Roads and Traffic Authority
Oral History Program

Construction of the Gladesville Bridge

Summary Report

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from interviews by Frank Heimans and Martha Ansara

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Some comments about Oral History...

Oral history has been described as *"a picture of the past in people's own words"*. It reveals what you often won't find in the files and the history books - the facts and the real reasons things happened. It is told by the people who were there - those who were involved, who made it happen, who were affected - in the colour, passion and inflection of their own voices.

Oral history accounts can also tell about relationships, perceptions, social and political climates, all of which are part of life and influence our actions and those of others. It often reveals the unsung heroes, the names of those actually responsible for innovations and important changes.

So, oral history provides a counterbalance to the formal written record by providing the personal, intimate, human and social account of events and why they happened.

The RTA Environment and Community Policy Branch established an Oral History Program in 1997, to investigate various topics of historical interest. *Construction of the Gladesville Bridge* is the fifth thematic oral history to be undertaken as part of the Program. As with previous projects, this oral history did not seek to present a definitive history of the bridge's construction, rather it involved a recounting of interesting stories and insights, told by those involved.

The Gladesville Bridge was opened on 2 October 1964. Along with Tarban Creek Bridge and Fig Tree Bridge, it was originally planned by the NSW Department of Main Roads (DMR) to form part of a north-western expressway serving the northern suburbs of Sydney. Whilst the expressway was never built, the Gladesville Bridge, at the time of construction the longest concrete arch bridge in the world, remains as an engineering feat and a testament to commitment of all those involved.

The major output of this project was over 20 hours of digital audio tape interviews with people who experienced or were involved with the construction of the Gladesville Bridge. Some were local residents or school children while others were employed on the project in varying capacities including engineering, surveying, filming, labouring, plant operation and worksite supervision.

This summary report features some of the key themes uncovered during the course of the project, including the inadequacy of the former low-level Gladesville Bridge, the planning vision, innovative bridge design, the construction process and the opening of the bridge.

The opinions expressed in the oral history interviews are those of the individuals concerned and do not necessarily represent in whole or in part the position of the NSW Roads and Traffic Authority.

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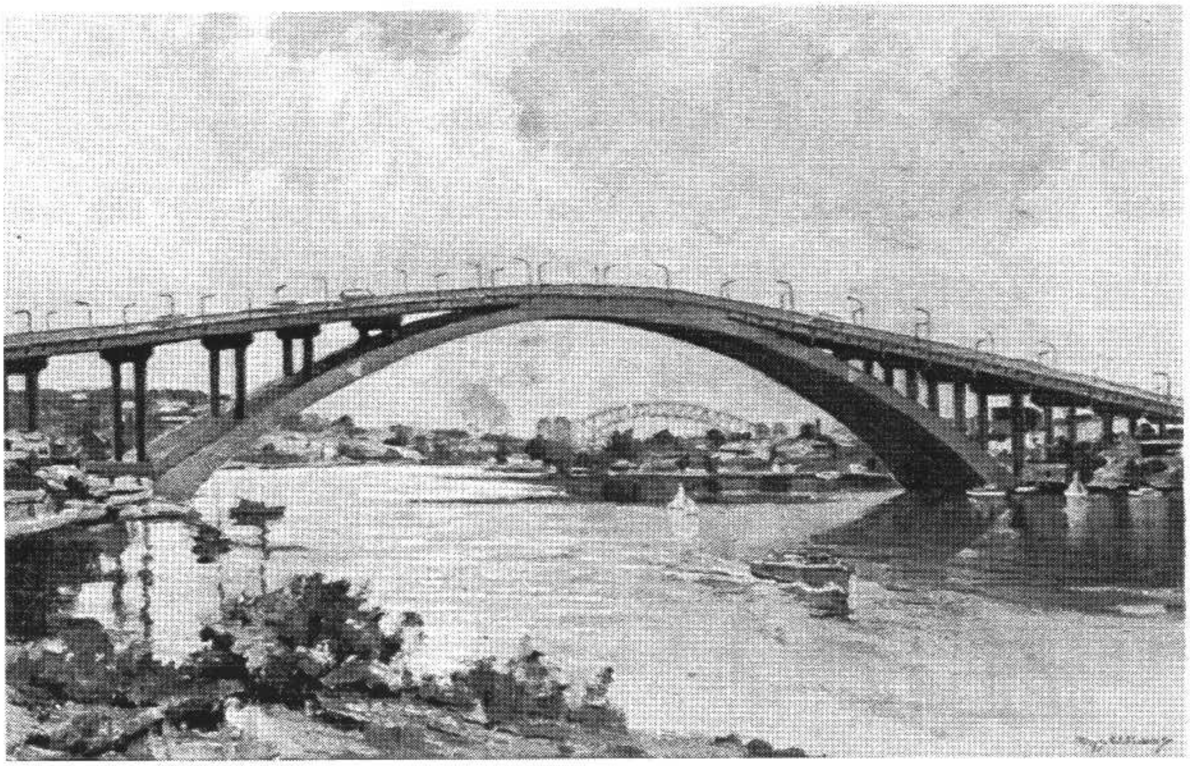


Oil painting by Rhys Williams, purchased by DMR, Jan 1965

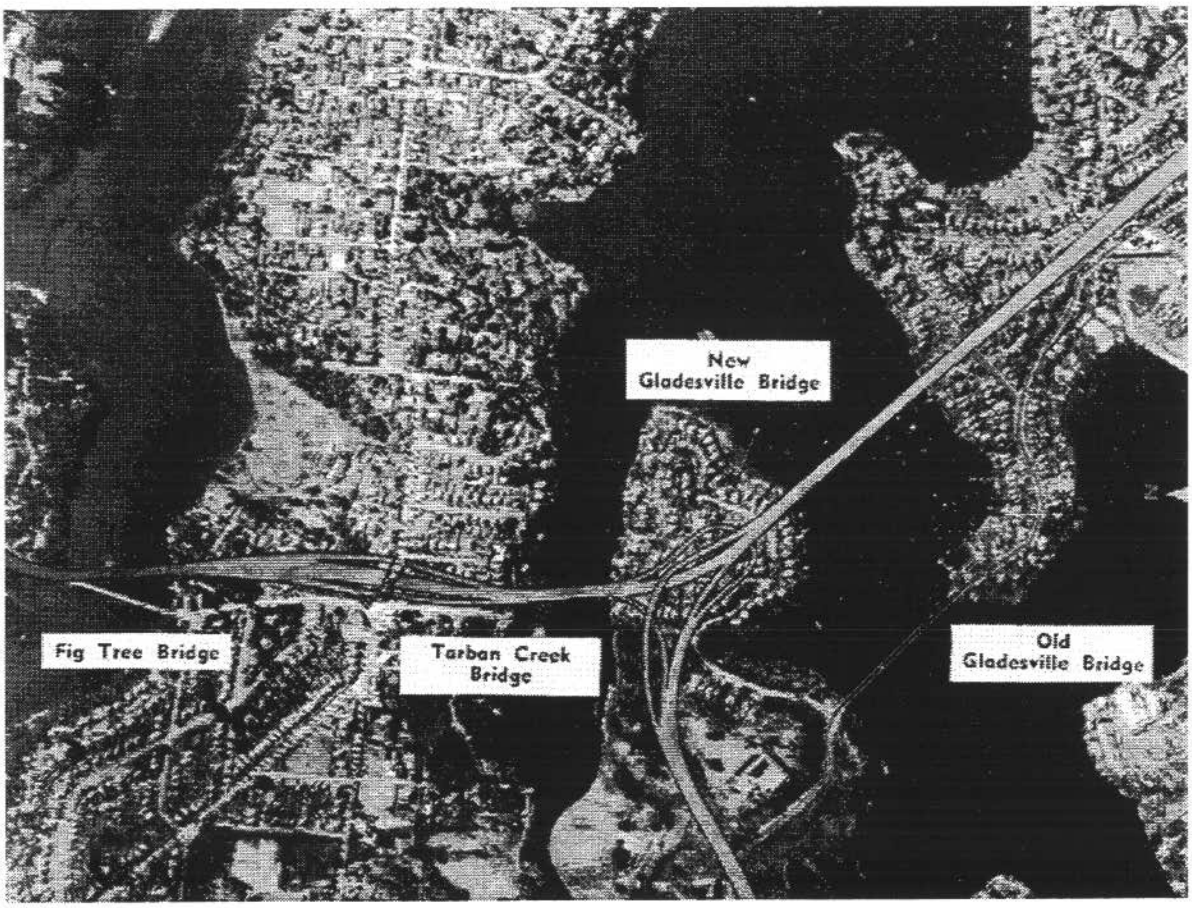
1. BACKGROUND TO THE CONSTRUCTION

I'm proud of working on the Gladesville Bridge.
I enjoyed every day of it.
-- Bill Davis, Bridge Worker

We were building roads in the sky.
-- Ray Wedgwood, Bridge Engineer and Historian

The Gladesville Bridge, which was opened on the 2nd of October, 1964, was one of a complex of three bridges originally planned by the NSW Department of Main Roads (DMR) to form part of a North-Western Expressway serving the northern suburbs of the Sydney Metropolis. While the North-Western Expressway never became a reality, the six-lane Gladesville Bridge, with its two associated bridges and broad expressway approaches and traffic exchanges, sweeps out of the suburbs of Gladesville and Drummoyne, across Hunters Hill and into Lane Cove. Within a length of approximately 7000 feet, the project arches over the Parramatta River on the Gladesville Bridge, over Tarban Creek on the Tarban Creek Bridge and finally across the Lane Cove River on the Fig Tree Bridge, onto the slope leading up the ridge towards Lane Cove.

It is easy to speak about the visually impressive Gladesville Bridge in superlatives. In its day, it was the largest concrete arch span ever constructed in the world, a great engineering feat and a symbol of the DMR's organisational and planning powers, brought to bear upon Sydney's ever-worsening traffic problems.



From DMR publication"The New Gladesville Bridge over the Parramatta River"

1.1 The Old Gladesville Bridge

In the years leading up to the construction of the Gladesville Bridge, car usage throughout the Metropolitan area had been increasing exponentially and by the time the contract for the new Bridge was let in June, 1959, traffic on the old bridge was, at times, literally at a standstill. Opened in 1881, the old two-lane Gladesville bridge was an 896-foot long, lattice truss bridge crossing the Parramatta River just upstream from the site of the new Bridge. Historically, it was an important early crossing point

Ray Wedgwood, General Manager, Technical Services, for the New South Wales Roads and Traffic Authority (RTA), and member of the RTA Heritage Committee tells us that Sydney Harbour's second crossing point after European settlement was situated nearby, at the end of the present Great North Road in Abbotsford, with Bedlam Point (and the Gladesville Mental Hospital) on the other side:

> It was a punt crossing. From what I've read about it, it was rather unreliable. There were two brothers that ran it and on Saturday nights, if they were bored they'd have a drink or two and sometimes they wouldn't be available to bring people across. The reason the punt was put there was....that that location is, in fact the narrowest part of the Parramatta River until you get further up the river. So it was a very sensible place to put the crossing. (Wedgwood; RTA-GB:FH 22 Side A, 13:24)

In the 1870s, as a link was needed with Newcastle and for the produce grown on Sydney's Northside, two more bridges were added along the route leading from the Glebe Island Bridge. In 1881, after three years of construction, the first Gladesville Bridge was completed. It had an opening swing span to allow for river traffic and, later, carried the tramline from Sydney to the North shore. Another Bridge was built across Iron Cove. These two bridges became part of the "Five Bridges", a route including Pyrmont Bridge, Glebe Island Bridge (both renewed around the turn of the century), Iron Cove Bridge, Gladesville Bridge and Fig Tree Bridge over the Lane Cove River (Wedgwood, RTA-GB:FH 22 Side A, 13:24)

By the 1950s, this route, and the old Gladesville Bridge, in particular, could no longer cope with the volume of traffic in and out of Sydney. Laurie Stewart, Assistant Surveyor for the DMR on the Gladesville Bridge Project, remembers the problems of the old bridge quite clearly:

> It was two lanes only, that is, one lane in each direction.... It had a tramway across it. When the tram went across, of course, the cars and trucks had to go behind it. There wasn't room beside. There was no pedestrian footway, whatsoever. The public could travel free of charge on the tram ... to get across the bridge. By the time the new bridge was being constructed, traffic volumes had become quite considerable and quite a problem in peak hour. And in the morning peak, particularly, police officers would be there at the bridge and would stop the outbound traffic -- the Ryde-bound traffic -- and give the two full lanes for city-bound traffic for periods. And then they would stop that briefly and let a few vehicles trickle from the city towards Ryde, and then two lanes back on city-bound. That was how they had to contend with traffic until the new bridge was opened. (Stewart; RTA-GB:FH18, Side B, 38:41)

Lynn Joyce, who grew up in nearby Gladesville, was a teenager when the Gladesville Bridge was built. She remembers the old bridge as:

> an old metal bridge, a very simple design. It opened sideways to let boats through. Unfortunately, it didn't cope with anything terribly tall. And I remember on hot summer's nights my father would be coming home from working in the city and they would open the bridge and they wouldn't be able to get it closed again because of the heat making the metal expand. So quite often they used to have to call the little tugboat ferries from the city to come and spray water on the bridge so the metal would retract and they were able to close the bridge again. And on those particular occasions, Dad would get home at about midnight, and we'd all be waiting there very excited for him to come home and tell us the story about the major event that happened at the end of the day.... It just seemed every time that we were in a hurry for an appointment, the bridge had to open and there'd be a traffic jam for about thirty or forty minutes....We used to get out (of the car) and chat and walk around and watch it opening. It was quite an interesting engineering feat, actually, to see it open. And then get back in the car and off we'd go again. (Hanrahan and Joyce; RTA-GB: MA15, Side A; 02:30, 03:27)

Brian Pearson, former DMR Chief Engineer, Bridges, and Supervising Engineer for the DMR on the Gladesville Bridge recalls yet other problems:

> The swing span was often hit by the colliers travelling up the river and the effect of this was that it was very difficult to close the swing span at times. And although it could be closed sufficiently for road traffic to use the bridge, the tram tracks wouldn't line up. So the tramways people got very upset. The road traffic was using the bridge but the trams couldn't. (Pearson; RTA-GB: FH10, Side B, 49:10)

Old Gladesville Bridge. From DMR publication "The New Gladesville Bridge over the Parramatta River".

1.2 Traffic, Bridges and Expressways - the DMR Vision

The old Gladesville bridge was not the only bottleneck. Throughout Sydney in the 1950s, the road system was coming under accelerating pressure. Tony Prescott, a historian with the NSW Heritage Commission, explains:

> With the growing post-war affluence every family had to have (a car) and this certainly generated a pressure for road building and an expectation that the roads would be improved to meet the demands of the traffic. (Prescott, RTA-GB:MA 17, Side A, 20:37)

Cars were not merely a means of getting from A to B; they were special. Many families had only recently acquired their car. And going for a ride in the family car was still regarded as fun, a form of entertainment. (Hanrahan & Joyce, RTA-GB: MA15 Side A, 22:30)

Given the rapid growth of the car culture, the need to provide facilities for motor vehicles to get around Sydney efficiently led here, as elsewhere around the world, to government funding of an impressive program of road and bridge building. Ray Wedgwood estimates that during the 1950s and 1960s a new bridge was completed in New South Wales every three or four working days. (Wedgwood, RTA-GB: F22, Side B, 39:17).

The unique topography of the Sydney Metropolitan area required the construction of many significant bridges in order to expand the road network across the Harbour and the numerous other waterways. Amongst these bridges, the Gladesville Bridge, as Ray Wedgwood has noted, was, in its time, the lynchpin of the North-South-East-West axis of city. (Wedgwood RTA-GB: FA23, Side B, 45:48). As such, its place was especially important.

The DMR had been prepared for a growth in car usage since the 1930s and had planned ahead for the expansion of Sydney's road network. (Prescott, RTA-GB:MA 17, Side A, 22:50). But this growth had been delayed by the Great Depression and the Second World War. Now, in an environment of post-war prosperity, the DMR was responding vigorously to allow quicker access to the city for the increasing numbers of people living further out. Prescott explains that the projected North-Western Expressway, of which the Gladesville Bridge was to be the centrepiece:

> was part of a web of expressways and bridges radiating out of Sydney. It was to come down from Newcastle on the F3 and down the Lane Cove River Valley and across the bridges and then through Annandale and Glebe (Prescott, RTA-GB: MA Tape 16, Side B, 41:23)

Laurie Stewart, as a DMR surveyor during this period, recalls that within the DMR:

> There was a huge amount of groundwork that was done in planning for those freeways about 1960 which I was involved in. It was on Saturdays and Sundays because their workload couldn't accommodate Monday to Friday. I believe they had a very good system planned but ... a lot of that was abandoned. (Stewart 18 Side A, 05:53)

Despite the reservation of land corridors, a Southern Freeway through Rockdale and Kogarah and a Northern Beaches Freeway heading out across Middle Harbour were put on hold. (Wedgwood RTA:GB: FH 22 Side B, 32:33). The North-Western expressway was abruptly terminated on the Gladesville Bridge's Drummoyne approach. There the relatively narrow Victoria Road, lined with shops, joins up with the Bridge at an angle which speaks clearly of unrealised intentions.

The reasons for the halt to the North-Western Expressway and the larger DMR vision have been many and complex, but -- along with costs -- in the words of Ray Wedgwood:

> Obviously there's a political element to it as well. If the political mood is that they don't want a bridge, or they don't want this good access, well, that gets into the equation as well. (Wedgwood RTA:GB: FH 22 Side B, 35:02)

In the 1970's amidst anti-freeway protests, Tony Prescott began to share some of the protesters concerns:

> The motor vehicle was seen as part of the technology for the future and something that would augment the development of the city.... (But) the road network envisaged for the city, seemed to me, in my early thinking, to be (designed) to replace the public transport city with a car-oriented city....The expressway network, as it was designed then, seemed to be very radially focussed on the city as though people were going to drive into the city and you immediately asked the question, what were they going to do with their cars once they get there? (Prescott, RTA-GB: MA Tape 16, Side B, 43:15, 46:17)

In fact, these very sorts of questions had been debated during the 1950s, even as the DMR road expansion program was gearing up. In August 1958, the fifth Australian Planning Congress, held in Sydney, discussed "Metropolis — the Problem of the Expanding City". And in the months leading up to the Congress, the *Sydney Morning Herald* featured a series of articles on the subject. In one of them, Denis Winston, Professor of Town and Country Planning, University of Sydney, wrote (June 2, 1958):

> In one sense the traffic problem is insoluble. That is to say, the better the traffic routes and parking places, the more people will use them, until they clog up again as they are now....It is obvious that no conceivable system of expressways, bridges, tunnels and multi-storey carparks will ever make it possible to accommodate the cars of Sydney's future citizens...the authorities must improve public transport services so that it is no longer a hardship to use them...

But by this time, the opportunity to improve public transport seems to have been lost:

> Hindsight's wonderful! But....I reckon that after the Second World War, the opportunity existed to criss-cross that area west of Parramatta and Liverpool with an efficient train service. The train service was ahead of the population development through the 1920s....(But) as industry developed and we were probably following trends in both Europe and America, the constraints of the rail system ... led to enormous pressures to find alternative means of moving freight. (Freight) is what bridge design and road design have always been about ... Cars are important when it comes to congestion and traffic modelling, but in terms of freight movement, the customers were requiring shorter time frames, quicker turn arounds, and the rail system, one way and another, just wasn't able to measure up, in my view.
> (Wedgwood, RTA-GB: FA23, Side B, 48:52, 51:08).

Wedgwood also mentions tax and cost structures as influencing the development of road over rail at this time. And Tony Prescott further points out that, given that the long-term costs -- in terms of road accidents, use of fossil fuels and environmental problems -- were not widely accepted in this period, infrastructure solutions for motor vehicles seemed cheaper relative to rail expansion. And in the short term, they were. (Prescott, RTA-GB: MA17, Side A, 07:14)

Traffic pressures on Sydney were mounting and the DMR was the one organisation with sufficient political clout and organisational strength to respond.

1.3 The Mighty DMR

The Gladesville Bridge, albeit part of a larger project which was never completed, was in itself a visionary and successful construction job. In order to understand the knowledge, experience and efficiency that the DMR brought to the job, it is necessary to know something about its history as an organisation.

As an historian, Tony Prescott was a member of the Bridges Committee set up by the National Trust and the DMR (later RTA) to deal with heritage issues. His experience of this Committee gives some sense of the traditions of the DMR:

> It was a great committee to be on and I was fascinated that it had not only the current bridge engineer on it but his predecessor and his predecessor as well. And then up on the walls of this well-appointed meeting room were their predecessors: paintings of Lennox and Bradfield, looking down on us. And so you felt you were inheriting a mantle....It was certainly a group of lovely people and you certainly admired their work. I mean, it was a very, very professional group. I think that comes with an organisation that has so much self-confidence, too, that it attracts good people and talented people.. and they stay with it and they do great things.
> (Prescott RTA-GB: FH16 Side B, 53:46)

Ray Wedgwood, as one of the Chief Bridge Engineers serving on this Committee also has a sense of the impact of the DMR's history. He explained that the forerunner of the DMR was set up in the mid-1920s as an advisor to local councils but gradually acquired equipment and took on the responsibilities of building the higher level main roads system: the national roads and the state highways. (Wedgwood RTA-GB: FH23 Side B, 36:48) By the time Wedgwood joined the organisation during the construction of the Gladesville Bridge:

> There were a lot of can-do people, a lot of people who, if they were thwarted or held up by other government departments in terms of planning things that had to be done, were prepared to do their own planning and get on with the job....It was an organisation that was very much run along military lines in those days. A lot of the bosses at the time had had wartime experience and had served in construction regiments.... A number of them had worked on the building of

> the road between Alice Springs and Darwin through the War and had been in the services or seconded and the structure was military in that we had Divisions and various officers at Officer level. Obviously, the military simile can't be carried too far, but there were certain efficiencies, I think, from that process in terms of mobilising numbers of men to do work at the field level and having a chain of command where you could react quickly to emergencies. (Wedgwood RTA-GB: FH23 Side B, 32:05)

Tony Prescott found in his studies of the planning history of Sydney that from the 1930s the DMR was rarely questioned in what it proposed to do. All the more so once the road lobby was on the ascendancy. (Prescott RTA-GB: FH17 Side A, 00:30):

> The DMR had a lot of -- I'm not sure that a lot of power is the right term -- but it was very well-placed in the public service in terms of self-confidence and esteem....Their position seemed to be relatively unchallenged compared to that of the railways which was constantly under siege....and probably reflected the relative political strengths of the cases for public transport and the case for roads. They were in a very strong position and they knew it....It certainly has been said that they were almost a de facto planning authority, they had that much strength. As far as roads are concerned, I don't think the planning authorities really wanted to move into their territory. The DMR did the road planning and the planning authorities filled in the bits in between, so to speak. (Prescott, RTA-GB: FH16 Side B, 52:04) It certainly was an organisation that the politicians tended to listen to and do what it suggested, compared to some of the other government departments where the Minister gave out the directions. (Prescott RTA-GB: FH17 Side A, 01:10)

As Sandy McKenzie, Resident Engineer on the Gladesville Bridge, puts it, in those days the Commissioner ran his own ship, with very little political interference. (McKenzie, RTA-GB: FH12 Side B, 49:17). In fact, according to Ray Wedgwood:

> There are stories that back in the days of John Shaw as Commissioner, and even one or two after him, the Minister would come down to <u>his</u> office and sit outside and wait until Shaw was ready to see him. (Wedgwood, RTA-GB: FH23 Side B, 32:05)

John (J.A.L.) Shaw, C.B.E., D.S.O., B.E., M.I.E. Aust., M. Inst. H.E., M. Inst. T., F.A.P.I.; Asst. Chief Engineer, 1946; Chief Engineer, 1946-1953; Asst. Commissioner, 1953-1962; Commissioner, 1962-1967) was, as Brian Pearson recalls, typical of the experienced Commissioners of the day who had risen through the DMR ranks. They were strong-willed men with leadership ability, supported by their ministers, regardless of which political party was in power. (Pearson, RTA-GB: FH8 Side A, 09:10)

According to Pearson, the Commissioners took pride in the fact that they paid a little more to their staff than did other organisations. (Pearson RTA:GB: FH 8, Side A, 05:45). By the early 1960s, staff numbers had almost doubled from the levels of ten years previously, with the DMR employing nearly 20,000 officers and workers, either directly or by contract. During the course of the building of the Gladesville Bridge, the numbers of DMR Professional Officers increased from 574 in 1958 to 984 in 1964 (Department of Main Roads, 1976; 278-279)

Not everyone had a sanguine view of the size and composition of the DMR. Phil Hallinan, formerly Works Engineer for Metropolitan Bridge Maintenance, reports that it was regarded by some as "The Department of Many Relations" and was a bureaucracy in the old Public Service mould, with bureaucratic practices. (Hallinan, RTA-GB: FH1 Side A, 01:40)

It could be said, on the other hand, that such a size was a reflection of the DMR's organisational and political strength. Moreover, in Pat Hills, MLA, the Gladesville Bridge project had a strong Minister who was fully committed to the DMR, to the development of Sydney and to the broader road-building project. In October 1960, Hills announced his intention of committing £456 million, over the next decade, to roads and bridges. (Hansard, 26/10/60, 4c)

Nicknamed "Hoist Hills", The Hon. P.D. Hills, MLA, a former Lord Mayor of Sydney and power-broker of the Labor Party Right, was Minister for Local Government and Minister for Highways, 1959-1965. He was an active and enthusiastic advocate for the Bridge, which was a prestigious project, issuing press releases, announcing each stage of progress in Parliament and visiting the site on a number of occasions. The Resident Engineer, Sandy McKenzie, remembers

Hills on one of those visits as a "man of the people" sort of bloke, easy to get on with.

(McKenzie, RTA-GB FH12 Side B, 48:40)

2. DESIGN AND TENDERING

> *All structural engineering is being able to foretell collapse and what you're worried about all the time is how is it going to collapse. And that's what you do. That's what you look at.*
>
> -- Kevin Forrester, Design Analyst

How was it that the largest concrete arch in the world at that time came to be built in Australia? In fact, for Australia it was not only a first, but a particularly bold first, as bridge design in this country was still in transition from the steel truss era. As Brian Pearson has said:

> One can't deny that it was ambitious — because here we were in Australia, taking on the construction of the largest arch bridge ever built in the world, a span of a thousand feet. It was something that no one in the world had tackled before but the design was simple. It was two thousand years old....The Bridge Section had designed reinforced concrete arches and even our first bridges, the bridges built by David Lennox in New South Wales, were stone arch bridges, built roman-style with block construction. So to some extent we'd had experience with arches, but to nowhere near an arch of the size now contemplated. (Pearson RTA-GB: FH 8 Side A, 40:01)

Others involved in the construction reacted to the bridge plans with surprise and even concern. Brian Cox, the DMR's supervising surveyor, recalls that the design was way beyond him and he couldn't comprehend how the bridge would actually be built, even as he was checking its laying out. (Cox, RTA-GB: FH 7 Side A, 09:16) Joe Ward, one of the Stuart Brothers foremen on the job, recalls that some of the techniques necessary to realise the design had never been tried before in Australia and he found the responsibility of the launching gantry used to maneuver the giant pre-cast concrete blocks into place extremely stressful. (Ward, RTA-GB: MA25 Side A, 22:10) Sandy McKenzie recalls that pre-casting was another new technique.

(McKenzie, RTA-GB: FH12 Side B, 40:14). And Kevin Forrester, the DMR engineer assigned the task of checking the initial design for the Department, remembers:

> One day, Robertson came up with a bundle of drawings and he flung them on my desk -- he says, "What are you doing!"
>
> I said, "Oh, I'm just finishing off this job here."
>
> "What is it!"
>
> I told him.
>
> "Oh, when you've finished that, just have a look at this!"
>
> I gave him my usual look of dumb insolence and he walked off. And I never even unrolled these drawings -- that was the way I reacted . I just left them there. And about an hour later I thought, "Well, I'd better humour the poor old bugger." So, I unrolled it. Oh God, I nearly fell off the chair. It was a one thousand-foot concrete arch, which was -- you know, it's no small thing. That was the Gladesville Bridge. (Forrester, RTA-GB: FH2 Side B, 43:10)

2.1 The DMR Bridge Section

Within the DMR was a large, well-organised and experienced Bridge Section, responsible for designing and constructing bridges of all sizes throughout the State. New South Wales, with its many rivers and inlets, was the leader of bridge-building amongst the Australian states. And, as Brian Pearson has pointed out, while the most typical bridges at that time were ten-metre spans in reinforced concrete or steel, Bridge Section specialists produced very large bridges when the need arose. (Pearson RTA-GB: FH 8 Side A, 06:18) Moreover, the legacy of the Sydney Harbour Bridge was still present within the Department.

At the time of the Gladesville Bridge, the Section was headed up by the Design Engineer, Bridges, (1953-1965) Cliff (S.C.) Robertson who supervised engineers with a range of specialties, along with area leaders responsible for bridges in different sectors of the state. Robertson had been one of Bradfield's senior assistants on the Harbour Bridge, and other designers in the section had also worked on that landmark project. Amongst the engineers in the Bridge Section singled out for mention by Brian Pearson was Laurie Challen. While not directly concerned with the construction of the Gladesville Bridge, Challen was responsible for a special section, set up to introduce pre-stressed concrete into bridge design during this period. The Bridge Section also included a number of European engineers, who had migrated to Australia, as Brian Pearson puts it, "to escape intolerable situations there". Pearson mentions, in particular, Vladimir Karmalsky, a White Russian expert on steel bridges, and Albert Fried, a "very, very competent designer", who was responsible for the design of many of the State's later pre-stressed concrete Bridges. (Pearson RTA-GB: FH 8 Side A, 11:31)

But the Bridge Section was not without its conflicts. Albert Fried has suggested that there were differences between him and Karmalsky in respect to the relative merits of steel vs. concrete design. In his view, Karmalsky represented the old guard, holding the design section back, while he himself championed the new reinforced concrete wave of the future. (Private conversation, 7 December, 2000).

Ray Wedgwood, who had started at the DMR as a cadet in 1959, was appointed to the Bridge Section, following the completion of his engineering degree in 1963. His first direct experience of the Bridge was on a university field trip in 1962. Wedgwood regards the Bridge Section as having been a good section for a young engineer to be in, with its cosmopolitan European staff members. He found in the Section an interesting mix of experience and talent.

Brian Pearson worked initially on the administration of the contracts for the project at the DMR Metropolitan Division headquarters at Milsons Point, under George Fawkner and Pat Schmidt who were, successively, Assistant Metropolitan Engineer. As Supervising Engineer for the Gladesville Bridge and many other such major bridges, and ultimately Chief Engineer, Bridges, Pearson's understanding of the contribution of the Bridge Section to Australian engineering extends well beyond this one particular bridge:

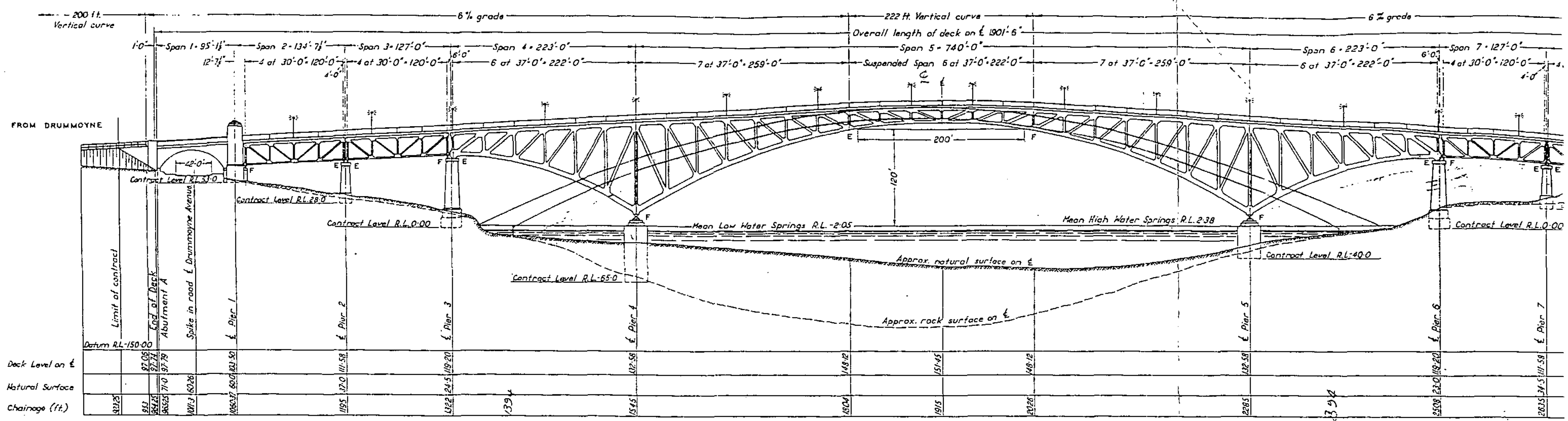
> There were very few consultants that were sufficiently experienced to tackle a major bridge design whereas the staff in the Bridge Section felt completely competent in such a project. And it became a training ground for designers to proceed out to consultants and eventually the consultants were greatly strengthened by the acquisition of people who had been trained in the DMR. (Pearson RTA:GB: FH 1 Side A, 14:20)

Pearson makes an additional and very important observation concerning the system of supervision of bridge contracts by the Chief Engineer for Bridges and his staff. Under this system, which he believes resulted in the highest quality of work, there had never been a failure of a bridge under construction in New South Wales, and after the Sydney Harbour Bridge, no loss of life. As over 90% of bridge projects were constructed by contract, the maintenance of relations of mutual respect between the Chief Engineer for Bridges and contractors was the cornerstone of this success. Disputes of a major nature in the administration of a contract were generally settled by the contractor stating his case to the Chief Engineer for Bridges. And:

> This respect extended to the tendering stage when the Chief Engineer would at times offer the lowest tenderer the opportunity to withdraw his tender if he considered that he had no possibility of completing the contract at the tendered price and would suffer financial loss if he proceeded.

> The Chief Engineer was also expected to offer advice when so requested by a contractor who had, by misfortune, succumbed to an impossible situation....The handling of each contract was undertaken with fairness and humanity, and in the absence of any legal obstruction or interference. The written words of the contract documents were tempered with the wisdom and experience of long practice.
>
> Today's bridge contracts require the contractor to be responsible for the quality control of the project, thus relieving the principal of his traditional role. The finalisation of the contract is often a matter for the legal profession, while the bond and respect between the contractor and the Chief Engineer has been largely lost by virtue of the introduction of new channels in the Administration network. (Pearson, 2001; 6)

It is apparent, in reviewing the progress of the Gladesville project and in speaking to a range of workers and engineers involved, that the success of the Bridge both as a structure and as a job was, to a significant degree, the success of the DMR's system of contract supervision.



