EHA

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Engineering Heritage Australia Magazine

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Cover Images:

Front – Sydney Harbour Control Tower – Noel Jackling, 5th August 2014.

Back – B-24 Liberator Bomber (A72-109)
For attribution see page 18.

This is a quarterly magazine covering news items and stories about engineering and industrial heritage in Australia and elsewhere. It is published online as a downloadable PDF document for readers to view on screen or print their own copies. EA members and non-members on the EHA emailing lists will receive emails notifying them of new issues with a link to the relevant Engineers Australia website page.

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Editorial

Here is an appeal to EH members in all divisions – or any of our readers. If I am to go on writing, or publishing, interesting stories from around Australia and elsewhere, I need someone to tell me about them and either write them for me, or point the way to the material I need to flesh them out. This is your magazine. If there is something interesting happening in your division, email me and tell me about it. Don't forget I'm isolated up here on top of a mountain and I don't know what is happening, or going to happen, in other states. For instance, I had no idea that the Hydro in Tasmania was having a Centenary this year. I would have loved to do a story about that!

Much of our professional industrial and engineering heritage practice has been about recording historic structures before they get demolished, so it's great to have the occasional good-news story to tell. I have been waiting for a place to record the story of saving the Rockhampton Railway Roundhouse from demolition and facilitating its recycling for many years, but I guess I needed a magazine such as this one. When a visiting Queensland colleague told me the Roundhouse was entering its Centenary year, the time had obviously arrived. I hope to bring you more such stories in future. Other stories have an element of serendipity about them. My partner was recently at an engineers' dinner where one of the guests drew his attention to the small hydro-electric scheme near Batlow in which his father had been involved . It sounded interesting, so I asked our Chairman to follow it up. He did, and came up trumps.

Some stories strike a personal chord. In December1975 my partner, myself and our three children, travelling in a small campervan, were attempting to race the wet season south from the far North, and somewhere near Ingham we came across a very large flooded river and a submerged low level bridge such as described in the story on page 6. My diary doesn't record the exact place, but when I read the Low-Level Concrete Bridge material I had my suspicions. We thought we would be stuck there for the rest of the summer, but a kind gentleman with a large tractor offered to tow us across. If we knew then what we know now about Queensland floods, we probably would have declined – but ignorance is bliss! There were no side railings and the bridge was invisible under the fast-flowing water. The water reached above the wheel hubs and it was weird to look down from the windows and watch fish swimming past.

The process of researching and fact checking these stories can be fascinating and sometimes frustrating and would have been entirely impossible for me – living hours from the nearest decent library – before the invention of the internet, emails, and, above all, Google. In one case frustrating, because wherever I searched I could not find the name of the engineer who was responsible for the structural design of the Sydney Harbour Control Tower. Fascinating, when the B-24 Liberator research led me to discover the detailed fate of a family friend who died in 1945, a few months before the War ended. All we knew previously was that he had been in the RAAF and on active service when he was killed (see page 21).

However, on a lighter note, here is a good one from *B-24 Liberator Australia Newsletter December 2012* :

From the Airport Tower: *Delta 351, you have traffic at 10 o'clock, 6 miles.*

From Delta 351: *Give us another hint. We have digital watches.*

Connections

Congratulations EHQ

Engineering Heritage Queensland received a High Commendation in the National Trust of Queensland Community Awards on 27 August 2014 for their *Engineering Heritage Inner Brisbane walk/drive tour program.* The program comprises a published walk/drive tour booklet, and a series of guided walks and bus tours. The PDF format booklet is on the EHQ webpage at: https://www.engineersaustralia.org.au/engineering-heritage-queensland in Publications & Reports or Archives.

Museums & Galleries NSW (MGNSW)

http://mgnsw.org.au/articles/day-cockatoo-island/ Takes you to the MGNSW website, where they recently added a story about visiting Cockatoo Island in Sydney Harbour. Nothing in very great depth, but it does mention a new exhibition – Shipyard Stories – open until 31st December – see http://www.cockatooisland.gov.au/whats/shipyardstories

Commemorating World War 1

MGNSW have also compiled a list of World War 1 commemorations and exhibitions across the State. As a starting place, see http://mgnsw.org.au/articles/remembering-world-war-i/ For similar lists in other states, try Googling *Remembering World War 1* in your State or Territory. Also, Tim Smith, Executive Director of Heritage Victoria and a maritime archaeologist sent a link to an ABC story *The Silent Anzac*, featuring the AE2 Submarine Commemorative Foundation's 2014 volunteer expedition's work. See: http://iview.abc.net.au/programs/catalyst/SC1302H007S00

British Pathe Newsreel Collection

A Melbourne correspondent sent me a link to the entire British Pathé newsreel collection, now available on YouTube – see https://www.youtube.com/user/britishpathe Much trivia, but many historic moments also.

Vale Bob Harvey – 1950 to 2014

A Canberra Engineer and a Leader in Heritage Conservation

Bob Harvey with his Award of Merit Citation in 2012 Photo Keith Baker

Engineering Heritage Canberra lost one of its treasured members in early August when Bob Harvey passed away after a short battle with cancer. He was 63.

Bob grew up in Queensland and studied Civil Engineering in Rockhampton, but moved to Canberra in the early seventies after completing his studies to take up a position with the then Commonwealth Department of Works. Apart from a short stint working in the South Pacific project managing the installation of water infrastructure on the island of Tarawa as a Federal Government foreign aid project, Bob was to remain in Canberra for the rest of his life.

Very soon after arriving in Canberra, Bob met and then married Tonina. They settled in the then newly developed Southern suburb of Wanniassa, raising three boys in a house that Bob largely constructed himself, a house that is still the family home.

Bob was always fascinated by all forms of technology from steam to radio, to mechanical and civil. He worked hard to recognise the efforts of those engineers that came before him but at the same time was very hands on himself, with a great love of designing, tinkering, and 'fixing' all manner of items.

As an hydraulics engineer within ACT Electricity and Water (ACTEW), which separated from the Works organisation as a statutory authority, Bob championed the cause of heritage recognition and conservation with senior management, ACTEW staff and the wider community. His passion for heritage was instrumental in ACTEW historical assets in the ACT associated with power generation, water supply and sewerage being valued and retained. In addition to his contribution to the recognition of Canberra infrastructure from within ACTEW, his promotion of heritage in the Canberra Division of Engineers Australia was noteworthy. He was an active Division committee member and served as Division Deputy Chairman, along with his participation, leadership and encouragement of new membership in the Canberra Heritage Panel from 1988 to the present. Bob was Secretary of the Heritage Panel (later Engineering Heritage Canberra) from 1991 to 1995, Chairman from 1996 to 1998 and Treasurer from 1999 until 2004. He continued to serve in any role required of him right up until this year, and many readers will have met him at last year's EHA conference in Canberra where he hosted the Canberra environs tour amongst other tasks.

During his time with EHC, Bob was involved with the conservation of the Cotter pumping station including the Hydro Pump, supporting applications for grants for heritage studies, the conduct of oral history recordings, and arranging open days for public inspection of heritage facilities. He also had a major role with the engineering heritage recognition of the Kingston Powerhouse (adaptively reused as Canberra Glassworks), the Tharwa Bridge (recently upgraded for heavier transport) and the Cotter River Dam Precinct (now enlarged as a continuing part of Canberra's water supply). Bob also served as the Canberra Division representative on the National Engineering Heritage Committee from 1996 to 1999, where he contributed among other things, to the National Recognition Program.

Bob was presented with an EHA Award of Merit in 2012 in acknowledgment of the major contribution he has made over many years to the recognition of the engineering heritage of Canberra and more widely, for his promotion of heritage in his work environment and within Engineers Australia.

Bob was farewelled at a service at Norwood Park in the ACT on the 15th of August. His family was joined by hundreds of friends and former workmates, and EHC members were proud to represent EHA at the ceremony. He was a wonderful advocate for engineering heritage and Engineering Heritage Australia, and we will miss him greatly.

Lyndon Tilbrook, Chair, Engineering Heritage Canberra

From the Chair – Bridges and Poetry

After reading some of my published material on the heritage of Canberra, the convenor of a poetry group invited me to talk to the group about bridges. I was happy to do so and put together some photos of bridges in the region as I thought about what might be of interest to a group of poets. While being careful not to overwhelm with technical details (dangerous territory for an electrical engineer), I thought discussion of some basic types of bridge structures would be in order, ranging from the oldest to the newest in the area, along with the materials they were built from. Some stories would be necessary part of the mix, so I thought of Percy Allan as a 19th century NSW bridge engineer improving the timber trusses formerly in use, and some of the disasters encountered by the Commonwealth's engineers working in unfamiliar territory with very limited river flow records.

This was feeling too much like a lecture so I thought of contrasting bridges with spans that intentionally open, like the lift span bridge at Batemans Bay and the bascule bridge at Narooma, with the unintended openings of abutments or complete spans being washed away in Canberra's 1922 and 1925 floods. There were also issues of maintaining and strengthening bridges for increased flood resistance and load capacity, giving rise to philosophical questions as to whether the Allan Truss Tharwa Bridge, opened in 1895 and recently restored (for a time in use without trusses), was an old bridge or a new one. More fundamental thoughts about what bridges represented should have a good chance of appealing to the poetic mind. I felt they represent *safe passage on a journey*, whether that was across water or land, by road, rail or on foot. Happily this sat well with the thoughts of the group which suggested bridges represented *both meeting and separating*. My illustrations of road overpasses clearly satisfied the latter case.

Bridges like the Golden Gate, the Tower Bridge and Sydney Harbour Bridge have become symbols which often define their location, and I was able to suggest that the Kings Avenue and Commonwealth Avenue Bridges, though structurally different, were aesthetically similar and their placement defined the Parliamentary Triangle of Canberra, key to Griffin's design. Commonwealth Avenue Bridge had been described on an architectural website as *the finest building in the National Capital,* and the group agreed that a simpler foot bridge to Aspen Island in Lake Burley Griffin was a close competitor.

We spent an enjoyable and stimulating hour together in the School of Music café, at which I hopefully conveyed that engineering was multi -faceted, and then discovered that one member of the poetry group was a structural engineer who had designed bridges!

Keith Baker, Chair, Engineering Heritage Australia.

[Lake Burley Griffin, including Scrivener Dam and the bridges, was recognised by EA as a National Engineering Landmark in 2001. – Keith Baker]

Images – Canberra Bridges by Keith Baker.

Top: The road under the Commonwealth Avenue Extended Bridge.

Above: Commonwealth & Kings Avenue Bridges from the Black Mountain Tower.

Right: The Aspen Island Bridge.

