single entities just did not exist. The Project team consciously broke this scope down to manageable portions and adopted a "stretch target" ethos for those components to ensure that the team was not overwhelmed by this scale and that time objectives were maintained.

Some of the startling statistics illustrating the size of the Project are:

### ***Bridges and Interchanges***

- **144 bridges** - these included 34 matched cast concrete box segmental bridges (not previously constructed in NSW) made up of 12 balanced cantilever bridges constructed over existing operating motorway carriageways and other major roads, 15 continuous span bridges and 7 simply supported bridges. Many of these bridges were significant structures in their own right
- **16 grade separated interchanges**, two of which were constructed over existing operating motorways, the M4 and M5.
- The longest bridge is the Hoxton Park Road twin viaduct bridge (651m and 626m viaducts)
- The longest single bridge span is the 94m long balanced cantilever bridge which forms part of the bridge over Old Windsor Road at Bella Vista
- 2,729 reinforced concrete bridge segments cast by ALJV's workers at the M7 precast manufacturing yard at Eastern Creek, which was purpose built and operated by the ALJV to provide a consistent aesthetic quality to the bridges seen from the motorway
- At peak production the precast manufacturing factory used 400 tonnes of concrete a day, had up to 500 bridge segments weighing up to 100 tonnes each stored on site and delivered 14 segments a day
- 400,000 tonnes of concrete used in the M7 bridges
- 30,000 tonnes of reinforcing steel used in the bridges
- The Light Horse Interchange connecting the M4 with the M7 is the largest interchange in the southern hemisphere

### ***Earthworks***

- Over 15 million tonnes of earth moved
- Over 1.5 million tonnes of sandstone placed for pavement works, much of which was procured from other major construction projects being undertaken in Sydney
- Five million tonnes of earth moved for construction of the M4/M7 Light Horse Interchange alone

### ***Paving***

- Almost 500,000 cubic metres of concrete was laid containing 12,000 tonnes of steel reinforcement
- Truck mounted steel-fixing jigs laid an average of 450 metres of reinforced steel the width of each carriageway per day
- Maximum concrete batching capacity of 1,300 tonnes per hour
- Slip form paving machines laid full carriageway width pavement an average of one meter per minute

- Mainline and ramp pavement required 1,000,000 tonnes of concrete and 300,000 tonnes of asphalt

### ***Services***

There were approximately 200 existing utilities which required locating and then relocation or upgrading. These included power, communications, water supply drainage and gas mains. The implementation of the adjustments to these utilities was critical to carrying out construction of much of the work along the M7.

In order to ensure that adjustments were carried out in an orderly and timely manner a specifically tasked group within the joint venture was formed to liaise with the many authorities, to supervise contract work and ultimately gain certification from the relevant authority.

## **1.3 Some Key Features**

### ***The Light Horse Interchange***

The Light Horse Interchange takes its name from the mounted regiment of Light Horsemen that trained in the area prior to departing overseas during the 1<sup>st</sup> World War and this in turn influenced the urban design features of this area.

Almost a project in itself and made up of 12 bridges and eight ramps connecting the M7 and the M4, the Light Horse Interchange was designed to enable easy use and continuous traffic flow between the two motorways.

The interchange, comprising four levels of bridges, was constructed while the M4 Motorway and Wallgrove Road remained as operating roads. Consequently those parts that were constructed over the M4 were carried out using the balanced cantilever construction method. This led to spectacular sights for motorists when match cast concrete segments were being launched over the M4.

Rising 23m above the M4 at its highest point, the interchange has two main bridges crossing the M4, measuring 431m and 397m in length. In total, 802 bridge segments, each weighing 40-100 tonnes were used in the interchange. The interchange also required 5,000 square metres of retaining walls to be built and 5 million cubic metres of earth to be placed.

### ***Bridge Construction***

The original tender included 175 bridges using conventional concrete planks and supertee girders, with longer spans conceived to be constructed from fabricated steel box sections. Detailed planning conducted post tender revealed that the long term temporary traffic arrangements on the M4 and M5 required by this type of construction could be eliminated when match cast segmental units constructed as balanced cantilevers were used.

The balanced cantilever approach to construction allowed normal traffic to flow through the peak hours without limitation while segments were erected at night with only minor disruption to late night traffic.