ELEVATION
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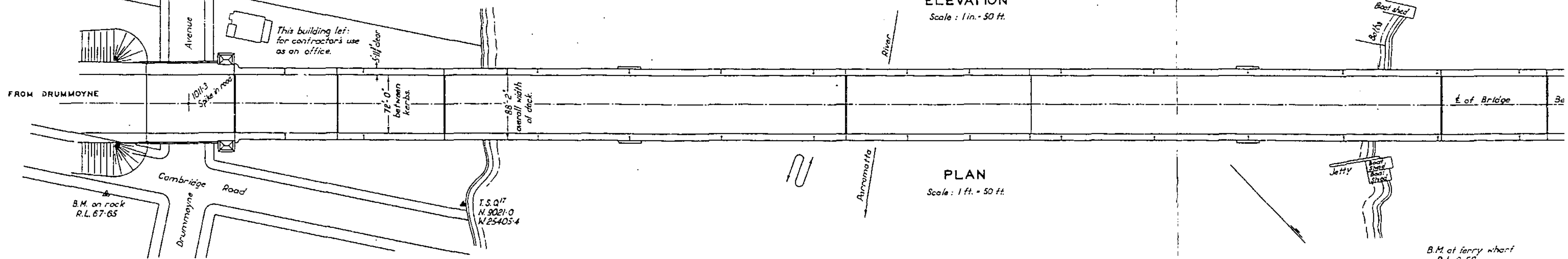
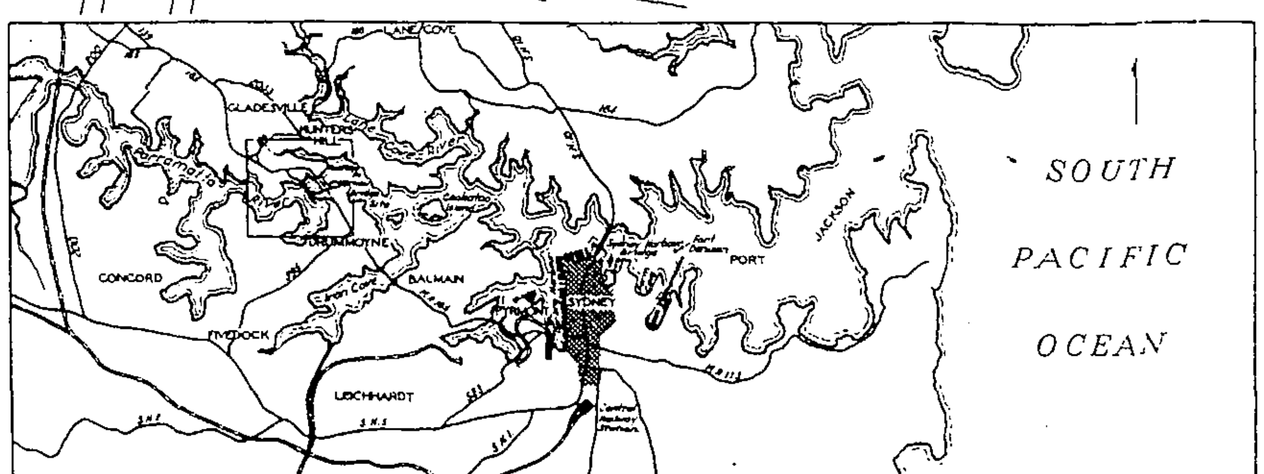
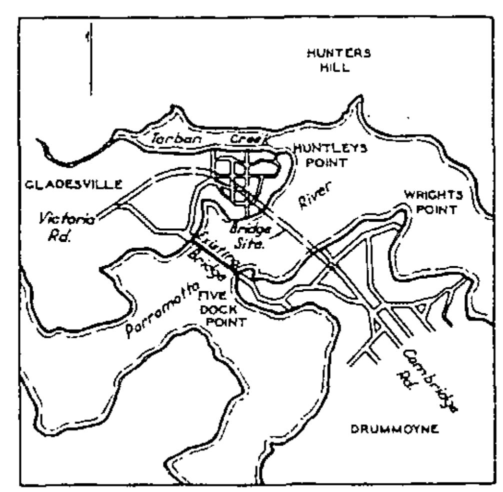


PLAN
Scale: 1 ft. - 50 ft.



LOCALITY PLAN
Scale: 1 in. - 1 mile



SITE PLAN
Scale: 1 in. - 20 ch.

Earthwork, pavement and fencing of approaches not included in contract.
All levels are reduced to Standard Datum.
E indicates expansion end of span.
F indicates fixed end of span.

Maximum Foundation Pressures	
Abutments	11·6 Tons/sq. ft.
Piers 1 and 8	6·2 Tons/sq. ft.
Piers 2 and 7	6·5 Tons/sq. ft.
Piers 3 and 6	6·5 Tons/sq. ft.
Piers 4 and 5 (rets.)	10·3 Tons/sq. ft.

REDUCED SIZE PRINT
THE SCALES OF THE DRAWINGS ON THIS SHEET ARE EXACTLY TWO FIFTHS OF THOSE

2.2 The Tender Process

In 1958, Brian Pearson, who had been on other duties, began work on the Gladesville Bridge project. He learned that tenders, which had been called internationally in June, had closed on 17 October, 1957 and that the lowest tender which the DMR wished to accept needed investigation. In fact, this tender was to replace a design which the Department had been working on for about five years, since the early 1950s. (Pearson RTA-GB: FH 8 Side A, 22:09)

According to Pearson:

> That design was a balanced cantilever design in steel material and it was very similar to the design which Bradfield had earlier favoured for the Sydney Harbour Crossing.....People in the Bradfield team had worked on this balanced cantilever design and were aware of it and I think that probably influenced the bridge section and the DMR senior people that that style of bridge would suit the Gladesville Crossing.
>
> There was no doubt that it would suit the crossing, but it was very labour intensive in the preparation of the steel components and labour costs in that type of bridge would have been quite high, the same as they were with the steel arch bridge that was built across Sydney Harbour. (But) the design was proceeded with and completed and tenders were called, based on that design. In those days, alternative tenders were not favoured and generally the Chief Bridge Engineer of the day required that a tenderer, if he wished to submit a tender for an alternative design of his own, had also to submit a tender on the Department's design. To my knowledge, this was not a requirement in the Gladesville tendering process, however. (Pearson RTA-GB: FH 8 Side A, 24:43)

Pearson also explains the usual tendering procedure. Before any major design was commenced in the Bridge Section, both the favoured design and alternative designs were costed. The most economical design, not necessarily the favoured design, would then be proceeded with. Four companies had tendered for the DMR's cantilever design, with tenders ranging from £2.51 million to £3.87 million. However, the lowest tender received was for a concrete arch of the tenderer's own design at £2,395,289.

This submission, supported by preliminary drawings, some calculations, a scale model and a perspective drawing, was from the English company Reed and Mallik, in association with an experienced and well-established Australian firm, Stuart Brothers. Originally the tender included another English firm, Alderton Construction Company, but they soon dropped out. The arrangement that Reed and Mallik put to the Commissioner was that they would supply the project manager, the chief engineer and the engineering staff. Stuart Brothers would supply the site foreman and the labour. The engineering role of the Bridge Section would be in checking the work of the contractor at every phase of construction. The DMR accepted the Reed and Mallik design, provisional on checking, in the name of "Stuart Brothers and Partner". (Pearson RTA-GB: FH 8 Side A, 24:43, 28:30, 47:02)

This rejection of the Departmental design in favour of a design from an outside tenderer had a precedent. After years of designing its own big projects in-house, the Bridge Section's design for the removal of the tram tracks on the Harbour Bridge had recently suffered a similar fate. In Brian Pearson's opinion:

> It was very demoralising for the Bridge Section to lose out, particularly on Gladesville Bridge, because there were a large number of people involved in preparing the arch cantilever design. It was also demoralising when the Bridge Section missed out on the Harbour Bridge Tram Track Design, because this was one of the first designs that was undertaken in the Bridge Section in pre-stressed concrete. It was felt, at the time, that pre-cast, pre-stressed concrete was the way to go with a number of our bridge designs and I think missing out on the Harbour Bridge job delayed, to some extent, the implementation of pre-stressed concrete bridge design. But it didn't take the Bridge Section long to recover from those two downs. (Pearson RTA-GB: FH 8 Side A, 35:09)

The Gladesville Bridge design had been prepared for Reed and Mallik by Tony Gee, an engineer with the London firm George Maunsell and Partners. Maunsell himself was highly regarded in engineering circles for his work during the Second World War, designing forts along the Thames for anti-aircraft guns and "Mulberry Harbours", concrete boxes used to provide safe harbour during the D-Day Normandy invasion. (McKenzie, RTA-GB FH12 Side A, 19:54)

The impact of the DMR's choosing an English design, according to Pearson:

> made the Bridge Section senior people realise that no matter how good they thought the Bridge Section was, there was still room for improvement in their designs. Maunsells established a branch of the firm in Australia and, very shortly afterwards, the Bridge Section experienced the advantage of having a leading overseas consultant in Australia, bringing into Australia the latest in European bridge design techniques. (Pearson RTA-GB: FH 8 Side A, 36:34)

In 1958, the DMR submitted the Reed and Mallik tender to design checks by Professor Roderick of the University of Sydney, Kevin Forrester in their own Bridge Section, and Eugene Freyssinet, the world renowned French expert in arch bridges, regarded as the founder of pre-stressed concrete bridge-building:

> Reed and Mallik had confidence in their design and they appointed a project manager for the site, Reg Voss. He arrived out and obtained accommodation near the bridge site and planned the commencement of the construction of the bridge -- desperately awaiting the reports. (Pearson RTA-GB: FH 8 Side A, 42:01)

But the months passed and the reports did not arrive. Ultimately:

> The health of the project manager started to fail and it became a regular thing for him to arrive on my doorstep here on a Saturday afternoon with all the woes of the week on his shoulders, desperate to find out if maybe I'd had any word on how these checks were going. Well, one thing I knew from experience is you cannot hurry a university professor, nor a world expert on pre-stressed concrete. We just had to wait for things to happen. Eventually, the project manager had to return to England and he didn't see the job finished. (Pearson RTA-GB: FH 8 Side A, 47:02)

Meanwhile, the DMR's design analyst, Kevin Forrester, who had moved into the Research and Development area while working on the Snowy Mountains Hydro-Electric Scheme, was feeling somewhat intimidated by the task of checking the Gladesville Bridge design. His previous experience had been confined to small span arches which can tolerate non-linear behaviour, whereas designing a structure the size of the Gladesville Bridge must take into account the problem of deformation. With significant deformation, the relationship between loading and stress becomes non-linear. Doubling the loading may even quadruple the stress. Forrester felt he was not sufficiently familiar with such relationships. (Forrester, RTA-GB: FH2, Side B, 48:30)

Fortunately, Forrester, who had also worked in Scandinavia, recalled the Sando Bridge, an 880 ft Swedish span of a similar type, and was able to find and translate some papers in Norwegian and Swedish on non-linearity to help in his analysis. (Forrester, RTA-GB: FH2 Side B, 54:25) He was greatly assisted by reading Bergstrom and Jakobsen regarding the collapse loads of arches and the increase in stresses that occur by virtue of deflections.

Today, with computers, he adds, one wouldn't go about analysis in this way, but in the late fifties, there were only limited tools available for his calculations. (Forrester, RTA-GB: FH3 Side A, 00:25):

> We had these electrical calculators. All they'd do was add, subtract, multiply, divide. The whole of the Bridge Design Section -- there must have been, I don't know, about twenty or twenty five engineers there and just the one calculator -- which is not surprising because I always remember the one we had cost £600, which was quite a fortune then. Funny thing is today you get the same thing for about $35 and it's got trigonometric functions and logarithms, and it'll give you standard deviations and you name it. All for thirty-five dollars. And it's silent. This thing in the middle of a design office, it was noisy! I think it was an American Monroe and it was like cranking up a diesel engine when the thing was going. And, of course, you'd have to take it in turns to use it, which was a bit of a pest. Fellows, sometimes they'd play tricks on it. Like they'd punch in a number and then try and divide it by zero and the thing'd just go crazy trying to print out infinity. That sort of humour was not appreciated. (Forrester, RTA-GB: FH3 Side A, 02:47)

Even using a slide rule for much of his work, Forrester remembers being accurate to within about an inch in calculating the deflections of the arch, and in his view, "it's all about deflections". (Forrester, RTA-GB: FH4 Side A, 09:44)

Ultimately, the Bridge design was found to be basically sound, But, as Brian Pearson recalls, certain improvements were recommended to make it more stable. These comprised the deepening of the arch rib by two feet at the crown, tapering back to no increase at the springing, plus longitudinal stressing cables to be placed in the twelve-inch gap between each pair of ribs. These cables were not to be stressed but concreted in place to resist any tendency of the bridge to buckle during its life. This, in Pearson's view, might only ever happen through earthquake action, and was only an insurance. (Pearson RTA-GB: FH 8 Side A, 53:15)

Forrester goes even further, suggesting that because the American designer Whitney, a guru of that period, was opposed to un-reinforced arches, the cables in the arch were used as a face-saver. In Forrester's opinion, it is the shape of the arch which is important.

The increased depth was also arguable:

> One thing that was a big argument between us and Maunsells early on was that we asked for thicker ribs at the crown....we asked for extra depth. What we were after was a higher collapse load, which made sense. They argued that if you have it stiffer, your temperature effects are going to be more severe, which was true. You can argue both ways. So anyway, we insisted on...an extra couple of feet. Being stiffer, it would have a higher collapse strength. (Forrester, RTA-GB: FH3, Side B, 53:47)

An additional and quite significant change was made in the Maunsell design, a change which in retrospect is somewhat controversial. This was the decision to increase the length of the arch from 910 feet to 1000 feet. It has been said that one reason for the change was the DMR's ambition to achieve a world record. But Brian Pearson recalls that it was Mr Reed of Reed and Mallik who initiated plans for an increased span, suggesting it for aesthetic reasons -- and, as well, because this would make it the longest concrete arch bridge in the world.

Sandy McKenzie also believes that:

> It actually got the arch thrust blocks out of deep water and made the excavation for these much simpler. But I suppose everybody wanted to have the longest concrete arch in the world!
> (McKenzie, RTA-GB FH12 Side A, 22:13)

The Bridge Section recommended to the DMR that the increase in length be accepted. In any case, Brian Pearson says, the DMR regarded the nine hundred-foot span as too short for the crossing:

Tombstone of Bill Reed with Gladesville Bridge motif. Photography by C.Bryce Ward

> It wasn't a choice that was made to establish a new world record. That came by chance. It was a change that was made so that the arch would fit better between the two Sydney sandstone banks of the river. (Pearson, RTA-GB: FH 11 Side A, 42:10)

With these changes, the price of the tender increased to £2.56 million from the company's previous tender of £2.39 million. But this figure was ultimately to increase still further. At the end of 1964, the DMR's estimated, somewhat cautiously, that the final cost of the bridge and its approach roadworks would be in the order of £4.5 million (Department of Main Roads New South Wales, 1964; 61) Perhaps this lack of a firm figure was because in 1966 the DMR became embroiled in a prolonged court case with Reed over costs. (Pearson, RTA-GB: FH 11 Side A, 22:14)

Although the amended Reed and Mallik tender was now higher than the lowest tender for the Department's original steel design, in the long run, the DMR considered that the concrete arch involved considerable savings. As Sandy McKenzie has pointed out, a concrete arch bridge gives almost unlimited life and little maintenance (McKenzie, RTA-GB: FH12 Side A, 17:35)

However, this wasn't to be the end of the tender changes. After the checking process, Maunsells was required to produce a full set of bridge drawings, as the plans in the actual tender, which became known as "The Green Book", were not adequate for the construction of the bridge, having been supplied only minimally, according to the European system of tendering.

As rapidly as possible, George Maunsell completed those drawings needed urgently for initial activities to proceed, but meanwhile, according to Brian Pearson, who was heavily involved in the contracting process, another problem had occurred. This problem was of the DMR's own making:

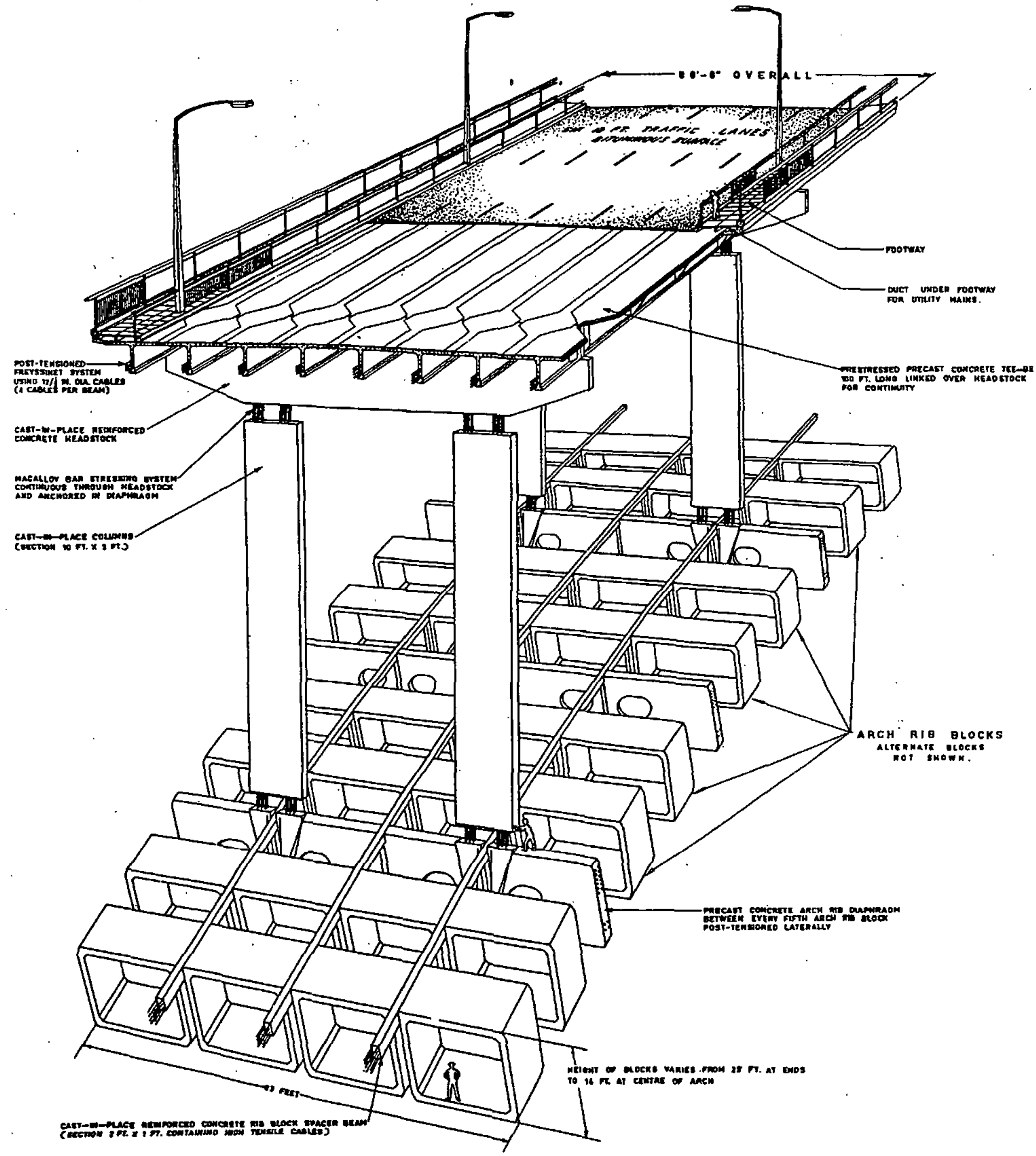
> "...In the DMR's initial investigations, it considered that it could get ten traffic lanes into the approach area to the Bridge at Huntleys Point, and would thus avoid any interference with the design of the Bridge. The lanes were needed to feed traffic from the Ryde area, that's one arm, and traffic from the Hunters Hill area, the second arm, onto the Bridge. In the detailed investigation in preparation of the road design, however, the Road Design Section of the DMR

> found that it would have to intrude into the Bridge itself and that meant that the Northern Bridge deck abutment had to be widened from six to ten lanes. All this information was conveyed back to Reed and Mallik and on to George Maunsell and....once that had been finalised, new quantities had to be calculated by the contractor for the whole bridge and checked by the DMR and a new contract price determined. (Pearson, RTA-GB: FH9 Side A, 00:30)

A further cost rise was necessitated once excavation for the thrust blocks began in December, 1959. According to Pearson, it soon became clear that these would have to be deeper than allowed for in the original tender:

> (Assistant) Commissioner Shaw was then approached by Reed and Mallik who, because of the long delays, were suffering financial problems. And he agreed that the variation due to the contractor from this additional excavation work should be paid for immediately, without delay....We calculated that variation to be worth a quarter of a million pounds Australian. And that payment was made immediately.
>
> That payment, with the variation due to the widening from six to ten lanes, plus the variation due for the longitudinal stressing cables, and the variation due for the deepening of the crown of the arch raised the price of the Bridge from the original tender price of £2.39 million to £3.6 million, or thereabouts. Which, in today's dollar figures, I think would be in excess of a hundred million dollars.....That's an interesting figure because, in effect, the Glebe Island (Anzac) Bridge and the Gladesville Bridge have a similar cost in today's dollars. The Anzac Bridge cost about $80 million dollars in 1994. (Pearson, RTA-GB FH9 Side A, 05:00)

Despite all the delays, changes and increased costs, Pearson reports, the Department's attitude towards the whole design and tendering process was that "we got a pretty good bargain" (Pearson, RTA-GB FH9 Side A, 07:20).



DEPARTMENT OF MAIN ROADS

GLADESVILLE BRIDGE

PERSPECTIVE OF

ARCH RIB BLOCKS, PIER COLUMNS & DECK AS

2.3 The Design of the Bridge

The new Gladesville Bridge is located not far downstream from the old bridge. Laurie Stewart, the DMR's Assistant Surveyor on the project, says that factors influencing the choice of the site were a combination of the narrow width of the river, the existence of a main road leading to the site and the nature of the terrain. It was envisaged that large ships would need to pass under the bridge and, although this did not eventuate, the topography of the site was appropriate for a design of a high bridge. There was a lot of solid rock in which to anchor it. (Stewart, RTA-GB FH18 Side A, 12:39)

In fact, the underside of the Gladesville Bridge arch is more than 120 feet (36.5 m) above high water level for a width of 200 feet (61 m) in the middle of the arch, the maximum clearance being 134 feet (40.8 m) at the crown. The bridge is 1901 feet, 6 inches (579 m) in length, including a four-ribbed concrete arch with a clear span of 1000 feet (305 m) and, on each side of the arch, four pre-stressed concrete girder spans, each 100 feet (30.5 m) long. As originally designed, the six lane roadway was 72 feet (22 m) between kerbs -- this distance was later widened to accommodate an extra lane -- rising on a grade of 6 feet in 100 feet (1.8 m in 30.5 m) from either side. The grades are connected by a vertical curve 300 feet (91.4 m) long over the centre of the structure. Originally, there were two footways on either side of the road, six feet wide, divided from the roadway by inner protective barriers and with high vertical-barred railings along the edge.

In their design, arch bridges aim for an appearance of lightness and openness, and the Gladesville Bridge, viewed from upstream or downstream, is graced by slender columns for the piers carrying the deck. These piers are only two feet wide, the same width as the diaphragms on which they sit, except for piers 4 and 11, which sit over the arch thrust blocks. These two piers are an additional six inches wide, as they accommodate the expansion system for movement of the deck above. The Bridge is generally considered a very successful design, with the exception of the headstocks on the piers, which have been criticised by no less an eminence that Professor Leonhardt, in his authoritative book on bridge design, *Brücken*, as adding to the heaviness of the bridge. This was an element of Maunsells design; Brian Pearson says that the Bridge Section tried to avoid headstocks on large bridges and incorporate the pier columns straight into the deck system. (Pearson, RTA-GB: FH9 Side B, 43:10)

Brian Pearson finds a great deal that was familiar in both the Bridge design and the plans for its construction:

> The Gladesville Bridge design is very much like an enlargement of the Roman arch. The Gladesville Bridge arch is a block arch, which the French call a Voussoir Arch. The Romans built...their blocks from stone. The difference from the Gladesville arch is the blocks are built from reinforced concrete and are also hollow. Each block in the arch weighs about fifty tons and varies in height from 14 feet at the crown to about 20 ft at the thrust blocks or arch abutments, also known as arch springings. The walls of the blocks are 12 inches thick in the vertical faces and 15 inches in the horizontal faces. (Pearson, RTA-GB: FH8 Side B, 38:05)

> The ribs themselves were pre-cast blocks with three inch joints separating each block and the joints were just filled with mass concrete. The ribs themselves were only of reinforced concrete, not pre-stressed. The connection of the ribs to each other was to be undertaken by means of transverse stressing cables that were cast into biscuits or diaphragms. That's just slabs of concrete that were two feet wide and occurred every fifty feet in length of the arch itself and those diaphragms were to link the four ribs together to form a single arch. That was a pretty straight-forward operation. Pearson, RTA-GB: FH8 Side B, 55:11)

Kevin Forrester adds that looking at a cross section of the arch, with its hollow blocks consisting of 12 inch slabs at the side and 15 inch slabs, top and bottom, there's not a lot of concrete. To preventing this tube failing locally as a column, the almost solid concrete diaphragms are placed every fifty feet to give it stiffness. And once the four ribs were up, post-tensioning cables through these diaphragms tied the four arches together. (Forrester RTA-GB:FH3 Side B, 38:13)

Pearson continues:

> The pier designs were pre-cast columns that were erected on these diaphragms with 100 feet centres, or headstocks, linking the tops of the columns. And the system was joined together by

> high tensile bars that were stretched and we were very familiar with pre-stressed concrete techniques by then. The deck itself comprised beams of a hundred-feet length to span between the piers and they were post-tensioned. They were a T section. If you can imagine a capital T, with a cross member, a vertical member and a little bulb at the bottom. That was the section of a beam. And the beam flanges, that's the horizontal part of the T, were joined together by strips of concrete laid between the flanges after the beams were positioned. So these activities that were required to build the bridge we were very familiar with and had used a lot of them on our own bridges. (Pearson, RTA-GB: FH8 Side B, 55:11)

Ray Wedgwood is more interested in the innovative aspects of the Bridge. While the superstructure design -- the girders that span across from pier to pier -- had been used in two or three other bridges, for example, at Bobbin Head, their hundred foot span was a significant span in those days. But, most of all:

> What was innovative in this design was that the design allowed for flat jacks built into the arch at the two quarter points of the arch. They were a bank of four flat jacks and there were a whole series of jacks right around the perimeter of the boxes in four layers. And by inflating these flat jacks, the arch was actually made longer. So rather than dropping the falsework away, which would have been quite a major effort, a major event in the construction process, instead the arch lifted off it. And then the whole falsework was built in such a way on its foundations that it could be slid across. Rather than build the arch in one go, the arch was built as four separate ribs, one along side the other. They're quite close but you can see the gap between them. Then the four ribs were joined at diaphragms at various points. And then the piers were built up from the arch and the bridge put on the top. So that was very, very innovative. (Wedgwood RTA-GB:FH22 Side B, 42:10)

This falsework was originally intended to be a floating structure, but at some point a further amendment was made to the tender to build the Bridge arch on fixed falsework. (Department of Main Roads New South Wales, 1964, 54)

Sandy McKenzie also calls attention to the new techniques that had to be employed. He points out that while pre-stressed concrete had been around for a while, pre-casting was quite new. A lot of the Gladesville Bridge was pre-cast, and the decision to pre-cast at Woolwich, one full rib at a time, was an innovative one. (McKenzie, RTA-GB FH12 Side B, 37:54)

Looking at the structure's complex design, Kevin Forrester says, "the Department was understandably concerned about this great enormous bridge that was heading into uncharted waters". And he too, as the person charged by the Department with checking the design, had concerns about it. Nevertheless, as he says, intuition has always played a role in bridge design:

> ... if your thrust is central to start with and it's very large compared to everything else that you do, your intuition tells you that you're pretty safe and -- by all means, check it out -- but you'll probably be alright. If a thing looks alright, well, then you're pretty safe with it. (Kevin Forrester RTA-GB:FH2 Side B, 48:30)

So, with the Bridge looking right to all involved, the first drawings arrived at the DMR and construction was ready to begin.

3. THE FIG TREE DISTRICT AND HUNTERS HILL

In those days road planning was road planning

and you fitted everything else around it.

-- Tony Prescott, Heritage Historian

While the main focus of attention was on the Gladesville Bridge and its complexities, it was the clearing of land between it and one of the smaller bridges which set off community concern in certain quarters.

The new four-lane Fig Tree Bridge was to span the Lane Cover River at Hunters Hill, replacing an old 2-lane iron bridge built in 1885; it would be a 7-span steel and concrete structure, 749 feet long, downstream from the mangrove swamps where the Lane Cove River emptied into the Harbour. Leading onto it from the Gladesville Bridge would be the new roadway planned as the first section of the North-Western Expressway. Between four and six lanes wide, this road was to include Sydney's first cloverleaf exchange, located between the Gladesville Bridge and Tarban Creek, cross Tarban Creek on the new bridge to be built there, and then cut deep through the hill, in what was known as the Fig Tree District of Hunters Hill, north of Tarban Creek. This expressway, taken together with its overpass, on and off ramps and grass verges, would bowl down some of the most historic buildings of the area.

The tenders for the Fig Tree Bridge opened on 29 August, 1959. Despite early hopes that the new roadway would not interfere with the historic homes and buildings in the district, it was soon revealed that a number of them would have to go.

We have a vivid personal account of the impact of the expressway on Hunters Hill from heritage historian Tony Prescott. Prescott grew up there and was just reaching his teens when the buildings were knocked down. Tony Prescott recalls Hunters Hill as:

> an idyllic place to live...it had all those general clichés about the olden days -- the sort of place where you could leave doors open, and you'd see neighbours a lot and you'd drop in to people all

> over the suburb. Some of them, I realised later, were quite famous, like the painter Nora Heysen and I remember Hal Missingham, the director of the NSW Art Gallery, lived in a house which was knocked down next to the Bank of New South Wales. And there were others. (Prescott, RTA-GB: MA16 Side B, 02:08)

Tony saw the construction of the expressway and the bridges as cutting a divide through the suburb, creating a sense of "the peninsula and the rest". It's worth including at some length the following edited version of his interview for the RTA in which he gives an account of the impact of the construction on his district, as he experienced it:

> Obviously, it made a large physical impact. Before the construction work, there was a whole scene there, including the police station at the corner, a number of houses, the vacant blocks, and the Bank of New South Wales -- and that was swept away. South of Church Street to the north, apart from all the houses, there was the Fig Tree Chapel, which was on the corner of Joubert Street and Church Street. As a result of the protest activity emerging at the time, the DMR funded its dismantling, stone by stone, and it was relocated to another street in Fig Tree, a bit further down the hill. Of course, there was St. Malo and Mary Reiby's cottage, and a big set of tea rooms at the bottom of Joubert Street up against the old Fig Tree Bridge and overlooking the river. It was on the edge of the slope. I remember going in there as a boy and there were these immaculately laid tables, with white table cloths and silver cutlery, a very elegant type of affair.
>
> St Malo's was probably one of the things that triggered my interest in history and heritage. I remember going to visit it as a boy. It was a lovely, big shady place. It had a verandah around it and it had big thick sandstone columns, which I later found out came from The Burdekin House in the city. It had these nicely vegetated grounds and a great ambiance around it. Very Georgian and stone and all that sort of thing. It had a wonderful feeling about it. And Mary Reiby's cottage was a rather ramshackle structure in the grounds, of sandstone. St Malo was basically used as a historic house. It was owned by the National Trust. It was their headquarters at the time.
>
> I only have the vaguest recollection of St Malo's being demolished. The general scale of the works there was enormous. There were great swathes of bulldozed countryside all the way from

Lane Cove River to Tarban Creek. I remember the standing house quite well but maybe I've subconsciously blanked the demolition from my mind because it was such a terrible thing to be happening at the time.

How did people in the neighbourhood feel about the bulldozing for the bridge and the roadway that was being built?

I was only quite young at the time, so I probably didn't have the same perception of following the community issues in the paper. But certainly it was a very big issue and people were very upset about it. Obviously, St. Malo was a big issue and it was talked about a lot. But I think at that time there were people who were in favour of the progress that the expressway would supposedly bring and I remember the barber at the Fig Tree shops mentioning that he felt that after it was built you'd be able to play cricket in Ryde Road, there'd be so little traffic on it. This was the journey of discovery people later made, I guess, about the effects of urban road building and that, in fact, there was more traffic.

You can see from the literature on Hunters Hill that people appreciated it in the 1930s and earlier. It was seen as one single heritage item. It wasn't a house here and a house there; the history was integral...You could see that something like the expressway would...strike at the heart of the history of the area quite fundamentally.

To build the Bridges, they had to take away a block's width of land right across the peninsula and even more at Huntleys Point. And, I know there was a lot of debate going on with the Minister Pat Hills involved as to whether it had to happen this way and whether St. Malo could be saved by deviating around it. And when you look at the siting of St. Malo and the way they've approached some of those roadworks in more recent times, in retrospect, it's probably quite possible that they could have saved some of those buildings. But in those days, I think, they seemed to approach everything on a very grand American scale and there was no other way of doing it. (Prescott, RTA-GB: MA16 Side A, 20:04 - Side B, 30:18)

In 1968, four years after the completion of the Gladesville Bridge, the Hunters Hill Trust was formed for the future protection of the area's heritage. Reg Martin, one of the founders and office-bearers of the Trust, recalls the disruption of the casting yard in a horse paddock opposite his house at Woolwich. For him, one impetus towards action was the new roadway and the concerns associated with the issue of St. Malo's that Hunters Hill would go the way of Kirribilli, destroyed by the roadway and high rise development. Martin was further involved in the early 1970s, when Hunters Hill mounted a successful fight for Kellys Bush. (Martin, 2001) This action helped to kick off an upsurge of environmentally-concerned resident action groups right across Sydney, as well as initiating the first-ever Green Ban by Australian building unions. Thus, heritage and environmental consciousness, perhaps, as much as the actual demolition of historic buildings, was also a legacy of the Gladesville Bridge.