An Unusual Concrete Bridge in North Queensland

The 1891 Gairloch Bridge over the Herbert River at Ingham

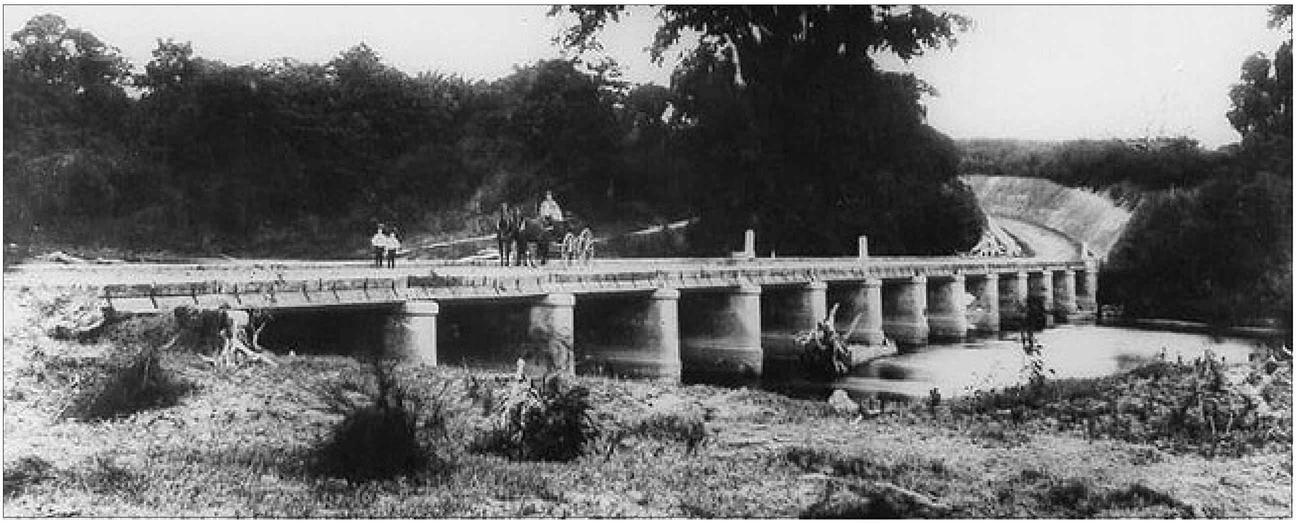
On Tuesday March 18th 2014 a ceremony was held at Ingham to unveil an Engineering Heritage Marker for the Gairloch Bridge. The Marker was unveiled by the Governor of Queensland, Her Excellency Ms Penelope Wensley AC, Rodger Bow, the Hinchinbrook Shire Mayor and Blake Harvey, the President of Queensland Division of Engineers Australia in front of a gathering of some 40 guests – an impressive gathering to celebrate the heritage of what appears on the surface to be a small and rather insignificant bridge. In fact, it still has very high significance, being the first permanent crossing of the Herbert River, the first bridge purposely designed to survive despite being submerged under flooding, and one of the earliest bridges in Queensland to be built substantially of concrete.

The 123 years old Gairloch Bridge, photographed on the day of the award ceremony   Photo – Brian McGrath

Tropical North Queensland is renowned for its regular wet season floods. In the 19th Century, it was a challenge to build bridges which could withstand these floods for more than a few seasons. But the Herbert River near Ingham, with its headwaters on the Atherton Tablelands in the highest rainfall area in Australia, posed a particular problem where bouts of heavy rainfall in the wet season cause the river level and speed of flow down near Ingham to rise very suddenly.

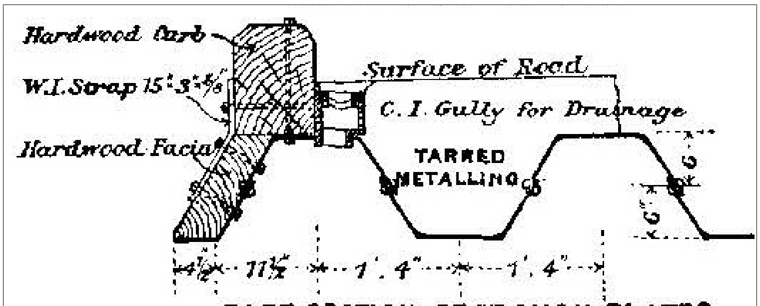
The town of Ingham was founded as late as 1864, but only twenty years later the area had become a major sugar producer and the growers across the north bank were calling for a bridge over the Herbert River to access the port near what is now Lucinda. It's hard to imagine there was no river crossing before 1890 – perhaps attempts at bridges were soon swept away, and punts the same. Perhaps there were fords – but these would only have been safe in the dry season, and not always then. The calls for a bridge that would be safe for most of the year and would survive the monstrous floods were answered by Alfred Barton Brady, an English architect and civil engineer who migrated to Australia in 1884. He became Acting Engineer for Bridges in the Department of Mines and Works in June 1889 and Gairloch was his first design for the Department. Brady's design was outstandingly different – a low-level bridge which would go under water in most floods with a shallow deck structure that presented minimal obstruction to speeding water and debris. Brady's own words present the best argument for his design, in an extract from a paper he presented to the Institution of Civil Engineers in 1896 – *Low-Level Bridges in Queensland, by Alfred Barton Brady, M.Inst.C.E.*

> "IN Queensland and in other parts of Australia where heavy floods are frequent, low-level bridges are necessary for carrying the main stock-routes and roads for mail-coaches, carriers' teams, cattle and sheep over the rivers and creeks in the interior. High-level bridges, above the reach of all floods, would be too costly; and even if constructed would in many instances be unapproachable during the wet seasons, on account of the low-lying country on each side being submerged. Low-level bridges are found to be much less liable to be carried away by floods than semi-high-level structures; and are frequently built even where the higher bridge would, on account of being near to centres of population, be more desirable. Floating logs and driftwood cannot accumulate against a low-level bridge, for debris is not usually carried down-stream in considerable quantity until the bridge is entirely submerged, and then all trees, logs and rubbish can float harmlessly over it. A high-level bridge to be perfectly safe, must be above the level of the highest possible flood, and must admit of the free passage of logs underneath the superstructure. In some instances, during the floods of January 1887, March 1890, and February 1893, high-level bridges have been destroyed, through no defect in the design or fault in construction, but solely on account of the water reaching such a height that the superstructure was subjected to great lateral pressure from the accumulated drift, to resist which they had not been designed. Bridges built at a low level must, however, be of strong and in some localities of exceptional construction, to successfully resist the repeated strains to which they are subjected every year during the flood-season."

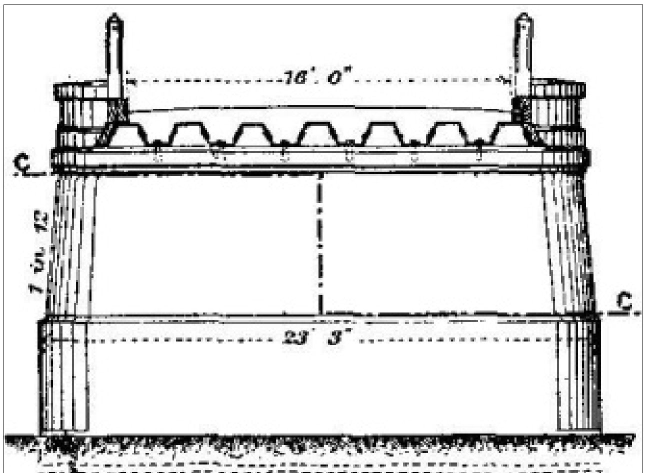


The Gairloch Low-Level Bridge in 1900, viewed from the South Bank. & downstream. Photo from the Hinchinbrook Library Collection

The crossing place chosen was at a wide but fairly shallow stretch of river, where the bridge deck was only about three metres above "normal" (non-flood) water level, but would be about nine metres below the highest flood-mark. The bridge is 147 metres long and consists of 14 spans of 10 metres each. The slightly tapered bulk concrete piers were seven metres wide – the full width of the deck and the low curbs along the edge. The most innovative part of the shallow deck was the mild steel trough shaped plates, riveted together, one up one down, spanning between the piers and acting like lost formwork for the decking material. The steel troughs were painted with three coats of tar and fixed down to the piers at each end with Lewis bolts.



PART SECTION OF TROUGH PLATES.



Section across deck between piers

It would be interesting to know where and how the 10 metre lengths of steel trough were manufactured and taken to the site. Via ship and then how? Bullock wagon? And the pieces of the wrought-iron caissons used for casting those long (7m), narrow piers. How did they get to this remote site? Building this bridge was a mighty adventure, although in Brady's description it appears entirely commonplace. The hardwood curbs and fascias, as seen in the drawing above, and the sand and rock used for the concrete piers were about the only things to be found locally. Everything else had to come by ship from down south, or England, and had to be planned for meticulously. No popping down the street to replace lost tools or buy more Lewis bolts!

Brady says that: *All exposed faces of the concrete in the piers and abutments were floated with a mixture of one part of Portland cement to two parts of sand.* The visible concrete surface of the piers, as seen in recent photographs, appears almost as good as the day it was floated, 123 years ago. Other parts did not weather quite so well. The steel troughs were originally filled with *metalling* (rock) *broken to 2-inch and 1-inch gauges in equal proportions, mixed with boiling coal-tar.* This also formed the road deck above the troughs – pounded and rolled and covered with sand. This lasted until April 1894 when the Herbert river was visited by the most disastrous flood that has ever been recorded in the district, considerable damage occurring to the tarred metal or asphalt roadway on the bridge, necessitating its entire renewal. All of the trough fill and deck above was replaced with concrete, topped off with a layer of tarred metalling and asphalt. This constituted an advanced form of composite construction which hasn't re-appeared in floor slabs and decks until very recent years. The indications are that this concrete fill has remained substantially intact, and it has been in situ for 120 years. The steel troughing has also survived remarkably well – said to be in poor condition at the end span supports, but elsewhere even the coal tar coating appears largely intact, with little corrosion of the steel evident.

The 1891 Gairloch Bridge over the Herbert River at Ingham

The recent photo (at right) of the underside of the deck shows the form of the mild steel troughs and the way they were riveted together. Some corrosion and a little staining are visible where the base of the trough lands on the pier, but otherwise the troughs appear in better condition than some 20-year-old structural steel I have seen in a similarly exposed location.