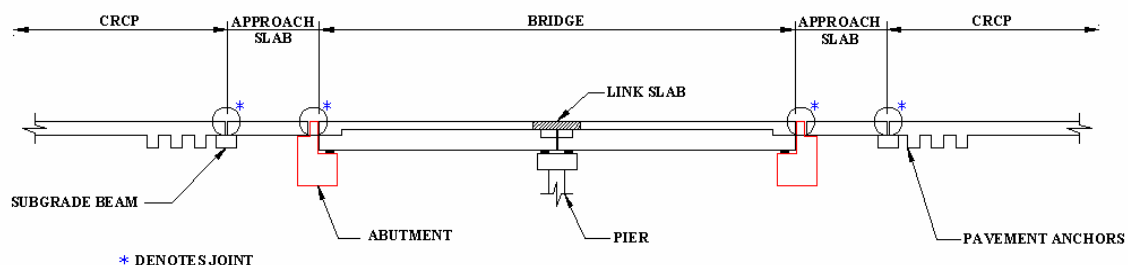
To procure the segments for these bridges, ALJV built its own precast concrete yard for production of match cast segments. As there had been no bridges constructed using match cast box segments in New South Wales, expertise in the construction of the units and then the installation was obtained first by securing the services of a highly experienced precast manufacturing engineer and then by employing experienced engineers from overseas with experience in this type of construction. In addition the ALJV entered into an innovative alliance with VSL to erect the units. Over the duration of the project 2,729 segments were produced at the plant.

Apart from the segmental bridges, the team faced a number of challenges on the Project's other bridges. For example, some pedestrian bridges were required to allow water and sunlight through for the vegetation beneath whilst still maintaining a safe surface for bicycles, pedestrians and wheelchairs. Such challenges resulted in a number of new precast beam shapes being devised uniquely for the M7.

### ***Seamless Pavement***

Innovation was the hallmark of the entire M7 project.

In contemporary practice rigid concrete pavements, including continuously reinforced concrete pavements (CRCP) that were adopted on the M7 motorway, are terminated and anchored at each bridge approach. An approach slab, jointed at each end, provides the link between the pavement and the bridge abutment. This traditional arrangement is shown below in Figure 1. Often this transition is not always smooth as the provision of transverse joints can lead to discontinuities in the carriageway profile, particularly if the approach embankment settles. Maintenance of these transverse joints and the approach pavements can also be very costly and disruptive to traffic.



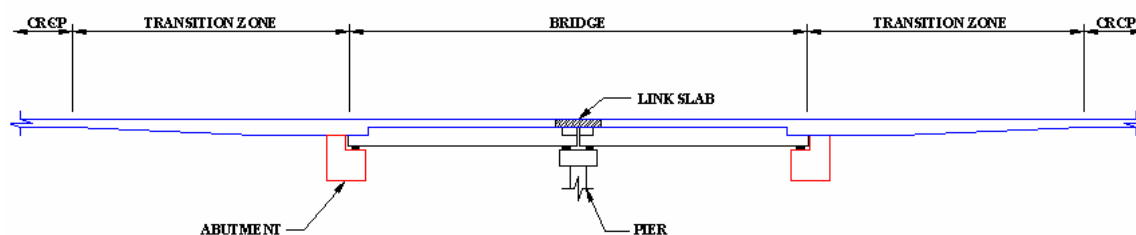
*Figure 1: Conventional CRCP/Bridge Interface*

As indicated above, each of the M7's 40km long two-lane carriageways is comprised of a 10.5m wide continuously reinforced concrete pavement (CRCP) with an asphaltic concrete (AC) wearing surface. CRCP generally allows for the

construction of long pavements lengths without transverse joints. However, due to the number of bridge structures required for the numerous crossings of local roads and watercourses by the motorway, the carriageways cross a total of 68 bridges over the length of the Project. The potential for long-term problems with motorway rideability and maintenance was of concern to the Project team.

To overcome these considerable concerns as well as delivering a range of other significant benefits the Project team began examining an enhancement of the conventional pavement/bridge interface that would eliminate transverse joints by providing a reinforced concrete connection between the CRCP and the cast-in-situ bridge deck. This new innovation developed by the Project team became known as “seamless pavement”.

There has been a long-term trend in multispan bridge construction to reduce the number of deck joints, which has largely been achieved through the use of link slabs at internal piers. The seamless pavement concept is seen as a natural extension of this concept aimed at minimizing the overall number of joints in the pavement (Figure 2). Continuity is achieved by connecting the CRCP longitudinal reinforcement directly into the bridge decks with additional pavement reinforcement provided in the vicinity of the bridge to resist the induced forces.