But not all residents in the area were against the expressway. On the other side of the divide that Tony Prescott refers to, Christine Hanrahan lived in Henley, about half a mile from the Bridge:

> I remember them clearing the land, I do remember that there was quite a bit of bush there on the headland and they were clearing that for quite some time. That was the first visible change in the area. But it was never a negative thing. Nobody ever regarded that it was going to be an imposition. It was always welcomed because we needed it so badly. I mean we needed the flow of traffic and all of this area was opening up. A lot of it was originally market gardens and dairy farms. And it was opening up as residential. And there was a great cry for a better form of transport for this part of Sydney. So it was really welcomed by the locals. Nobody complained about the removal of the bush or the noise of the building of the bridge. It was just accepted that it was something that was needed. (Hanrahan and Joyce, RTA:GB MA15 Side A, 07:18)

And while Resident Engineer Sandy McKenzie imagines that the many residents of Huntleys Point whose housing was demolished, must have been unhappy, he wasn't aware of any organised community complaint -- although some of the remaining residents were "less than amused" by soil washing down on their backyards from the denuded hill above them. But, as he comments, "I don't think the Greenies had invented themselves in those days." (McKenzie, RTA-GB: FH12 Side A, 26:31)

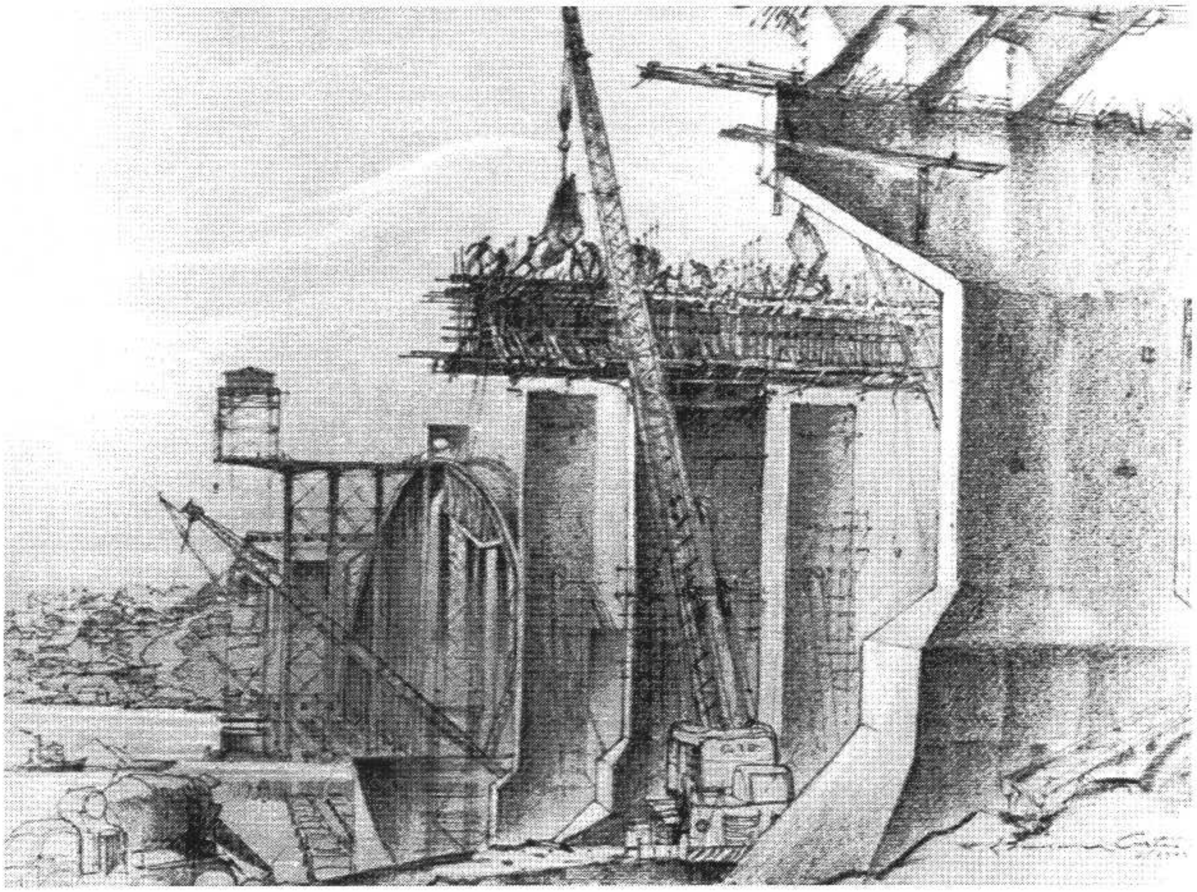
And, in the end, as Ray Wedgwood implies, planning involves a certain amount of pragmatism:

> I know a number of houses did have to be relocated. But in order to get a bridge through, you'd be limited by the approach roads and not wanting to rebuild the approach roads which would lead to even more disruption of houses. The difficulty is that you need, really, to get back to the existing approaches relatively quickly. And I'd say that was the least worst scenario that they had to find. (Wedgwood, RTA-GB: FH 22 Side B, 30:53)

Looking back now, Wedgwood explains that in the era of the 50s and 60s the building of better roads was regarded as a good thing, regardless. The DMR had enough legislative capability to be able to resume properties for whatever roads were considered necessary. He agrees that sometimes this was done in the face of other notions about what might be planned for that area. (Wedgwood RTA-GB: FH23 Side B, 39:04)

However:

> It was about getting things done, building things that people could use. I don't think it was about having their way over the community. There was more the attitude that there was a lot of work to be done and they used to get on and do it. (Wedgwood RTA-GB: FH23 Side B, 42:31)



Work proceeding on piers and headstocks. Drawing by R. Emerson-Curtis, purchased by DMR, May 1962

4. CONSTRUCTION

I think everyone on the Bridge didn't treat it as just a job. They put their heart and soul into it and there was some really good workers that made a good finished product because they knew they were building something special.

-- Ossie Cruse, Rigger-dogman

It took a very long time for the actual construction of the Gladesville Bridge to begin. Brian Pearson remembers that:

> The most frustrating thing was the waiting. I had plenty of work to do with other bridges, but I could see that the people on the contractor's side and our own site people who were appointed to supervise the work -- that's the foreman, Sandy McKenzie and his assistant -- were being demoralised by the waiting. Considering that the original tender was accepted in 1957, it wasn't until the beginning of 1960 that work started on the site....The design was changed from 910 to 1000 feet. The design was referred to experts....university people are very difficult people to get anything out of in a hurry. And we had to be patient and wait. And wait. Until their reports were received. And, of course, when the reports were received, they had to go back to the contractor, who sent them back to his consultant, and the design drawings had to be completed and sent through for checking. So there was a delay of about three years, but once the job got started , it went very rapidly. (Brian Pearson RTA-GB:FH10 Side B, 38:05)

Pearson recalls that the first step was a site meeting with the contractor's main engineers to set down procedures, discuss plans for falsework and formwork and the DMR's requirements for the concrete in the various components. They also discussed the location of the casting yards and who the sub-contractors would be:

> This meeting went on all day. In fact, I think it continued for several days. And the contractor had a long list of points that he wanted to discuss and clarify and we waded through them all. And surprisingly, with no experience whatever in that size of bridge, and very little experience in arches generally, we were able to answer all these queries on getting going. It didn't become a

> situation of us and them -- it became "us", us being the partnership of the contractor and the DMR. Whenever I found a foreman referring to "them", I always pulled him up, "It's always 'us'." (Pearson, RTA-GB: FH9 Side A, 12:45)

According to the official record, construction of the Gladesville Bridge began in December, 1959, with the building of the coffer dams for the excavation of the arch thrust blocks on either side of the Parramatta River. Brian Pearson recalls that that this task was completed by February, 1960. (Brian Pearson RTA-GB:FH10 Side B, 38;05)

Land clearing and excavation were also required for these abutments at the ends of the bridge and for the shore pier columns of their approach spans.

The next stage of construction involved the building of the formwork and the pouring of the concrete for the thrust blocks, abutments and shore piers. The Gladesville thrust block was completed on 22 August, 1961 and on the Drummoyne side on 30 October, 1961. The driving of the piles into the river for the fixed falsework was also under way and by November, 1961, the steel falsework was in place to support the first arch rib. Casting of the hollow blocks (box units) and diaphragms for the arch ribs took place in a special casting yard downstream from the site at Woolwich. The casting yard was large enough to allow all the blocks of one rib to be laid out and cast. These fifty-ton units were then loaded on to lighters and towed upstream to the bridge site, lifted by crane to the crown of the falsework and winched down on bogies into their correct places. Meanwhile, the units of the next rib were being cast. The first box unit was placed on the first arch on 23 February, 1962. By this time, articles about the Bridge were appearing in the press and a viewing platform was in place on the Drummoyne side of the structure so that members of the public could watch it progress. Other visitors were given an even closer view of the construction, as Sandy McKenzie recalls:

> Apart from the occasional visitors, there came a time when the Commissioner decided that every engineer in the Department should visit Gladesville Bridge. Now that was about 450 engineers. And we decided that fifteen was about the maximum number we could accommodate in a party. So this was thirty parties and the tour of the Bridge and down to Woolwich would take at least half a day. (McKenzie, RTA-GB: FH12 Side B, 44:43)

It took five months to complete the first arch. On 31 July, 1962, the last box unit was in place. Cables and jacks were put into position and the three-inch gaps between the units were filled with concrete. Then followed the jacking operation, with the first arch becoming self-supporting in September, 1962. The falsework was then moved sideways to carry the next rib of the arch. The procedure was repeated for each of the three remaining arches. The second arch became self-supporting in January, 1963, while the third and fourth arches were completed more quickly, by March and June, 1963 respectively. The falsework was later removed from beneath the arch.

At casting yards at both ends of the bridge, 143 pre-stressed concrete deck beams, each weighing 65 tons were being manufactured. Once the arch was in place, they were lifted by a special launching truss and placed in position. This operation was completed in February, 1964.

As the erection of the pier columns and deck beams was completed, the concrete deck between the beams was cast into place. The cantilevered footways were also cast in place and then the footways, railings, and light standards were erected. The asphaltic concrete surface of the six-lane roadway was laid. Meanwhile, the associated roadways and approaches were being completed and landscaped. The Gladesville Bridge was opened to traffic on October 2, 1964. (Department of Main Roads New South Wales, 1964; 54-58)

4.1 Construction Personnel - The Officers

In this period, not only was the DMR organised hierarchically, in military fashion, but work relationships in general were more formal and less flexible than they are today. There was more respect towards senior staff, more of a social gulf between higher and lower. While in the stratification of the Gladesville Bridge workforce, the engineer may have been relatively remote from the worker, there was an important middle group -- the sergeants, as it were -- who ran the job from the point of view of the ordinary worker. Rigger-dogman Ossie Cruse described the structure of supervision as he experienced it:

> The engineers were the seniors, they were Pommie engineers most of them, a few Australian engineers. They were the senior people. There was a middle strata there, like the foremen and the supervisors and that sort of thing. We had a mateship with them but they were pretty strong in their leadership. They knew they were boss and we knew they were boss too, even though they were close friends. (Cruse, RTA-GB MA19 Side B, 39:32)

Some foremen were employed by the contractor and others by the DMR. And the DMR made good use of this opportunity to develop its corps of foremen:

> Up until about the time the Gladesville Bridge started, the Department had three grades of foremen and many of these functioned as superintending officers on bridges, generally. Just one man looking after a small bridge. But about that time, the Department decided to recognise those senior foremen who had a lot of experience and ability and they created a new grade which they called Special Grade. They were very important (to the Gladesville job) indeed. I actually had three of them working with me as well as a number of more junior foremen. In fact, it's worth stating here that the Department regarded Gladesville, I suppose because of the fact that there were a lot of senior foremen working there -- these Special Grade Foremen -- as a suitable training ground for new recruits. And often the newly recruited foremen from outside the Department would spend weeks or months with us before they were sent out to their other work. (McKenzie, RTA-GB FH12 Side B, 31:50)

Before Sandy McKenzie arrived on the Bridge, supervision was under the control of Special Grade Foreman, Ross Brealey with assistance from junior grade foremen Brian Crocker and Harry Gronow. (McKenzie, RTA-GB FH12 Side B, 29:56)

Brealey remained McKenzie's right hand man throughout the work. McKenzie regarded him as a "Special Special". Brealey was a fitter by trade who had worked in gold mines and dam construction before joining the DMR where he had supervised the construction of many bridges before coming on to the Gladesville Bridge job. (McKenzie, RTA-GB FH12 Side B, 31:50)

Another of McKenzie's foremen was acquired as a result of a falling out with a cantankerous divisional engineer who then wanted to dispose of him, so the story goes. But:

> George Fawkner, who was a very forthright man, declared, "He can't sack Charlie Boughton, give him to me!" So they gave him to George and George gave him to me. And Charlie supervised the casting yard at Woolwich where the concrete blocks for the arch were manufactured. George Barty was another one-off: a rough diamond, a very valuable man. You can imagine that these foremen on bridge works in the remote parts of the state were living under rather hard conditions at times and generally they were paid a camping allowance, or living away from home allowance. But George had a special arrangement, he had a caravan and he had a wife. And wherever he went, the department moved his caravan and his wife for him. So in due course, George arrived on Gladesville and we found a spot on Huntleys Point where nothing was going to happen for a while and there we placed George's caravan and George joined the team. (McKenzie, RTA-GB FH12 Side B, 34:00)

The foremen stood between the engineers and the workers. Leading Hand Bill Davis recalls that although the engineers and the workers got along well, they ate separately and did not mix socially. (Davis, RTA-GB FH:21 Side A, 27:11) Joe Ward, an experienced bridge carpenter and a foreman on the launching gantry, says that the foreman were also supposed to eat separately from the ordinary workers. (Ward RTA-GB MA25 Side B, 30:06) This was the social order of that time and place.

Stuart Brothers supplied one of their directors, Will Noble, to be associated full-time with job and also the site foreman, named Jack Bryant, whom Pearson regarded as extremely competent. Bryant ran into difficulties, and, although well-liked by the men and regarded by them as realistic and knowledgeable, he eventually got the sack.

Some of the English engineers employed by the contractor who were recalled by interviewees included Ken Parsons (who later became Chief Engineer on the Tarban Creek Bridge), Michael Watley and Peter Austin. But perhaps the most respected man on the job, according to all who mentioned him, was the contractor's Chief Engineer, Howard "Baikie" James, likewise from the UK. James also became project manager, upon the return of the original project manager, Reg Voss, to England.

In addition, there were a number of engineers from England and elsewhere who came to Australia for the critical jacking operations -- which gives some indication the significance of this record-breaking arch was at the time. These included Gordon Wright, an expert in pre-stressed concrete, and the bridge designer, Tony Gee, both from England. Monsieur Guyon, a French engineer, and Peter Jensen, a Dane, represented the Paris-based Société Technique pour l'Utilisation de la Précontrainte, the organisation with which Freyssinet, who died prior to the jacking, had been associated.

As well, in a period in which academics were fewer in number and more highly respected than they are today, the staff from the University of Sydney continued to play a role: Professor J.W. Roderick as general consultant, Associate Professor D. Campbell-Allen, special consultant on concrete, and Associate Professor R.L. Aston, special consultant on the precision surveying required during the arch construction.

Other Australian construction companies, along with Stuart Brothers, were involved in special aspects of the project. These sub-contractors included Sydney Bridge and Wharf Pty Ltd with its principal, George Harvey, dredging and driving and extracting the falsework piles, and the Sydney architectural firm, Fowell, Mansfield and Mclurcan, whose partner Mr. D.C. Maclurcan provided advice and design sketches for the special protective barriers for the footways and footbridge. Another fifteen construction companies took on various specialist aspects of the job, including manufacture of the blocks and diaphragms for the arch, manufacture of the steel for the falsework, concrete reinforcing, excavation, erection of the falsework and specialist crane lifting. (Department of Main Roads, October1964)

In this era, while most of the road work was done by the DMR's directly controlled workforce, bridges were generally tendered out to contractors. The primary role of the DMR engineers on such a project, therefore, was to check the work of the contractors. Ray Wedgwood explains how the Department's Quality Control and supervision of contractors operated in that period and how it differed from the "Quality Assurance" under which such government authorities operate today:

> Under Quality Control, the DMR would let a tender. The contractor would come on site and start to work and we would supervise every aspect of the work he did to make sure that we got what we wanted, what was in the spec books and the drawings. And if you didn't do it properly, we would say, "Well, you can't proceed until you've fixed this up or done that."
>
> Briefly, with Quality Assurance, we're saying to the contractor, you show us that you've got a system of assuring the quality by your own people and that they have procedures that they will use and you'll verify that they've used those procedures and you will give us the product we want. The difficulty in bridge building for Quality Assurance is that there are some procedures, if it's not done right, you can't get to see the finished result -- like driving piles, like pre-stressing. If you're not there when it's happening, you just don't know. (Wedgwood, RTA-GB FH23 Side B, 55:25)

In the early 1960s, the DMR's Quality Control involved a number of its staff very closely with the Bridge. Some were on site continuously; others visited the site regularly while also engaged in checking other bridge construction elsewhere. The Commissioner and those in the top levels of the DMR approved all important decisions.

Perhaps the most senior officer directly concerned with the work was Frank Cook, Assistant Bridge Engineer, Gladesville Bridge, a designer and a constructor, with a double degree in mechanical and civil engineering. During this transition period from steel to pre-stressed concrete, Cook visited Europe and made a study of pre-stressed concrete and its advantages over steel. (Wedgwood, RTA-GB: FH22, Side A, 23:59) Cook played a significant role within the DMR in the decisions and administrative aspects necessary for the success of the project. Even when promoted to the position of Bridge Engineer in December 1962, despite many other responsibilities, Cook continued to play an active role in the Gladesville Bridge project. Cook also supervised the legal cases which followed its completion. Within the hierarchy, the Metropolitan Engineer, R.W.P. Hirt was nominated as Engineer under the Contract, while the role of Assistant to the Engineer under the Contract was filled by George Fawkner and, upon his promotion in May 1962, by Pat (A.F.) Schmidt. These two men were the superior officers with whom Brian Pearson worked in his role as Supervising Engineer. Pearson describes a typical day in his life during the period in which he was in charge of the construction of the Bridge:

> Most days were the same, time-wise. I'd arrive at the office at Milsons point about 7 am. The stenographer would arrive about 7:30 and for the next hour or so, I'd dictate correspondence and give her other material such as progress payment vouchers, progress returns -- routine material such as that. From the end of the hour of dictation, for the next hour or so, I'd be available on the telephone for the sites to contact me to discuss their problems with me, what they needed. And then from about lunchtime onwards, I would visit the sites that had problems and sort out those problems. And then the work would continue. If I wasn't discussing problems, I'd probably be meeting with our site representatives and the contractors and discussing programs for the next week or so. That would be the same each day: I'd be available in the office in the mornings and then I'd do my routine inspections in the afternoons. They were quite lengthy days actually. I'd finish probably about six o'clock. (Pearson, RTA-GB FH10 Side A, 20:21)

Sandy McKenzie, Resident Engineer, started on site in February, 1959, just before the pre-stressing of the girders began. McKenzie's assistant engineer was Dick Holland. Their work included filling in forms, checking test results, and checking reinforcement. A typical day for Sandy McKenzie also began with cleaning up the paper work left from the previous day, and looking at test results. Then

> Unless there was anything pressing, I tried to walk the job every day because there were the operations going on, on six or more places on the job as well as down at Woolwich and I felt it necessary for me to keep in touch with what was happening everywhere. (McKenzie, RTA-GB: FH12 Side B, 44:43, 55:15)

Rex Cooper was Testing Operator on the site, responsible for concrete samples. Brian Cox was the Surveyor for the DMR, checking the accuracy of the contractor's work to within half an inch, and with him worked Laurie Stewart, Assistant Surveyor.

The Bridge Section's materials and research staff played an important role. Initially, Frank Mullin was the Materials and Research Engineer. He was replaced by Laurie Browne early in 1963. Under them worked Alan Leask, Supervising Engineer, Materials and Research, supported by a testing officer, N.W. West, and other staff. As this was the first experience the DMR had with high strength concrete, a sophisticated testing program was established to test the quality of the concrete, the proposed mix designs and the properties of the steel reinforcement. A testing laboratory was set up on site to cater for the large number of tests. This included a temperature-controlled fog room. (Leask, RTA-GB FH14, 11:30-14:50)

All these men were engineers, but other DMR staff were involved in the project in various ways. On the administrative side, the DMR maintained large secretarial and accounts sections, and it should be remembered that all such government organisations in that period performed in-house many of the functions -- e.g., cleaning, driving and courier services, vehicle maintenance, preparing morning and afternoon tea and sometimes meals -- which are "out-sourced" today. In 1964, for example, the DMR employed, along with 984 professional salaried officers, 756 clerical salaried officers and 507 general salaried officers, plus many others in the lower ranks. (Department of Main Roads, New South Wales, 1976; 279)

4.2 Construction Personnel - The Men in the Ranks

Interviewees generally present the engineers as a sober, orderly, self-restrained and focussed group of people; but when the tradesmen and laborers -- the "workers" -- speak or are spoken of, a very different type of personality emerges. It is often the jokes, the eccentricities, the mateship, the adventures, the fears and the misdemeanours which are recalled -- along with a unanimous appreciation of what a good job the bridge was to work on. Some of the workers stayed on the project virtually all the way through, others came and went, either because their skills were no longer needed, or because -- even with the relatively high wages paid on the Bridge -- they could get even better money elsewhere. The construction of the Sydney Opera House was a job that drew quite a few bridge workers for that reason.

Joe Ward, the launching beam foreman, was one of those who eventually left for the Opera House. His sphere of daily work, lower down the chain of command, was a very concentrated one:

> I'd arrive by car to the bridge, park, lock the car up and go up onto the Bridge site. Have a good look around for a start and see that no vandalism or anything's been disturbed. Have a look at the compressors and just a general check-out. And the men would be there, changing their clothes, in their change shed...When they'd get all changed and everything, they'd come out onto the job and we'd start operating.
>
> We mightn't be always launching the beam. We could be stripping a beam down, stripping the form work off, have the labourers there cleaning it all...In construction work, it's like a household. You've got to clean all the time, you can't have build-up.
>
> ...I had to report every morning. A time keeper would come around and he'd just copy out the hours off your time sheet that you made out. A junior engineer used to come around about once a week and have a bit of a talk to you and say, "How's things going"....We'd have our lunch and smokos and in the afternoon, pack everything away and then knock off. The hours were 7:30 till about 4:30 - 4:15, something like that. You couldn't say that we had to knock off on a certain

> minute ....It's not like working in a factory where the old whistle goes and you knock off.
>
> (Ward, RTA-GB: MA25 Side B, 48:58)

Men of different nationalities worked on the Gladesville Bridge. It appears that the Maltese and Italians -- in those days the term was "New Australians" -- were mainly concrete workers -- renderers and steel-fixers -- and did not move into the areas of carpentry, plant operating, rigging or crane-driving. As Joe Ward put it, native-born Australians didn't like working with concrete, but the Italians had a lot of experience in this area. Some of the Italians had worked on the Snowy Mountains Hydro-Electric Scheme, and Ward believes they may have gained their experience there. (Ward, RTA:GB: MA25 Side B, 35:40)

Each group -- old Australians and new -- had their somewhat stereotyped views about the other. Ward tells a story which is worthy of John O'Grady's classic novel *They're a Weird Mob:*

> We knew his name, but it was so long we couldn't say it -- we called him George Spaghetti. He was very impatient. He was a labourer. We were working on the Gladesville side and had to go down and go over the old Bridge to get back to the main office to knock off of an afternoon. That's where you'd come and bundy on, over there. Anyhow, he'd run out on the middle of the road and put his hand up -- because he had to cross the road. And he got knocked over with a car. Into hospital. We all took a collection up for him, poor old George, got him back to work. Blow me down, if he didn't do the same thing again, a second time. Anyhow, we took another collection up. And we were having a bit of a meeting there, one day, he said, "Me no *understand," he said, "You Australian Bs," he said, "They stop for a woman. They stop for a* dog. Not poor old Spaghetti George. Down all the time." Ahh, that was a classic. (Ward, RTA:GB: MA25 Side B, 33:28)

Ward didn't have a memory of Aboriginal workers on the Bridge, but there were, in fact, quite a number. Ossie Cruse, presently Chairman of the N.S.W. Aboriginal Lands Council, started on Gladesville Bridge as a plant operator and jack hammer worker, passed the Department of Labour and Industry (DLI) exams for his rigger's and dogman's tickets, and ended up riding the hook, a couple of hundred feet above the water. Ossie's brother, Ray Cruse, was one of the crane drivers. Other Koori workers were Brian Monto, Ray Vincent, Chicka Madden and Freddy Beale. (RTA-GB: MA19 Side A, 13:27):

> That was the time when we were coming out of the racism period, I suppose. And I think that a lot of times they didn't expect Aboriginal people to excel in the way that they did. And I think from the outset there was a bit of suspicion. To be accepted, the Aboriginal person had to prove themselves that much more in the work field. And Aboriginal people did that. Some of the men like Freddy Beale, they were top concrete finishers, top men, and they did an excellent job. And they gained respect because of that. And the people that used to treat Koories -- Aboriginal people -- as a joke a lot of times, started to see that these men in their job in the workplace were equal, if not better than them a lot of times. As a rigger-dogman, I used to say that if a whitefella can do it, I can do it just the same. And I can remember now that some of the lifts that I did, I could put one sling in the middle of a massive load -- say the load was three or four ton -- put one sling in the middle and it would balance correct. So that was showing me that, you know, you could do things and you can do it equal to anybody else.... (Cruse, RTA-GB: MA19 Side B, 45:08)

Some of the other men whom Ossie remembers working with on the rigging crew were Johnny Brotherston, the other dogman rigger, Lenny Sherring, rigger, Slim Godfrey, Crane Driver, and Maurie Sweeney, their foreman. He remembers that Billy Brown was a foreman with the concrete men and Keith Jenkins was a scaffolder. (Cruse, RTA-GB: MA19 Side A, 13:27). And sometimes, they had a lot of fun:

> But those days were really wonderful days. I can remember the day that somebody got into the ear of old Slim, the crane driver. It was a rainy day and we never had a lot to do. So Slim asked me to do a job over the other side of the yard and I jumped into the sling and I'm riding the sling over. And I'm wondering why he's going out over the water. He put the jib out as far as it would go in the Parramatta River and then he started to lower it -- toward the river. And I'm thinking, "Now what's this silly old coot doing?" Cause they never told me that what he does with a new dogman is give him a dunk in the river. So I'm going down and I started blowing

> the whistle to stop. And old Slim didn't hear me. He didn't want to hear me. So he put me in the river. I had all this regalia on. All the wet weather gear -- gum boots and all. And down I went into the water, right into the water too -- in the sling. I stayed in the sling though. And when he pulled me up, I was shaking my fist at him and he was laughing like mad.... And all the lads on the bank were clapping and cooee-ing this dogman going in the river. But we always took it in good fun. (Cruse RTA-GB: MA19 Side A, 21:49)

Speaking more generally about the workforce, Cruse recalls many rough characters who nevertheless had a sense of responsibility. The men were tough, he says, because they had to be. Their job took "extra human spirit and human strength" and with the heights and the weights involved, a mistake could mean disaster. (Cruse, RTA-GB: MA 19 Side B, 42:24)

Bill Davis, first a labourer, then a charge hand, started on the job when the slope was being graded for the transport of the beams. Like many men, he got his start through knowing someone, in this case George Holford, who was in charge of the site office. Davis stayed on the job until the end, in part because he felt he had very good workmates. He recalls some of the more colourful characters on the job:

> Well, at one stage there we had a father and two sons who had been dunny carters at Riverstone and they decided to have a change and come and work on the bridge. Oh God! Whenever they'd carry drums, they carried them on their shoulder like they used to do the toilet can. They'd throw them on to their shoulder and they'd rush around.
>
> Another father and son team there, a fellow named Wal Cummerford and John Cummerford. John was a chronic stutterer and they tried to make him union delegate. Well, he'd take ages and ages to get one -- he didn't last long at that. But he had a sense of humour. He'd say, "For God's sake, spit it out!" They had stiff-legged cranes on either side of the bridge and they used to call one crane driver "Donkey". He was an old guy; he was in his seventies then. He used live in the crane. Until they stopped him doing it. He wouldn't go home. He just lived there, had his stove. All that sort of thing. He was probably the greatest character there. (Davis, RTA-GB FH21, Side A, 21:54)

Joe Ward also got a job through knowing someone, in this case Jack Bryant and Ray Wheeler, the union rep for the carpenters at Woolwich. Ward spoke about the culture of mateship which on occasion led him to cover for errant workers, despite being a foreman:

> I was in the union with them. I realised, the same as any other union foreman, a lot of them anyway, you never ever turn your back on your mates. If you left that job, you got to go and work somewhere else tomorrow. You've got to look after your principles. .(Ward, RTA-GB MA25 Side B, 29:31)

4.3 Trade Unionism

On the Gladesville Bridge, trade unionism seemed to be more a matter of principle than a necessity for obtaining decent conditions. Ward says that Kevin Robinson, who was in his gang, was the Australian Workers Union (AWU) rep and Ray Wheeler was the Bridge and Wharf Carpenters Union rep and they got on pretty well with management. Wheeler, Ward maintains, always took into account the bosses' point of view too. There were little bitchy problems, he recalls, but nothing major -- no strikes.. Nor were there problems over demarcation -- the men "knew better than to do someone else's job". (Ward, RT-GB: MA26 Side A, 04:33)

It was also on the Bridge that Joe Ward and Ray Wheeler started a successful drive among the state membership to take the Bridge and Wharf Carpenters into the Building Workers Industrial Union (BWIU). Moreover, if what Joe Ward says is true, the Gladesville Bridge contributed to trade union history in yet another way:

> We had a policy in the BWIU that was "no work in the rain". And it was a dangerous job. You don't work in the rain on that type of structure. And what we did -- we were the first ones, I think, to invent the cigarette paper test. Somebody'd pull out a cigarette paper. And it was agreed -- after a lot of argument and everything -- if it was too wet to roll a cigarette, it was too wet to work. The paper used to get wet, so we'd go inside. When it had eased up a bit, the rep would go out and pull a cigarette paper out and if it didn't get wet, we'd go back to work. (Ward, RTA-GB MA25 Side B, 30:06)

Ossie Cruse, however, had a different view of trade unionism:

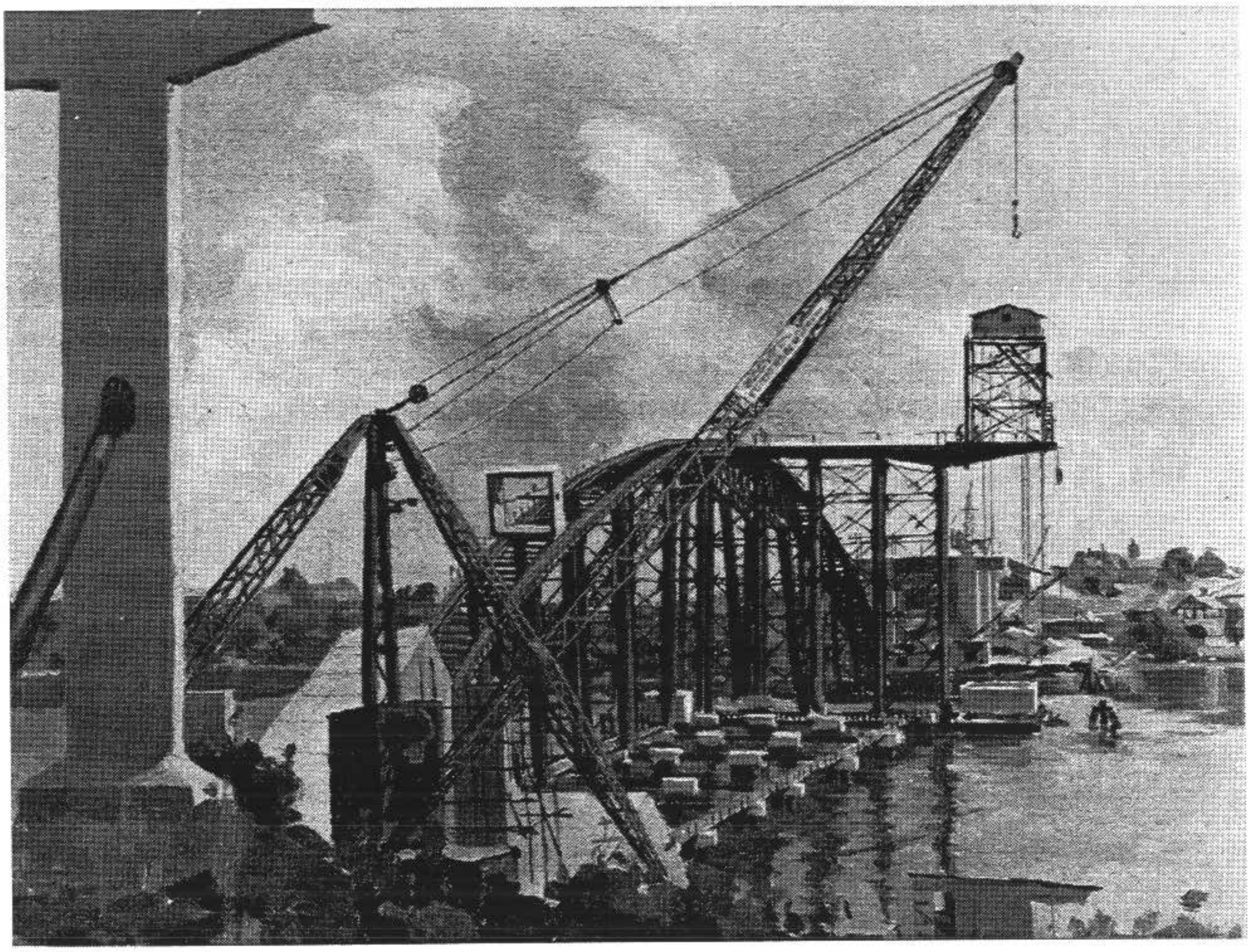
> The union was pretty strong. I never did like unions when I was a worker because I started work when I was eleven years of age and used to love to work hard and I used to love doing different jobs and when they come up with the "one job, one person", it cut across the grain. I used to like to do any sort of work. If the job needed to be done and you were there, I'd just pile in and give the guys a hand. But the rules were "one man, one job".

I remember once when a guy came in and he was drunk on the job, and he was actually a scaffolder. And the boss kicked him out, sacked him. And I know what can happen if a scaffold is put on wrong ...I agreed with the boss when they sent him out the gate, but the guys wanted to go to the races and they went out with the union and had the day off, in sympathy with the man. I stayed and worked. I didn't have any time for people that did things like that.

But there were good and bad things. The unions done good with the workers because they got conditions, you know. But I was a reluctant union man.

What were the conditions like on the Bridge job?