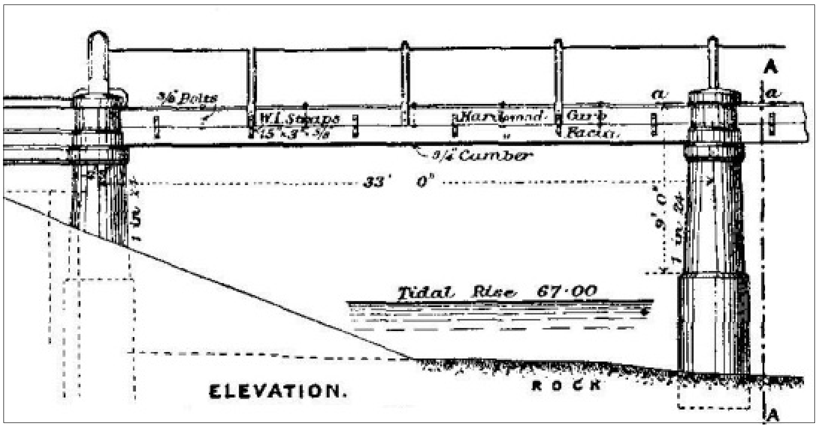
Soffit of the bridge deck A recent photo – source unknown

The hardwood curbs and fascias and the bolts and wrought iron straps holding them on, as shown in section on the previous page, and in contrast to the original decking materials, lasted nearly forty years before having to be replaced by reinforced concrete in 1929.

The bridge deck photographed before 1929 Source unknown.

The photo of the bridge deck at left, with a motor car in the distance, shows the hardwood curbing still in situ. It looks as though the deck surface has been worn away down to the concrete, with piles of broken up asphalt and road metal lying in the gutters along the edge. There are no posts and chain handrails (as shown in the drawing below) – these had disappeared before the 1900 photo was taken – or perhaps they were never installed?

(Left) A recent photograph showing the condition of the bridge roadway surface. Source unknown.



(Right) Elevation of the bridge across one span. Shows the hardwood curb & fascia, the wrought-iron straps and bolts holding them on, the ¾ inch camber of the steel troughs and the 1 in 24 batter of the splayed pier plinth. The thickness of the piers is not shown in the drawing published in Brady's ICE paper.

Gairloch Bridge remains one of the earliest concrete bridges in Australia and, although the existing construction is not to the original design, is the only known bridge using unreinforced concrete and mild steel in a composite construction. It is surprising that no-one else thought of using concrete and steel together in a similar manner for another 50 or 60 years – and then the concrete was usually reinforced in some way. Only a few years later Brady designed another robust concrete bridge at Maryborough in Queensland – the Lamington Bridge – but this one was all reinforced concrete with multiple shallow arches, not quite as thin a deck structure as Gairloch.

Alfred Barton Brady had a distinguished career in the Queensland Government. He was on the way up soon after he designed Gairloch bridge, being appointed to the position of Government Architect and Engineer of Bridges in 1892 and Under-secretary in 1901. He held this position until his retirement in 1922. It is obvious that the 1894 failure of the original fill of the bridge deck did him no harm at all.

References: The principal reference has been the Engineering Heritage Australia Queensland Panel's *Nomination Document for Gairloch Bridge, Ingham, Queensland*. This contains a copy of Brady's ICE paper No.2880 – *Low Level Bridges in Queensland*. That whole document should soon be available for download from the Engineers Australia website. Some information came from Brian McGrath's report of the recognition ceremony. This was published on the EHQ webpage at:

https://www.engineersaustralia.org.au/engineering-heritage-queensland/1891-gairloch-bridge-ceremony-report

Another reference has been the Queensland Heritage Register entry for Gairloch Bridge – found at:

https://heritage-register.ehp.qld.gov.au/placeDetail.html?siteId=3944

Almost the Last Giant Hammerhead Cranes

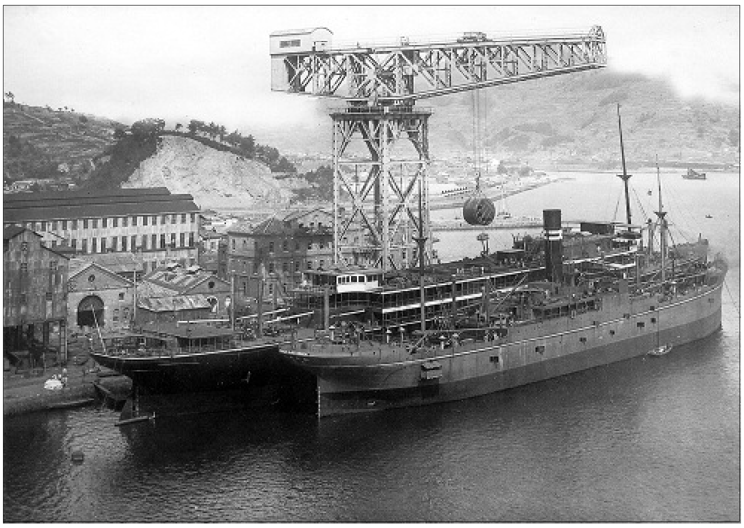
Sydney's Crane Scrapped, while Nagasaki's still working Crane is Celebrated.

I am sad to record the final demise of the famous Hammerhead Crane at the Garden Island Naval Dockyard in Sydney Harbour. The crane was relatively young as these cranes go – it went into service in 1952. It was designed by Arrol in Glasgow, following the pattern of the 'Titan' crane on Clydebank (see the December 2013 issue of this magazine), but was much bigger – at its testing it lifted a 300 ton load and it was rated for 250 tons. There is a good description of the crane in an article at: http://www.mmci.com.au/articles/hammerHead.pdf For a more philosophical view of the crane's place in Sydney Harbour, go to: http://www.afloat.com.au/ and look for Graeme Andrews' May 2008 article in Afloat magazine.

This photograph (at right) was taken by Michael Clarke on 22nd July 2014 and shows the almost completed demolition of the giant hammerhead's boom.

On 17 July 2013, the Department of Defence (Defence) received approval from the then Minister of the Department of Sustainability, Environment, Water, Populations and Communities (SEWPaC) to remove [ie. demolish] *the Hammerhead Crane located at Fleet Base East, Garden Island, New South Wales.* Defence called for *Expressions of Interest and/or tender, proposals to accept free of charge or purchase at a reasonable cost any component(s) of the Hammerhead Crane (except the high value components identified by condition 1 of this approval) for conservation purposes, or any use that sensitively commemorates and interprets the heritage values of the Hammerhead Crane.* In other words, you couldn't just grab any piece that took your fancy and build a backyard shed out of it. Condition 1 was about parts of the crane that were *identified and assigned gradings of heritage significance. . . . . As per the SEWPaC Conditions of Consent, components of high heritage significance are required to be retained by Defence and will be salvaged during the removal, conserved and utilised in future interpretation initiatives for the Hammerhead Crane.* These are detailed in a report of January 2014 at: http://www.defence.gov.au/id/_Master/docs/garden%20island/reports/HHC%20Salvage%20and%20Re-use%20Report%20FINAL%20January%202014%20(For%20WEB).pdf

It is ironic that only five weeks later, on August 20th, the American and British Societies of Civil and Mechanical Engineers jointly dedicated the conserved Arrol Titan Crane on Clydebank an International Historic Civil & Mechanical Engineering Landmark. And now further irony. It is a year later, and the demolition of the Hammerhead is presumably complete – **at the same time as the 1909, 150 ton electric hammerhead crane at the Mizunura Pier of Mitsubishi's shipyard at Nagasaki has been nominated for World Heritage recognition by the Japanese Government.** The crane came from Scotland in 1908 and now sits in the heart of Nagasaki Harbour - the birthplace of Mitsubishi Heavy Industries. It is included in the 'Sites of Japan's Meiji Industrial Revolution' World Heritage nomination. **It is still in working order and regularly used for its original purpose, more than 100 years after it was built!**



The Nagasaki crane in 1913 (left) and in 2014 (right)
Photos from the Glasgow School of Arts Media Centre.

INTERSCAN – A Great Australian Invention

INTERSCAN was an early Microwave Landing System (MLS) for airfields, invented in Australia, which became the International Civil Aviation Organisation (ICAO) world standard for high precision landing systems to replace the older Instrument Landing System (ILS). The development work on INTERSCAN was complex, with the Department of Transport, CSIRO Division of Radiophysics, Hawker de Havilland, the University of Sydney and Amalgamated Wireless Australasia (AWA) all involved. AWA in Sydney built the equipment. Australia teamed up with the United States to submit INTERSCAN to International Civil Aviation Organisation (ICAO) which adopted the system as the world standard for future airfield precision instrument approach systems in 1978.

The INTERSCAN MLS is a ground based precision approach aid to assist aircraft to approach runways and land safely. MLS is particularly valuable in poor light conditions such as heavy cloud and thick fog. The system enables the aircraft to be manoeuvred along a precise, predetermined, final approach path. The system comprises separate components for vertical and horizontal course information on approach, and transmits coded signals to determine the amount of deviation from the optimum approach path. The system is hardware-based with microprocessor monitoring, and is fully solid state with no moving parts. The system meets or exceeds all ICAO requirements.

Image:
One of the early experimental INTERSCAN antennae temporarily installed on the 250° approach at Sydney Airport in c1974. It collected data for the International Civil Aviation Organisation to demonstrate the immunity of the system to signals reflected from hangars.

To the right of the antenna is an Automatic Optical Tracker, developed by the Department of Transport, and used to determine the true position of the test aircraft so that it can be compared with the position indicated by the guidance system.

Source:
Essendon Airways Museum website.

The INTERSCAN project was started in 1973 and was seen as an Australian contribution to international civil aviation. An important purpose was to ensure that the new system chosen by ICAO would meet Australian requirements. The program was not directed towards commercial objectives but possible benefits to Australian industry were recognised. Australia developed a substantial lead in microwave technologies as a consequence of the INTERSCAN project. Despite INTERSCAN being adopted as the standard, a lack of interest by Australian companies in marketing INTERSCAN MLS, contrasted with strong American commercial interest, saw the system taken over as an 'American' system. The great promise of INTERSCAN MLS never fully materialised. The 60-year-old ILS system is still in use in many parts of the world and many countries have recently moved to Global Positioning System (GPS) based automatic landing systems.

Nevertheless, INTERSCAN MLS has been installed in certain specialised locations where operational requirements have dictated a need for the particular combination of precision and flexibility that, for the moment, only MLS can provide. In recent times British Airways chose MLS for Heathrow Airport in London. Their objective was to be able to continue landing in poor visibility conditions, quite common at Heathrow, and hence avoid disruption of their passengers' schedules whenever the airport was closed to other airlines not equipped with MLS.

INTERSCAN – A Great Australian Invention

The United States Air Force adopted MLS using portable ground-based equipment, for use at the most dangerous forward military airfields such as those in Afghanistan. Their objective is to achieve more flexible approaches to airfields where enemy ground fire represents a particular risk. The USAF has equipped its C-130 (Hercules) and C-17 (Globemaster III) transports with MLS equipment. An MLS system was also used by NASA to land the Space Shuttle fleet.