*Figure 2: Seamless pavement concept*

This elegant yet simple concept requires the bridge and pavement be assessed as a seamless continuum. The bridge, which is stiff compared to the pavement, drags the pavement towards the bridge as it shortens transferring loads to the pavement subgrade in friction. The total movement is taken up in multiple cracks in the CRCP transition zone. The length over which these loads are transferred varies depending upon the imposed strains and the relative stiffness of the bridge and pavement elements. Additional longitudinal reinforcement is provided in this region to ensure that concrete crack widths and reinforcement stresses remain within the code requirements.

### **Seamless Pavement Advantages**

The seamless pavement has the following major advantages over the conventional bridge approach slab and pavement anchor configuration:

*Reduced Maintenance.* Joints in pavements are a continual source of maintenance. The asphalt placed over isolation joints at the interface between the CRCP and the bridge approach slabs is a point of weakness in the wearing surface. Cracking and long-term failure in this vicinity is significantly greater than for other pavement sections and the passage of water through these joints can result in the deterioration of the approach embankment.

Bridge deck joints also require significant maintenance effort. They are locations where water and other contaminants can concentrate, thereby decreasing durability. Replacement of joint seals and resetting the location of the joint are common maintenance activities.

The seamless pavement eliminates all transverse joints from the bridge and pavement so that maintenance at these locations will be no different from any other CRCP section.

*Improved Rideability.* The removal of joints allows the wearing course to be installed in a continuous process, minimizing carriageway roughness and providing a running surface similar to any other location on the pavement.

*Reduced Noise.* The noise of vehicle wheels striking pavement and bridge joints is a cause of considerable community protest in urban areas, often resulting in expensive retrofitting of joints and additional treatment of pavement surfaces. The adoption of the seamless pavement eliminates this problem.

*Reduced Longitudinal Loads on Bridge Substructure.* Bridge structures are designed for the effects of horizontal loads, primarily arising from vehicle braking, centrifugal effects of curved bridges, and impact loads on the superstructure. Traditionally; the horizontal loads have been resisted by load paths through the piers and abutments. By adopting seamless pavement, the horizontal loads applied at deck level can be carried by the pavement well away from the bridge substructure, with a resulting saving in substructure costs.

*Elimination of Bridge Deck Drainage.* Drainage systems are often provided on relatively short bridge decks to minimise the quantity of water flowing across open deck joints. The elimination of deck joints obviates the need for drainage systems on short bridges.

*Simplified Construction.* Construction of the conventional triple anchor system is a labour intensive process that interrupts the effective operation of the paving equipment. It also isolates the area adjacent to the bridge abutment thereby affecting construction vehicle access and the timely completion of follow up construction activities.

The elimination of the pavement anchors and the use of a simple connection to the bridge deck means that the approach slab subgrade beam and subsoil drainage systems associated with the beam and pavement anchors are no longer necessary.

The seamless pavement connection was used on all M7 bridges less than 120m long. An extensive monitoring program was developed as part of the detailed design with the results confirming that the actual performance was consistent with design expectations.

The interest subsequently generated in this design led to it taking out the prestigious Robert G Packard Prize for “Best Innovation in Pavement Design of the Year” at the 8<sup>th</sup> International Conference on Concrete Pavements in August 2005, in the USA.

### ***Stringless Slipformed Pavement***

The M7 also has the first truly “stringless” slip formed motorway paving in Australia, whereby a full width concrete paving machine is controlled by laser guided survey station with no string-lines used.

### ***Other Structures***

*Noise walls.* Much of the M7 route passes through well developed urban areas requiring long lengths of noise walls with heights up to 6m. The noise wall details vary from area to area to reflect the various urban design treatments, which were tailored to individual environments.

Large precast concrete units were used in the majority of noise wall locations to enable rapid erection and to satisfy the program requirements.

*Roadside tolling equipment.* As the motorway is fully electronically tolled, with the toll dependant on distance travelled, tolling points are required at every entry and exit ramp. The design of the gantries to support tolling equipment was optimised to minimise steel quantities without compromising deflection tolerances and to meet urban design objectives.