Very good, very good. Dust was minimised and you had good protective gear and you weren't compelled to do things that were dangerous, like working on steel in the wet. Even though we did, when we wanted to finish the job. The conditions were good. I think it was because the men themselves saw that you looked after the team. You made sure that if the job wasn't safe, you made the conditions safe. You did things yourselves, you didn't have to be told. But the dust was minimised because we used to get water in the hydraulic drills. Only with the jack-hammers, there was a bit of dust about. And we'd put a neckerchief around our throat and breathe through that. (Cruse, RTA-GB MA19 Side B, 48:13)



Oil painting purchased by DMR by Rhys Williams, 1962

4.4 Safety

It's fair to say that neither engineers nor workers thought about safety in the way we do today. Laurie Stewart, as part of the surveying team, observed this first-hand:

> There was no safety footwear, there were no safety vests, there were no hard hats. I can't recall any safety measures at all as far as the surveyor was concerned. He would walk over the rib, he would walk on practically any part of the partially-built structure without any safety harness or the like, nothing whatever. That's how things were in those times.
>
> I had cause to walk all over the structure all the time.... It could be quite dangerous if you weren't very careful in what you were doing. And of course there were workmen everywhere, huge numbers of workmen crawling all over it like ants, incessantly. (Stewart, RTA-GB: FH18 Side A, 26:48)

Nevertheless, the Gladesville Bridge had a good safety record. Brian Pearson attributes this to the bridge worker's innate sense of survival and the experience of the supervisors:

> Work safety rules hadn't been introduced in those days. But work safety, I think, was born into the bridge worker anyway. Not only was he aware that he was working on a structure that was potentially more dangerous than working on a building site, but he was also supervised by people who had been on bridge construction work for most of their working lives and these supervisors, largely the foremen employed by the DMR, insisted that basic safety operations be observed by all the workmen supplied by Stuart Brothers for the project. In fact, I would say that the DMR Bridge foremen trained those Stuart Brothers workmen in basic safety procedures for bridge construction.(Pearson, RTA-GB: FH10, Side B, 30:36)

Perhaps so, as Bill Davis, a Stuart Brothers employee, recalls that it took some time before he was pulled into line over footwear:

> When I first started, people were wearing thongs. Including me! Just walking around in thongs with picks and shovels and walking over reinforcing and stuff -- in thongs. And finally Jack

> Bryant, who was the supervisor at the time, issued an order that no one was to wear thongs any more.
>
> Hard hats -- occasionally someone would wear them, but it was very, very rare indeed. Not like today. you wouldn't dare go in there without the boots and hard hats and ear muffs and God knows what. (Davis, RTA-GB FH21 Side B, 35:12)

Joe Ward, on the other hand, says that there were hard hats available but the problems was that the men hated wearing them. The men could also ask for ear muffs. (Ward, RTA-GB: MA 25 Side A, 08:28) So perhaps there was a matter of lack of consciousness as well as a lack of regulation.

While there were no fatalities or major accidents on the Gladesville Bridge, it appears that there was the usual share of less serious injuries. Bill Davis remembers the air winch cutting a "gigantic lump" out of the leg of the man who was operating it, someone else being hit in the face with a stressing cable, and a rather odd accident which acquired some notoriety. One worker, late for lunch, started running down the steep decline of the arch and gathered so much speed that he couldn't stop. He finally smashed into a column at the bottom and broke his nose. Legend has it that he had the hide to sue the company, but was unsuccessful. (Davis, RTA-GB: FH21 Side A, 27:50).

Ossie Cruse recounts a number of accidents occurring through workers taking short cuts and breaking the rules:

> I was a pretty rough character in the early stages when we were cutting the foundations. Unknown to me boss, I used to come on to the job a little bit under the weather with the grog. Me and my mate, we both drank a little bit in those days -- that was before I became a Christian, of course. And one day, I was cutting with the jackhammer. We were breaking up these big rocks. And the rules are you never use a sharp point jackhammer. When the point sharpens, you change the point. Well, I didn't. I wanted to get this job done and get it over with. The jackhammer jumps around when you've got a sharp point on it. And it jumped around and jumped off the rock I was cutting and went straight through my gum boot into my foot. And when I jerked it up, the blood just squirted out through me boot. And my mate that was there, I

> think he got a bigger fright than I did. He started screaming out for everybody there to "Get the ambulance; get the ambulance"! And when I pulled the boot off, I was lucky: it just went between my toes and pinned my foot to the ground. Because when it jumped into my foot, instead of me stopping the trigger, I pressed the trigger harder into the ground! Anyhow, I paid for it. Because they seen that I come on the job with grog in me. But after that I became a Christian and gave up drinking. I never drank again since that day and that's why I'm a minister today. (Cruse RTA-GB: MA19 Side A, 20:20)

In fact, today Cruse is quite a well-known church pastor. But it seems to have taken more than one incident to knock the rule-breaking tendency out of him. Despite the laconic humour he brings to his stories, he was, in fact, lucky not to pay for his careless youth more dearly:

> I injured myself a few times. Once I broke the rules in relation to settling a sling-load of steel down on the skids. When you're working as a dogman, you don't touch steel with your hand. You never touch it. You hang on to the rope and pull the rope around.
>
> I was standing on the end and I had my hand on the steel, pushing it over to line it up, and the crane driver dropped it a little bit quicker than I expected and when the steel hit the skids, it pulled my hand into it. And when I finally looked at me finger, four of my fingers are hanging off! And I tell you, I turned around and if a man ever screamed, it was I screamed from the pain that was in those fingers.
>
> I thought it'd get me the money over it, but the doctor was so good, they sewed the finger that was hanging down back on again. So I never got any compo out of it other than eight weeks in hospital. Paid me hospital bill. (Cruse RTA-GB: MA19 Side A, 19:15)

Ossie Cruse's brother Ben was involved in a very lucky escape -- but in his case, breaking the rules was the only thing that saved him:

> There was only one accident that I can recall and it was an incredible accident. It was one of the big gantries that they swung under the Bridge, from one side to the other, to clean the face of the underside of the Bridge. There were four men working on that -- four workers. My brother was one of them. The Chief Engineer was away and the guy that was relieving was only a young fella and even I knew you don't use these toggles twice. Not on a heavy gantry that weighed about six

ton. It was the toggle that fixes on the rope to lock the frame underneath and he used it twice. You can never use a thing like that twice.

The whistle blew for lunch and these guys are coming up and they broke the rules too. See, the rule is only one man on a ladder at the time, but they were rushing for lunch and the four of them were on the ladder at the same time, climbing up the side of the bridge to the top decking. And they heard this "swoosh" and that's all they heard. And when they looked down, they saw the gantry was passing away from them. It slipped down and sank a hundred ton barge down below. So that was an incredible thing. These four men hanging on the ladder, swinging backwards and forwards on this ladder, with nothing under it. You know, that could have been a real disaster, had they been spread out along the gantry working. It was amazing that nobody was hurt and they got out of that safe. That was the only mishap I saw. Even though we were careless, a lot of us, restless in a lot of our ways. (Cruse RTA-GB: MA19 Side A, 15:01)

This carelessness, Cruse recalls -- albeit with a somewhat unrepentant air -- extended to riding the bucket on the crane down from the top of the bridge in free fall. (Cruse RTA-GB: MA19 Side A,12:13) During this period, free-falling -- letting the cable go and putting on the brake just before ground level -- killed perhaps a dozen Sydney building workers before the practice was finally stopped, but it was a way of saving time and reducing tedium — and was perhaps also an exhibition of machismo.

In any case, for even the most confident bridge worker, there were also concerns -- in particular, the stress of knowing in the back of one's mind that a massive accident could occur at any time. Cruse himself admits to suffering from stress, riding his 50-ton concrete blocks to the crown of the bridge, while Joe Ward recalls the stress of the launching gantry eventually impacting on his health. (Ward, RTA-GB MA 25 Side A, 22:10).

But, as many of those involved with the Bridge emphasize, from foreman Joe Ward to Supervising Engineer Brian Pearson, it was the people on the job who were important, and who looked after each other's safety. As Joe Ward says:

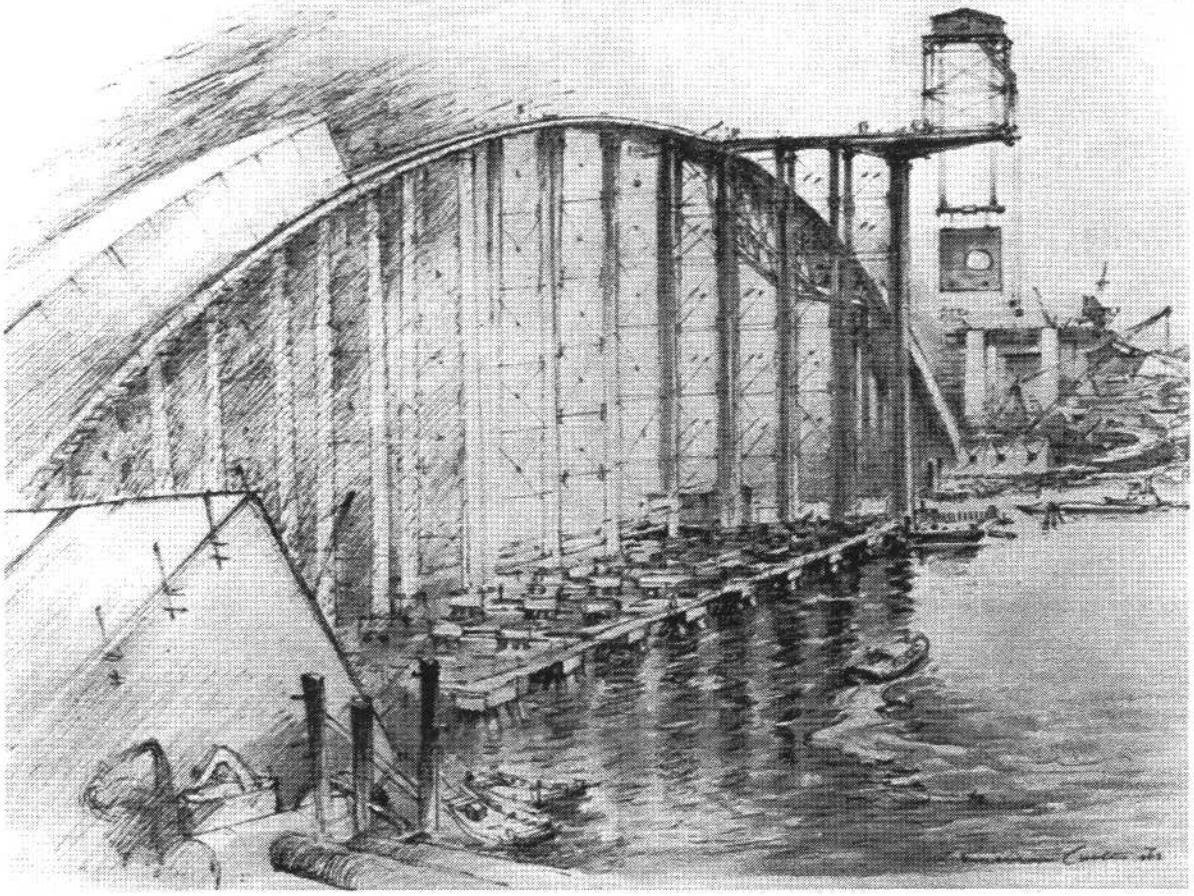
It was the type of job where you had to have a lot of faith and trust in each other. I was the foreman on the job and if I seen someone in the morning that arrived for work, might be a bit

> seedy, might have too many drinks the night before, I couldn't afford to let him carry out his part of the duties with a lot of hydraulic jacks and stuff, in case there might have been an accident. So I'd just go and have a yarn with him and say, "Look, get down the back with one of them on the form work." (Ward, RTA-GB: MA25 Side A, 07:15)

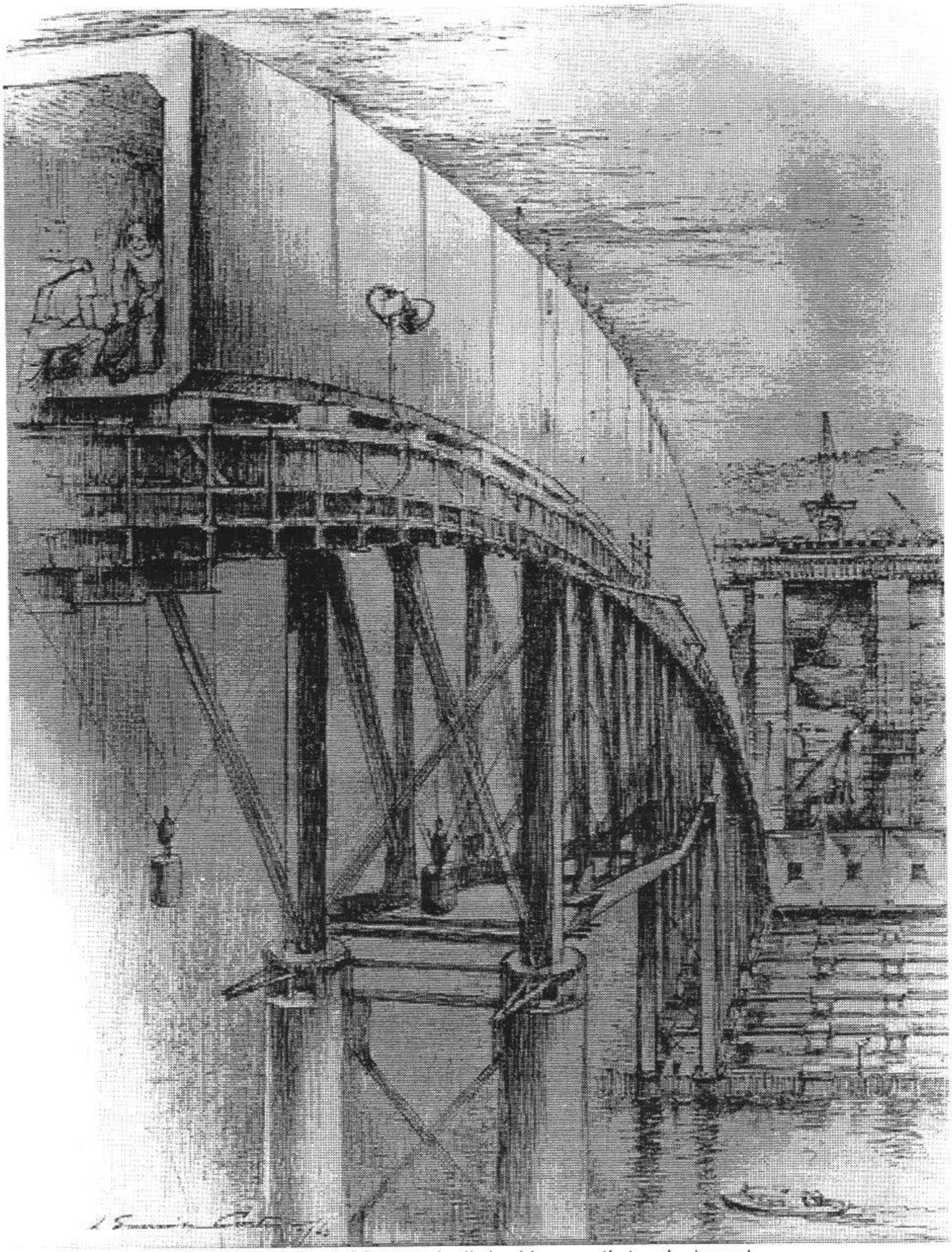
Ossie Cruse confirms Ward's view:

> With that, there was a tremendous mateship, you know, with men working together and I can remember that -- that we all worked together and we all looked after each other. You'd have to climb up through the steel -- we didn't have safety belts -- we'd climb up maybe 120 foot in the air through this steel and we'd all look after each other and look out for each other. And help each other. Make sure that nobody had any accidents. (Cruse RTA-GB: MA19 Side A, 15:01)

No doubt this mateship was one of the factors that made this innovative, and at times difficult, construction such a safe and successful job.



Falsework in position supporting some box units. Diaphragm being hoisted from a barge. Drawing by R. Emerson-Curtis, purchased by DMR, May 1962



From centre of first arch rib looking north to abutment.

Drawing by R. Emerson-Curtis, purchased by DMR October 1962

4.5 Surveying

Surveying was a cornerstone of the Department of Main Roads' supervision of the Bridge contractor. Brian Cox, DMR surveyor, remembers that he was excited by the opportunity to be involved in the construction of such a major Bridge as Gladesville. He began his work by setting out permanent survey marks from which he would check every part of the construction longitudinally, transversely, horizontally and vertically. He remembers that in starting the job:

> We triangulated across the Parramatta River to establish the correct distance between marks. And that was supported by an actual traverse via the old Bridge. Our main concern was to ensure that we had the correct distance between marks on each side of the river. (Cox, RTA-GB: FH7 Side A, 12:17)

Once the abutments had been established, there was an accurate base for further survey measurements. One of the survey tasks Cox remembers was the positioning of the approach columns, using steel band, the main item in survey measurement of those times. Cox recalls that, in general, he was able to achieve about half an inch accuracy (about 1.5 cm) with the tools available: a theolodite and levelling staff. (Cox, RTA-GB: FH7 Side A, 19:01)

Cox, who was also responsible for the surveying of two other major bridges during this time, made his general headquarters at Huntleys Point, on the Northern approach to the Gladesville Bridge. On his team were two field hands and, for some of the time, an assistant surveyor. Cox and his team checked every element of the bridge, as it was put in place by the contractor. However, as Cox remembers, the DMR and the contractor did not always use separate marks for their surveys:

> Department of Main Roads had the responsibility of establishing the position of the bridge, The contractor used our marks. We didn't think it was reasonable to have separate marks. They did the placing of the units and we checked them. We used the same marks. As it turned out, there was no problem at all. The experience of the contractor's engineers was fairly high. They were pretty honest in establishing the position on our marks. They checked out the position. And it

> was then decided to avoid using different marks for setting out purposes. It didn't seem reasonable. (Cox, RTA-GB: FH7 Side A, 26:41)

Laurie Stewart was Cox's assistant for one year on the Bridge. While the contractor may have used the DMR's marks, according to Stewart, it was never the other way around:

> We had our own reference points which you always have to do when you're dealing with a contractor. You establish your own network of reference points and you use those. Sometimes it gets to the point where the contractor feels he's not winning and he chooses to try and use your points. So be it. But you endeavour to be independent of them wherever possible. Otherwise, you negate the purpose of having an independent check. We never used the contractor's points normally. Never. Unless there was some extraordinary dispute and maybe by liaising with them you might resort to using something of theirs to try and find out why a discrepancy or a dispute occurred. (Stewart RTA-GB: FH18 Side A, 20:15)

Stewart recalls the enormous responsibility of the surveyor on such a job in ensuring that each item added to the structure was in its precise three-dimensional position. Checking these positions involved making hundreds of thousands of calculations and this painstaking and tedious work never stopped. In Stewart's opinion, the team's accuracy was more like an eighth of an inch. (Stewart, RTA-GB: FH18 Side A, 16:38, 30:35). While Cox did the calculations, Stewart did the field work. Although at the time he realised what an amazing structure the Bridge was, he recalls being too busy in his daily work to contemplate such matters:

> On many days, I would get to work early and one of my jobs was to precisely level right across the steel falsework from Huntleys Point to Drummoyne and back again before morning tea, with a precise level and parallel plate micrometer -- which was quite difficult on account of three things in particular. One was you had extremely short foresights going up the arch. Another thing was if there was much wind, you had to be very patient in taking your readings. And another matter was that the steel falsework was most of the time shaking because of many workers going about their activities on it. I didn't consider it dangerous, though by today's standards it would have been called a disaster, safety-wise. Mainly, my concern was to get the

> accurate readings which took a lot of concentration and perseverance. But you had to do it. (Stewart, RTA-GB: FH18 Side A, 10:53)

There were other difficulties for a surveyor, including air shimmer in the warmer parts of the year when taking observations over distances, and the contraction and expansion inherent in an all-concrete structure. Stewart recalls surveying the columns supporting the approach roads:

> In the afternoon of one day you would check the form work at a high stage of some of these high columns and be convinced that it was all in place for the concrete pour early the next day and you'd come along the next morning and check it again, just to be sure, and you'd be quite surprised to find the thing was somewhat different in position to where you believed it was the previous afternoon. The reason for this being that where the sun was on the concrete part of the column that had already been poured would make it wave around in the air. And this was something that was quite difficult to contend with. (Stewart, RTA-GB: FH18 Side A, 17:37)

Stewart remembers the DMR survey team getting along well with the contractors on the actual Bridge site, but:

> Things were a little different in the casting yard at Woolwich. That is where all the units for the four ribs were cast in quite a precise sequence. One of my survey roles was to go there on call and check the formwork prior to pouring each unit. The tolerance was an eighth of an inch and sometimes you'd get there and you would decide that the thing wasn't quite right and you found that they were learning to depend on your telling them how to get it right. So a decision was made that if it was more than an eighth of an inch out, you would say, "It's not correct, we are leaving the site. Call us when you have it correct." -- rather than using us, the DMR personnel, to get the thing right for them, the contractors. We got to that stage. (Stewart, RTA-GB: FH18 Side A, 21:23)

Nevertheless, overall, Stewart feels the surveying went well despite having a lot of "difficult calcs to be doing the whole time -- by "coffee grinder" (i.e., by hand-cranked calculator). (Stewart, RTA-GB: FH18 Side A, 23:00)


Oil painting by Rhys Williams, purchased by DMR

4.6 Excavation, Thrustblocks, Piers and Falsework

The actual construction of the Bridge began with excavation for the thrust blocks and grading of approaches to the Bridge. Bill Davis recalls working as a labourer, grading the slope on the Southern side where rail tracks were laid for the future transport of the deck beams. These beams were to be produced in a casting yard established just behind the Southern extent of the Bridge where the Department had set up offices in a number of houses destined ultimately for demolition. Another yard for the same purpose would be set up on the Northern approach. According to Brian Pearson, the contractor wanted to plan the production of the deck beams well in advance, anticipating that this would be a lengthy process (Pearson, RTA-GB: FH9 Side A, 12:45).

At the same time, during December 1959 and into the first part of 1960, approximately 1300 cubic yards of earth and 9,000 cubic yards of sandstone were excavated for the foundations of the two arch thrust blocks, under the supervision of a sub-contractor. An additional 3400 cubic yards of rock and earth were excavated for the foundations of the Bridge's abutments and approach piers. (Department of Main Roads, New South Wales, 1962; 11-12) Ossie Cruse remembers working on a ninety pound jackhammer on this excavation:

> After they moved some of the very little top soil that was there, we started cutting the wall of the foundation. From memory, I think it went down about 64 foot into the sandstone. The old boss was a pretty careful old guy and he liked to see his jobs done neat, He wouldn't let you waiver an inch one way or the other. So we had to plumb bob our cutting all the way down. And when we used to cut down into the sandstone a certain depth, say 8 or 10 foot, they'd set the charges and they'd blow that piece out and you'd just go with the jackhammers again and you'd cut down the trench again and blow the trench out again. So that was the way that we went down through this massive foundation.
>
> When we got down to a certain depth, we were starting to get down below the water level and the engineers had to put a steel levy around, using sheet piling. That levy (coffer dam) held the Parramatta River back. And we went down, must have been about 22 foot below that into the solid rock. So it was incredible. Even the foundations were an incredible bit of work. Then when

> we finished the foundations, we started to fill it up again. It was a crazy thing: we cut it out of the solid rock and then we started to fill it up again with concrete and steel. (Cruse, RTA-GB: MA19 Side A, 03:41; Side B, 52:27)

The 14,500 cubic yards of concrete used in the arch thrust blocks was poured in five foot thick layers, compacted with vibrators and used a stepover procedure to counteract shrinkage and cracking. Three classes of concrete were used: Class A —2500 psi. (6 bags cement per cubic yard), Class AA — 3000 psi. (7 bags cement per cubic yard), and Class PS — 6000 psi. (9.5 bags cement per cubic yard). The high-strength PS mix was used also in the piers, deck beams and arch rib units. It contained river sand and crushed gravel from the Nepean River and had a cement-water ratio of 0.35, giving a slump of 1 -1.5 inches. (Department of Main Roads, New South Wales, 1962;12)

The abutments were of reinforced Class AA concrete on spread footings on sandstone foundations, with counterfort ribs behind the exposed faces of the wings and front walls, which were plain. Steel pipe falsework supporting lined timber forms was used for forming up the abutments. (Department of Main Roads, New South Wales, 1962; 12)

As an experienced bridge carpenter, this was the job for which foreman Joe Ward was initially hired:

> I did the Drummoyne side first, formed all that up first and that was done in segments. You do a section of it and then you pour it, and then wait until it cures a little bit, strip the formwork and then up, the same thing -- repetition work. They blasted out the rock face. It was actually sandstone -- beautiful old sandstone -- all that area there is sandstone country. They had to clean that all out and then we put anchors into the rock face. It was done with a drill and steel work. They went down to the Maritime Services and got a lot of old steel rope that was lying around in the yard, miles and miles of this steel rope, just laying there. And they brought that up and used that as anchorage. Instead of using shear bolts, they put the ropes around the formwork, tied it as tight as possible and then twitched it to ply the ropes together.
>
> Now, when the concrete was poured, all they did then was get the oxy torch and cut the ropes outside the strong backs that were standing up. That released the formwork to go up a layer.

> Then there'd be repetition again. Do the same again: from the rock anchor out to the form work, twitch it and then pour. (Ward, RTA-GB: MA25 Side A, 13:52, 16:05)

Formwork was also used in the construction of the pre-stressed approach piers. Vertical pre-stress by Macalloy bars was carried into the bases of the columns in the approach piers, and into the transverse diaphragms in the case of the piers on the arch. To allow for the extension of the Macalloy bars during stressing they were encased, before the concrete was placed, in special wrappings which separated them from the concrete and permitted relative movement. There is a simple reinforced concrete headstock on top of each pair of columns. (Department of Main Roads, New South Wales, 1962: 11,12)

The scheduling of construction on such a bridge requires good coordination of the work on its various elements. Ward recalls that as he was working on the abutments, pile work was already being put in across the river to take the falsework for the arch formation. Sandy McKenzie remembers this well:

> There were clusters of four piles to each pile cap, all splayed out from the corners. The contractor employed a sub-contractor, Sydney Bridge and Wharf, but the contractor actually designed the rig for him to drive the piles. This was a very special rig which allowed the head of the pile to be moved fore or aft, right or left, so that it was possible to rake a pile in any direction. The machine could shape up to a pile cap and drive the four piles which were raked in four different directions.
>
> It was quite notable sitting in the office, just listening to the constant hammer of the pile driver and you could tell as soon as the pile hit rock because of the change in the note of the hammer. A lot of the piles were around about a hundred feet. They varied, but there was a fault in the rock and three of the piles went into this fault and went much deeper. The deepest went to 160 ft. (McKenzie, RTA-GB: FH 12, Side B, 50:28)

The piles, each designed to carry a maximum load of 85 tons, were shorter (minimum 33 feet) on the northern side of the river where the rock is close to the surface. There the piles were potted into the rock. Altogether 298 piles were driven and 140 potted. A five-ton hammer was used for the driving and where extensions were required, they were welded over the water.

(Department of Main Roads, New South Wales, 1962; 12) The cost of the additional material needed for the piles which had to be placed in the rock fault later became a matter of dispute between the DMR and the contractor.

In the water, the piles were checked by divers in old fashioned diving suits with copper helmets, and on a couple of occasions McKenzie "quite unofficially" was allowed to go down himself. He recalls the first time being a scary experience, but the second time lots of fun.(McKenzie, RTA-GB: FH 12, Side B, 50:28)

Once the piles were in, the erection of the falsework began. It consisted of spans of steel beams 60 feet long, with a steel truss span 220 feet long towards the Gladesville side of the River as a navigation gap. Fendering for the protection of shipping was placed around the falsework in this gap. The falsework was all tied together and anchored at each end to Macalloy bars set in the arch thrust blocks and supported on steel tubular columns founded on steel tubular pile bents which extended the full width of the bridge. The column and girder system, however, was only wide enough for one rib at a time, and designed to be moved sidewise on rails on the pile bents, supporting each of the four arch ribs in turn.

At the centre of the span a braced tower also extended the full width of the bridge, serving as a stay to prevent sideways movement of the individual arches until they were tied together and to carry the gear to lift the arch blocks into position. With the crown of the Bridge 200 feet above high water, the tallest columns and the truss work for the falsework required a huge lift. (Department of Main Roads, New South Wales, 1962; 12-13)

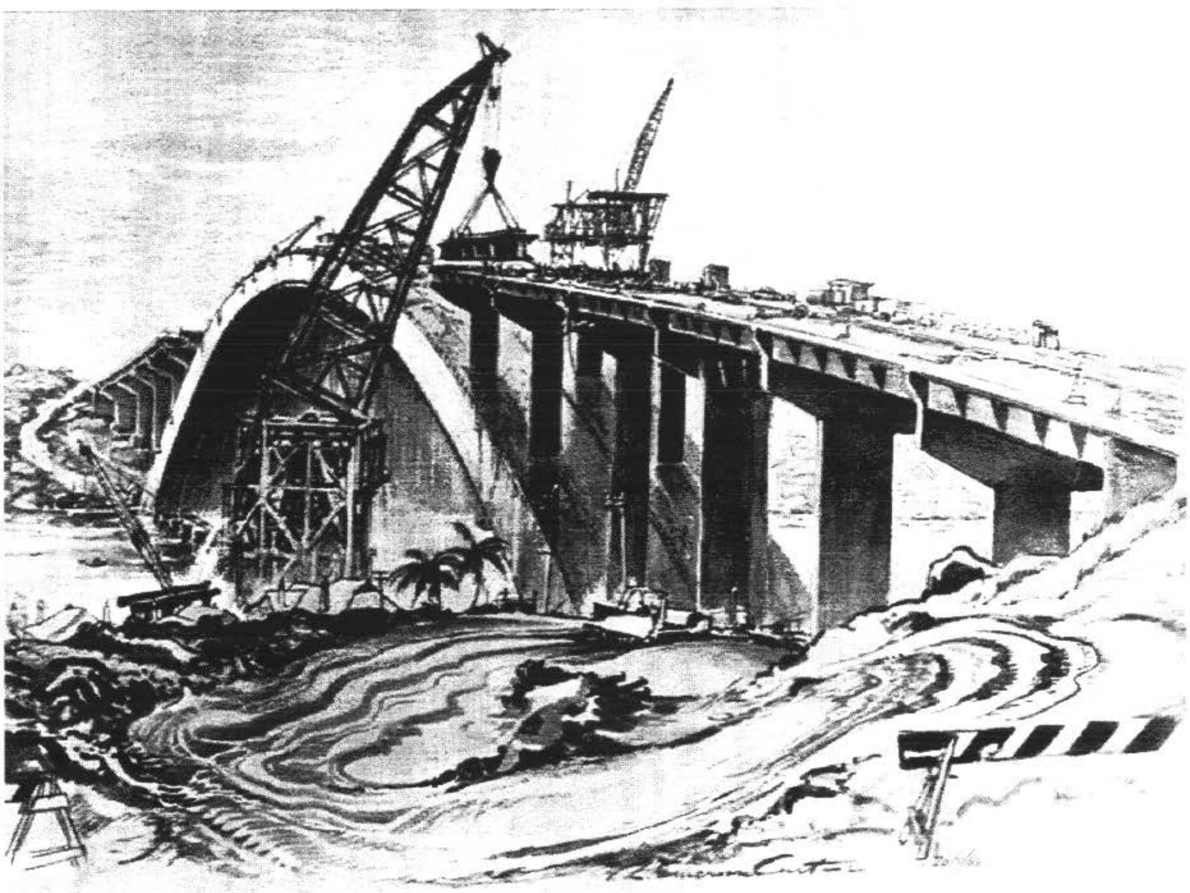
The steam-driven Titan crane was brought up periodically from Cockatoo Island for use in such lifts:

> I suppose one of the more unusual features of the construction of the Bridge was the extent to which the contractor used the Titan floating crane. That crane had been originally brought from Scotland, used in the construction of the Harbour Bridge and had operated in Sydney Harbour ever since. The contractor used it for the construction of the falsework and then after the experience with precasting the blocks at Woolwich, the contractor, taking note of the difficulty in placing concrete in the columns and headstocks that had to be erected on the arch, decided to

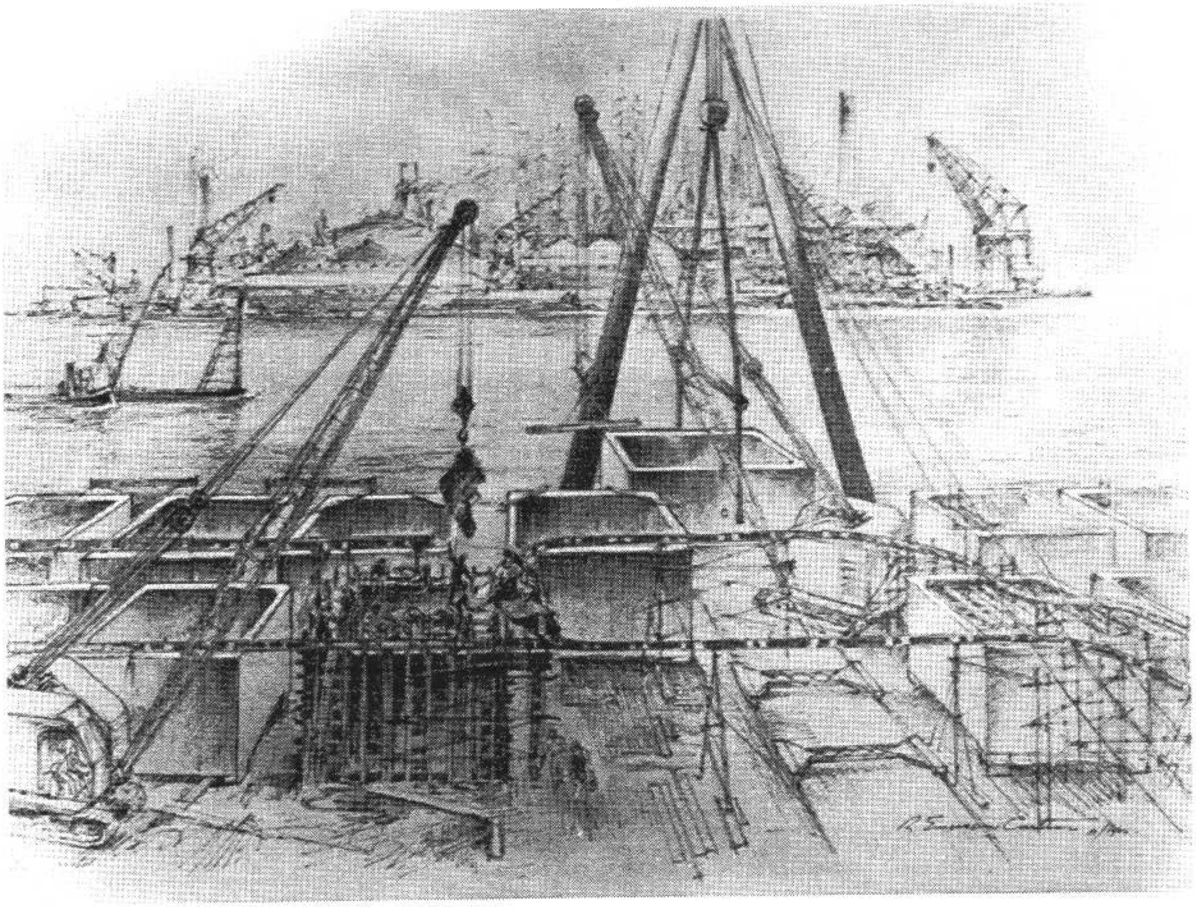
> precast these units at Woolwich and that was regarded as quite innovative. These were duly floated up the river...(McKenzie, RTA-GB: FH12 Side B, 37:54)

And, as Ossie Cruse recalls, they were erected using the Titan crane:

> One of the most magnificent lifts I've ever seen in my life was 94 ton. It was one of bulkheads on the bridge we had to lift up about thirty-odd feet in the air. They brought the big Titan, the water crane, up. That crane would lift 250 ton .... I can remember everybody just holding their breath, watching this massive piece of concrete going up and being settled in. (Cruse RTA-GB: MA19 Side A, 06:23)



Titan crane lifting deck beam into position
Drawing by R. Emerson-Curtis, purchased by DMR, December 1963



Block casting yard at Woolwich.