C-130 Hercules Transport Image - United States Air Force

Prototype INTERSCAN equipment was originally installed on the east-west runway at the Melbourne Tullamarine Airport. It has not been in use for many years, so in 2013 it was removed for restoration and future display, at a publicly accessible area at Tullamarine. An exhibit about INTERSCAN is held at the Airways Museum & Civil Aviation Historical Society at Essendon Airport in Melbourne. Essendon Airport is the original Melbourne Airport, and is not far from Tullamarine. The museum has a comprehensive collection telling the story of air traffic control, navigation aids and civil aviation communications systems, with a strong emphasis on Australian technologies.

Image LEFT:
Two different antennae on the INTERSCAN MLS experimental installation at Melbourne's Tullamarine Airport in 1977. On the left is a conical elevation antenna and on the right a planar antenna.
The 'planar' antenna produced a narrow, fan-shaped beam which was swept up and down from near zero elevation to an angle of +15°. The alternative 'conical' antenna was 20 feet high and the scanning beam produced was not fan-shaped but formed an inverted conical surface, co-axial with the elevation antenna with apex at ground level.

Image RIGHT:
The same antennae still in place in 2007. The curved antenna seen lying down in the background is the Flare Guidance Antenna, which was an original requirement of MLS but was deleted from the final standard system.
Both images from Essendon Airways Museum website.

The key scientists involved in the development of INTERSCAN: Brian O'Keeffe (left) & Herry Minnett (centre), of Dept of Civil Aviation, with Dr Paul Wild of CSIRO, with an early INTERSCAN antenna Image: CAHS

Engineering Heritage Victoria conducted a heritage recognition ceremony for the INTERSCAN system at the Airways Museum, at Essendon Airport on 9 November 2013. The National Engineering Heritage Marker has been added to the INTERSCAN exhibit at the Museum. The Marker was unveiled by Ms Madeleine McManus representing Engineers Australia, Professor Brian O'Keeffe AO, formerly of the Dept of Civil Aviation and Roger Meyer OAM, President of the Civil Aviation Historical Society.

Other people who had been involved in development of INTERSCAN attended the ceremony, which created a strong reminder of the ground-breaking Australian INTERSCAN technology and the high profile which Australia has had in the past and continues to strive for in air navigation aids.

From Owen Peake, Chair, Engineering Heritage Victoria

For more reading, go to: http://www.airwaysmuseum.com/index.htm and do a site search for INTERSCAN.

Of particular technical interest are two articles: *The INTERSCAN Microwave Landing System* written in 1978 by Egon Stern, and *A History of the INTERSCAN Microwave Landing System* by Professor H. Brian O'Keeffe.

The Batlow Hydro-electric Scheme & George Brown

The Story of an Exceptional Man and His Extraordinary Project.

Batlow (formerly Reedy Flat) is a small southern New South Wales town located in the western shadow of the Australian Alps and nearly 800m above sea level. Because of its location it has cold winters, a high rainfall and good soils, all combining to make it an ideal place for apple growing. Reedy Flat was established in1855, but later named Batlow after the man who surveyed the town site. Like so many places in Australia, it was gold hunting that originally brought settlers to the area, but when the gold ran out, the locals changed to farming. By 1910, when the township of Batlow was gazetted, it had become a major source of apples for the rest of the state, and beyond, and timber milling was an important occupation. By 1922, there were orchards all over the district – the business was huge and the first cool stores in NSW were built in Batlow. A cannery was needed, but to operate a cannery in 1922, you really needed electricity. Since 1910 a small DC (direct current) plant had provided an electricity supply to the hotel, shops and Hall, but modern industry needed something more, and this is where George Brown came in to the story.

George Brown was one of those people who didn't wait around for the Government, or someone else, to do something that needed doing. He did it himself. He came to Batlow from Sydney in 1910 to manage a mill at Laurel Hill near Batlow, but by 1917 he had set up his own mill, the Batlow Case and Timber Mill, (also known as Brown's No. 1 Mill) on Brown's Hill near the northern boundary of Bago State Forest.[1] By 1922 he was confident enough of his place in the community to stand for election to the local Gadara Shire Council.[2] Still in the 1920s, George Brown and Mr Shedley, the forester-in-charge of the Bago State Forest, were out measuring and marking trees for the mill, close to the Gilmore Falls on the Gilmore Creek. One of them remarked on what a place this would be for an electricity generating plant. The remark stuck with Brown and he set about working out how such a thing could happen.

Gilmore Falls Powerhouse c1934. Photo Courtesy Norman Brown.

By 1930, the town was lobbying for a better electricity supply. A State supply was far in the future, and although the hydro-station at Burrinjuck dam, nearby on the Murrumbidgee River, was producing electricity, none of it was going to the towns in the region. The proposed fruit cannery couldn't go ahead without a suitable electricity supply and the Batlow Progress Association applied to have electricity connected to the town. In 1931, Tumut Shire Council – the successor of Gadara Shire – called for tenders for the supply and George Brown was successful, receiving a 20-year franchise for supplying 3-phase AC electricity to the town. David Byles, an electrical engineer was hired to design and supervise the project.

Boxed Channel Photo courtesy Norman Brown

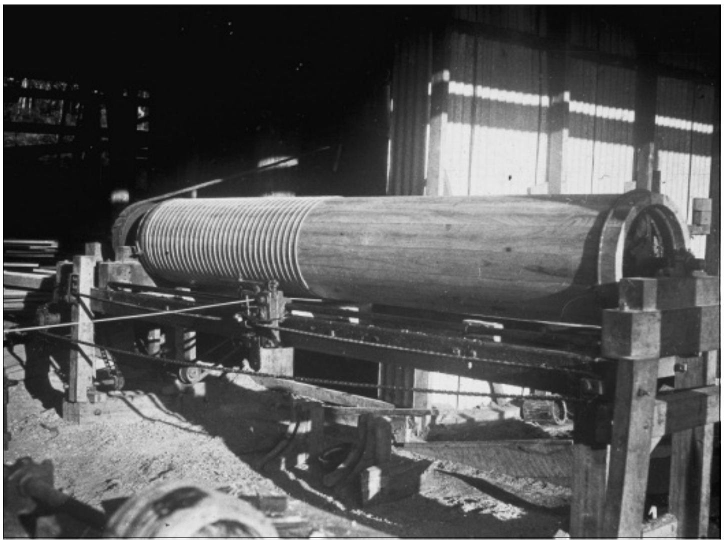
Brown knew of several old water races leading away from near the head of the Gilmore Falls. These had been cut by gold miners, probably back in the 1850s, and left disused since then – but they proved to make a perfect route for building a channel from the water intake near the head of the waterfall to the penstock. These days the channel (or flume) would be built of concrete, but in the 1930s there was no nearby batching plant, or ready mix trucks, or any way to get the trucks through the bush, so George Brown used something he had in abundance – sawn messmate timber.

1 State Forests of NSW - Forests Resources Series No.37 - page 21

2 Adelong and Tumut Express — 27 November 1925.

The next task would have been how to source the pipe for the penstock. Reinforced concrete pipes were a fairly new invention then and would have been far too expensive – and so would steel, or cast-iron pipes. Again – George Brown had the answer, and that was woodstave pipes, like those used by Sydney Water in 1926-27 for an emergency supply from Upper Canal to Pipehead at Guildford and in many other projects before and later. The woodstave mains were manufactured for Sydney Water by the national Australian Wood Pipe Co. Ltd. Their catalogues were available, but as a saw miller from Sydney, George Brown was probably already familiar with the techniques of construction – and again – he had sawn timber in abundance.

The staves for the penstock pipes were cut from messmate again – 1½ inch (38mm) thick, tongue and grooved and dressed and fitted together beautifully to make a pipe of 15 inch (380mm) internal diameter and 10 feet (3m) long. The intricate cutting for this job was done on machinery put together at the mill. The pipes were then spirally bound with 6 gauge (5mm diam.) galvanised wire, again using a machine designed and made at the mill which could wind the wire closer for sections that needed greater strength. The finished pipe was then coated with tar. The separate lengths were joined using wire bound wood stave collars – pipe ends and collars being machined to fit together perfectly.



Mill made machine winding wire on a messmate pipe
Photo courtesy Norman Brown

D.J. Byles, Jack Brown & F. Shinn with a stack of finished pipe collars.
Photo courtesy Norman Brown.

J. Hearn, George C. Brown & Mick Waters putting the pipeline together.
Photo courtesy Norman Brown.

Part of the finished pipeline, showing the pipe collars bolted down to the 31° concrete anchor blocks. Photo Courtesy Norman Brown.

More than 500 feet of pipe was laid down the mountain at a slope of 31° through the scrub to the Power House at the bottom of the Falls. Every 10 feet the pipe joining collars were bolted down to concrete anchor blocks. Were these poured on site? Or pre-cast, dragged to the site and dug in?

The bottom wood stave pipe fixed to the Port Kembla made cast-iron manifold entering the Power House. Photo courtesy Norman Brown.

The concrete footings and floor for the Power House and the pipeline where it entered the Power House were obviously poured on site. What a mighty job that must have been! Every bag of cement and sand dragged down that hill. Did they use pebbles from the creek for aggregate? Or was crushed rock dragged down also?

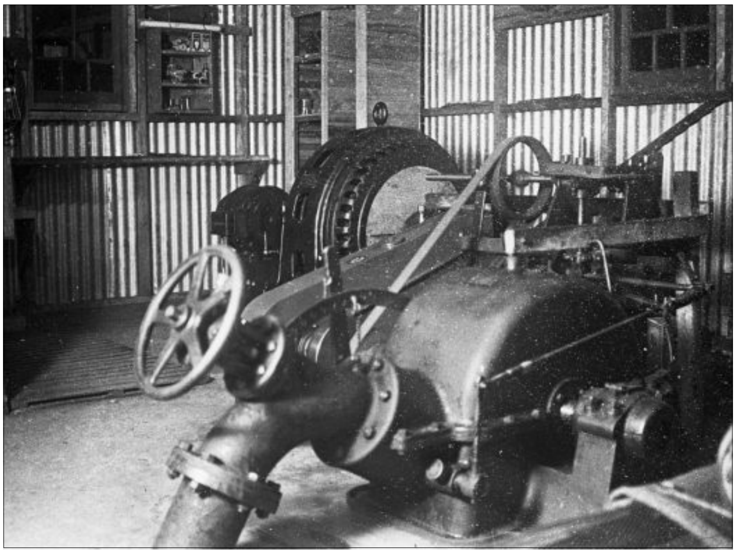
There was a head of 280 feet (85m) at the bottom of the pipeline where it connected to the cast-iron manifold taking the water in to the turbines inside. This manifold was specially cast to Brown's specifications at the Port Kembla Works.

The main plant consisted of a 24 inch Pelton Wheel turbine, made by James Gordon of London, running at 670 rpm, fitted with a spear-valve control, an emergency overspeed device and a centrifugal governor.