### ***Traffic Modelling***

Planning for the minimisation of disruption to existing traffic during construction was no “hit and hope” affair. Extensive traffic modelling work was undertaken and this was designed to produce both macro and micro-simulation traffic models that could accurately represent the effects of each of the stages of construction work on the surrounding road network. The model incorporated land use and trip generation modelling to account for traffic growth over the life of the Project.

The Project also required the development of 42 new signalised intersections on local roads as well as the design and erection of around 1800 signs.

## **1.4 Environmental Sustainability**

Another key issue for the Project was the minimisation of the environmental impacts.



A detailed Environmental Management Plan incorporated mitigation measures and environmental safeguards to be followed both during construction and during long term operation of the motorway. The ALJV worked tirelessly with the RTA and the NSW Department of Environment and Conservation to ensure the best environmental outcomes for the Project.

The primary contribution to environmental sustainability is the reduction in greenhouse gases and improved air quality through more efficient operation of road transport vehicles, minimisation of road grades and the bypassing of 60 sets of traffic lights, assisted this.

Environmental sustainability was also promoted through respect of native wildlife and heritage in all areas of design and construction, for example:

- Preserving the Cumberland Woodland and the Cumberland land snail
- Preserving Aboriginal and European heritage e.g. wood stave water pipes and the vent shaft to the original Sydney Water Tunnel at the corner of Elizabeth Drive and Wallgrove Road

The environmental characteristics of the water crossings on the project were enhanced in such ways as:

- Increasing the spans of bridges to minimise disruption to the waterways and in particular to preserve the riparian flows through the adjacent areas
- Interconnecting waterways in parallel box culvert structures and rock lining these structures to maximise amenity to local aquatic life
- Increasing the length of elevated sections of shared path crossings to minimise disruption to the surrounding natural environment and designing the decks of these structures to allow for infiltration of light and water
- Use of a reinforced concrete pavement with a long design life requiring considerably less maintenance intervention

## **2.0 MEETING THE PROJECT DELIVERY CHALLENGES**

### **2.1 Complexity and Difficulty of the Construction Task**

#### ***Special Requirements***

Carrying out construction activities concurrently along a 40km motorway and shared path work front through urban and semi rural communities in western Sydney, together with upgrading of 20 kms of local roads, created enormous logistical, management, site security and community relationship challenges.

The site and the works had to be broken down into manageable sized portions, with each portion appropriately resourced to ensure uniform controls and communications were established across the whole site. An umbrella management overlay was installed to ensure that uniformity of approach was maintained across the Project.

***Construction Complexity, Size and Speed***

Designing and delivering \$1500 million of project works in 42.5 months was always going to be difficult, particularly given the complexities of designing, building, coordinating and gaining approval for such elements as the 40 kms of motorway, 144 bridges, the 16 interchanges, 20kms of local roads, 45 sets of traffic signals, 40kms of shared path and the electronic tolling system and infrastructure.

The Light Horse Interchange connecting the M4 Motorway with the M7 is a four level interchange. It is the largest in the Southern Hemisphere which, because of the program constraints, was required to be constructed over live traffic.

***Time Constraints***

The 42.5 month project deadline for design, approvals, construction and commissioning required project expenditures in the excess of an unprecedented \$60 million per month. The work was ultimately completed in 34 months.

***Systems Complexity and Efficiency***

The most complex stand alone system designed and delivered on the project was the electronic tolling system. Reliability of this system is of paramount importance to the operator and this has now been proven with over 12 months of successful operation.

***Community, Environmental and Heritage Constraints***

The number of nearby residents, commuters and heavy transport vehicles affected by the construction activities on any day was well in excess of 100,000. Keeping disruption of this group to acceptable levels was a major objective.

Environmental constraints included:

- Managing activities for bridge construction over many waterways
- Controlling noise levels on adjacent properties
- Preserving significant areas of Cumberland Woodland flora and fauna
- Preserving all items of heritage interest identified in the comprehensive pre construction investigations carried out by professional heritage consultants and representatives of the local Aboriginal Communities.

***Risk Management***

A regular review of risks was carried out at all levels of the Project's management structure, from the Project Director and the ALJV Management Committee to the smaller teams on every construction workplace.

Risks were categorised into a hierarchy and were managed by those parties who had the experience and authority to deal with them. Some of the major risks included resource availability (personnel, materials and equipment), design and

construction approvals, site access timing and conditions, the project safety culture and industrial relations.

## **2.2 Leadership and Management of the Project Delivery**

### ***Project Team Relationships***

The Project was developed by the Roads and Traffic Authority (RTA) who called tenders for this build, own, operate and transfer (BOOT) project in 2001.