Drawing by R. Emerson-Curtis, purchased by DMR October 1962

4.7 Pre-cast elements

About three miles down river from the site of the Bridge, the contractor established a casting yard under the direction of a sub-contractor. This waterfront area at Woolwich, recalls Sandy McKenzie:

> had been one on which the granite blocks for the pylons on the Harbour Bridge were dressed to shape before being placed in the pylons. There were in fact, a few pieces of granite, presumably blocks which had been rejected, still on the site when we were there. (McKenzie, RTA-GB: FH12 Side B, 35:55)

In this yard, the 108 box units and 19 diaphragms for each of the ribs were cast:

> The arch tapered from the abutment or springing to the crown so that each of the arch blocks between those two points was somewhat different in shape from the block either side of it. So at Woolwich the contractor established a casting yard with enough foundations to cast all of the blocks for one rib of the arch without moving any of them. These were cast as four vertical walls. And in due course, after curing and testing, were moved onto barges, taken to the site, turned over and erected in the arch. (McKenzie, RTA-GB: FH12 Side B, 35:55)

A pan-type mixing plant was installed in the Woolwich casting yard. This resulted in a more uniform mix of concrete ingredients than in a rotating agitator type mixer. (Pearson, 2001; 8) Concrete was delivered by a mono-rail system from the mixer to each of the unit positions Again, the strength of the concrete used in the blocks was 6000 psi. Each block weighed 50 tons.

Brian Pearson estimates that there must have been a couple of thousand pre-cast items in the Bridge altogether. (Pearson, RTA-GB: FH9 Side A, 10:26) Other casting yards, also with pan-type mixing plants and mono-rails, were established on the approaches to either end of the Bridge for the deck beams. In manufacturing the deck beams, the end blocks and cross girder diaphragms were pre-cast and set up in forms, and then the remaining concrete was placed in situ and water cured for seven days. The purpose of this process was to minimize shrinkage cracks. Twenty-four hours after the concrete was placed, the first of four Freyssinet stressing cables in the beam was stressed, the other three being stressed when the concrete reached its 28 day strength -- again to minimize cracking. (Department of Main Roads, New South Wales, 1962; 14)

Bill Davis recalled his role in the process:

> In the casting yard, I was doing mostly the stressing after the beams were cast and poured. They were cured with water. And then when they took the shuttering away, they were sprayed on for 21 days, I think the curing time was. And then they put the cables through and they stressed from either end. And, of course, with the beam, like the arch, the cables went down in a dip ... when you pull either end, the middle of the beam pops up so that it's then swinging and this is the idea: just lift it off its pads and it was all ready to go. (Davis, RTA-GB FH21 Side A, 16:11)

As the piers and decks of the approaches were being constructed, the blocks and diaphragms were being barged up from the Woolwich casting yard and lifted into the first rib arch. Brian Pearson points out that a limiting factor on block size was the fact that the maximum weight for the lifting tower built into the centering of the falsework was 50 tons. In lifting, the block was turned 90 degrees, placed on a trolley and then moved into place. (Pearson, RTA-GB:FH9 Side A, 26:40)

Laurie Stewart provides a surveyor's insight into one of the details of maintaining the shape of the arch during this operation:

> There was always the problem that the ribs were being erected on a steel falsework and the units accumulated a huge tonnage as they were progressively placed from the bottom up towards the top, one side, one the other. I think there are 128 units in each rib -- a huge tonnage of concrete, so there was quite a bit of deflection of the steel falsework. The steel falsework was in chords. The underside of the Bridge arch had to appear to be a curve. And, of course, as the units were placed on the falsework, hardwood blocks of varying thicknesses had to be placed underneath them, as it were, to shim them onto the chords of the falsework so that their underside profile would come out as planned. That was quite a task to get these shims correct. The more units you put on, the more deflection of the steel falsework occurred. It was something that you just had to

get around by calculation and continual survey observations. (Stewart RTA-GB: FH18 Side A, 22:45)

Stewart recalls that enormous turpentine timbers of incredible quality were brought in from disused piles that lay around the harbour. These were cut into pieces as required for the shimming at an on-site sawmill. (Stewart RTA-GB: FH18 Side A, 22:45)

Brian Cox remembers problems with the timber wedges which were also placed between the units as they were set down on the curve of the arch. These wedges, intended to keep the units four inches apart for future concreting in the gaps between, were becoming compressed and the surveyors, who were required to check the position of each and every block, discovered that they had dropped down on the arch about half an inch. As Cox recalls, this problem was solved by using concrete wedges and then making allowances for this deviation in the placement of the following units. (Cox, RTA-GB: FH7 Side B, 34:34) This is an indication of the precision required in such a construction.

Sometime during the construction of the arch ribs, Ossie Cruse obtained his dogman's and rigger's tickets and was riding the blocks up to the arch. He explains that, in those days, the job of the dogman was to hook the loads up to the cables and ride the load to make sure it was settled in the right place. The dogman worked with the crane driver, communicating with him by means of hand signals and a whistle. (Cruse, RTA-GB: MA 19 Side B, 30:04). Cruse has vivid memories of his work on the arch and the piers:

> We were assigned to lifting the big blocks up into place. That was an incredible job. They averaged around 52 ton and we were charged with the responsibility of making sure all the rigging went on properly and there wasn't an attachment out of place -- because you took the lift and started up with a big block, and you'd be riding it up. It was incredible. Both myself and the crane driver, both of us, our hair started to fall out in chunks from the stress. Because the moment you took the lift, you can imagine, there were these cables almost as thick as your arm, and you'd be looking at the cables when they take the strain, making sure that none of the wires were broken or anything, making sure that once you took it, it didn't come undone. So you'd see these massive cables stretch like a rubber band and you'd feel the whole housing of the building

> where the winch was, up top, (settle) -- in fact, the guy that was driving said it used to settle down about five or six inches -- and that's when he started to get the stretch himself. Because he'd be weighed up at that end. But there was nothing out of place. Because once you started the winches and started moving up, it took 22 minutes from the top of the barge till you got to the top level where the bridge was. That was at the highest point. So you'd be riding this jolly lump of concrete up -- this big block of concrete weighing anywhere between 51 to 53 ton -- and you'd be all the time listening to sound of the machinery. You'd be listening for any little crack or anything that would signal that there was going to be a disaster.
>
> Well, there was only one block that we ever had a problem with. And that was one block that actually fell over when it had been settled up top. It's unstable itself and it crumbled and it just fell on the top of the gantry. And while it showered everybody with broken pieces, it never hurt anyone. And that was a tremendous thing, when you think of all the hundreds of lifts that we did. (Cruse RTA-GB: MA19 Side A, 06:23)

Bill Davis was on site when the block fell over. It was one of the diaphragms:

> It was a Saturday morning, I remember. I was getting changed. And they were already lifting the diaphragm up. They had an early start and the diaphragms -- unlike the blocks which were quite big bulky things and couldn't fall over -- were only two feet thick. They were about fifteen or eighteen feet in height and when they lifted them up, they were put on a trolley and transported across to be transferred down on to the arch itself.
>
> When they were put on the trolley, they had props bolted on to them. But they didn't put the props on. They didn't move it very far, and they thought, "I won't worry about that." And, of course, with the jerk of the trolley moving, it toppled over. It weighed probably about fifty tons. It slammed down flat and it was lucky it didn't go all the way. It hit and tore some of the RSJ flanges, tore them away from the metal, and, anyhow, there it was, perched on top of the arch. So it had to be broken up.
>
> They worked right around 24-hour shifts with the jackhammer and broke it into pieces.... Pre-stressed concrete's very hard and full of reinforcing and they had to break it all up and drop it all

> down below into a barge. They were there for days and days doing it. Everyone was into it, the whole works. Everyone got stuck into it.
>
> They'd ignored the procedure and the Chief Engineer, Baikie James, got them all into office like a school marm and he had a blackboard and he had all these diagrams showing them exactly what he wanted to be done in future. It didn't happen again, of course, but he hauled them over the coals over it. (Davis, RTA-GB FH21 Side B, 29:49)

But then, as Brian Pearson points out, losing one diaphragm "is a pretty good record from the hundreds of items that were produced." (RTA-GB:FH10 Side B, 34:00)

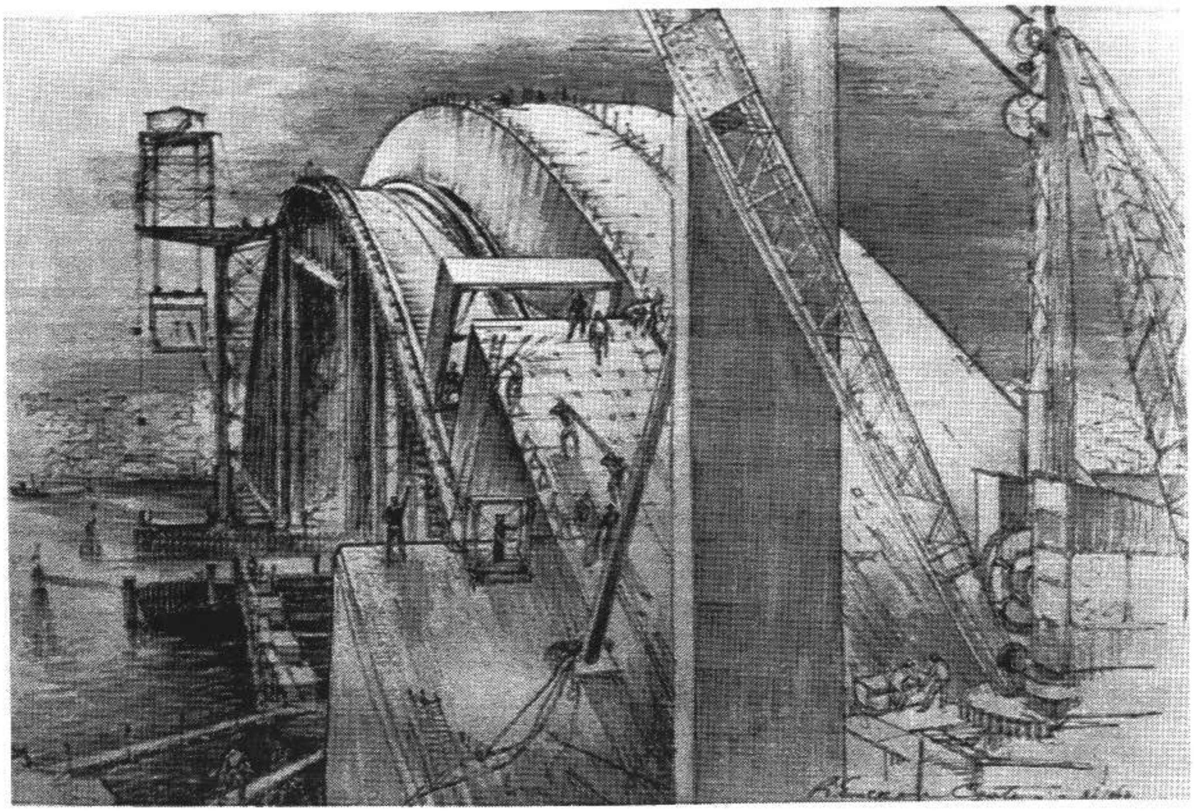
Another innovative and challenging lift was the launching of the 143 deck beams into position on the19 headstocks which rested on the Bridge's 19 pairs of piers. These 65-ton pre-cast, pre-stressed girders were loaded on rail bogies and hauled up to the abutments from the casting yards at the bridge ends. From there, they were lifted into position on their seatings by a special launching truss.

Joe Ward, as foreman of the launching truss, was conscious all the time of the danger of a massive accident, and so, he believes, were all the workers and engineers on the Bridge. One blow-out on the main hydraulic hose of the launching apparatus and down it would all come, he says. He launched all but about a dozen beams with this possibility ever-present in his mind and by the time he left, the job was having an effect on his health. He later heard that the foreman who took over after him similarly suffered from "big stress":

> I had the responsibility of making sure my men were alert and the gear we were working with -- hydraulic gear and one thing and another -- was all in good working condition. If you seen a frayed hose or you were suspicious -- seen a bubble on a hose -- you'd get it replaced straight away.
>
> It was a stressful experience. It was the first time it'd been done in Australia, to operate this launching gantry. They made up a big beam, the first one to be launched -- this is on both sides -- I think it was about 75-80 foot long. It weighed 80 ton. (DMR literature says 65 tons.) And it was the first time it was done. So they had a launching gantry, like a square sort of a gantry, on railway lines so it could travel sideways. And the beam that was to be the first beam to be

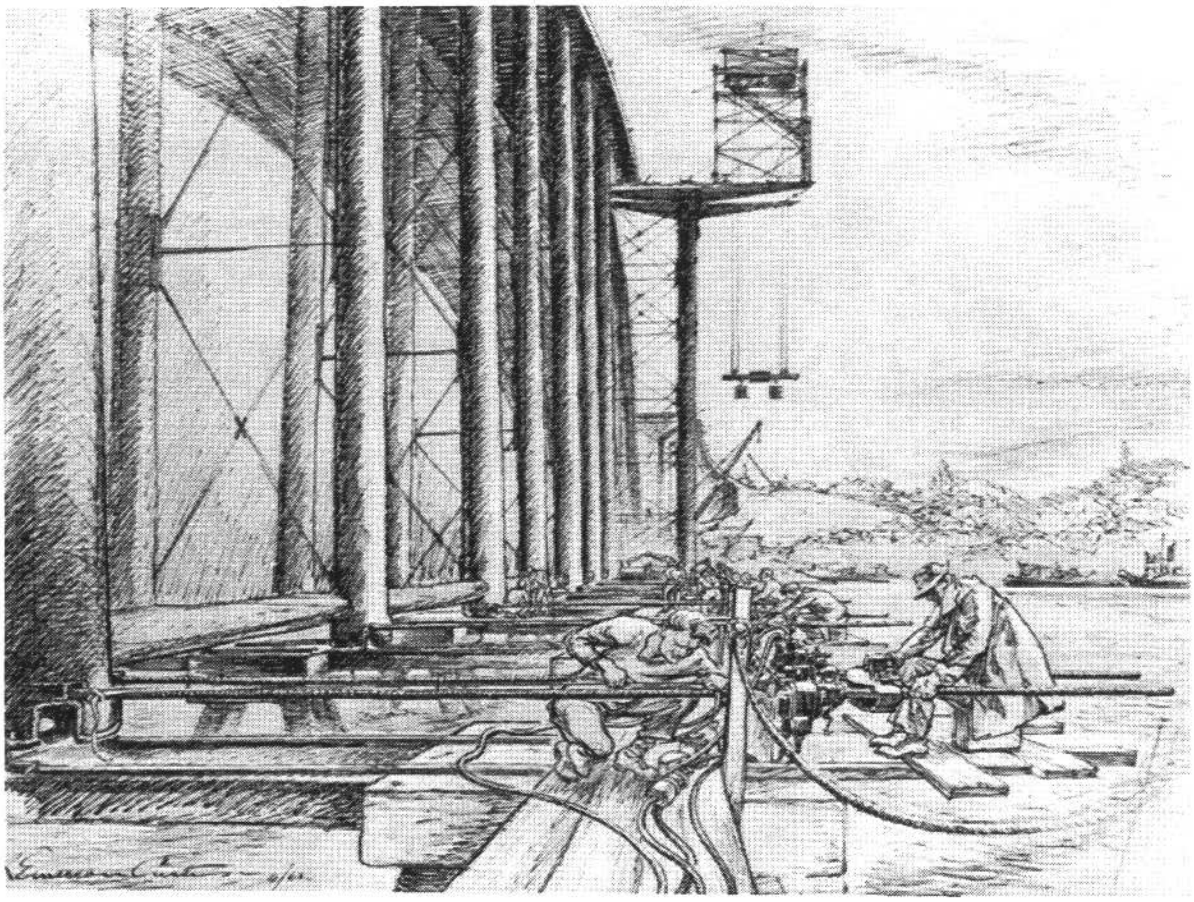
> launched became the counterweight for the gantry to go out to the first pier. It was counter-weighted from behind, with the beam. It was like a crab, going on a little bit, a little bit, a little bit, until we got the launching gantry over the top of the first headstock on the pier. And then it had to be lowered down. (Ward, RTA-GB: FH 22:10)

This operation went on as the arches were being erected and stressed, and in February, 1964, with the last of the deck beams in place on the headstocks of the pier columns, the concrete deck between the beams was cast into place.



Progress with third arch rib

Drawing by R. Emerson-Curtis, purchased by DMR March 1963



Moving falsework for fourth arch rib

Drawing by R. Emerson-Curtis, purchased by DMR, July 1963

4.8 Concrete Testing - Strength, Creep and Shrinkage

Prior to the introduction of pre-stressing, the strongest concrete used in reinforced construction was 3000 psi. But for many of the elements of the Gladesville Bridge, the contractors required a strength that was double. This meant that the mix had to be properly proportioned, with minimal water content. While today, under Quality Assurance, the contractors do their own testing, during the construction of the Gladesville Bridge, the DMR not only tested everything itself, but also ensured that one of its officers was there for every mix (McKenzie, RTA-GB: FH 13 Side A, 06:52).

An on-site testing laboratory was manned by DMR staff under the supervision of engineer Alan Leask. Brian Pearson recalls that as well as testing concrete strength, Leask was developing and testing different mixes:

> He was looking for developing mixes in the ribs that would give very low creep factors. And he was also looking for a different type of concrete mix for the arch thrust blocks, because the contractor wanted to concrete those blocks as quickly as possible. There was a lot of heat given up in the setting of the concrete and if that's uncontrolled or too much, the concrete will crack. He developed mixes for the thrust blocks that were appropriate for the conditions there. Those mixes performed very well. (Pearson, RTA-GB: FH9 Side A, 12:45)

The laboratory was behind Sandy McKenzie's office. There the tests were physically carried out by Rex Cooper and all results were quickly passed on to McKenzie, who was required to check them himself, which, he says, "got a bit monotonous, as they all were satisfactory". (McKenzie, RTA-GB FH13 Side A, , 08:31)

For Alan Leask, charged with setting up an effective testing program and procedures:

> This was a very special sort of job. It was one of the first experiences we had with very high strength concrete which was required to be very uniform throughout the whole of the work. So in order to achieve that, it was necessary to have a very sophisticated testing program. We needed to be able to handle a large number of test specimens in a very standard fashion. We needed to check the proposed mix designs. That's principally what the laboratory was for. (Leask, RTA-GB: FH14 Side A, 12:46)

The on-site laboratory Leask set up was influential in the establishment of on-going testing standards for the DMR. It was equipped with a 200-ton compression testing machine, a two cubic foot pan-type mixer for preparing experimental mixes, and aggregate testing facilities. Its principal feature was a fog room, described by Leask as:

> ... a room which has artificially produced fog, which means 100% humidity with a temperature controlled to 70° F, plus or minus 1-2°. That was regarded as a standard curing and everything had to be standard curing, otherwise you couldn't compare one with the other. The routine testing was comprised of cylindrical specimens of standard size, (which) were taken from the concrete delivered at the site and these samples were returned to the laboratory and placed in the fog room for curing for the required 28-day period and then tested on the compression machine that we had in the laboratory. The fog room could accommodate 1000 cylinders. There were 1000 tests done on the concrete box units during the construction. Not one failed the test. That's a tribute to the quality control that was exercised on this job.(Leask, RTA-GB: FH14 Side A, 18:17, 19:05, 24:43)

Leask explains the testing period further:

> Concrete develops its strength fairly slowly -- rapidly at first, but then tapers off. For example, it may get about 70% of its 28 day strength at seven days and then the rate of increase will gradually decline. The 28 days is the one on which specifications are based. Depending on the curing from there on, it will either cease to gain any further strength or it will continue to slowly gain strength. (Leask, RTA-GB: FH14 Side A, 19:05)

The high-strength concrete mixes for the arch units had to be determined before they started. Uniform strength concrete was a primary consideration for the arch units, as

> The bridge was comprised of four separate arches and ultimately each arch had to perform in exactly the same manner...so that the creep and shrinkage properties didn't cause any distortions which were not consistent with the other arches. Bearing in mind that the arch rib members were made over a period of up to 18 months, it meant that everything had to be kept exactly the same throughout the whole of the contract. The specified minimum characteristic strength was 6000 psi. at 28 days. Bearing that in mind, we examined the proposed mixing arrangements at the site

> and we ended up with a target strength of 7200 psi. which was intended to ensure that not more than 1% of the samples would fall below the 6000 psi..
>
> At the end of the job we analysed the results and for the one and a half inch mix used for the arch rib members, the final result was that the average test over about a thousand cylinders was 7410 psi.. The standard deviation was 506 psi. and the coefficient variation 6.8%, which is an excellent coefficient. These results were compatible with our assumptions in the first place of having a target strength .... (and) a tribute to the excellent supervision and quality control exercised by the supplier of the concrete. Over the whole of the contract. It wasn't any use fluctuating; it had to be for the whole 18 months. (Leask, RTA-GB: FH14 Side A, 16:55, 27:04, 28:00)

Leask explains that different mixes were required for different parts of the structure. For example, the heavily reinforced beams and columns could only use a mix with a 3/4 inch maximum-sized aggregate to fit between the reinforcement, while the arch boxes, which were very lightly reinforced and were large sections, required one and a half inch aggregate in order to keep shrinkage and creep down to an absolute minimum. (Leask, RTA-GB: FH14 Side A, 25:33):

> The mixes proposed by the contractor were initially rounded river gravel, in the belief that this would be the most workable mix and therefore have the least water and the best strength and creep characteristic. However, when we tested these out, they didn't perform as uniformly as required.... it was then decided that crushed river gravel was a better proposition and we based the rest of our testing using crushed river gravel. The final result, after all our testing for the one and a half inch mix which was the one that was most important for the arch rib members, consisted of one part of Kandos cement, one part of Nepean river sand, 0.25 parts of 3/8" crushed river gravel, 0.75 parts of 3/4" crushed river gravel and 1.75 parts of one and a half inch crushed river gravel. With a final water-cement ration of 0.37. (Leask, RTA-GB: FH14 Side A, 26:49)

Rejecting methods of checking the mix proportions with which they were more familiar, the DMR decided to use the Optimum Sand Method, developed by NSW Department of

Railways, which they had never used before. This method aims at accommodating the combined effects of all the physical properties of the aggregates and is a means of determining the proportion of fine or coarse aggregates which will give the maximum workability at any particular water-cement ratio. (Leask, RTA-GB: FH14 Side B, 34:30)

In the field also, Leask and his associates used an ultrasonic probe to test for flaws in the rib units:

> But such was the quality of the concrete and the placement, we really never (found) any significant flaws, so whilst it was a good idea, it didn't really amount to much in the end. (Leask, RTA-GB: FH14 Side A, 26:49)

But Brian Pearson does recall a testing failure:

> I can only remember one of the arch blocks failing in strength. That block had been made and put in place on the bridge before the 28-day strength results were obtained. The test cylinder failed in the laboratory to achieve the 6000 psi. which is the specified 28-day strength -- this is roughly 40 mpa in modern figures -- and at that time, because the block was in place, there was a lot of consternation.
>
> However, the Bridge Section possessed a piece of apparatus called a Schmidt Hammer. It was a Swiss invention and it was in the possession of Cliff Robertson, the Designing Engineer for Bridges. When he heard there'd been a concrete failure, he thought, "This is a great opportunity to use this special piece of equipment which is gathering dust."
>
> So, Cliff came out with Frank Cook. Baikie James was present and Sandy McKenzie and myself and Cliff got out the instrument from its box and started to use it all around the rib which was in place on the falsework of the arch. The Schmidt Hammer gives a calibration of the concrete strength by virtue of the rebound energy.... and he found where he got the lowest rebound and marked the spot and instructed that a man with a coring machine come in and drill through the concrete and get a six-inch cylinder out of the side of the slab where the lowest strength was supposed to be. That was all done with great ceremony and tested in the site laboratory.

> And it gave an enormous strength! I think something about 8000 psi.. So the Schmidt Hammer was put back in its box to gather more dust and the block was passed for acceptance. (Pearson, RTA-GB: FH9 Side A, 12:45)

The only other casualty was more significant: one of the blocks suffered from inadequate concrete compaction, as revealed by honeycombed areas in the concrete. These areas were removed and replaced with an epoxy mortar mix and the block was incorporated in the structure. (Pearson, 2001; 9)

Strength was not the only concern that the DMR engineers had in dealing with a bridge of such high concrete content. Shrinkage and creep were also issues for Brian Pearson and Kevin Forrester:

> Initially when the concrete is stressed, we get quite heavy shrinkage of the concrete and that effect dissipates with age, so that ultimately all shrinkage has occurred. Whereas the creep effect, which is due to the compression in the concrete, induced mainly by the stressing operations, remains and increases with time. (Pearson, RTA:GB: FH9 Side B, 46:45)

> Creep and shrinkage can destabilize an arch. If the abutments stay steady and the concrete shortens, then it gets out of shape and you get deflections and possible collapse due to secondary effect.
>
> Two components of the deflection are shrinkage, which is just purely the migration of moisture out of the concrete.... (and) creep, which is what we call plastic deflection. In other words, you put a load on, you get your immediate elastic deflection, but then the deflection continues and it increases while ever the load is left on. That's creep. (Forrester, RTA-GB: FH3 Side A, 26:43; Side B, 29:10)

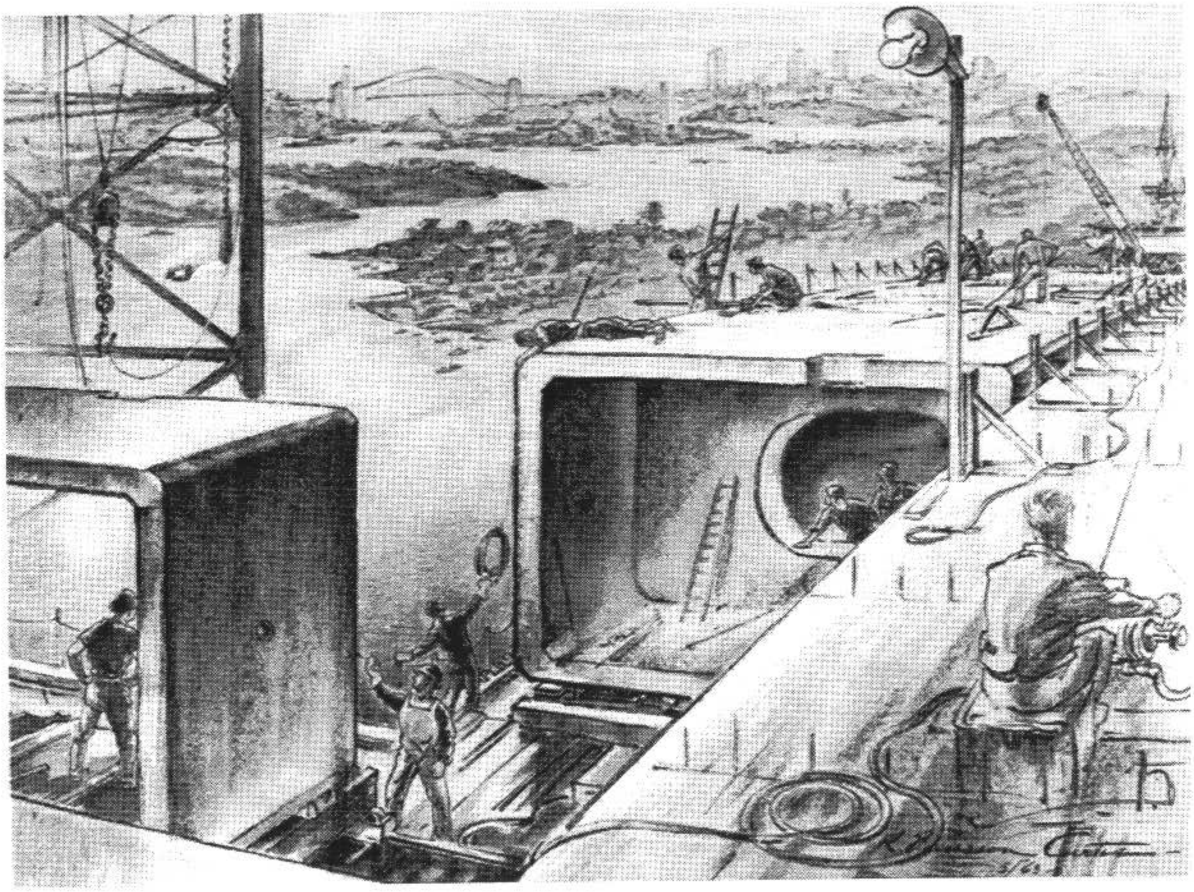
The creep factor was, in fact, put to work following the raising of the Gladesville Bridge arch. After the removal of the falsework, the arch was allowed to creep down to its neutral level. Nevertheless, creep and shrinkage did cause some minor difficulties with movement of the deck:

> Some years after completion of the Bridge that was apparent where the deck system pulled away from the abutments which were built on rock and couldn't move. The designer made the junction of the deck and the abutments a point of fixity for the deck. In retrospect, because of the creep

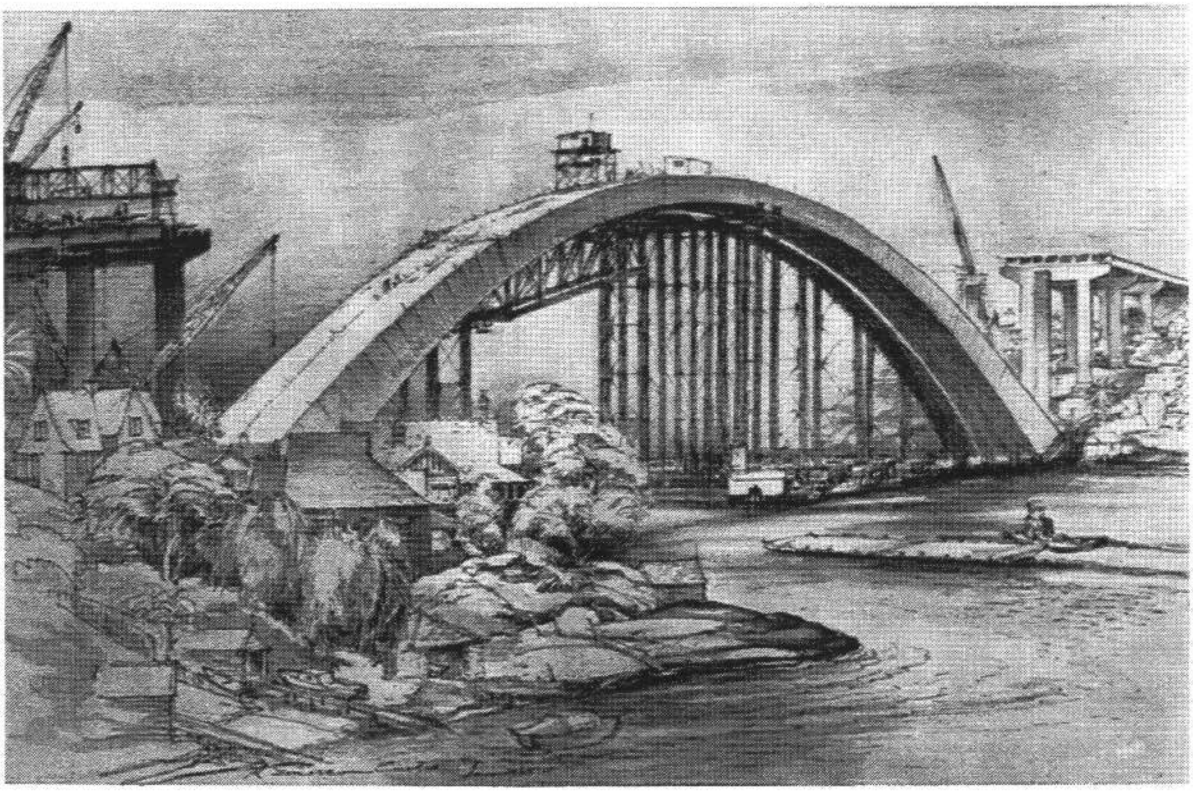
> effect, it would have been better to have had expansion joints at the deck abutments as well as over Piers 4 and 11. In theory, enough allowance was made at Piers 4 and 11. In actual practice, I think we got more creep than we had bargained for. (Pearson, RTA:GB: FH9 Side B, 46:45)

According to Kevin Forrester, Eugene Freyssinet's original research on pre-stressed concrete revealed the importance in this type of construction of using high strength concrete and high tensile steel, both of which minimise creep. And with the DMR's having ensured that this was done, Forrester's view on the durability of the Bridge is a positive one:

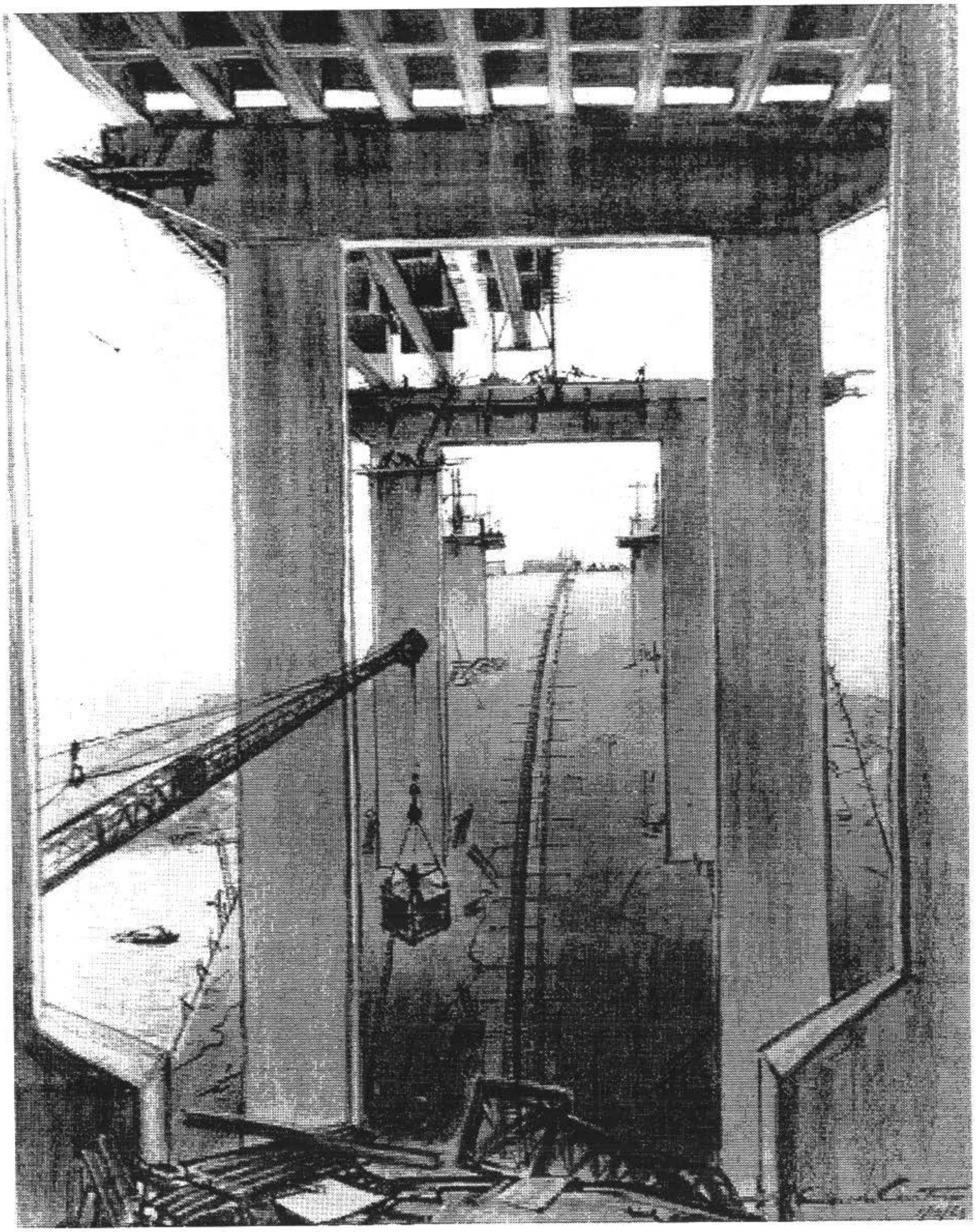
> Not many people realise that it really is a pure arch construction. As far as the concrete is concerned, you have examples all over the world of concrete that's lasted a thousand years: it'll be there until some different form of loading is imposed, I guess. (Forrester, RTA-GB: FH3 Side B, 29:53)



Fourth arch rib nearing completion. View from top of the arch.
Drawing by R. Emerson-Curtis, purchased by DMR, July 1963



General view of arch from Huntleys Point.
Drawing by R. Emerson-Curtis, purchased by DMR, March 1963



Beneath approach, northern side

Drawing by R. Emerson-Curtis, purchased by DMR, December 1963

4.9 The Arch - Jacking and Stressing

To most of those involved in the building of the Bridge the most impressive operation in its construction was the jacking of the massive 1000-foot arch, the first time such an operation had been conducted in Australia.