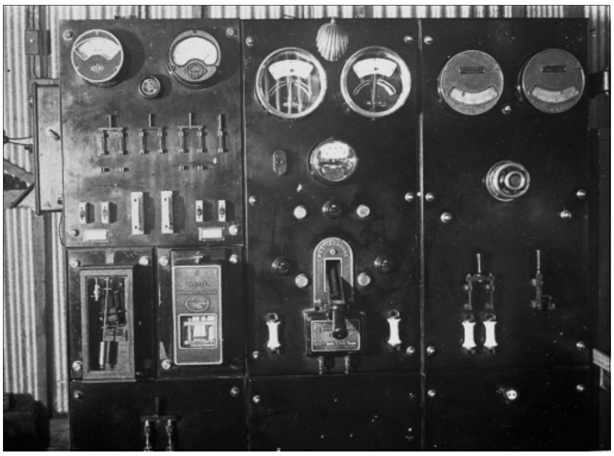
A Renold 1 inch duplex chain drive running in oil, connected the Pelton wheel to a 56 KVA alternator made by British Westinghouse – 2,200 volt, 3-phase, 50 Herz, 1000 rpm, 6 pole fitted with a direct coupled exciter.

There was also a small auxiliary set consisting of one 12 inch Pelton Wheel driving a 1 KW, 110 volt DC generator at 1200 rpm for power house lighting and emergency excitation of the big generator.

"How the Machinery Went Down" – sliding part of the Westinghouse alternator down the hill. Note the heavy rope, the man with a crowbar and the family dog taking an exciting ride. Photo courtesy Norman Brown.



Original plant in the Powerhouse. Shows spear valve control wheel & Pelton Wheel turbine in front, original governor on top, Westinghouse alternator at back and shielded Renold chain drive connecting them. Photo courtesy Norman Brown.



The original switchboard in the Power House. Photo courtesy Norman Brown

The Batlow Hydro-electric Scheme & George Brown

The first hydro plant, with 2nd governor, on display in a museum shed at Batlow. Photo Keith Baker.

The powerline climbed up the hill and through forest and farm to Batlow town, carried on messmate poles – from Brown's mill of course – and the power was switched on sometime between 1932 and 1934.

A Pelton Wheel bucket from the 1st hydro plant shows signs of cavitation. Photo K.Baker

By 1936, the power supply was already proving inadequate for the growing town, so Brown's installed a second pipeline and a much bigger generator, possibly in an adjoining building, since the first Power House was very small. This plant consisted of a Gilkes Turgo Impulse Turbine (with blades instead of Pelton Wheel buckets) coupled to an AEG 150 KVA alternator, again at 2,200 volts, 50 Herz. It is not clear from the information available if these generators were run in parallel, with a second powerline erected as far as the sub-station, or if the second generator superceded the first, which maybe could then have been used as a standby.

The second hydro plant on display in a museum shed at Batlow. Photo Keith Baker.

Brown's hydro plant provided 240volt, 3-phase power for the houses, businesses, farms and factories of Batlow for 25 years, until 1959 when the hydro plant closed. The later history of Brown's mill and power supply are outside the scope of this story, however the Batlow power supply wasn't taken over by the Tumut River County Council until 1963 or 1964. In 1984 The Brown family relocated the hydro plant to a new shed at the Batlow school, and there they are on display with images and printed information.

The information used to put this story together came from a variety of sources, including some internet searching, a story in the Tumut and Adelong Times, a story in the Forestry Corporation magazine, The Australian Heritage Database, material in the Batlow Historical Society Museum, and Mr Norman Brown of Batlow, son of George C Brown, who worked closely with his much loved father for most of the period of operation of the Mill and the Hydro Power Station.

Mr Norman Brown (figure at right) outside the Batlow shed housing the hydro gear. Photo K.Baker.

Keith Baker visited Batlow at my request and came back with nearly all of the above, plus an interview with Norman Brown, a collection of wonderful historic photos, some of which have been used to illustrate this story, plus some informative photographs of his own.

Thank you very much Keith.

The Editor

Diaphone Foghorn at Point Lonsdale Victoria
Saving ships from the dangers of The Rip in foggy weather

The 3 km wide entrance to Port Phillip Bay is known as 'The Rip' and has a long reputation as a very dangerous zone, with its narrow navigable channels, strong currents and often high winds. The lighthouses at Queenscliff and Point Lonsdale assist with navigation for ships approaching and traversing The Rip. The present Point Lonsdale Lighthouse was constructed in 1902. In order to provide an alert for ships approaching the entrance to Port Phillip Bay from Bass Strait in foggy weather, the Melbourne Port Authority installed an audible warning in the form of a diaphone foghorn at Point Lonsdale in 1928. The foghorn remained in-service for about fifty years.


The foghorn shed next to the Point Lonsdale Lighthouse. Photo Miles Pierce

Many locals missed the old horn's mournful warning on foggy winter nights, although more than one or two visitors to Point Lonsdale who wandered too close to the lighthouse as the old horn opened up have been thrown sideways by its assault on their ear drums. The low frequency sound at around 180 Hz is as loud as a jet engine (138 decibels) and can carry 15 km or more out to sea in foggy conditions.

The foghorn was manufactured by the Birmingham (UK) based lighthouse equipment manufacturers, Chance Brothers, and is their 'Type F' diaphone. It has been restored to full working order by a group of local volunteers. The foghorn is powered by a Gardiner two-cylinder kerosene engine coupled to a Reavell 4-cylinder radial air compressor.


The two air receivers in the foghorn shed, with the timing device on the wall at upper left.
Photo Miles Pierce

The air compressor feeds into two large air receivers and the diaphone is supplied with air at up to 35 psi (240 kPa) from these receivers via pneumatically operated valves. In order to produce a pre-determined sequence of the horn blasts there is a mechanically driven timing unit providing pneumatic signals to the 'operating' and sounding' air valves. This timer was originally powered by a belt drive from the Gardiner engine but is now operated by a small electric motor.

The plant is contained in a weatherboard shed with a galvanised iron gable roof and is located immediately to the east of the lighthouse. It originally contained two Gardiner engine and Reavell air compressor sets. The second set was replaced by an electric motor driven, vertical reciprocating air compressor when mains electricity supply became available to the lighthouse. (The second engine-compressor unit is now in the possession of the Queenscliffe Maritime Museum).

Diaphone Foghorn at Point Lonsdale Victoria (continued)

"Type F" diaphone piston Photo Miles Pierce

The 'heart' of the foghorn is the diaphone, a device originally developed to augment the low notes of pipe organs. The Chance Bros. diaphone consists of a hollow bronze cylinder, open at its outward end, with close spaced narrow circumferential slits. The piston fits snugly inside a similarly slotted cylinder. At the inner flanged end of the piston, 'operating air', when admitted thereto, causes the piston to oscillate to and fro about 90 times per second. As a result, the piston and cylinder slits align and then misalign at twice this frequency. Each time the slits align, a large volume of separately valved 'sounding air' passes into the hollow piston and escapes to free air via the resonator trumpet which protrudes from near the top of the roof gable. The successive compression and rarefaction of the air issuing from the diaphone, reinforced by the resonator trumpet, produces the very loud, approximately 180 Hz low-frequency sound.

The foghorn trumpet. Photo - Miles Pierce

The restored Point Lonsdale diaphone foghorn is operated on special occasions, with the compressed air supplied by the Gardiner engine – Reavell air compressor set. (For regular use during foggy weather, the Port Authority has installed a small modern audible warning system in a nearby former defence bunker). Operative diaphone foghorns are now quite rare in the world, however, across Bass Strait, at the Low Head light station on the eastern side of the Tamar River mouth, a similar foghorn, but with the larger 'Type G' diaphone, has also been restored to working order by a group of Tasmanian volunteers.

From Miles Pierce and Owen Peake

References: In 2009 The Queenscliffe Maritime Museum lodged a nomination for the Engineers Australia Colin Crisp Award for their work on restoration of the foghorn. That document was used in preparing this report.

A description of the 'Type F' diaphone can be found at: http://homepages.manx.net/fredd/diaphone.html

'Lost Sounds' by A Renton, Whittles Publishing, 2001.

Victorian Engineering Heritage Inventory

The Point Lonsdale Foghorn story comes from an entry in the new and developing Victorian Engineering Heritage Inventory. The idea of creating an inventory or listing of places and objects of engineering heritage in Victoria was developed by Miles Pierce and put to the Engineering Heritage Victoria Committee in 2011. The idea was adopted. It was decided that inventory entries would comprise of no more than two pages of text, including images. The idea for the Inventory is based on a similar database facility on the New Zealand IPENZ Engineering Heritage website. To date, around thirty entries have been written by members of the EHV committee with more 'in the pipeline'. Each entry includes references for obtaining further information, including reference to Engineering Heritage Recognition nominations where applicable.

Discussions have been entered into with Heritage Victoria on the possibility of hosting the VEHI material on their secure Hermes database that is accessible to accredited researchers, and with the general public then having access via the coupled on-line Victorian Heritage Database. A current upgrade of the Victorian Heritage Database is intended to make it easier to use, including via mobile digital devices. Other hosting options may also be considered. It is expected that searches would at least be available for 'Region' (e.g. Gippsland) and broad 'Category' (e.g. bridge, power-station). In the longer term, accessibility via a Smartphone App would allow searches for places/objects 'near me'.

I hope that eventually, the whole Inventory will be available on the Engineers Australia website, and that the other EH Committees in other EA Divisions will adopt the idea for their own areas. Expect to find more entries in the Magazine from time to time. *The Editor*

The B-24 Liberator Bomber

A Legendary Long Range Heavy Bomber used by the RAAF in World War Two

This B24 Liberator (A72-109) was operated from the RAAF No.7 Operational Training Unit (OTU) at Tocumwal NSW.
Image: RAAF Photographic Training Flight, East Sale

The Liberator story is a complex one. The aircraft was a key weapon on the Allied side in both the Pacific and European theatres during World War II. The development and manufacture of the aircraft in the United States was both innovative and heroic. In Australian service with the Royal Australian Air Force (RAAF) the aircraft played a key role in fighting back against the Japanese presence in the South West Pacific Region.

In more recent years the restoration of the last Australian Liberator, A72-176, has been a great story of dogged determination to get the job done and mateship within the Liberator Community. Each of these aspects is an engineering heritage story in its own right.

Historical Context

In the dark days after the bombing of Pearl Harbour on 7 December 1941 and the entry of the United States into the Pacific War, a powerful alliance was formed between the US and Australia. The United States moved its huge industrial economy into top gear in order to protect itself. Australia provided the bases and facilities to form a jumping-off point for military action to defend the South West Pacific Region. Australia and the United States fought together until the end of the War and have remained close allies ever since.

As a part of the Australia–USA alliance Australia acquired a fleet of 287 B-24 Liberator long range heavy bombers for the RAAF. These aircraft became the principal heavy bomber of the RAAF until the end of the War.