The Abigroup Leighton Joint Venture (ALJV), comprising Abigroup and Leighton Contractors, was contracted in February 2003 by Westlink Motorway Limited (the Concessionaire to RTA for BOOT delivery) to design and construct the M7.

The ALJV subsequently engaged the Maunsell/SMEC Joint Venture as lead consultants for the engineering design.

A focussed, cooperative relationship was developed between all parties to achieve the common project goals. These were achieved to all parties' satisfaction and there were no disputes.

### ***Innovation***

A project of this nature and size requires sound management practices and innovative initiatives to be adopted universally to ensure it achieves its objectives.

An example of this is the variety of tailored solutions required to meet the individual complex constraints of each of the 144 bridges. These constraints included differing levels of focus on traffic management, environment, continuity of resources, access, spoil management and coordination of the six construction teams for earthworks/ drainage, structure, paving, local roads, services and tolling infrastructure.

Design and construction responses to these requirements resulted in a variety of bridge solutions including match cast segmental concrete box girders (constructed as balanced cantilevers or span by span, with falsework or launching gantries), precast planks, precast super tee girders, cast in situ concrete, steel girders and steel trusses. The M7/M4 and M7/M5 interchanges had particularly complex constraints including construction over live traffic and a variety of bridge types.

Other areas of innovation included:

- Adjustment of the original alignment to allow for the importing of about 2 million tonnes of recycled material excavated from building sites, thus reducing its impact on landfill and reducing truck movements on public roads

- Acceptance of the majority of the sandstone excavated from the Cross City Tunnel and the Parramatta Rail Link projects, again reducing landfill disposal
- Establishing a “state of the art” precast factory, local to the site, to manufacture 2729 specialist match cast box segments for the 34 concrete match cast box girder bridges. Controlling this critical activity ensured that quality and program objectives could be achieved
- The design and construction of seamless pavement between the continuously reinforced concrete paving and the bridges structures was pioneered on fifty main alignment bridges. This innovation recently won the Robert Packard award for the most original idea at the International Conference on Concrete Pavements held in the USA.
- Approximately 40% of the concrete pavements were constructed using a stringless setting out technique developed during the pavement program. This meant that the control of pavement set out was guided by laser controlled survey stations and avoided the need for physically setting up strings to guide the paving machines. This was the first time that this technique had been used successfully in Australia
- The Light Horse Interchange connecting the M4 Motorway with the M7 is the largest interchange in the Southern Hemisphere and was safely constructed over and around live traffic
- Some noise barriers were replaced with landscaped earth mounds sourced from local excavation, substantially reducing haulage of fill on local roads
- The state of the art urban design provided a pleasing ambience. Earthworks, retaining structures, bridges, viaducts, underpasses, noise walls, gantries, barriers, fences and landscape elements combine to form a unified design language, in which nothing is jarring or extraneous and all elements sympathetically relate to each other
- Establishing a temporary traffic control room throughout construction which:
  - monitored activity on the surrounding road network
  - ensured a swift response to any incidents which occurred
  - was fully integrated with the RTA’s Transport Management Centre
  - had access to all of the RTA’s closed circuit traffic cameras in the region
  - had additional cameras installed at critical locations which were integrated into the RTA’s surveillance network.

### ***Design Management***

The detailed design, developed by the Maunsell/SMEC Joint Venture in the on-site design office, was managed by an ALJV design management team. External peer review was carried out on the design of many of the critical project elements.

The RTA and the Independent Verifier on site (Sinclair Knight Merz) reviewed and approved all design documents for compliance with briefing requirements.

### ***Planning and Control of Construction***

Planning was based around four geographic zones (very large construction projects in themselves) and systems were put in place for program, cost, technical and quality management.

Many design and construction innovations (e.g. those set out above) were incorporated into the planning process, and without these the incredible project outcomes could not have been achieved. Planning sequences and targets were documented through a hierarchy of programs culminating in a project master program utilising Prima Vera P3.

Cost management challenges included the control of about 200 works contracts and 60 supply contracts for outsourced work, together with direct managed work involving about 1500 direct employees, 250 plant hire contracts and 500 minor works contracts.

Technical and quality performance was subject to continual on site audit from the RTA's project verification team.