From Bill Davis' standpoint:

> When I went there as a labourer, it was just a bridge. I had an idea from the drawings, a public view of what it was going to look like, but other than that I had no idea. But once I got involved with the jacking and I knew what was happening, it was quite something. It was the biggest arch at that time and the method of lifting one single slender arch at a time off its bearer, seven inches in the middle, just by inflating jacks and the whole thing had to go somewhere, so it lifted up -- it was really impressive, the whole thing was incredible. And when they moved the falsework out, here's this ribbon of concrete, self-supporting across the river. (Davis, RTA-GB FH21 Side A, 06:59)

This method of raising the Bridge off its falsework had been developed by Eugene Freyssinet and its use on this enormous arch would have, under ordinary circumstances, brought him to Australia for the jacking procedure. He was, however, too ill to make the journey, although his associate, M. Guyon, was present, amongst other overseas engineers. The first Freyssinet-method arch jacking in Australia was, in fact, a momentous occasion.

Brian Pearson explains that only three out of the four banks of jacks were used. Each group of jacks was to exert a force of 4000 tons:

> The jacks were like circular disks, which were very thin and flat and the principle was that you pumped in oil under pressure and that expanded the disk and if the pressure was, say, a thousand or two thousand pound per square inch, you got an enormous force from a very small flat object. So the jacks were ideal for imposing very high forces in confined spaces. The arrangement of the jacks was equivalent to the edge of a block. In other words, we had the jacks fronting up the side walls of the block -- in the diaphragm -- and then the top and bottom walls. So that when the jacks applied their force, they applied the force through the block walls. There were four rows of

> jacks in the diaphragm, they butted against each other right around the circumference. (Pearson, RTA-GB: FH9 Side B, 32:50)

Bill Davis recalls that Gordon Wright, the Managing Director of Maunsells, came from England each time the arch was jacked. The first time, Wright showed Davis how to hook the pressure hose up and subsequently Davis recalls being able to do so himself, although Wright, of course, then checked it over. There were 56 jacks in each bank.(Davis, RTS-GB: F21 Side A, 14:01)

Ray Wedgwood, who was present for the jacking of one of the later ribs, explains the procedure:

> This process of expanding these flat jacks and then lifting the arch off the falsework was done midnight to dawn and that was to ensure that everything was at a uniform temperature. Because in the daytime, the sun will be on one side of the Bridge or the other and you can get transverse movement effects. Thinking back now, you'd say it was a quality control process that the little building they built to control all this jacking was actually built on top of the arch. So I guess that concentrated the mind of the people that were engaged in doing the work! They had a good reason to make sure it worked properly. (Wedgwood RTA-GB: FH22 Side B, 44:23)

For the DMR's Resident Engineer, Sandy McKenzie, as for many others who worked on the project, the most memorable moment on the Gladesville Bridge was the night the first arch rib finally lifted off the false work. McKenzie remembers an air of elation amongst the whole crew. (McKenzie, RTA-GB: FH 13 Side A, 00:30) Bill Davis recalls that:

> In the cool of the night, everything was back about normal as far as the concrete was concerned. It was a long process. They had targets for the theodolites sticking out either side of the arch on both sides and they had people on the shore with theodolites watching any movement as the thing started to lift. And if it started to move sidewise, they had primer jacks in the concrete that could counteract that.
>
> They inflated the first row of jacks and the thing started to rise and they had engineers scurrying around underneath, "Yes, it's lifted up! It's lifted up!" They were all impressed.
>
> Once they had inflated one jack, either side of the bridge, they then had to bleed the oil out of them, because there was about two and a half thousand pounds of pressure in there. And replace

> it with cement grout. So you'd release the jack, put an air hose on, blow all the oil out and then put in the grout, which was about 120-130 pounds pressure -- you're letting out two and a half thousand pounds, you're putting in a hundred odd pounds. So what was happening, as they started to do this, it started to go down again, very, very slowly.
>
> They had dial gauges across the joint so they could measure the movement. As the jacks inflated, they could watch in thousandths of the inch. And they kept on going and it kept on going down. I don't know what reason they kept on. And all of a sudden there's this terrific BANG! The pressure, of course, had increased in all the other jacks. As they were bleeding off thousands of pounds out of one, the others were taking up the strain and, of course, they got higher and higher and finally one exploded and they called a halt to proceedings. Fortunately it was one of the jacks on the top. It just blew it out like that -- and, of course, it resonated through the structure. Like a WHAAANGG. It was quite dramatic at the time. It drew everyone's attention to the fact that they weren't going about it the right way. And they then had a big conference. And how they rectified it: they let the oil out, put the grout in and then they pressurised that grout with an oil line, up to the pressure. So what's inside those jacks now is a mixture of grout and oil. (Davis, RTA-GB FH21 Side A, 08:02)

Brian Pearson remembers how "buoyed up" everyone was once that first rib was successfully off the falsework. There had been, as he says, "some consternation" amongst the engineers: rendering the Gladesville arch self-supporting in this way was so different from the traditional method of freeing an arch by driving out support wedges. However, with the success of the first rib, they realised

> ...that all the ribs were going to proceed satisfactorily. We wouldn't have any problems with the rest of them. (Pearson, RTA-GB: FH9 Side B, 41:30)

Once the first rib was up, the falsework was winched into position for the placement of the next rib and the procedure was repeated for each rib. Then, through the diaphragms, which are at fifty foot intervals, transverse stressing cables were cast to link the four ribs together to form the single arch. And as Bill Davis says:

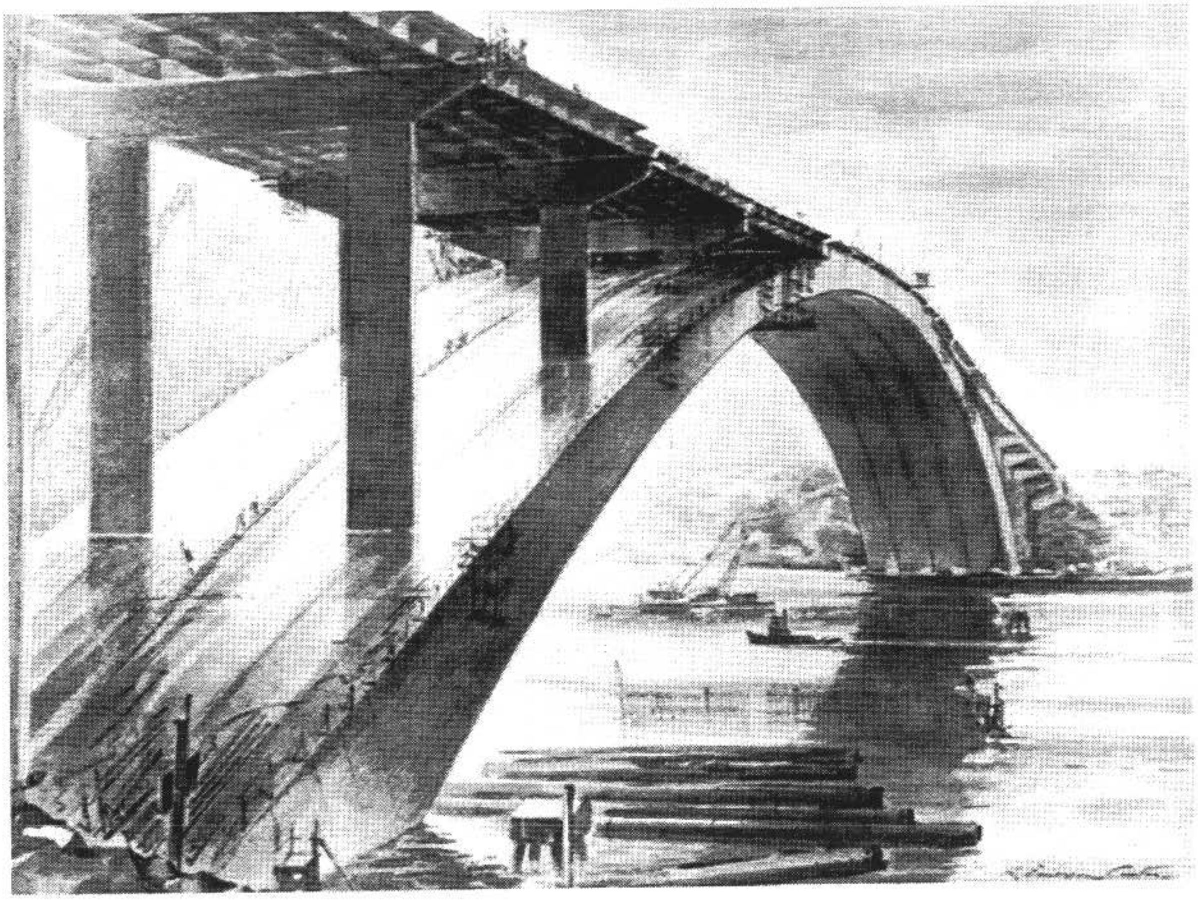
> Once the cables are stressed, it's pumped full of grout and they become one piece. All that tension's in there but it can't go anywhere.(Davis, RTA-GB FH21 Side A, 17:45)

Brian Pearson recalls that some problems were experienced in the anchorages of the stressing cables and that in the1960s and1970s, engineers had insufficient knowledge of anchorage forces in a post-tension situation, that is, where the cable is stressed after the component is cast, as in the Gladesville Bridge (Pearson, RTA-GB: FH10 Side B, 46:23) This did not have serious consequences.

As the Bridge assumed its final shape, Ossie Cruse looked back over the processes he'd been involved in:

> When you start to see it come into place, you become amazed at the intricate precision of the building of the Bridge itself. We came from both sides of the river and when we met in the middle, we were only just centimetres out. And it was an incredible feat of engineering. The stuff that's gone into it's incredible. The concrete, the big slabs, and the big cables that we pulled through that bridge -- massive cables. They were something like four inches in diameter. And they stretched right across the Bridge, up through the centre of the Bridge, we pulled them by hand, and by machine when we could get machines on it, or come-alongs, and so they were put in there and they were stressed up. (Cruse, RTA-GB: MA25, Side A, 25:20)

Finally, Cruse remembers, they checked the finished areas, crawling up underneath the concrete decking, squeezing into the narrowest places, inspecting all the joins and grouting up the last remaining cracks.



Completed arch

Drawing by R. Emerson-Curtis, purchased by DMR, April 1963

4.10 Roadway and Footways

Once the arch and the deck beams were in place, and the falsework was being removed, a moveable platform was slung under the bridge from which workers were able to erect the formwork for the concreting of the roadway. This was done from above. Cantilevered footways were likewise cast in place. Then the footways, railings, and light standards were erected. As Ray Wedgwood points out, even here the Bridge was innovative:

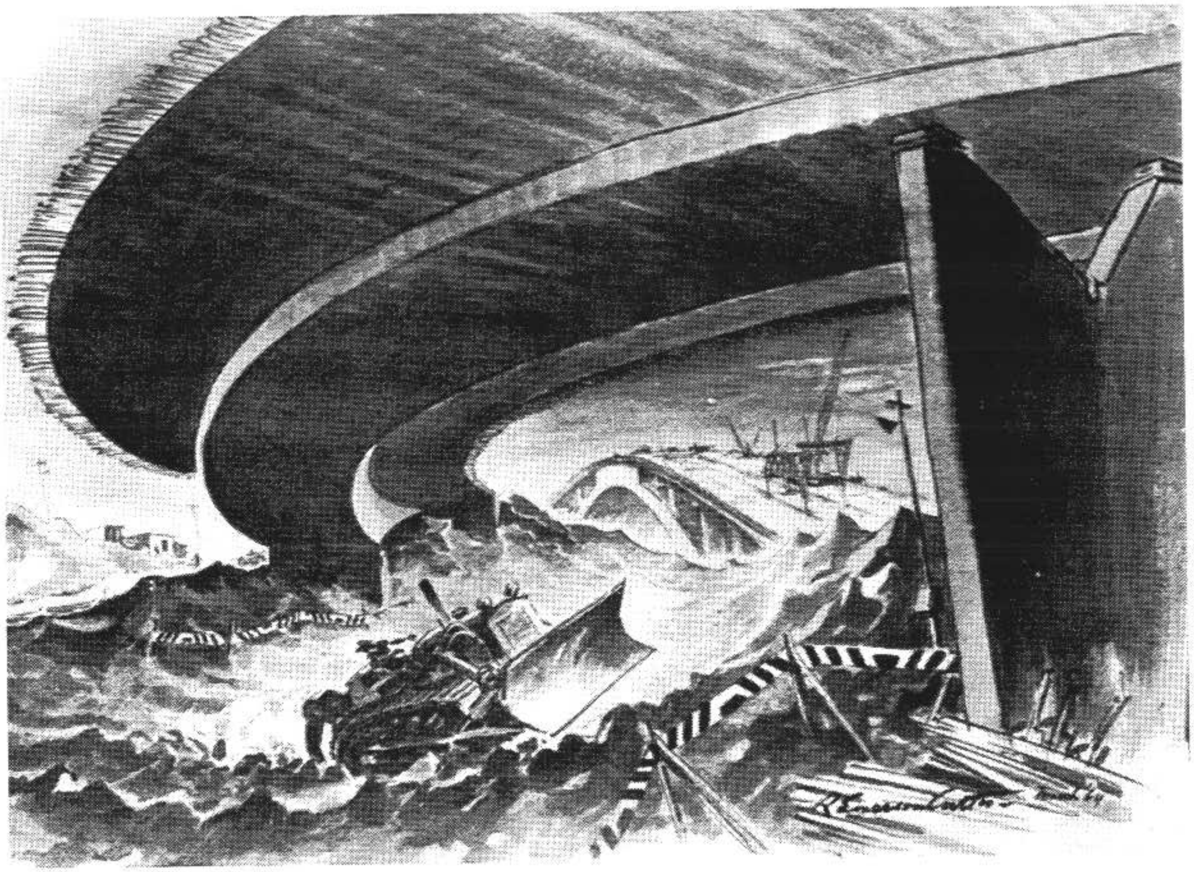
> There was some concern that Gladesville would become a place for people who wanted to commit suicide to go to. And that follows on from the experience of the Harbour Bridge, although the Harbour Bridge was built in Depression times. It's interesting if you look at the Harbour Bridge, there was a low rail, about three foot high ...and if you look at the picture of the opening of the Harbour Bridge, that's how the rail was, but a few months later, they cobbled together these steel angles which came up and bent over and there were three rows of barbed wire across the top. It's hardly aesthetic but from everybody's point of view that's the Harbour Bridge: it's still there. But at Gladesville, it wouldn't have been appropriate or suitable to have put that sort of rail on. In fact, it went as high as the Commissioner, J.A.L. Shaw, who took, as I understand, a personal interest in getting a railing that was very difficult to climb over. And he engaged some architects to assist him. What they came up with has been very effective... It's a tall railing, about seven or eight foot high, and it has quite a big tube on the top of it which is oval shaped. You can't really get your hand around it to get a grip on it to climb. And the other advantage, which a number of people have spoken about, is that when you drive over it in a car, if you're travelling at the allowable speed, the vertical rails become invisible -- this horizontal tube is high enough, so that, particularly as you're coming into the city, you can see the Harbour Bridge and down the Harbour as if there's nothing there at all. And I think that's a very good result. (Wedgwood, RTA-GB FH23 Side A, 09:46)

As these railings were being installed, the asphaltic concrete surface of the six-lane bridge roadway was laid and around the Bridge, the associated roadways and approaches were also being completed and landscaped. Ossie Cruse worked on this phase of construction also:

> After when all the blocks were in place, and all the stuff inside was tightened up -- the cables and that-- I had the privilege then of standing those side rails and the light posts. I always tell me kids, "Old Pops put them lamp posts in there when he was a young fella." I drove this old crane that had three wheels, two in the front and one at the back, and I used to stand those rails and those post lights coming over the Bridge. 'Cause you could see it coming together and that was the exciting part about it. Of course, I upset the road men there a few times, when they just had the bitumen down and I decided I'd drive across with the old crane and they started cooee-ing at me. But we were the bosses. We were the fellas that built the Bridge. They could do that again. If you made a mistake like that, you'd say, "Oh, that's it. We're the fellas that built this Bridge, mate, — you're the late comers." (Cruse, RTA-GB MA25, Side A, 25:20)

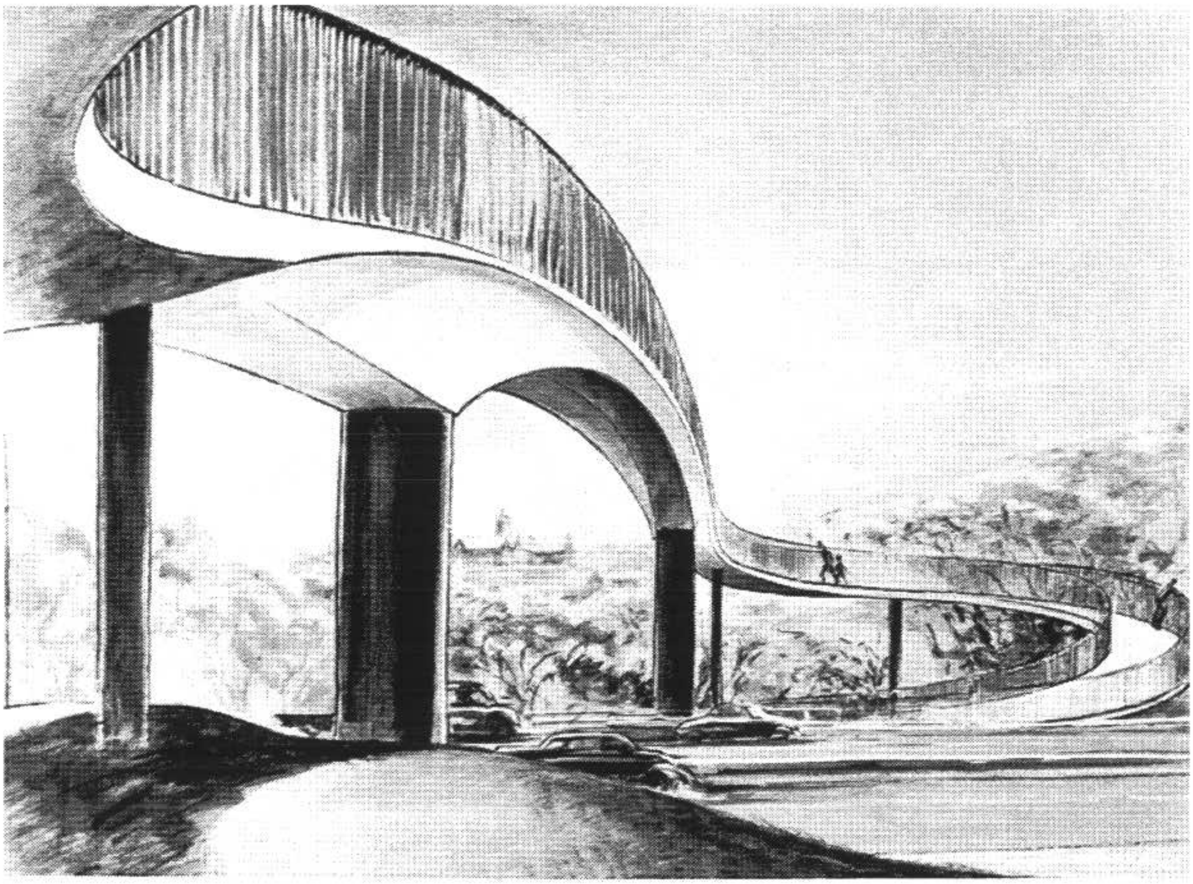
As the construction neared completion, Bill Davis, another of "the fellas that built the Bridge", asserted his authority as an old hand in a rather different way:

> Another fellow and myself were the first to drive over the Bridge -- which was long before it was opened. Peter Austin, one of the English engineers, he said all along, "I want to be the first to drive over this thing." And they were getting the roadway up -- it all met in the middle and there was a big section, I suppose about fifteen feet of nothing there -- it was on the top of the arch -- and so that they could get the concrete both sides, they brought up a couple of cranes, and all these great big massive timbers and they were putting down a temporary bridge so they could drive over.
>
> As they were laying these down, I was on the arch, thinking: "Peter Austin wants to know this." So I scampered down -- it was quite a way -- down to the office, and I said, "Look, if you want to be first over the Bridge," I said, "Hop in your car," I said, "Because they're putting the wood down there for traffic." He said, "Get in! Come on." And we drove up -- we rushed up -- I had no plan to be first over the bridge, but was sitting in the car -- and they're glaring at us too, the riggers. They finally got the thing down and Peter said, "Out of the road!" We drove over. Whht-bang! And came back. He said, "Well, we were the first to drive over the Bridge." Drove right down to the other side and back. (Davis, RTA-GB: FH21 Side B, 39:57)



Earthworks under Huntleys Point overbridge

Drawing by R.Emerson-Curtis, purchased by DMR, April 1964



Pedestrian footbridge over northern approach to Gladesville Bridge.
Drawing by R. Emerson-Curtis, purchased by DMR, June 1965

5. THE OPENING

Royalty, then, you kind of looked up to.

-- *Chris Hanrahan, ex-Riverside Girls High student*

The official opening of the Gladesville Bridge on Friday, October 2nd, 1964, was a large, formal affair. According to the commemorative booklet issued for the occasion, the proceedings were opened at 11:00 am by The Honourable P.D. Hills, M.L.A. Deputy Premier, Minister for Local Government and Minister for Highways. The Honourable J.B. Renshaw, M.L.A., Premier, Treasurer and Minister for Industrial Development and Decentralisation, was the speaker and Her Royal Highness, Princess Marina, Duchess of Kent made the reply and unveiled the plaque. The proceedings closed with a rendition of the national anthem. (Department of Main Roads, New South Wales, October 2, 1964)

The senior girls from the nearby Riverside Girls High School provided a Guard of Honour for the approach of the dignitaries to the Bridge. Two former students, Lynn Joyce and Chris Hanrahan, still have their souvenirs of this important day. They recall that the 120 or so senior girls of the school were groomed to participate in the Guard of Honour:

> On Mondays we always had uniform inspection and in the week leading up to the Bridge Opening, when the Riverside Senior Girls had been invited to be on the Guard of Honour, I think we had an inspection every day. Every morning at nine o'clock -- nails, hair, shoes, everything. The shoes had to shine. Because when royalty was coming, well! It was super important. I think we practiced our curtseys for a week before. And our yes Ma'ams - no Ma'ams. We were taught how to address Princess Marina if she were to stop and talk to one of us during her inspection of the Guard of Honour. I remember we were put through our paces every morning leading up to it. It was quite a big deal.

On the day, the girls were marched in formation up to the Bridge approach and took their places in double rows on either side of the road:

> We looked at the weather and it looked a bit cloudier when we first got to the bridge, but it fined up nicely. It was all important what the weather was going to be like. We'd scrubbed up well, so the weather had to perform too. There were quite a few of the local people there. My mother and father went. It was very exciting, the fact that finally this bridge that had been built over such a long period of time was being opened.
>
> Miss Thora Bosen was the principal of Riverside Girls High School. She was very present on the day. I do remember that she was standing there at the front of the line and woe betide anybody who misbehaved; she was looking at us with a very critical eye. I just went ahead and did what I was told -- what you did in those days. You shaped up; you made your uniform look beautiful. You stood there.
>
> I was terrified if Princess Marina stopped and talked to me that I wouldn't remember what I was supposed to be saying to her. And as it turned out that event didn't even occur. I think she only stopped to talk to one or two of the girls on the way. My Mum always thought Princess Marina was a very elegant, well-spoken charming lady. And well, royalty then, you kind of looked up to.... Just the fact that a member of the royal family came shows that the opening of the Bridge was a very important event in Australia. It wasn't just Australian dignitaries, (Hanrahan & Joyce, RTA-GB: MA15 Side A, 5:15-16:38)

Ray Wedgwood adds that royalty was always looked to do these things, particularly if it was a prestige bridge. He thought that Princess Marina was a good choice as a Royal, not only because she was admired and regarded as good looking, but because she had a lot of experience "opening hospitals and bridges back home" and was, in any case, already coming to Australia to open a British exhibition. (Wedgwood, RTA-GB: FH23 Side A, 14:46)

In the 1960s, he adds, there were a lot of these openings:

> Frank Cook's only complaint about these fairly big bridge openings through this period is that his wife said she needed a new hat every time there was a bridge opening. It was probably worth more than the food he had at the reception. (Wedgwood, RTA-GB: FH23 Side A, 14:46)

Frank Cook's wife, Deborah Cook, recalls that it was the biggest of the many bridge openings she attended: "Bridges are wonderful things", she adds, "I loved bridge openings." She recalls her new hat and also a party at Rose Bay attended by the engineers and their wives to celebrate the completion of the bridge. All the wives got a brooch in silver with an opal in it. (Cook, December 2000)

At the close of the Bridge Opening ceremonies, the Riverside High girls were given an early mark, while the invited guests retired to the grounds of the School for refreshments. Bill Davis, who like some of the other bridge builders was not impressed by royalty, didn't hang around for the ceremony:

> I wasn't on the Bridge; but I was at the party and it was a very lavish affair. I think the Main Roads spent a fortune on that. They took over the Riverside Girls High School grounds....They had the big marquees and I think there were several thousand people invited. Princess Marina opened the Bridge, but I didn't see that happen. We went to scamper over to the party which was pretty good and then on the way home I drove over the Bridge for the first time and I said, "Well, there you go!" It felt fantastic. (Davis, RTA-GB: FH21 Side B, 38:54)

Her Royal Highness Princess Marina, Duchess of Kent

OFFICIAL OPENING

Inspecting the guard of honour formed by the final year students of Riverside Girls' High School

6. THE FIG TREE AND TARBAN CREEK BRIDGES

It looks like a younger brother or sister to the Gladesville arch...

-- Brian Pearson, Bridge Engineer

The Fig Tree Bridge over the Lane Cove River was, in fact, the first of the three Gladesville/Hunters Hill bridges to be completed. It too was a large bridge, albeit overshadowed by the grandeur of the record-breaking Gladesville Bridge. Officially opened on 28 September, 1963, the new Fig Tree Bridge was a 4-lane, 7-span steel-girder, concrete-deck structure, 749 feet long, replacing a two-lane iron bridge built in 1885. It has one footway. Brian Pearson tells of solving an early problem in the construction of the new bridge:

> The bridge piers were supported by driven piles. In the driving of the piles, we found that the piles initially were pulling up for one of the piers much higher than we thought they should have. The piles were to be driven to sandstone rock. So we cored down through the rock and found that the piles, if we kept driving, were going to sit on the top of a roof of a cave in the sandstone. So each pile position had to be bored out so the pile could be driven through the roof of the cave down to the sandstone that was forming the bedrock of the river. And that was the only real difficulty we had with the construction of the bridge. (Pearson RTA-GB: FH10 Side B, 50:20)

Brian Cox, who did the surveying for the new bridge with the aid of the existing old bridge on the site, remarks that it was straightforward in its layout and design, and there were no other problems. (Cox, RTA-GB FH7 Side B, 51:12) The Bridge was designed by the Bridge Section of the DMR and constructed by N.H. Bowers Construction Ltd, with the steel fabricated by Clyde Engineering Company. The DMR built the approaches. The total cost of the project was approximately one million dollars.

The Tarban Creek Bridge, at 750 ft virtually the same length as the Fig Tree Bridge, was the final link for this section of the planned North-Western Expressway. It is, however, a more imposing Bridge. With its arch rising 75 feet above high tide level, it spans the outlet of Tarban Creek into the Harbour, between the Parramatta and Lane Cove Rivers. It is a 6-lane, 9 span reinforced and pre-stressed structure, incorporating a span of 300 feet. With a total width of 84 feet, it carries twin carriageways, each of three lanes, separated by a 12-foot median strip. There is a footway on the eastern side 8 feet 3 inches wide. (Department of Main Roads, New South Wales, 1966; 72) Brian Pearson notes that Tarban Creek Bridge was designed by Gladesville Bridge designer Tony Gee of George Maunsell and Partners in England. Tarban Creek Bridge:

> looks like an arch, like a younger brother or sister to the Gladesville arch, but was actually a portal frame. (Pearson RTA-GB: FH10 Side B, 37:39)

This little sister "arch", which, architecturally, blends very well with the Gladesville Bridge, is constructed from pre-stressed, post-tensioned concrete girders supported on inclined portal-type legs to form a two-pin arch with a parabolic soffit. It consists of five arch ribs supported on separate abutments which are joined above ground by a substantial concrete beam to give the appearance of considerable mass usually associated with arch supports. Vertical loads from the arch are taken on cylindrical concrete piles three feet in diameter, founded in sandstone some 25 feet below ground level. These piles were formed outside steel tubes and concreted under water, using the intrusion grouting process.

Horizontal thrust is taken on sloping reinforced concrete shafts 7 feet to 4 feet in cross-section let into sandstone on the creek banks. Falsework was salvaged from the Gladesville Bridge for the erecting of the beams and legs forming the arch ribs, and allowed for two ribs (not adjacent ones) to be erected and supported at the same time. Again, a travelling gantry crane with a 50-ton hoist was supported on the falsework for the heavy lifting. Fifty-ton hollow concrete blocks were manufactured in the Woolwich casting yard and brought by barge to the site where they were lifted onto the falsework to form the beams and legs of the arch ribs. With the Tarban Creek Bridge, the concrete hinge blocks at the crown were placed first and then the rest of the blocks, again allowing for 3 inch gaps, which were later filled with concrete to form continuous structural members. Each horizontal beam, 290 feet in length, was made self-supporting by means of 48 high-tensile steel cables passing from end to end and anchored at a force of 41,000 pounds. At this stage, the beam rested on the falsework at two points about 85 feet from each side of the centre. Using a technique like that of the Gladesville Bridge, it was lifted off the falsework by jacking up from the inclined legs using Freyssinet flat jacks set into the concrete of the adjoining blocks. The beam was then tied to each leg by means of 48 high tensile steel cables passing from the base of the leg into anchorages at the bottom of the beam. The cantilevered portion, the tail span, of the main beam was finally fitted with a further 30 high tensile steel cables while temporary kentledges checked excessive deformation. The main deck was supported on these beams, and, like the Gladesville Bridge, consisted of reinforced concrete poured in situ. The decks on the approach beam spans were formed of precast concrete slabs with concrete poured in situ on top. The whole deck was then surfaced with asphaltic concrete. (Department of Main Roads, New South Wales, 1966; 73, 75)

As Brian Pearson recalls:

> The construction proceeded as we expected, but in the construction, which was by Reed and Mallik again, the same contractors that did Gladesville, a chemical was used to block off some of the stressing cables so that they could be extended at a later stage as we got more blocks up. The chemical that was used was not the chemical that it was supposed to be and it induced -- subsequently -- corrosion in the cables. Happily. this corrosion was picked up by our maintenance inspection crews after construction was completed before any serious damage was done and we had to eliminate the corrosion and take steps to ensure that no further damage was done to the cables so that the stressing wasn't interfered with. It certainly would have been a catastrophe if it hadn't been. If the cables are attacked and ultimately fail, you've lost your stressing and that means there's no strength left in the Bridge. (Pearson RTA-GB: FH10 Side B, 52:12)

Bill Davis had worked on this stressing in the original construction and recalls that in the 1970s the DMR contacted him, asking him to talk to the engineers about what he knew of the construction in an effort to define the nature of the problem. Davis was able to tell them that Victor Hard Finish Plaster, used on the Gladesville Bridge, had also been used in blocking off the Tarban Creek cables. This, it seems, was the cause of their developing rust. (Davis, RTA-GB: FH 21 Side B, 42:05) According to Alan Leask, who also inspected the damage, these areas were then spanned over with another cable at relatively little cost. (Leask, RTA-GB: FH14 Side B, 39:31)

Leask thinks that a contributing factor may have been salt water rather than fresh water having been used in the mixture, but no one else has been able to confirm this speculation. All agree, however, that the problem has been taken care of, although Davis says that one can still notice a bit of a dip in the bridge where the cable tension has weakened. However, in the end, as Pearson points out, no bridge job ever runs perfectly to the designer's plans.