Consolidated Aircraft Corporation and the Liberator

The B-24 Liberator was conceived, designed and built by Consolidated Aircraft Corporation (1923 – 1993) of San Diego, California. The founder of this company, Reuben H. Fleet (1887 – 1975), had long experience in aviation and proved to be a great salesman for his products. He also employed the best aeronautical engineers of the time. When the Liberator was ordered in huge numbers Fleet realised that his company facilities in San Diego could not meet the demand. A plant was built by Ford Motor Company at Willow Run in Michigan, and this plant built nearly half the 18,400 Liberators produced. Consolidated also built a plant at Fort Worth, Texas to produce Liberators.

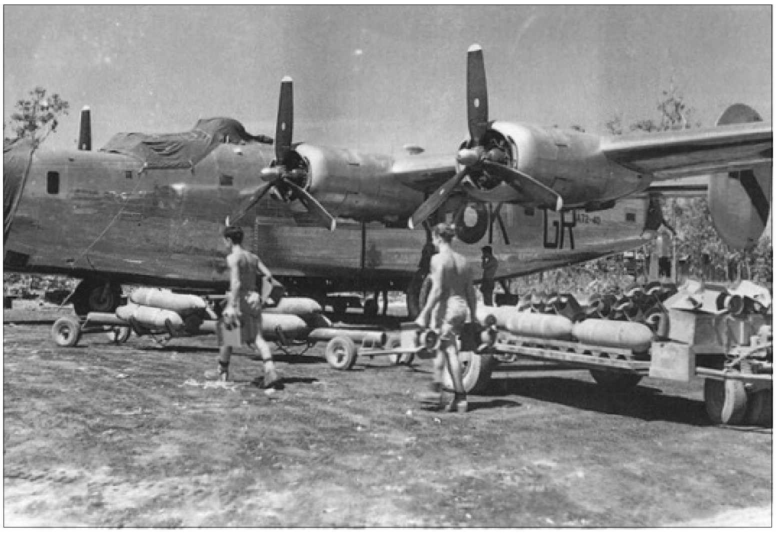
B-24 Liberators under construction at the Consolidated Factory at Willow Run, Michigan USA
Image: US Army Signal Corps, 1940 to 1945.

The B-24 Liberator Bomber

The Liberator was used by many Allied air forces during World War II. More Liberators were built than any other American military aircraft during World War II. It could carry a heavier weapons load further and fly faster than comparable heavy bombers.

Liberator Engineering Innovation

The Liberator first flew at the end of 1939 and it incorporated a number of design innovations. Most importantly it incorporated the Davis Wing design which gave greater lift and allowed the B-24 Liberator to carry greater bomb loads, and to fly higher, longer and faster than other bombers of the time. The aircraft also incorporated Fowler flaps (which were relatively novel in the late 1930s, although most modern airliners incorporate them). The Liberator was the first four-engine large aircraft to incorporate a tricycle undercarriage and later Liberators were fitted with airborne search radar which was novel at that time. The four engines for the Liberator were a high point of aeronautical engineering. The huge 1200 horsepower, 14 cylinder, air cooled Pratt & Whitney Twin Wasp radial piston engines were highly complex but proved to be very reliable. Huge numbers were produced and were used on many aircraft types including the legendary DC3 freighter / airliner, and the Consolidated Catalina maritime reconnaissance aircraft, also operated very successfully by the RAAF during World War II.



The Liberators in RAAF Service

The Liberator proved to be very effective in the hands of skilled and dedicated RAAF crews. RAAF Liberators flew from bases in Northern Australia and the Islands. Their principal targets were Japanese airfields, fuel storage facilities and merchant navy shipping. They tore craters in hundreds of runways to make them unusable, bombed fuel supplies and sank freighters supplying forward bases.

Above: 24 Squadron RAAF Liberator A72-40 being loaded with bombs, probably at Fenton in the Northern Territory circa 1944-45. Photographer unknown.
Image: Courtesy ADF-Serials Image Gallery.

Right: Liberator A72-189 carried CGS General Blamey to the WW2 surrender ceremony in Tokyo Bay in September 1945. Shown here at Haneda, Tokyo.
Image Source: Mike Mirkovic.

Left: B-24 Liberator A72-176, (see "The Last Survivor" below) served at No.7 Operational Training Unit (OTU) at Tocumwal. It was Group Captain Kingwell's aircraft during the war. It last flew Sale-Dubbo-Sale in 1946 then became "Instructional Airframe No.5" at No.1 OTU East Sale until it was sold in 1948. This is the same fuselage now under restoration at Werribee. Photo: Bob Brown, Tocumwal Historic Aerodrome Museum..

The Last Survivor – A72-176

The only Liberator surviving in Australia has been largely reconstructed by the B-24 Liberator Memorial Restoration Australia Inc. at its base at Werribee, south west of Melbourne. The derelict fuselage of this aircraft, RAAF serial number A72-176, was acquired from Gippsland in 1995. The wings were salvaged from a crashed Liberator in New Guinea; other parts came from all around the world; engines were acquired from various sources and some parts were re-manufactured from scratch. The aircraft has been under restoration for over twenty years and is now nearing completion. It will not be restored to flight condition but will be complete in every other way including the ability to run all engines.

As mentioned before, the Liberators were equipped with an airborne search radar. In very recent times a radar of the correct type has been acquired by the B-24 Group and is currently being restored prior to installation in the aircraft.

B-24 Liberator A72-176 at the Werribee hangar – shown with its engines fitted. Image: B-24 Memorial Restoration Aust.

The Engineering Heritage Victoria Role

Engineering Heritage Victoria recognised the rebuilt A72-176 Liberator with an Engineering Heritage International Marker at a ceremony at Werribee on Sunday 13th July 2014. At the same ceremony, the timber-framed aircraft hangars at Werribee Satellite Aerodrome were also awarded an Engineering Heritage Marker. There were once 5 similar hangars at Werribee, using very long span timber roof trusses up to 130 feet in length. These aerodrome hangars were American designed, but to save precious steel, their design was modified by Australian engineers to use plentiful Australian hardwood, allowing the hangars to achieve similar spans to their USA steel counterparts. The 130 foot wide hangar is the last of its kind in Victoria, and the 96 foot hangar – which houses the restored B-24 Liberator bomber – is the last of its kind in Australia. Thus both the B-24 Liberator Bomber and the Werribee Satellite Aerodrome Hangar housing it are the last of their kind in Australia and hold much historical significance for Australians. *Owen Peake, Engineering Heritage Victoria.*

Above: A72-176 in its hangar on the day of the ceremony, 13th July 2014. — 2 stitched photos - Judy Baker.

Below:: An original Pratt & Whitney engine from A72-176 at Gippsland Armed Services Museum in Sale.
Photo: Martin Edwards

Left: Looking from the bomb bay of A72-176 towards the cockpit.
Photo Owen Peake.

Right: Cockpit assembly in the hangar, waiting to be installed.
Photo: Judy Baker.

The Werribee Hangar Home of B-24 Liberator Bomber A72-176

Above: The 96 feet (29 metre) wide timber structure aircraft hangar at Werribee on 13th July 2014 – the day of the Engineering Heritage Recognition Ceremony. Photo – Keith Baker.

Right: Photo shows part of the hardwood timber truss structural frame of the Werribee hangar, now supported by tall steel tube props. Photo – Keith Baker

References:

A record of all, or nearly all, of the RAAF B-24 Liberators can be found at http://www.adf-serials.com.au/2a72.htm together with an impressive gallery of Liberator photos.
http://acesflyinghigh.wordpress.com/2013/03/25/restoring-the-last-surviving-raaf-consolidated-b-24-liberator/ has some great photos of the reconstruction work.
http://b24australia.org.au/home.html is the home page of the restoration project, with newsletters and many more images – including those of various B-24s in service.
http://militaryhistory.about.com/od/worldwariiaircraft/p/b24liberator.htm lists some specifications (imperial measurements) and a brief history of the plane from an American point of view. A typical crew was about 10 or 11 men – Captain, 2nd Pilot, Bombardier, Navigator Bomb Aimer, 4 Air Gunners, Flight Engineer and a couple of Warrant Officers.

I like one photo of Group Captain Kingwell, peering out of the cockpit of his A72-176. I checked him out via the Australian Government World War 2 Nominal Roll. Group Captain Deryck William Kingwell joined the permanent Airforce in 1936 at Point Cook in Victoria – not far from the Werribee Hangar – and graduated with the Sword of Honour from Point Cook in 1937. He was discharged from the Air Force on 27th July 1971 as Air Commodore Deryck W. Kingwell, CBE, DSO. He must have been quite a guy – or is he still with us ? (born 1916).

It is very easy to fly away on the Internet researching this sort of story. Searching for A72-176 I found A72-80 (Old Nick) which crashed into the sea in Vansittart Bay, W.A. in March 1945. All on board were killed. The Captain, Squadron Leader Nathaniel H. (Fanny) Straus was a skiing and student friend of my Mum and Dad. He died only a few days before my Dad sailed past on his way to Borneo. We never had any details of what happened to Straus back then, but all sorts of stuff has been available since the internet started, including a Court of Inquiry opened for access in 1992 (why so late?). A pity that it was too late to tell Mum and Dad.

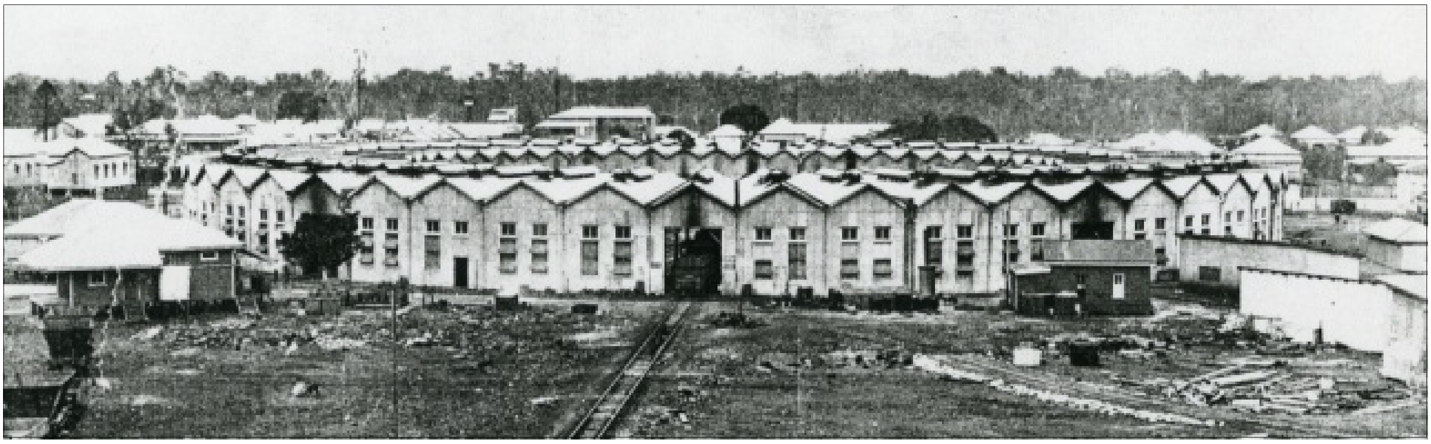
A72-80 was out from Truscott Airbase looking for enemy shipping, probably loaded up with depth charges and marine mines (which Liberators carried as well as bombs) to clear the seaways before all those soldiers sailed past, so it's not surprising that when she hit the water A72-80 was blown to bits. Even if the plane had been at a high enough altitude for the crew to bail out, they might never have survived – the grim nickname of the B-24 was: ". . . . the *Flying Coffin*, as it possessed only one exit which was located near the tail of the aircraft. This made it difficult to impossible for the flight crew to escape a crippled B-24." [1]