### ***OH&S Management***

Many initiatives were introduced to create a strong safety culture. These included:

- Comprehensive induction training
- Rigorous safety auditing
- Safety focus in all work processes
- Creation of a Workplace Initiatives Safety Unit

### ***Industrial Relations Management***

With a direct workforce of about 670 wages personnel, 800 professional staff and almost 13,000 subcontract employees over the course of the work, industrial relations was an important issue.

Following the negotiation of a Project Award applicable to subcontractors and an EBA for direct employees, the ground rules for the Project were firmly established. The conditions and procedures required by these agreements were implemented on the Project and there were no subsequent IR delays on the project.

### ***Project Initiation and Finance***

The RTA originally conceived the project and then, through liaison with industry and experience with other BOOT projects, formulated the project delivery arrangement.

This BOOT form of project delivery meant that the ALJV was integrally involved in structuring of and teaming for securing a cost efficient project financing arrangement for the works.

### ***New Technologies***

There were a number of new and state of the art ideas implemented on the project, including:

- The seamless pavement design and construction concept
- Construction of pavements using the stringless pavement method (essentially a laser guidance system which controlled the thickness of concrete pavement)
- Incorporation of the latest traffic signal technology to allow the complex intersection at Sunnyholt Road to operate
- The use of LED lamps in traffic signals in NSW was pioneered on the M7
- Extensive computer modelling of the Cabramatta and Hinchinbrook Creek catchments with state of the art software to confirm the minimal impact of the M7 on existing developed areas
- Computer modelling of the noise impact of the M7 on the adjacent community using software which produced an output that enabled easy recognition of problem areas by visual review thus providing for the first time a tool which could comfortably be used to demonstrate noise amelioration effects on adjacent properties

### ***Training and Development***

Training of site personnel was fundamental to achieving a safe, harmonious site and certainty of delivery. An extensive training program was implemented on site which exceeded NSW Government requirements by 400%.

## **2.3 Overall Outcomes Achieved**

### ***Achievement of Time, Cost, Quality and Safety Objectives***

With regard to cost management, the original contract price of \$1540m was maintained, with the small exception of approximately \$15m for changes to Client specified requirements for works (e.g. additional local road works).

With regard to time management, the original contractual period of 42.5 months, with a completion date of August 2006, was bettered by over 8 months with the road being opened for traffic in December 2005. To achieve this outcome,

expenditure in the order of an amazing \$60 million per month was averaged over a twelve month period.

Safety awards, such as Workcover's "Best Solution to a Workplace Manual Handling Hazard" were received. The quality outcome on the project was certified by the RTA's Project Verifier.

### ***Client Satisfaction and Project Success***

Our end client, the RTA, is ecstatic with the delivery of the project and the quality of the end result. He has joined with us in submitting the project into the Engineers Australia Excellence Awards in NSW, where the project recently was awarded the Excellence Award in the Infrastructure and Project Management categories, together with the overall Bradfield Award. It was also highly commended in the Innovations and Inventions category.

Subsequently the Project was also awarded an Excellence Award at the national level, the only infrastructure project to do so.

A very complimentary reference is available from the NSW Minister for Roads, describing it as:

- "Enjoying praise from its users and the general Western Sydney communities"
- "It has delivered , in record time, the economic and social benefits sought by Government"
- "One of the foremost engineering accomplishments in recent times"

### ***Stakeholder Satisfaction***

References from members of community Liaison Groups involved with the project testify to their satisfaction with such comments as:

- "At all times the ALJV officers conducted themselves in a most professional manner and engaged with the community in a spirit of genuine partnership'.
- "It was a privilege to watch the M7 take shape....it is amazing ... especially finishing it before schedule".

The success of the Project is further illustrated by the following typical sample of a number of similar statements made by various interested parties and stakeholders.

*"Westlink M7 will provide a safer and more efficient route for heavy vehicles travelling through Sydney, as well as providing improved access to the Sydney motorway network, Port Botany and Sydney Airport. It will be a catalyst for urban renewal. This is a once in a generation opportunity for civic and business interests in western Sydney to regenerate the region and fully integrate it with the rest of Sydney."*

Jackie Kelly, Member for Lindsay

### **3.0 CONTRACT DETAILS**

The project was conceived by the Roads and Traffic Authority of NSW (RTA) and it developed the conceptual design and associated studies to the stage that was required for obtaining Development Approval. This approval was granted with very stringent conditions.