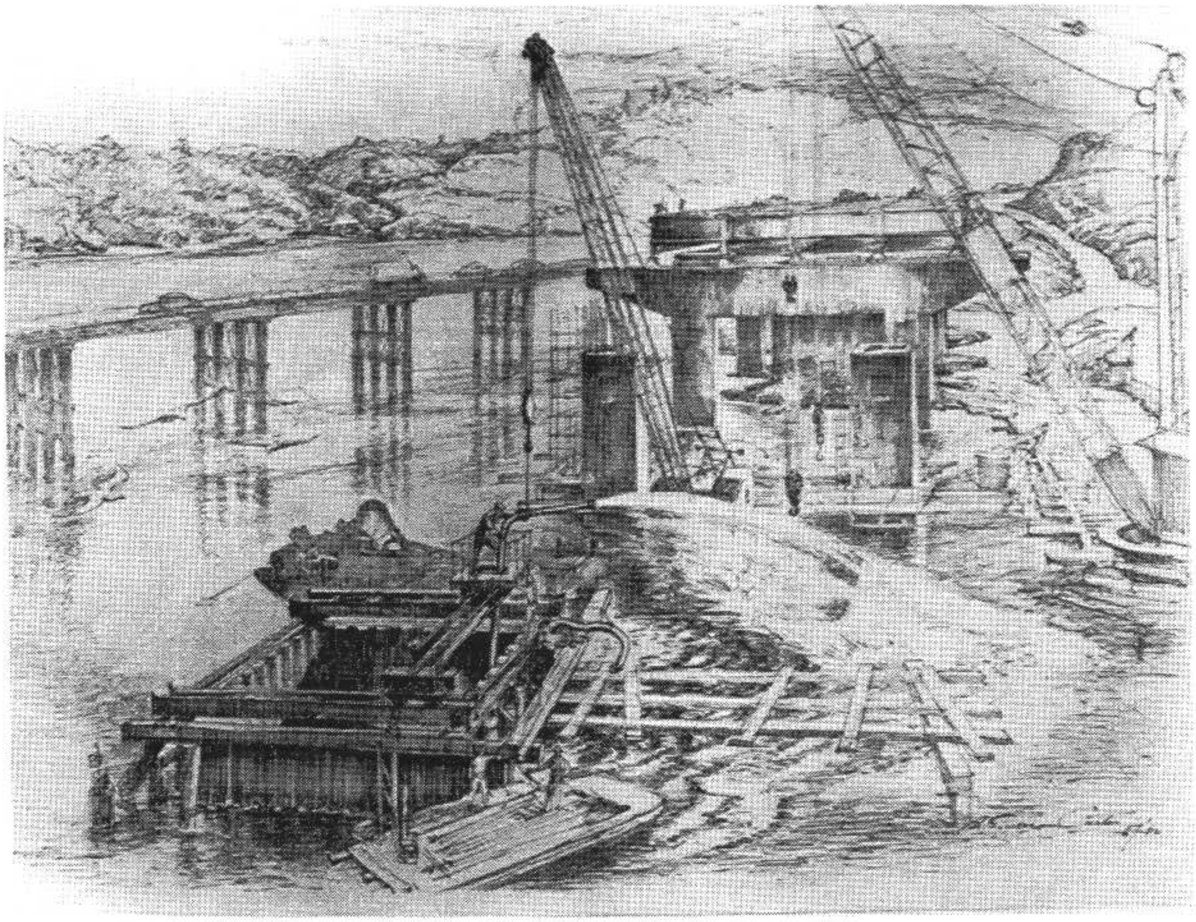
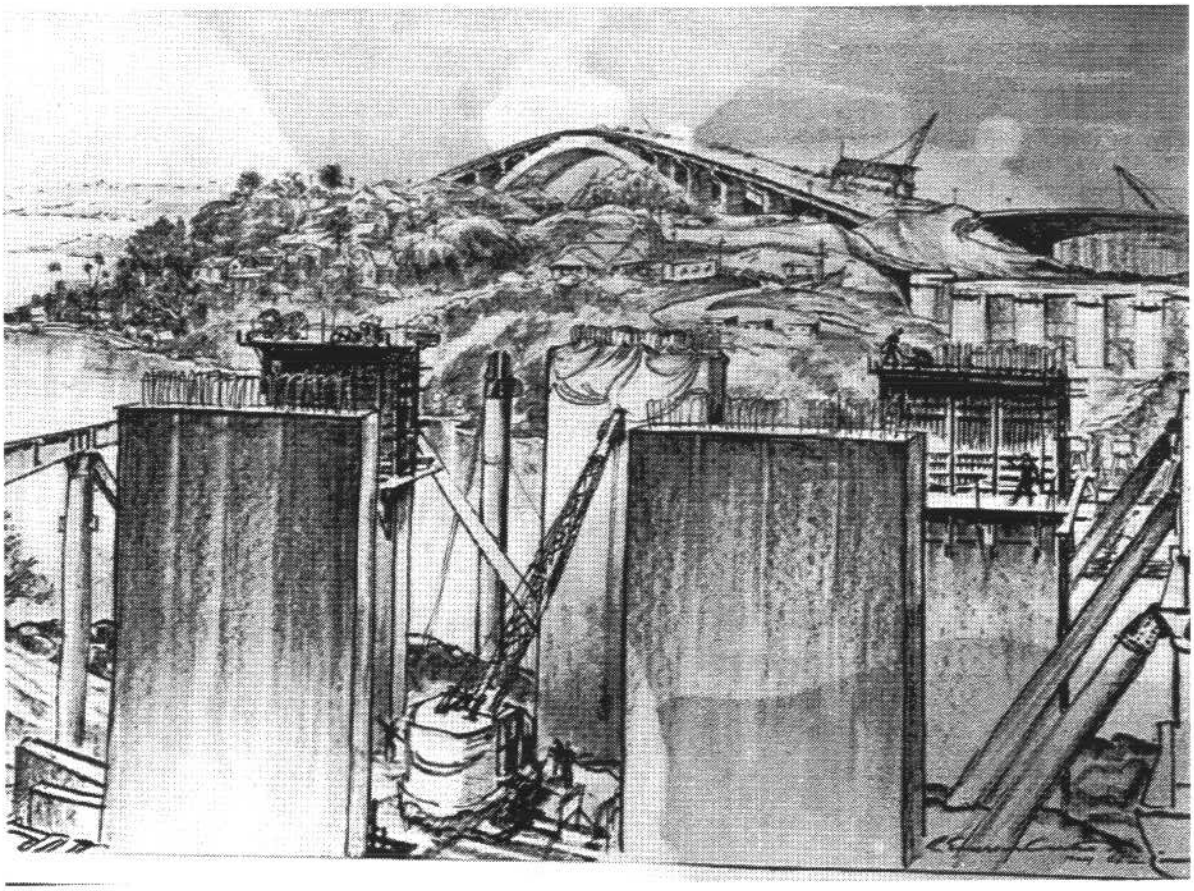
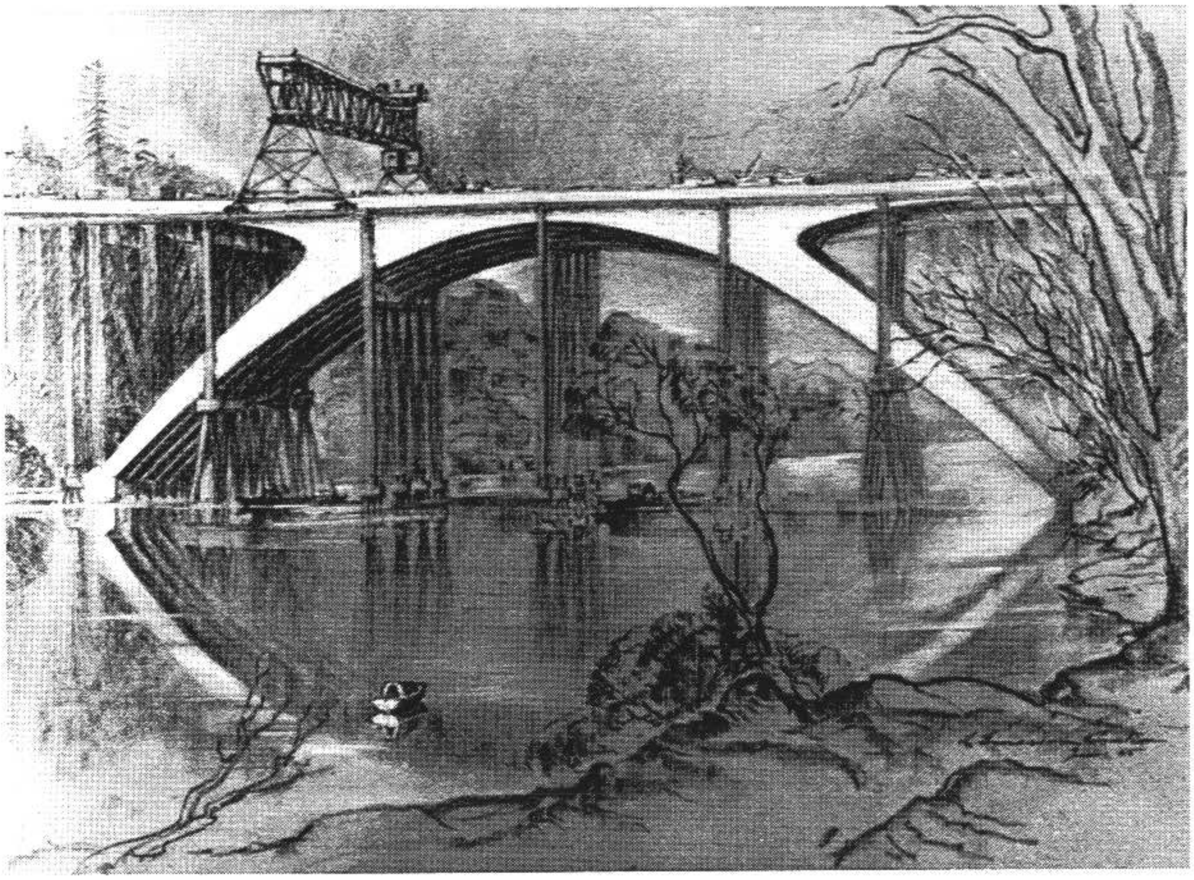


Fig Tree Bridge under construction.

Drawing by R. Emerson Curtis, purchased by DMR, October 1962



Piers for Tarban Creek Bridge with Gladesville Bridge in background.
Drawing by R. Emerson-Curtis, purchased by DMR, August 1964



Tarban Creek Bridge from upstream.
Drawing by R. Emerson-Curtis, purchased by DMR, June 1965

7. THE COURT CASE

He thought that he was justified in asking for...an increased payment for the work he'd done.

-- Brian Pearson, Bridge Engineer

Brian Pearson has said that Bill Reed, one of the principals of Reed and Mallik, was known for trying to get extra money at the end of a job. In Pearson's opinion, the DMR had a reputation for being fair and would help out -- but only within reason. (Pearson, December 2000)

In any case, Reed and Mallik finished three bridges for the DMR at this time, and, according to Brian Pearson:

> In 1966, from memory, Mr. Reed wrote to the Commissioner and said that he would like to meet with the Commissioner and discuss reasonable compensation for the construction of the three bridges, which he considered had been well executed by his company and he thought that he was justified in asking for a final payment -- in other words, an increased payment for the work he'd done. In effect, what he was saying to the Commissioner was that he was in dispute with the Commissioner over the payment for these projects. (Pearson, RTA-GB: FH11 Side A, 14:53)

Pearson recalls that the Gladesville Bridge specifications allowed for resolution of disputes by arbitration and it was agreed that a mutually acceptable arbitrator, Mr. Max Lawrence, would be appointed by the Institution of Engineers, Australia. About eight or nine points were taken to arbitration, according to Pearson, of which all but two were relatively minor matters, easily resolved. The other two were referred by the arbitrator to the Supreme Court and resulted in lengthy court cases, with a judgement finally being delivered in1970. (Pearson, RTA-GB: FH11 Side A, 14:53)

Frank Cook, in his position as Bridge Engineer, was given the task of handling this dispute. According to Ray Wedgwood, this was a duty which caused him much frustration, as it took up a great deal of his time — time which he wanted to devote to bridge building around the State. Moreover, Reed was, so Cook told Wedgwood, lobbying the more senior members of the DMR as well as the politicians on behalf of his claims. (Wedgwood, RTA-GB: FH23 Side A, 21:12)

The first of the two substantial claims that went to the Supreme Court was who was responsible for an additional expense of £77,000 in the driving of the extended piles for the falsework at the deeper level required by the unexpected rock fault. The second was the question of responsibility for the installation of fendering along the edges of the falsework for the protection of shipping.

Pearson explains that, as regards the piling, the DMR had supplied details of two rock levels only in their original cantilevered bridge design and maintained that if other rock levels were needed for the alternative concrete arch design tendered by the contractor, then it was the responsibility of the contractor to determine these levels themselves. The fendering argument was based on a specification in the tender that the tenderer was to find out from the Maritime Services Board (MSB) what its requirements were for the protection of shipping in the navigation channel during construction. Reed argued that the MSB requirement was satisfied by his provision of four dolphins at the corners of the navigation channel and that anything over that requirement should be paid for by the DMR. The DMR argued that the specifications specifically stated that fendering was among the requirements for the protection of shipping and that the contractor had to allow for fendering if the MSB required it. Captain Harvey, the President of the MSB at the time confirmed that he had asked for the fendering as an MSB requirement.

The Supreme Court gave its decision in 1970 and Reed, the contractor, lost in both cases. So, as Pearson says, "all in all, the contractor's request for additional payment for Gladesville Bridge wasn't very successful." (Pearson, RTA-GB: FH11 Side A, 22:14).

8. GLADESVILLE BRIDGE WIDENING AND MAINTENANCE

Gladesville Bridge was a fairly well behaved bridge,

as I recall.

-- Phil Hallinan, Works Engineer

As the DMR had anticipated, once the new Gladesville Bridge was opened, travel times to and from the city in peak hours were reduced and queues were eliminated on the Bridge approaches. Travel times to the city had been reduced by six minutes during morning peak hour once the Gladesville Bridge was opened, and a further reduction of five minutes was achieved with the opening of the Tarban Creek Bridge. Of course, traffic volumes also increased. While an average of 38,900 vehicles had crossed the old bridge every day, within a year of the opening of the new bridge, this figure had increased to an average of 49,400 vehicles. The DMR calculated that this was an 18% increase in the annual average daily traffic above that expected due to normal traffic growth. In the second year after the opening, the annual average daily traffic volume was 57,500 vehicles, with the maximum daily traffic recorded at 64,600 vehicles. The DMR estimated that 7000 new vehicles a day were induced to use the new Bridge, drawing approximately 4,500 vehicles away from the Sydney Harbour Bridge and approximately 1000 from the Ryde Bridge. By 1966, over 1000 more vehicles per hour were using the Bridge in the direction of the major peak hour flow than had been crossing on the old bridge.

Into the 1970s, the vehicle traffic on the Gladesville Bridge continued to grow, while the two wide pedestrian footways received relatively little use. So, as Ray Wedgwood explains, the decision was taken to add a traffic lane:

> A benefit was seen for an additional lane to be provided for the Northbound traffic in the diversions of the road, one leading to Parramatta and the other leading around to Lane Cove. And so it was decided to minimise the width of the upstream footway and set up the

> arrangement that the pedestrians would all go to the downstream footway and cross at either end of the Bridge and provide an extra lane on the Bridge. It wasn't a major modification structurally. The Bridge deck had the capacity to take the extra load associated with an extra lane, so it mainly involved the demolishing of the existing California kerb that was part concrete and part steel rail and rebuilding it.

Only a token footway remained on the upstream side:

> It was work that required a lot of planning because it was done adjacent to the traffic flow. So it had to be thought out and followed through. That was done by our own day labour forces by what was then our offices at Annandale and eventually at Five Dock. Phil Hallinan looked after it as I recall and he had Steve Lipman and Rolf Lunsman, two engineers who worked on the job. (Wedgwood, RTA-GB: FH 23, Side A; 22:53)

Phil Hallinan recalls that the roadside kerb was moved towards the outside of the Bridge by about a metre and that by narrowing the other lanes, they were able to fit in the extra lane. This required them to take out the old median strip and construct a new one. There was no structural alteration.

> The main problem with doing the construction of the widening of the bridge was the length of time we had to work on the bridge because we had to accommodate clearway hours and so forth. We only had four or five hours on the outside on the bridge and the widening went the full length of the bridge which was long, so it would have gone over a couple of months, working with these constraints. (Hallinan, RTA-GB: FH1 Side A, 17:45)

Phil Hallinan was also involved in the maintenance of the Gladesville Bridge for a few years when as Works Engineer, Maintenance, he was responsible for checking bridges in about half of the Greater Sydney Metropolitan area:

> Now, any bridge had to have what we would call routine maintenance: keeping the bridge clean, for example, just making sure there wasn't a build up of rubbish... because if it got caught up in the drainage system of the bridge, when it rained we might get flooding.... keeping the finger joints in the road deck at each end of the bridge clean because if those bridge joints got filled up

with dirt, the finger joints could not expand properly in hot weather and that could induce stress in the bridge.

We had a foreman specifically dedicated to looking after the inspection of all bridges and he would do a report on the Bridge which I would examine and look at the Bridge itself if there were any particular problems. The foremen would inspect the obvious things such as whether the drainage and so forth on the Bridge surface was all clear and maintained. But more importantly what they would look for was cracks and any signs of distress in the Bridge. (Hallinan, RTA-GB: FH1 Side A, 6:45)

In fact, as Brian Pearson explains, there were cracking problems after construction as a result of concrete creep and some cracks needed to be sealed to protect the reinforcement. (Pearson, RTA-GB: FH 10 Side B, 43:44) Phil Hallinan explains that while all concrete cracks and all bridges have cracking:

...really the problem is picking those cracks which are critical. Now, Gladesville Bridge was a fairly well behaved bridge, as I recall. In my period there from 1979 to 1982, the main problem we had with regard to maintenance was that there was some cracking in the concrete where the Bridge deck sat on the top of the crown of the arch..... It was falling in between some girders. And some concrete was breaking out....We had to repair that, by taking out the concrete which was very loose, replacing that concrete and also putting epoxy in cracks....

What would normally happen is that a pier would flex or bend slightly to account for the fact that the length of concrete in between the pier and crown had shortened slightly due to the natural shrinkage of concrete. But it appeared that the pier might not have been quite flexible enough to bend. So what happened, instead of the pier bending, the deck at the crown of the bridge pulled away just a little bit from the crown and caused this cracking. (Hallinan, RTA-GB: FH1 Side A, 9:09)

Hallinan did not regard the problem as particularly serious, but "It didn't look good!" he declared.

Laurie Stewart mentioned an additional issue of which the other interviewees appeared to have no knowledge. He says that while monitoring surveys were carried out on the Gladesville

Bridge for a number of years, they are not being done at present. And to some degree, he disagrees with the conventional assessments of the longevity of such a bridge. "Concrete structures are not as permanent as we think," he maintains. It is his belief that some of the diaphragms have become compressed by the enormous tonnage of the Bridge. (Stewart, RTA-GB: FH18 Side B, 53:51)

There was one maintenance problem which Phil Hallinan said he could not rectify, namely, the rust stains beneath the steel scuppers taking the water from the internal drainage system out from the Bridge. Because the Gladesville Bridge is so high, these cannot be cleaned from below; *and because the anti-suicide rails are also so high, Hallinan found that the usual cherry-picker* type of equipment available for reaching over the railings and down the sides of bridges could not be used. (Hallinan, RTA-GB: FH1 Side A, 25:45) Some interviewees recall that the bridge looked terrific when new and regret that it has a somewhat dirtier look today.

9. LOOKING BACK

> *The people on the bridge...were all intensely keen and interested in what they were doing and everyone endeavoured to give his best to the project. And that's why it was such a successful project in the long term.*
>
> *-- Brian Pearson, Bridge Engineer*

Without exception, all of the people interviewed about the Gladesville Bridge expressed a special appreciation for the structure and their work on it, each in their particular way.

Laurie Stewart says that it was the most interesting project of his career and expresses his pleasure at being there to see such an unusual and ingenious means of construction. (Stewart, RTA-GB: FH18 Side B, 44:30)

Sandy McKenzie still slips down to the Hunters Hill wharf where he once took progressive photographs of the bridge over the course of its construction -- "for a nostalgic look":

> I still think it's beautiful....My feeling about Gladesville is satisfaction that I did the job that I was required to do and gratitude that I had the privilege of being associated with it. (McKenzie, RTA-GB: FH13, 19:10)

Ossie Cruse made life-long friendships on the Bridge, and for him it has a particularly personal significance:

> You don't realise the immensity of a thing until it's all finished and you come back later and you're thinking out, "Were we involved in that? That massive thing - were we part of that?"... It helped me build my character because I was going nowhere for a long time....But then when I became a Christian and I got on this job (on the Bridge), I seen all these opportunities to change and to get experience and get qualifications and I went for them. See, you've got to learn how to work with people, you got to learn to talk with people and basically how to work together and they were things that I learned there.... it follows you all your life.... To me the job was an incredible job, a beautiful experience. (Cruse, RTA-GB: MA20 Side A, 6:01)

Kevin Forrester is another who was personally affected by his time on the Bridge:

> It was a real milestone in my life. I was pretty fed up with engineering anyway, and all of a sudden I got this insight into R & D work. Which is what it was all about. It was quite revolutionary for me. It made me satisfied to stay in Civil.
>
> My daughter's the one that's got the backwash of it. She was driving over it with some friends one time and they were remarking what a fantastic bridge it was and she said, "My Dad worked on that." They were very impressed. (Forrester, RTA-GB: FH4, 11:27)

Driving over the Bridge is an experience which many interviewees commented on. Chris Hanrahan, the former Riverside Girls High student, still lives in near the Bridge today:

> I do remember the first couple of trips over it because it was so high, it was so much higher than the original bridge and the view was, and still is absolutely spectacular. It's one of the highest points you can be in a car in Sydney.... You can see all of the way up to the Harbour Bridge from the top point. I really love the Bridge. I never tire of the view when I ride over it. (Hanrahan & Joyce, RTA-GB: MA15 Side A, 23:31)

Tony Prescott, also finds the drive over the Bridge:

> ... still a bit of an ethereal experience. It's the one point of the otherwise dreary experience of driving along Sydney's roads.... I always like looking at Hunters Hill because I used to live there. You know, you get a good view of Hunters Hill. It's a good experience. It's the one point where you sort of rise up and you see what Sydney's weather's like and all this sort of thing. It brings you up high and you get a good look at things. (Prescott RTA-GB: FH17 Side A, 13:15)

Bill Davis is one bridge worker who now questions the purpose of the Bridge:

> In those days, before I saw the light so to speak, I thought it was great to have all this progress, destroying things to build something else. I thought that was terrific but, of course, I don't now. Then I did. I thought it was great and the more work the better. Now I have an absolute hatred of motor cars. (Davis RTA-GB: FH48:06 Side B, 48:06)

Nevertheless, his present hatred of the motor car does not tarnish Davis' memory of the Bridge work itself:

> Every morning I got up -- it was one of those things -- I was looking forward to going to work. A lot of time you get jobs and think, "Oh God..." Nope, I wanted to get there. I enjoyed every moment of it, actually. It was excellent. (Davis, RTA-GB FH21 Side A, 5:43)

And even today he feels proud to think that something he worked on is still there. (Davis RTA-GB: FH48:06 Side B, 55:38)

Alan Leask believes the Gladesville Bridge may still be there for a long time to come; concrete has been known to last a thousand years. He regards the Bridge as a magnificent structure and its construction as a highly successful operation. Moreover, he later saw benefits in the spin-offs from the concrete testing that his team did there. (Leask, RTA-GB: FH14 Side B, 42:22, 50:27) Similarly, Brian Pearson recalls that the Bridge introduced him to pre-stressed concrete, a new and exciting material which would be unlimited in its application to bridge work. He agrees with Leask that:

> ...the biggest advantage that the DMR obtained from the construction of the Bridge was the experience its engineers obtained from the development and use of high strength concrete. Once we became confident that we could produce high strength concrete of excellent quality, on a routine basis...from then on we used concrete of minimum strength of 6000psi.. as a routine operation on all our pre-stressed concrete bridges. So that was one tremendous advantage that came out of the Bridge. But there were other advantages in the concrete area too. Mr. Alan Leask developed mixes for the arch abutments, low heat mixes, and also he developed low creep mixes. And that helped us to eventually master the creep problem in concrete. Another advantage, I think, that came out of the Bridge itself from a design aspect was that it took the DMR out of an era of steel truss design into modern concrete and steel box girder design....
>
> There was a further advantage that up till that time, local consulting engineers had very little experience in bridge design. All the major designs were pretty well done in house in the Bridge Section of the DMR, but once Maunsells from the Gladesville era established branches in Australia, other consultants set up and decided that they should also get involved in major bridge designs, And the Bridge Section had been a training ground for bridge designers and a lot of these designers then moved out into the consulting field. So Gladesville really started off an

era of modern bridge design, not only for New South Wales, but it spread throughout Australia.
(Pearson, RTA-GB: FH10 Side A, 25:59)

From this perspective, the Gladesville Bridge, has a unique heritage value and a very special place in history. Moreover, as Tony Prescott explains, the Bridge is visible evidence of the thinking of road and bridge builders of its era. Prescott believes that it:

> ... certainly tells us about some very grand visions for Sydney and a very strong point of view that was based on the movement of people and goods by motor vehicle. It tells us about a whole era of post-war planning and the approach to the engineering works that were part of that planning .... these works, the Gladesville Bridge, the Fig Tree Bridge and Tarban Creek Bridge, are very emphatic statements on the landscape and they reflect the unquestioning view of the way things should happen. Whereas if somebody in future comes and looks at the Eastern Distributor, they'll see this very compromised looking sort of engineering that snakes its way under and between the landscape... (So the Gladesville Bridge) certainly makes a statement in that way and tells us something about the period and the way things were viewed at that time.
> (Prescott RTA-GB: FH17 Side A, 19:01)

In summing up, Ray Wedgwood, as an engineer and historian, points to a 32-year cycle of building major bridges spanning Sydney Harbour and its inlets and says that Gladesville Bridge is:

> ... unquestionably a future heritage item, the same as the Harbour Bridge, a very important heritage landmark. I see it as part of a triangle of bridges, the Harbour Bridge, and Gladesville, and Anzac Bridge ... representing the state of the art at the time that they were built.
> (Wedgwood, RTA-GB: FH24 Side A, 11:40)

But for the people involved in its construction, the Bridge was more than a physical object. Brian Pearson, looking back on this period in his life, expresses something of the feeling they all seem to share:

> The most important factor were the people. The people on the bridge, whether they were our people or the contractor's people, they all formed part of us and they were all intensely keen and interested in what they were doing and everyone endeavoured to give his best to the project. And

that's why it was such a successful project in the long term. It was the people who made it.

(Pearson, RTA-GB: FH11 Side A, 34:55)

10. FINDINGS

In their accounts of the building of the Gladesville Bridge, those who were associated with it have made a number of interesting and significant points. In brief, these are the following:

• In terms of bridge design and construction, the Gladesville Bridge, with its 1000 ft concrete arch, the longest in the world at the time, was a significant step forward for the DMR. The skills and procedures developed on the project greatly assisted the Department's successful entry into pre-stressed concrete construction.

• The establishment of an on-site testing laboratory was one of the most significant aspects of the project, as were the concrete testing methods trialed there.

• A number of innovative procedures were introduced into Australia through the construction of the Gladesville Bridge. These included the use of Freyssinet flat jacks to lift the arch off of its falsework, moveable falsework for building successive ribs of a large bridge, a launching gantry advancing from pier to pier to mount very heavy deck beams, and a casting yard large enough to hold all the precast components of one arch at a time.

• The design of the railings for the Gladesville Bridge, as specified by the Commissioner, allowed a clear vision of surrounding landscape while being relatively suicide-proof.

• The overall excellence of the Gladesville Bridge Design, aesthetically and functionally, has been widely acknowledged and led to its being awarded the 1965 Civic Design Award by the New South Wales Chapter of the Royal Australian Institute of Architects for a "Work of Outstanding Environmental Design".

• Quality Control, as the means by which the DMR supervised the work of the contractor, appears to have been an important aspect of the success of the project. Several interviewees reflected unfavourably on the present-day substitution of Quality Assurance for Quality Control.

• The organisational and political force brought to bear on the project by the Department of Main Roads in this era was regarded by most interviewees as significant.

• The role of highly capable foremen employed by both the DMR and the contractor emerges as a valuable contribution to the job.

• The Bridge was built without loss of life or major injuries. Given the poor consciousness of safety during this era, this good safety record can probably be attributed to the generally high quality of supervision on the job.

• The excellent relations between contractor and DMR staff and between workers and supervising engineers contributed to a harmonious and enjoyable work experience for all interviewees. An ethic of "the fair go" appears to have been strong at all levels.

• The workforce was composed of men from a several ethnic groups. While workers from non-English speaking backgrounds were generally confined to the less-desirable concreting jobs, the Bridge employed at least half a dozen Aboriginal workers, a number of whom filled highly skilled positions.

• The old Gladesville Bridge had become a traffic bottleneck of serious proportions, particularly during peak hours, by the time construction began on the new Gladesville Bridge. The opening of the new bridge led to significantly improved travelling times and ease of access to the city.

However, accelerated use of the Bridge by motor vehicles soon necessitated its alteration to provide an extra lane for traffic. Peak hour traffic has subsequently become very heavy and delays on the new bridge are not uncommon.

• The Gladesville Bridge was part of a DMR vision for a web of radial expressways carrying traffic in and out of the Sydney CBD. While this vision has increasingly come under criticism, in the early 1960s it was regarded by most interviewees as a desirable one.

• While, on the one hand, the Bridge and its associated stretch of the North-Western expressway resulted in the destruction of important heritage buildings in the Fig Tree District of Hunters Hill, on the other hand, this same destruction also helped foster resident action groups which made the further realisation of the North-Western expressway politically impossible.

APPENDIX A: THE FILMS

Kingcroft Productions, a small production house specialising in industrial documentaries, had already made a number of films for the Department of Main Roads when they successfully won the tender for the production of four films on the Gladesville Bridge. The films were titled ***Expressway over Water*** (Parts I, II and III) and ***The New Gladesville Bridge***. Kingcroft partners, John Kingsford-Smith and Jack Gardiner, assigned the film to Peter Menzies, who shot the film as cameraman/director on 16mm Kodachrome, a colour stock originally developed for the home movie market, which had come into professional use in Australia. The film was shot mute, with narration and music added in the editing stages. Over the four years in which he followed the progress of construction, Menzies visited the site about once a fortnight, consulting with Resident Engineer Sandy McKenzie who became closely involved in the making of the films. As a junior cameraman, Menzies was proud of his efforts, although at the time he did not realise the historical importance of his work. The films survive as an important archival record of the building of the Gladesville Bridge.

APPENDIX B: INTERVIEWEES

Brian Cox (Cox, RTA-GB FH 7; 9/1/01)

Ossie Cruse, O.A.M. (Cruse, RTA-GB: MA19-20; 5/2/01)

William Ernest Davis (Davis, RTA-GB: FH21; 7/2/01)

Kevin Forrester (Forrester, RTA-GB: FH2-4; 3/1/01)

Albert Fried (Fried, RTA-GB: FH6; 5/1/01)

Phil Hallinan (Hallinan, RTA-GB: FH1; 2/1/01)

Christine Hanrahan (Hanrahan & Joyce, RTA-GB: MA15; 18/1/01)

Lynne Joyce (Hanrahan & Joyce, RTA-GB: MA15; 18/1/01)

Alan Leask (Leask, RTA-GB: FH14; 16/1/01)

Ernest Alexander ("Sandy") McKenzie (McKenzie, RTA-GB: FH12-13; 11/1/01)

Peter Menzies (Menzies, RTA-GB: FH5; 3/1/01)

Lawrence Stewart (Stewart, RTA-GB: FH18; 2/2/01)

Brian John Pearson (Pearson, RTA-GB: FH8-11; 10/1/01, 15/2/01)

Tony Prescott (Prescott, RTA-GB: MA17-18; 22/1/01)

Joe Ward (Ward, RTA-GB: MA 25-26; 16/2/01)

Raymond John Lloyd Wedgwood (Wedgwood, RTA-GB: FH22-24; 7/2/01)

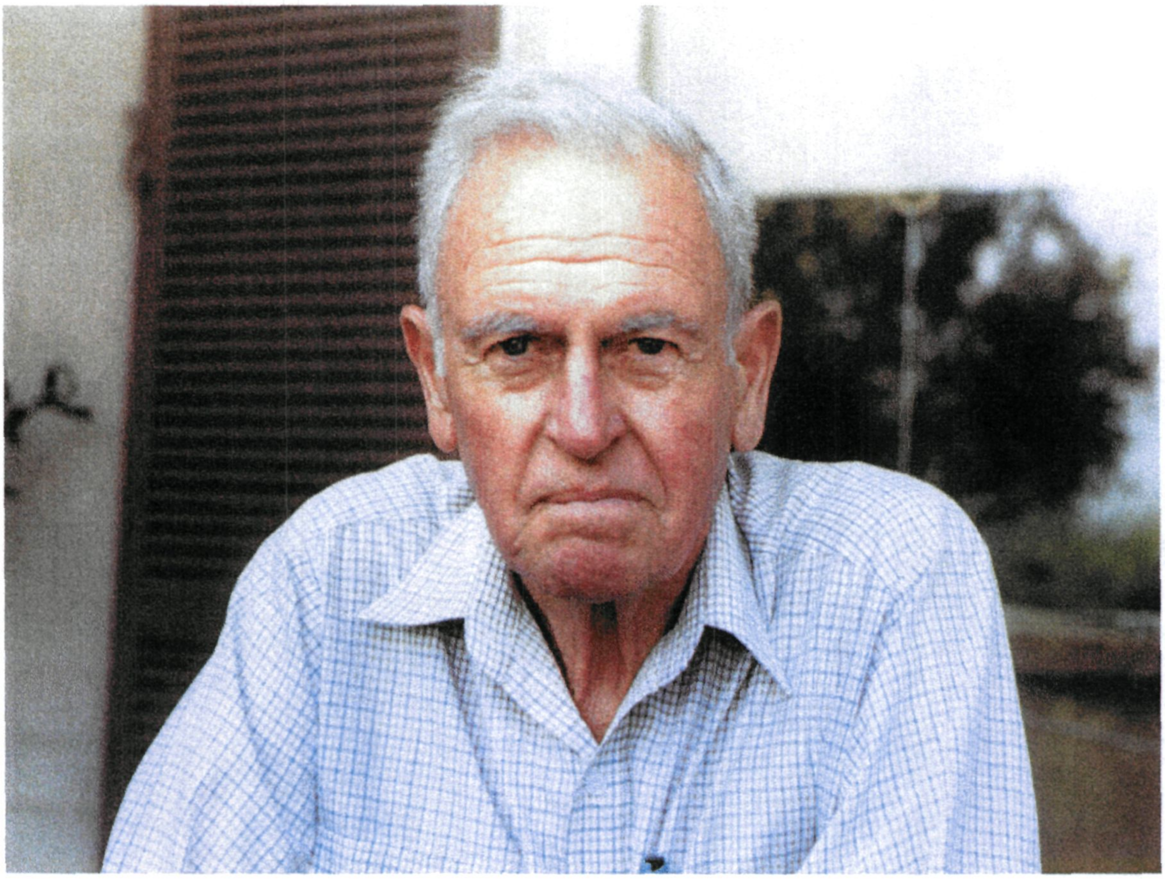
Brian Cox

Brian Cox was born in Sydney on 24 September, 1928. His father was a radio technician and later the railways Station Master at Chatswood. Cox attended Manly Intermediate and then Shore, at North Sydney, where his interest in football was stronger than his interest in studies. He played Rugby for Australia as halfback from 1952-1957. In 1947, he was articled to a registered surveyor, completing his exams at the Surveying Institute by private study. There were no university courses in surveying at that time. In 1953 he became a registered surveyor and was employed all his working life by the DMR. He was assigned by the DMR to the Gladesville Bridge project to double check the surveying work of the contractor. He also worked on the Silverwater and Captain Cook Bridges during the same time.