From The Editor

1 See http://militaryhistory.about.com/od/worldwariiaircraft/p/b24liberator.htm

Rockhampton Railway Roundhouse 1914 to 2014

Saved from Demolition and Successfully Recycled 1991 to 1994

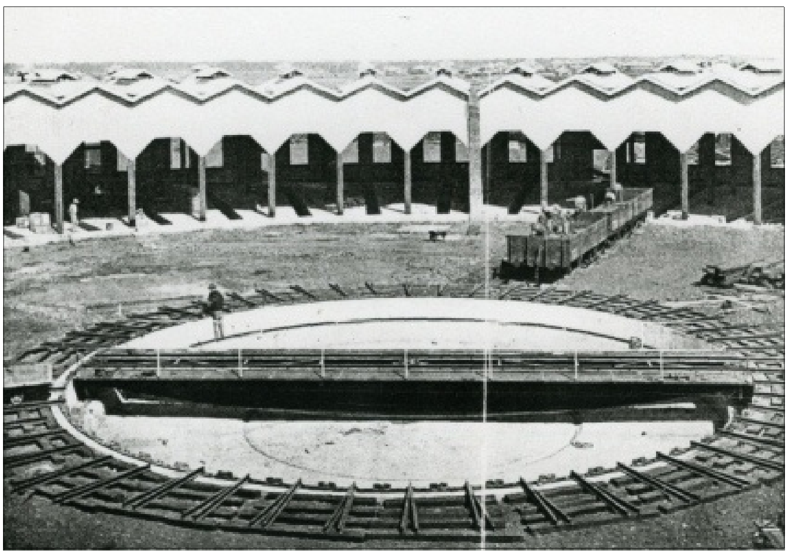


The Rockhampton Railway Roundhouse in 1917 — Source: not recorded, but probably a Queensland Rail Annual Report

Look at a map of Queensland, and Rockhampton is only about ⅓ of the way from Brisbane to the Far North – 600 km from one to the other – but it was not until 1903 that it was linked to Brisbane by railway. In the 1850s, when Rockhampton was first settled, coastal shipping was the fastest way south or north. Rockhampton town developed at the limits to navigation of the Fitzroy River and traces of that first port remain. Then, Rockhampton was a classic East Coast river port, like Grafton on the Clarence in NSW – and Rockhampton on the Fitzroy became the coastal link with the vast and enormously rich pastoral districts in central and western Queensland and the richest gold deposits ever found in Queensland at Mount Morgan.

The railway inland was started in 1867, and although it didn't reach Longreach (700km away) until 1892, very soon it was carrying tons of goods into Rockhampton – and more every year. Soon the port on the river was becoming overwhelmed, and two new ports, at the mouth of the Fitzroy, were developed in the 1890s – Broadmount on the north side and Port Alma on the south. These, too, needed rail access – Broadmount got its own line in 1898, Port Alma in 1911. By then there seem to have been railways and branch lines in abundance – all starting in Rockhampton. At the time it was possibly the busiest freight junction and terminus in Queensland, with lots and lots of trains. Lots of trains meant workshops were needed, particularly considering Rockhampton was an isolated system with no access to Brisbane. Locos must be erected and maintained, wagons built and maintained, and countless other jobs done. The first workshops, with a partial roundhouse, were started in 1877, then extended, then extended again, until a new roundhouse was planned with triple the capacity existing in 1909. It was completed in 1914 and went into service straight away, used for storing and maintaining steam locomotives.

The Rockhampton Roundhouse *is significant as the only full circle roundhouse ever constructed in Queensland for the use of steam locomotives, and as one of the last surviving examples of such a building in Australia.*[1] The roundhouse had corrugated iron roof and wall cladding and round timber posts supporting a timber-framed concertina roof with 52 roof ridges and 52 valley gutters, and with solid brick firewalls separating 7 segments of 7 or 8 bays each. There were 5 entry and exit roads (railway lines) from outside the building, leading into and out of the centre turntable, and 52 lines radiating from the turntable leading to the 52 bays, in most of which locomotives could be stored under cover, repaired and cleaned. Fifty two bays? They originally planned for TWO roundhouses with 52 bays each. What were they thinking of? Of course the 52 existing bays were never all used for locos, and many bays got used for other purposes, like copper smithing. And it is ironic that the Beyer-Garratt locos introduced in the 1950s could not fit on the centre turntable, so could only be housed in the bays opposite one of the entry roads!



Interior of the Rockhampton Roundhouse in 1914 when it was still under construction.
Source: not recorded, but probably a Queensland Rail Annual Report .

1 Queensland Heritage Register – place ID 600783.

Over the years, and with the introduction of diesel-electric locomotives which, like the Beyer-Garratts, could not conveniently be serviced in the Roundhouse, its practical uses declined, until in the 1980s parts of it were used as a wagon repair shop, part for a makeshift office space and the rest empty or used for storage. This huge donut of a building covered a ground area of approximately 1 hectare – the floor area of the building was more than ½ a hectare, and the hole in the donut, with its turntable and radiating rails, grew nothing but weeds and wheel sets. Nevertheless this was (and is) an unique building, a landmark in Rockhampton, the largest such building in Australia (and possibly world-wide), and a vivid reminder of the huge importance the railways had in the history and development of Rockhampton and Queensland.

In about 1989 Queensland Rail determined to demolish what to them was a huge white elephant, and replace it with an Electric Locomotive Overhaul Shop of about 6,400m² ground area and a concrete box of around 1000m² ground area – an administration building, designed by Qld Rail architects. They went ahead with a building application, which included demolition of the Roundhouse, but this application was refused on the basis of the building's cultural significance, under the then very new Queensland Heritage Building Protection Act 1990. It is notable that the Roundhouse had been individually entered on the Register of the National Estate since before 1981, so this was not an unjustified refusal – the heritage significance of the building was well recognised. But Queensland Rail persisted in their arguments against the decision, producing a folio of photographs of the building's perceived faults, and even getting the Qld Rail Principal Architect to write: *Whilst the building is somewhat interesting, I consider that it possesses little Architectural merit and is of little Architectural significance. I would raise no objection, on this basis, to its demolition.*

However the Queensland Heritage Branch continued to refuse a demolition permit — and this is where the Editor has to declare an interest. In January 1991, the Heritage Branch asked Queensland Rail to engage my partner Carl Doring, engineer and industrial archaeologist, to visit Rockhampton with an officer of the Branch, and make a preliminary assessment of the building, its condition, its significance, and to come up with some ideas to justify its continued existence – or otherwise. Carl and I had been to Rockhampton before, in the mid-seventies and we knew it was a unique town, with a unique idea of the importance of its railway heritage – after all it has railway trains running right along the middle of its main street. We came barrelling up from the south, intending to drive straight through Rockhampton, and came to a dead stop at an intersection as a huge diesel-electric loco cut us off from the left – no lights, no fences, no railway gates, no give-way. We seemed to sit there for a quarter hour while a long train of wagons clanked slowly past. Where else could this happen? Unfortunately we didn't stay long enough in town to notice the Roundhouse, which would surely have made a deep impression on us.

The photographs on this page were taken in c1990 by Queensland Rail to support their application to demolish the Roundhouse.

Rockhampton Railway Roundhouse 1914 to 2014

The Heritage Branch was told, in the conclusion to a long sad story about the damage retention of the Roundhouse was causing Qld Rail that: *The preservation of the Roundhouse would severely restrict the modernisation of the Rockhampton Railway Workshops which provides employment for approximately 700 people, some of whose jobs could be in jeopardy if some functions of the workshops are transferred to other centres . . . . There is no merit and no technical solution to try to incorporate parts of the features of the Roundhouse in the new construction. It is therefore earnestly requested that approval be given for the demolition of the Roundhouse.* However, Qld Rail was eventually persuaded that there was plenty of room for the new Electric Loco Shop elsewhere on the site, although whether it was fitted into an existing building or a new one I don't know. Carl's conclusions were that the Roundhouse was highly significant and was not in the parlous – even dangerous – condition we had been led to believe. In a letter to Qld Rail he said: . . . . *it appears that the Roundhouse is an important item of the industrial/cultural heritage, of State and possibly National significance. The Roundhouse at present provides an historically interesting and highly characteristic interface between the Railway Workshops and Rockhampton City. It has the potential to be an important showpiece in Rockhampton, and a distinctive focal point for one of the major employers in the local community. We consider that with a suitable design approach, it will be possible to use the Roundhouse to provide the Railways with high quality and attractive floor space for administrative and similar purposes, without compromising the heritage values of the structure, and at the same time meet the needs of the Workshops for enlarged loco and wagon repair facilities.*

Qld Rail replied that the budget for the Admin building was only $1.75M, and Carl's proposal would cost twice as much. Note that the $1.75M did not include the cost of demolition and rehabilitation of the site – probably close to an extra $1M. Carl suggested they engage an architect specialising in heritage conservation for the work and Richard Allom, a well known Queensland heritage architect, of the firm Allom Lovell Marquis-Kyle was asked to do a feasibility study and concept plan for Carl's idea of fitting the admin. building inside the Roundhouse. Qld Rail were reluctant and sceptical, but soon withdrew their demolition application, and on 18th March 1991 sent Allom a brief to: *1. Review existing designs of Roundhouse and site plan; 2. Identify the heritage significant aspects of the building which are required to be retained. . . . . .; 3. Prepare concept and layout plans to retain all heritage significant aspects of the Roundhouse, while incorporating all features of the alternative design for the administration complex; 4. Prepare estimates for the cost of incorporating the workshops administration centre into the Roundhouse as in (3) above. . . . .*

Allom's report was received by Qld Rail in under a month and included room for the admin offices plus a health centre, with 40% more space than the Qld Rail designed building, at an estimated cost somewhat more than the Qld Rail budget, but well below what their real costs would have been. The new building would be constructed within 2 segments or 14 bays of the existing 52 bay building with a freestanding steel framed building of ground floor and mezzanine and a gross floor area of 1364m^2. Richard Allom tells me: *Our summary found that the scheme was not only feasible but cost effective. Our commission to carry out the recommended work was not however straightforward. Queensland Rail's own architects were reluctant to acknowledge that their own scheme would not provide a better outcome and later, when the decision to adapt the building was confirmed, were determined to do the design work themselves.* However Qld Rail soon backed down, and in May 1991 Alloms were given total carriage of the work.