Concurrently with this process, the RTA called tenders for the project on a build, own, operate and transfer (BOOT) basis in 2001. This contract was purpose written to maximise the transfer of risks to the private sector and to also incorporate the stringent conditions of project approval.

Following this competitive tender process, the successful Concessionaire to the RTA was Westlink Motorway Limited (Westlink), a company created for the tender. Both Abigroup and Leighton Contractors were equity participants in this company.

In February 2003, the Abigroup Leighton Joint Venture (ALJV), comprising Abigroup and Leighton Contractors, was contracted by Westlink to design and construct the M7. The contract between Westlink and the ALJV transferred the stringent design, construction and approval condition risks to the ALJV. The ALJV subsequently engaged the Maunsell / SMEC Joint Venture as lead consultants for the engineering design.

All four companies allocated their best staff to the project, creating an exceptional delivery team.

### **4.0 PLANNING & CONTROL PROCEDURES**

#### **4.1 Technical and Quality Management**

The RTA's Scope of Works and Technical Criteria was converted into a design, documented through drawings and technical specifications. These were carefully vetted by the Independent Verifier for compliance with the Brief, prior to approval by the RTA.

Work activities were then packaged and procured as described in Section 2.2 above, and then quality was monitored carefully through comprehensive auditing. Abigroup's Quality Engineering Safety and Environment System (QESE) system was utilised for the management of all quality records.



Document management was a challenge on a project of this size, with over 400,000 documents to be created, reviewed, actioned and stored. These were managed through Leighton Contractors' Electronic Data Management System (EDMS).

The independent audits carried out on behalf of the RTA verified that the project met all quality expectations.

## **4.2 Health and Safety**

An enormous focus was placed on the management of health and safety on the Project.

A comprehensive induction program followed by an ongoing safety training regime was implemented. Concurrently, a rigorous audit program was carried out across all work fronts on the 40km alignment to ensure compliance with all site safety rules and safe work method statements, and to ensure that only inducted workers could access the site.

A Workplace Initiatives Safety Unit was created to identify and implement safer practices across the Project. There were also 10 safety committees consultatively established across the site, with full training backup and a communication network to ensure everybody was kept up to date with the latest issues affecting the work.

A major cultural shift was achieved during the course of the project through training and example, to get ownership of safety right down to the workplace. This was evidenced by a progressive improvement in the LTIFR.

There were no deaths on the project.

Safety consciousness was extended through all work processes. For example, in conjunction with its steel fixing subcontractor the ALJV designed and built a pavement steel fixing jig which won the Workcover NSW "Best Solution to a Workplace Manual Handling Hazard" Award.

## **4.3 Community Relations**

Management of community input was largely achieved through establishment and liaison with five Community Liaison Groups (CLGs), which included the public and council representatives. These CLGs aimed to ensure that all community expectations were understood and addressed, with end benefits fully explained.

A Community Involvement Plan documented all initiatives in relation to community management including letterbox drops, construction updates, local area updates, advertisements, media releases, the project website and public meetings.

Much of the project alignment passed through densely populated areas of western Sydney. In all, the works backed onto approximately 4,000 neighbours all of whom seemed to take an active interest in the design, construction and general community amenity at various stages of the work.

It is testament to the efforts of the Community Liaison Groups that all issues were resolved during the course of the work or shortly after opening to traffic. ALJV has a fine collection of glowing references from members of the public and industry.

#### **4.4 Commercial Viability**

Whilst the Commonwealth Government contributed \$356m towards the project, other costs are completely funded by the collection of tolls.

The commercial viability of the project has been proven, even at this very early stage of use. This has been facilitated by the early completion of the Project and by the public patronage. This was previously unheard of for a toll road in the Australian experience.

#### **5.0 CONCLUSION**

The M7 Motorway was a project of superlatives with everything being bigger, longer and more complex than previous jobs, yet the 40km motorway through the densely populated heart of western Sydney was delivered on budget and eight months ahead of schedule.

The motorway has proved very popular with residents and industry with predicted traffic flows being achieved at an early stage.

Motorists were given an initial one month toll free period to get to know the motorway and there-after they pay only for the distance travelled.

The opening of the motorway has resulted in enormous growth of industry and employment in western Sydney.

#### **References**

Griffiths, Steve; Bowmaker, Geoff; Bryce, Chris and Bridge, Russell, *"Design and Construction of Seamless Pavement on Westlink M7, Sydney, Australia"*.