In Richard's words – *The design was developed, documentation completed and the work put to tender. Building contractor G&J Box was the successful tenderer and the work was completed, under our direction, by November 1994 at a cost of only $1.4million* [considerably less than the Qld Rail budget]. *The work subsequently won the Royal Australian Institute of Architects Regional Award, the RAIA State Award for Conservation and the RAIA National Award for recycling (1994). The building also received a commendation in the National Trust of Queensland John Herbert Award in the same year.* I wish we could have been there to congratulate Richard and see the finished work for ourselves. Perhaps Engineering Heritage Queensland might someday give us the opportunity?

From the Editor.

An Approach to Conservation
Rockhampton Roundhouse Case Study – Allom Lovell 2005

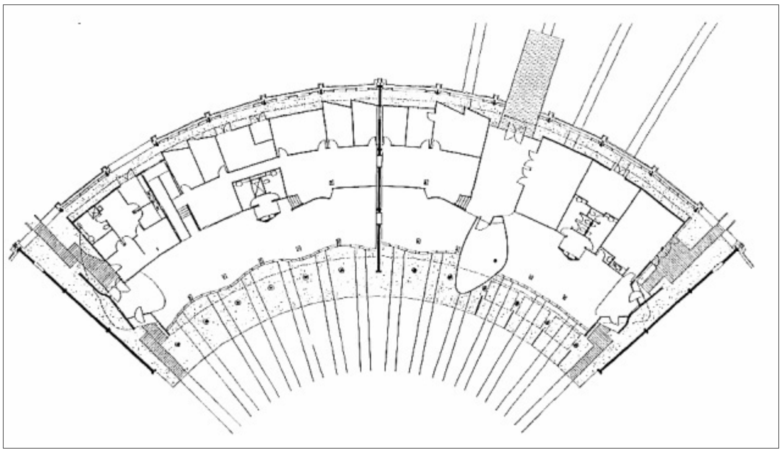
The following text (and drawings) are taken from a case study prepared by Allom Lovell for the Queensland University of Technology. It explains Allom Lovell's approach to the design and construction of the new work within the original structure.

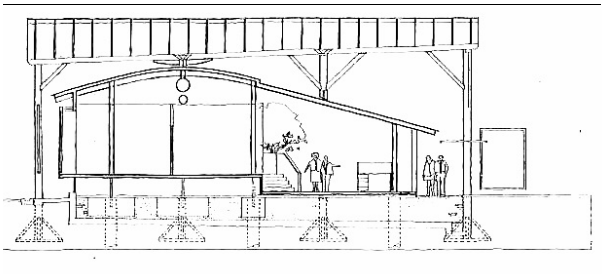
A conservation plan was prepared to identify the cultural significance of the place and conservation policies were developed to protect that significance. Essentially the building was significant for the following reasons:

1. As a rare surviving example of a roundhouse.
2. It survived with all of the years of use as a working railway workshop.

A design solution was developed to protect all of those aspects of its significance. The solution was simple and involved the "insertion" of a new steel framed building within the structure of the roundhouse. Conventional solutions which involved modifying the existing building into an office building would have involved major intervention into the fabric.

The building was conceived structurally as a series of steel portals on the line of the structure of the existing building. The steel frame supports both the new and the old building, where early structure was modified to achieve planning flexibility. The adopted approach instead involved using the existing structure as a parasol roof to the new building within. The rusting iron sheets were retained as were the service pits and railway tracks which were filled with sand so that the project was reversible. The new steel structure was clad in lightweight composite metal panels. Walls to the internal perimeter were glass from floor to ceiling.





Above: Section across the building showing retained structural elements (see text).

Left: Ground Plan, showing the new offices inserted into 14 bays (2 segments) of the 52 bay building.

The new column layout was offset to avoid the elaborate timber piles. The tops of the two internal timber posts in each bay were retained so that views into the timber roof space from the centre of the roundhouse were not changed. The ends of the new building were set back from the existing structure so that visitors could understand the elegant volumes of the existing building and structure. The existing building was intentionally not "cleaned up" as the soiling and decay was an important aspect of its significance. Similarly, the landscape design for the project involved the planting of two palm trees to mark the entry.

Photos by John Gollings of the new offices in the Roundhouse.

The Sydney Harbour Control Tower

Nominated by the National Trust (NSW) for listing on the State Heritage Register

The Sydney Harbour Control Tower may seem rather new to be considered a significant item of the Engineering Heritage, but it has been a highly visible Landmark for Sydney ever since it was built, in 1974 – even more prominent than the now vanished Hammerhead Crane at Garden Island. It was like a medieval Watch Tower, guarding the shipping that passed by.

The basic Statement of Significance in the nomination document covers the reasons the tower deserves listing succinctly and well:

> *The Sydney Harbour Control Tower (the Tower) is of state significance for its pre-eminent role in the history and maritime operation of the Port of Sydney — the primary commercial port of Australia — and for its capacity to demonstrate a tangible link to Sydney's long maritime history.*
>
> *The Tower demonstrates 35 years of 24/7 operation in the Port of Sydney from 1974 to 2009 as the Port Operations and Communications Centre providing supervisory control over the many thousands of shipping movements in Sydney Harbour every year.*
>
> *It represents a key investment by the NSW Government in shipping infrastructure, as the most up to date approach to harbour traffic surveillance and control at a time when cargo volumes and shipping size were increasing with the advent of commercial container shipping.*
>
> *The Tower represents the culmination of the Sydney port authority's quest for 360 degree surveillance and control over all shipping operations in Sydney Harbour where commercial shipping had to co-exist with naval movements, passenger ferry services and ocean-going liners, and recreational vessels.*
>
> *The Tower was a significant milestone in engineering design and construction in Australia for its time, involving pioneering academic studies into the structural requirements.*

The previous paragraph should be of great interest to structural engineers, because of the problems that had to be overcome in designing the concrete cylinder shaft, 4.9m diameter and 80+m high. Unfortunately, the nomination document fails to note which was the consulting engineering firm involved. The architectural firm of Edwards Madigan Torzillo and Briggs was commissioned to design the Tower, and the builders were Sabemo. Perhaps all the engineering design was done in-house?

Wind loading was said to be a critical factor and preventing excessive vibration required *innovative and unusual skills in post-tensioned concrete construction. Design of the building incorporated the advice of the CSIRO and a detailed wind-loading study by the University of Sydney which led to an increase in the weight of the building a the top of the shaft, to dampen wind-based vibrations. The building retained a 15 cm sway in winds.*

To read the nomination in full, go to:
http://www.environment.nsw.gov.au/heritageapp/ViewHeritageItemDetails.aspx?ID=5062030

From 2009, container shipping moved to new wharves in Botany Bay, cutting the amount of commercial shipping traffic in Sydney Harbour drastically. In 2011-12 the Ports Corporation installed a radar-based surveillance system which would cover both Sydney Harbour and Port Botany, and the Tower lost its reason for being. It is a great pity that it is now under threat of demolition, for no apparent reason other than it has lost its original purpose and gets in the way of new developments.

Or does it? Have a look at:
http://www.smh.com.au/nsw/barangaroo-tower-should-stay-experts-20140703-zsv45.html

Perhaps it could become a public access observatory and cafe/restaurant?

The image of the Tower at right is a slice of a beautiful photograph by Noel Jackling, taken on the 5th August 2014.

THE CONSTRUCTION of the SYDNEY HARBOUR BRIDGE

Purchase a DVD of a Film made by Henri Mallard

Henri Mallard was one of Australia's best-known photographers and he was principal of Harrington's photographic supplies in Sydney. In 1929 he was granted the agency for one of the first home movie cameras, which used 16mm film. Looking around for a publicity vehicle to demonstrate the camera's capabilities, he realised that, virtually on his own doorstep, one of the world's greatest construction projects was taking place. He asked permission from Dr Bradfield to risk his neck by accessing the structure and was turned down. He then asked Lawrence Ennis, director of Dorman, Long the contractors, and was given permission.

The result was two 45-minute reels of 16mm, black-and-white silent film. (In a book of Mallard's still photographs about the same site, there is an image of him holding a movie camera which has a large, circular film magazine.)

The Mallard family donated the two reels to Sydney Division of the Institution of Engineers, Australia in 1970. Chairman of Sydney Division at the time was Professor Denison Campbell-Allen of the University of Sydney. He had the idea of running the films and simultaneously recording comments by Frank Litchfield who was one of Bradfield's assistants on the Bridge. The showing/recording took place in the School of Civil Engineering of the University of Sydney on Shepherd Street. A remarkable feature is the sharp memory of Frank Litchfield forty years after the events. The sound was recorded on a domestic-type Sony, reel-to-reel recorder. After taking care to synchronise the tape with the film, this combination played to packed houses in the 200-seat former EA auditorium in Milsons Point.

Through the good offices of Don Fraser, then of the University of New South Wales, this material was then passed to the UNSW TV Unit who added animated explanatory sections and a small section of newsreel at the end showing the Bridge opening – and de Groot. This resulted in a 45-minute VHS video tape which sold quite well. In due course, this was converted to DVD which was available mainly through museums and BridgeClimb until it sold out a few years ago. As indicated, it is now available again.

From *Ian Bowie, Engineering Heritage Sydney – September 2014.*

Supplies of the above 45-minute DVD are again available from the Engineers Australia Sydney Division office at $27.50 (plus $8 postage) for non-members or $22.00 plus postage for members of EA.
Enquiries: Rimma Kolodizner on 02 9410 5621 or rkolodizner@engineersaustralia.org.au or see the EA website at:
http://www.engineersaustralia.org.au/sydney-division/engineering-heritage-sydney#harbourbridge

The image above is from the Australian National Maritime Museum. The notes are as follows:

This image was taken from Walsh Bay wharves, looking east. Two arcs of the bridge can be seen under construction with cranes positioned at either ends. SS CANBERRA is passing underneath, viewed on the starboard quarter.
This photo is part of the Australian National Maritime Museum's Samuel J. Hood Studio collection. Sam Hood (1872-1953) was a Sydney photographer with a passion for ships. His 60-year career spanned the romantic age of sail and two world wars. The photos in the collection were taken mainly in Sydney and Newcastle during the first half of the 20th century.
The ANMM undertakes research and accepts public comments that enhance the information we hold about images in our collection. This record has been updated accordingly.
Photographer: Samuel J. Hood Studio Collection — Object no. 00035750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