Ossie Cruse

Ossie Cruse, O.A.M. was born in Orbost, Victoria in 1933. He married his wife Beryl in 1952 and has three children, 12 grandchildren and 10 great grandchildren. Today he lives in Eden, NSW and is a councilor and chairman of the New South Wales Aboriginal Lands Council. He works as a community worker and is a pastor with the Aboriginal Evangelical Church. Ossie had little formal schooling, beginning work at age 11. He traveled in the Eastern States extensively in many jobs, including working with his wife for over 15 years as a seasonal worker. He became involved in the Gladesville Bridge in its early stages as a plant operator and labourer, leaving to work in the bush again. He later returned to the Bridge, where his brother Ben was a crane driver, got his dogman's and rigger's tickets, and stayed almost until the completion of the Bridge before leaving Sydney for good.

Bill Davis



William Ernest Davis was born on 28 August, 1925 in Sydney where he worked as an apprentice fitter and machinist, having left High School after third year. He joined the Airforce, spent two and a half years in New Guinea during the War, finished his apprenticeship, and then returned to New Guinea for a short period. After coming back to Sydney, he went to sea as a ship's engineer, travelled to the UK, had a milk run and a variety of other jobs, and eventually found work through a friend as a labourer on the Gladesville Bridge. Before long, he was made a charge hand and stayed with the project until the completion of the Tarban Creek Bridge.

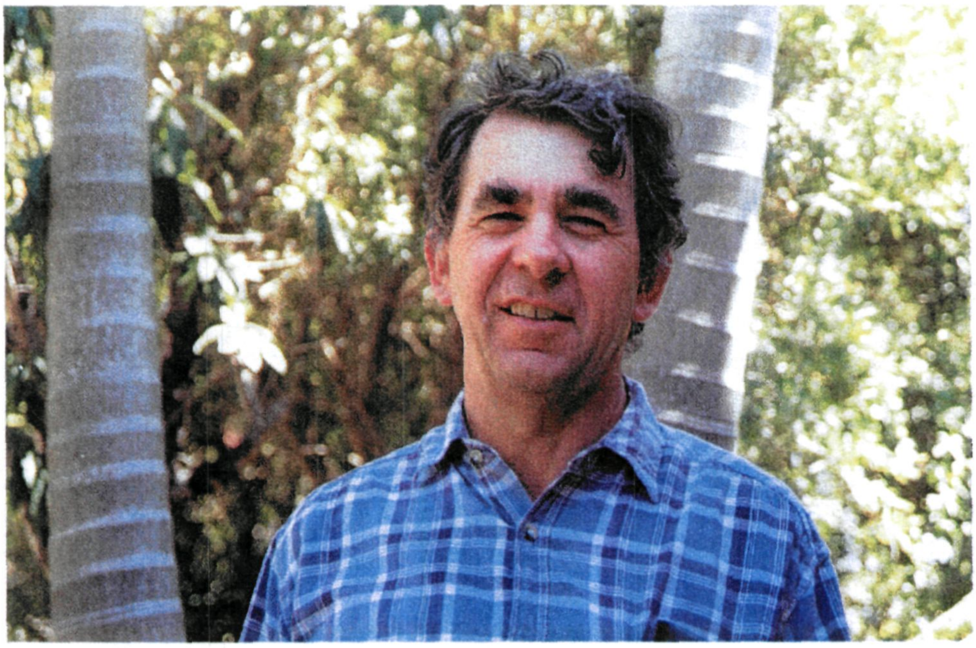
Kevin Forrester

Kevin Forrester was born at Cremorne, Sydney, 3 February 1927. His father was a Librarian for the Sydney Council but during the Depression ran a petrol station in the Blue Mountains where the family lived from 1931. After working as a cadet draftsman in the Lands Department Forrester, thanks to his parents' savings, was able to enter the University of Sydney in 1946, a year in which the influx of ex-servicemen in Civil Engineering swelled the number of graduates from 16 in 1945 to about 200 by 1950. Jobs for these graduates were plentiful and Forrester chose to go to the Snowy Mountains Authority. He later worked in Norway and travelled in Europe, returning to Australia in 1957 to join the DMR, where he was involved in the structural analysis of the Gladesville Bridge. Later on, he became involved in the emerging field of soil mechanics and slope stabilisation. He retired in 1987, but has maintained an active involvement in the field and has recently written a book on the subject.

Albert Fried

Albert Fried was born in Vienna, Austria, 23 April, 1910. He came from a family of Jewish merchants with their roots in Czechoslovakia and Hungary. In the course of obtaining his engineering degree at Vienna's Technology University, Fried became particularly interested in reinforced concrete, which was then a relatively new technology. In 1939, realising the threat posed by Hitler, he fled to Australia, where engineers were needed. There he joined the DMR Bridge Section as one of five engineers accepted from Germany and Austria. He left the DMR for a period, but on his return became part of the design team for the Gladesville Bridge. Fried later designed several major bridges in New South Wales, including the Captain Cook Bridge and Stockton Bridge. His most important work, however, in his own estimation, was in the West of the State building miles and miles of relatively inexpensive bridges which allowed people to traverse flooded plains to places which formerly would have been cut off. Fried taught at the University of Technology, Sydney and is a highly respected engineer.

Phil Hallinan



Phil Hallinan was born on 29 December, 1950 and grew up in Newcastle. After earning his Civil Engineering degree from the University of Newcastle, he worked for Transfield and then in 1973 joined the DMR. He started working in the Bridge Design Branch in Pitt Street, Sydney, on basic bridge design, largely pre-stressed concrete slab bridges with simple substructures. In 1979 he became Works Engineer for Metropolitan Bridge Maintenance and for the next three years was responsible for maintenance of the Gladesville Bridge.

Chris Hanrahan and Lynn Joyce

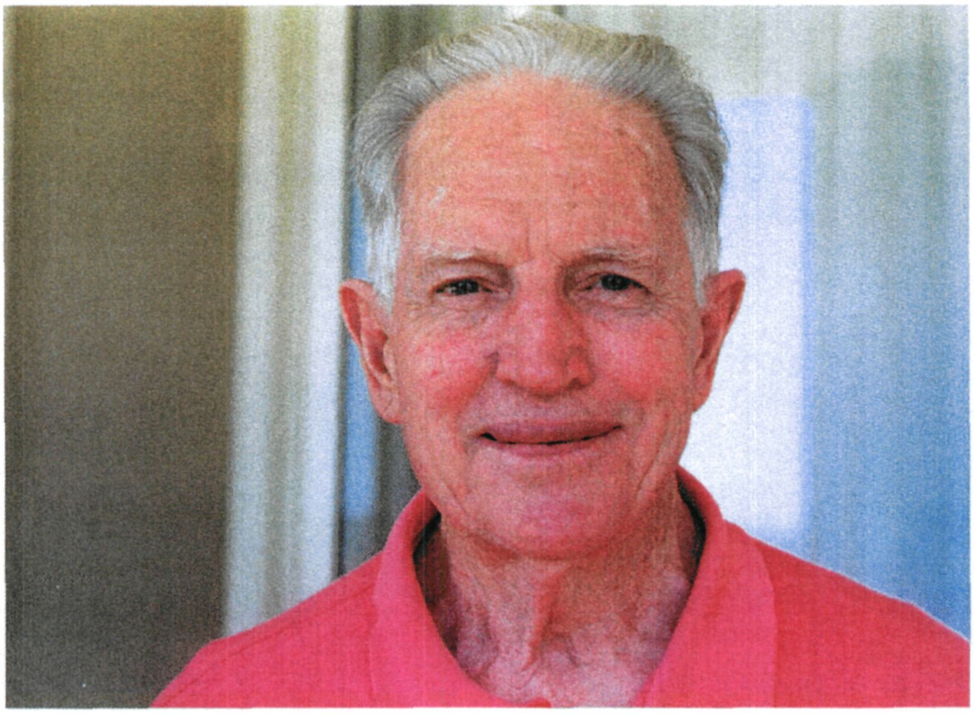
Christine Hanrahan (née Akehurst) was born at Ryde Hospital, 26 July, 1949, and grew up in Henley, about half a kilometre from the Gladesville Bridge. She attended Riverside Girls High School and was present at the opening ceremony for the Bridge.

Lynne Joyce (née Ironside) was born 17 March, 1950 and moved to Gladesville from Ryde when she was seven. She also attended Riverside Girls High School and was present at the opening ceremony for the Bridge.

Alan Leask

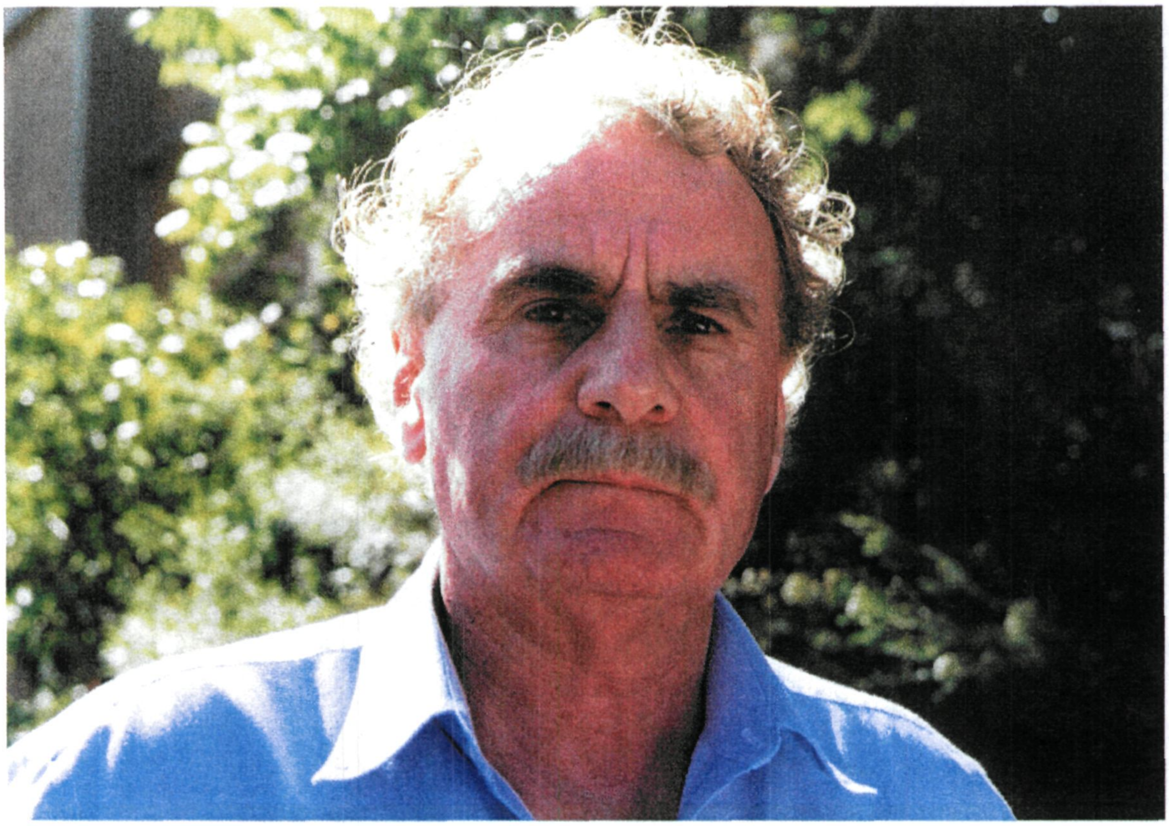
Alan Leask was born in England on 24 August, 1924. At age two, he arrived in Sydney where his father, formerly a model maker for a shipping company, found work as a construction foreman. Leask left school at 18, working for a year as a junior draftsman at the DMR. He joined the RAAF as a pilot and was stationed at Morotai, flying Beaufighters in the Pacific. At the end of the war, aged 21, he returned to the DMR and started his university course on a Commonwealth allowance. He graduated in Civil Engineering in 1951 and entered the Bridge Section as an engineer. His time in the DMR was interrupted by a trip to Europe. He returned to the Department in 1954 and became involved with the Gladesville Bridge in 1960 as Supervising Engineer in the Materials and Research Section. He was appointed Materials and Research Engineer to head the section in 1968.

Sandy McKenzie



Ernest Alexander ("Sandy") McKenzie was born at Griffith, NSW, on 24 January, 1923. His mother was from Sydney and his father, born in North Scotland, moved to Australia in 1912 and served with the Light Horse, AIF at Gallipoli as well as in France, surviving to take up a Soldier Settler allotment in the Murrumbidgee. However, in 1928, the family left the farm and moved to Sydney. At the age of 15, McKenzie left school to become a clerk with the Water Board, and also studied accountancy, before joining up as a pilot with the RAAF. After the war, as a returned serviceman, he received government support to study at Sydney University, graduating with a Bachelor of Engineering degree in 1951. Upon graduation, McKenzie worked with the Water Board on construction and then with a private bridge construction firm. He joined the DMR in February, 1959 and worked full-time on the Gladesville Bridge site as Resident Engineer. He retired from the DMR in1983.

Peter Menzies

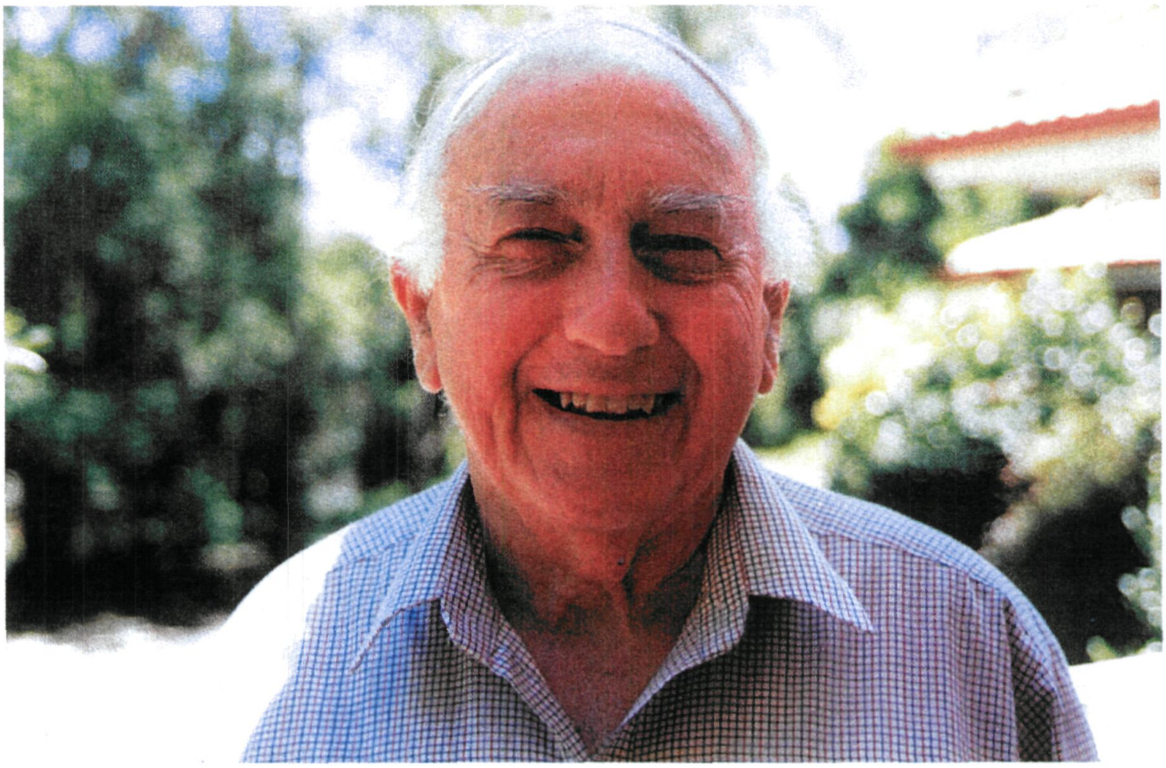


Peter Menzies was born in Sydney in 1938. He got involved in the film industry after taking his Intermediate Certificate, working in the Kinelab laboratory. He then worked with Kingcroft Productions, a company specialising in industrial documentaries, with Jack Gardiner and John Kingsford-Smith, as assistant cameraman and assistant editor. Kingcroft produced a number of films for the DMR and when they got the tender for several films on the construction of the Gladesville Bridge, Menzies, although still only a junior cameraman, was assigned the role of cameraman. In those days, the documentary cameraman was, in effect, a cameraman / director. He liaised closely in making the film with Sandy McKenzie and followed the progress of the bridge over four years.

Laurie Stewart

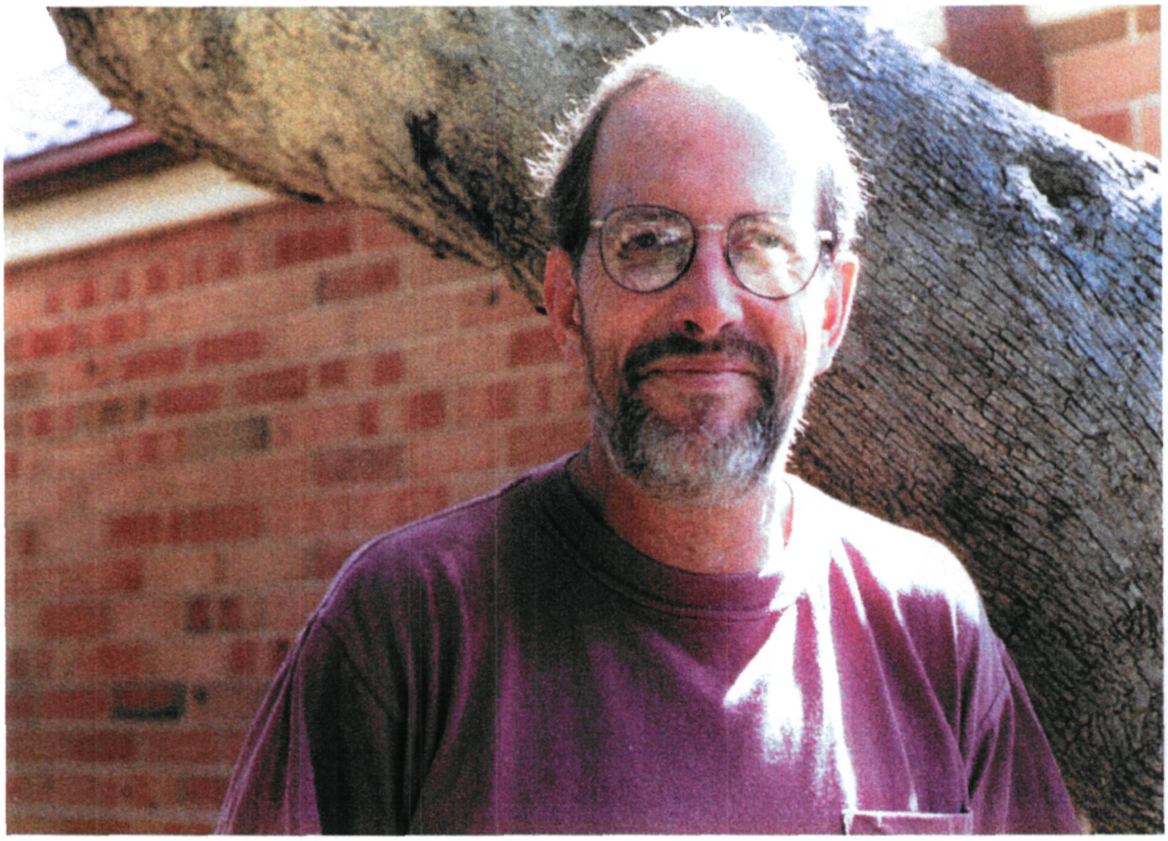
Lawrence Stewart was born in Sydney in 1940, growing up in Drummoyne, a middle class suburb, near the site of the future Gladesville Bridge. He attended the selective Fort Street Boys High School, and studied on his own after school to pass the Board of Surveyors Examination, and articled to a firm of registered surveyors. In December 1956, Stewart started working for the DMR, and in 1957 was transferred to Tamworth. He worked on the realignment and sealing of the State Highway leading to Port Macquarie and was sent to the Gladesville Bridge project to assist surveyor Brian Cox, just as the falsework was about to be put in.

Brian Pearson



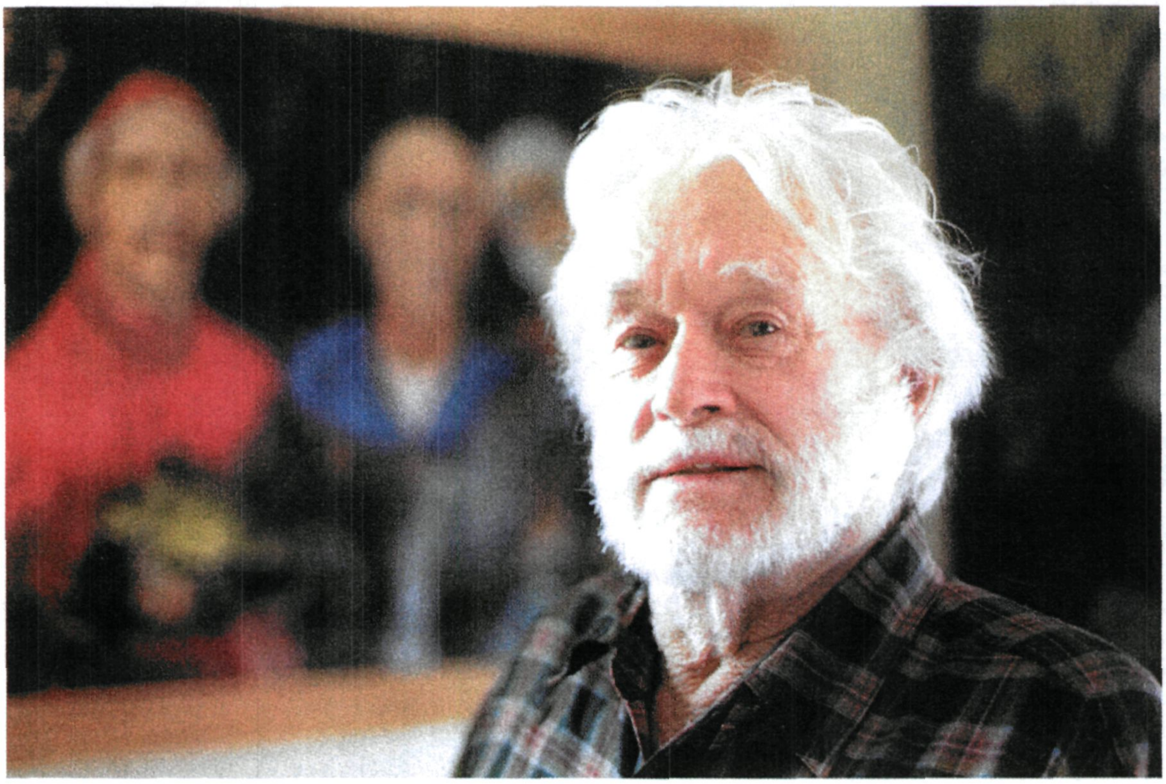
Brian John Pearson was born in Epping on 22 January, 1927. One of 32 students in Professor Miller's Civil Engineering Faculty at Sydney University, like most graduates he went to work for a government organisation upon graduation. In 1947, he joined the Bridge Section of the DMR as acting engineer. In 1948 his appointment was confirmed. He worked at Port Macquarie as Works Engineer and in other country centres, including Deniliquin. In 1955, he resigned from the DMR to gain experience overseas, working in England and Rhodesia. He left Africa in 1957, returning to Australia to get married, and rejoining the DMR to supervise the conversion of the tramlines on the Harbour Bridge to roadway. He was attached to the Bridge Section, and then the Metropolitan Division, Milsons Point, becoming Supervising Engineer for all major bridges in Sydney. He was Chief Engineer, Bridges prior to Ray Wedgwood's appointment to that position, retiring to private practice at the time of the formation of the RTA. He is a member of the RTA Heritage Committee and was the Supervising Engineer for the DMR on the Gladesville Bridge. He has recently published a book on incrementally-launched bridges.

Tony Prescott



Tony Prescott was born on 10 September, 1947. His family lived in Hunters Hill from 1948 to 1972 and he witnessed the building of the Gladesville Bridge from close-up. He trained as a historian at the University of NSW and the University of Sydney, later working as a historian in museum and heritage areas. He is currently working in the NSW Heritage Office. He is a member of the National Trust Historic Bridges Committee as well as the RTA Historic Bridges Committee.

Joe Ward



Joe Ward was born on 19 April, 1924, and was brought up on the north coast of New South Wales, north of Kyogle. His father worked on the railway line building bridges during the Depression. Ward left school at 13, working on farms to help the family financially. At 18 he joined up and served in the Second World War. He married in 1945, did a course at Ultimo Tech, and became a bridge carpenter. By the time he started on the Gladesville Bridge project as a foreman for Stuart Brothers, he'd gained experience on bridges at Rydalmere, St. Mary's and Kurnell, among others. He was the launching foreman on the Gladesville Bridge, but left to work on the Opera House in a less stressful position.

Ray Wedgwood

Raymond John Lloyd Wedgwood was born in Dorrigo, New South Wales on May 27, 1942. His father moved with his family to Dorrigo from Lake Cargellico, played football for St. George and was in the RAAF. After the War, the family settled in Bellingen. There Ray played in the local band, attended high school at Coffs Harbour where he was good at maths, and, in 1958, obtained his Leaving Certificate. He received a cadetship with the DMR in 1959, studied engineering at Sydney University and started work as an engineer in the Bridge Section in 1963. For 13 years he served as Chief Engineer, Bridges. At present he is General Manager, Technical Services with the RTA. He is a member of the RTA Heritage Committee, a representative for the RTA on the Austroads Bridge Structure Group, convenor of a group revising the bridge design code through Standards Australia and involved in the National Roads and Transport Commission.

Additional Interviewees:

Deborah Cook, telephone conversation, December 8, 2000.

Albert Fried, private conversation, December 7, 2000.

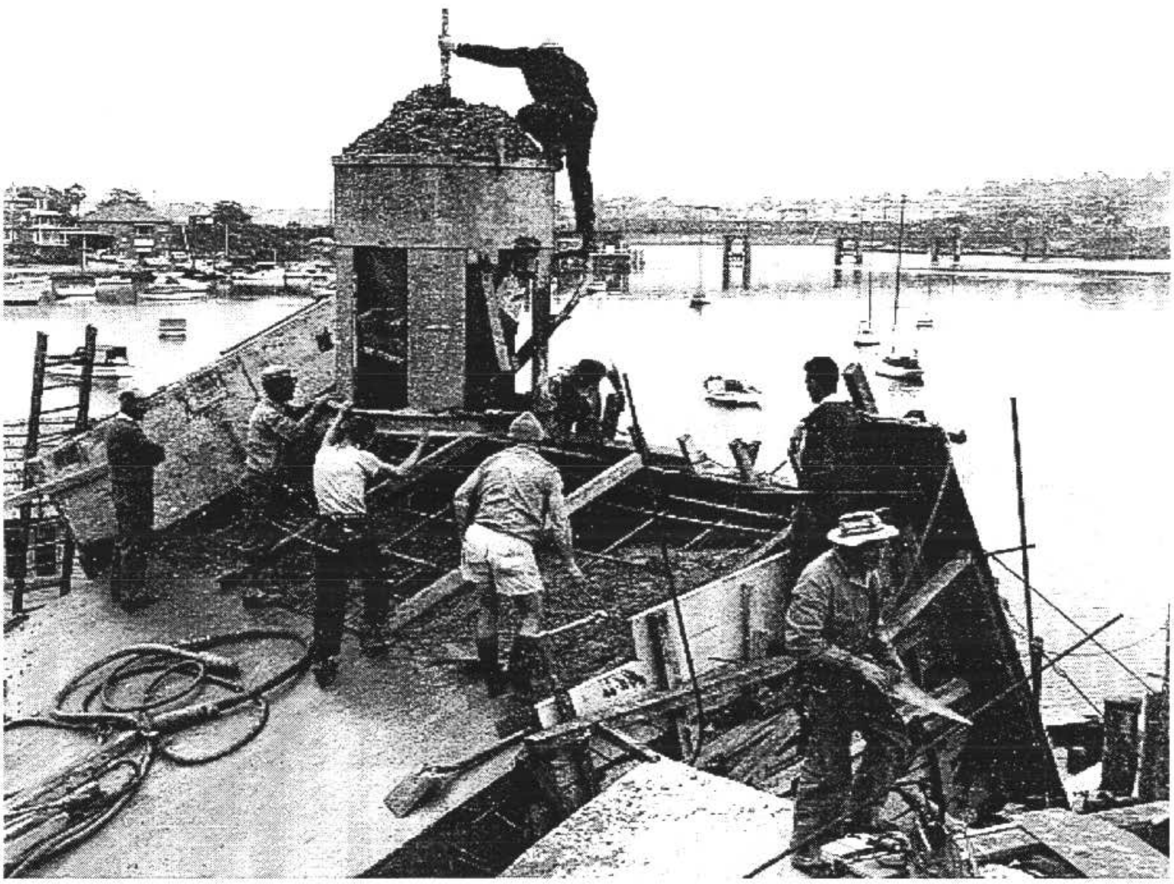
Reg Martin, telephone conversation, January 15, 2001

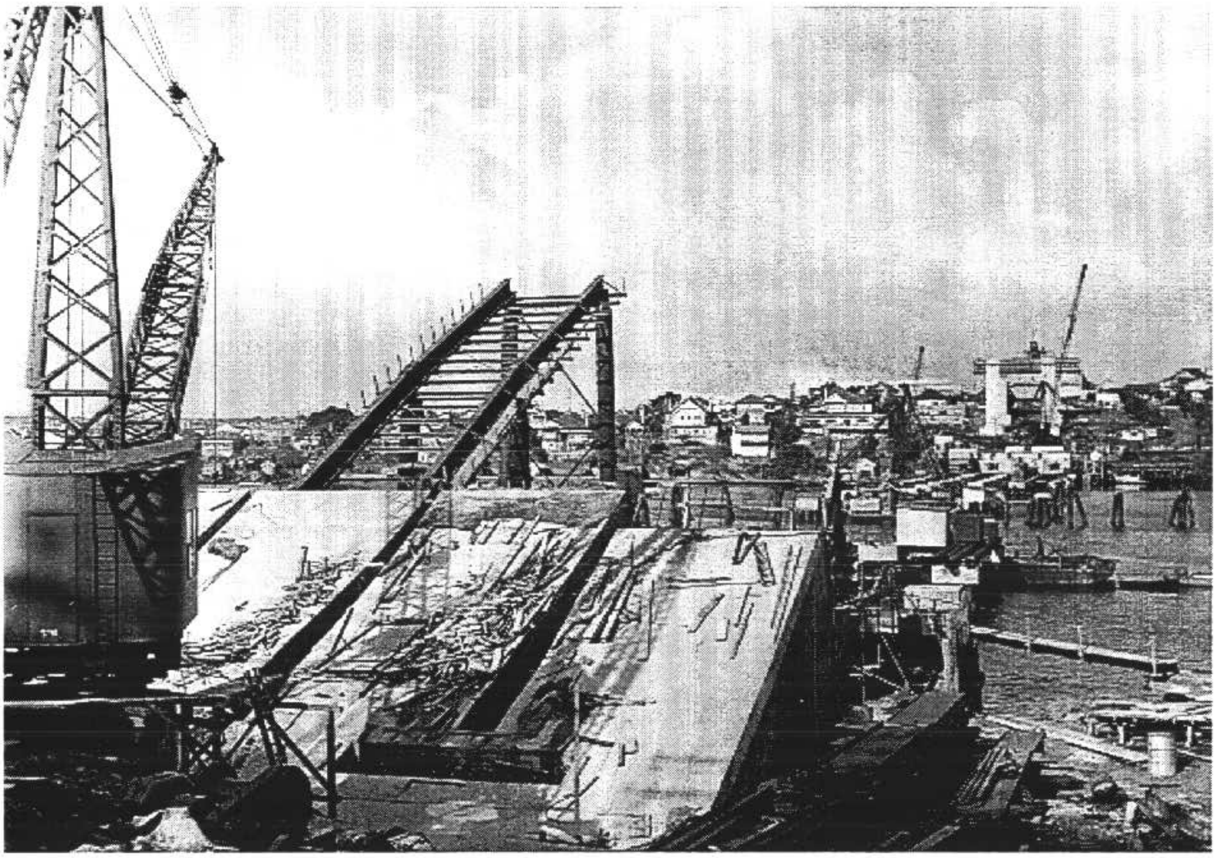
Brian Pearson, telephone conversation, December 10, 2000

Special Note re: Frank C. Cook

Frank Cook was the Assistant Bridge Engineer (Construction) for the Gladesville Bridge and in that role made an important contribution to the project. Frank was to be interviewed for this Oral History project but was unfortunately unable to participate due to failing health. Frank Cook passed away in January 2001.

APPENDIX C: PHOTOGRAPHIC RECORD OF GLADESVILLE BRIDGE CONSTRUCTION



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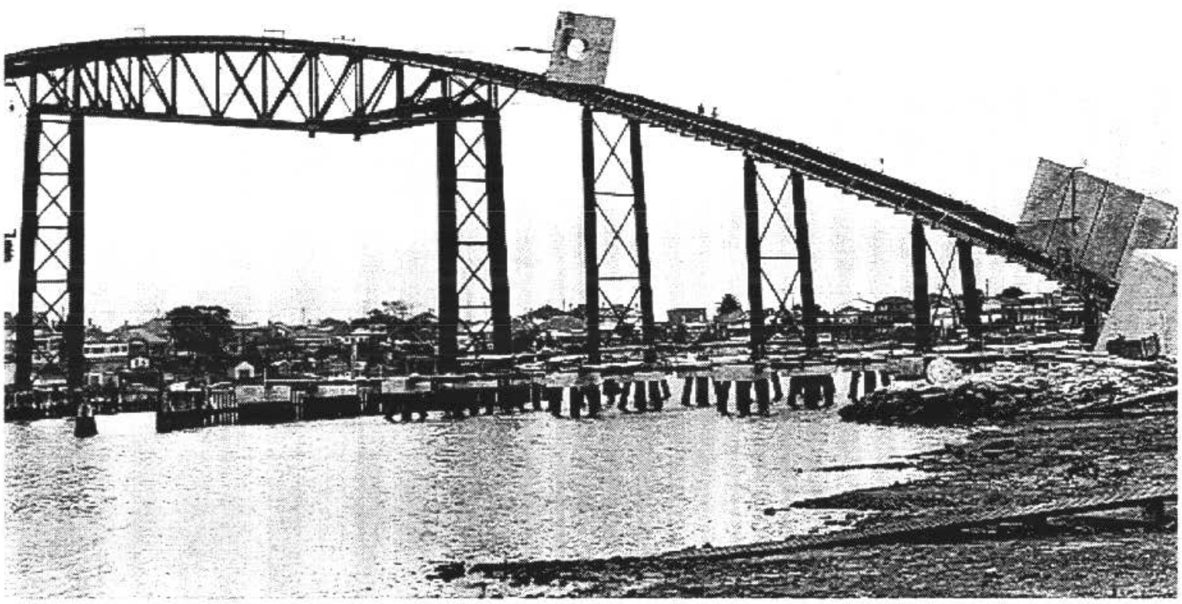

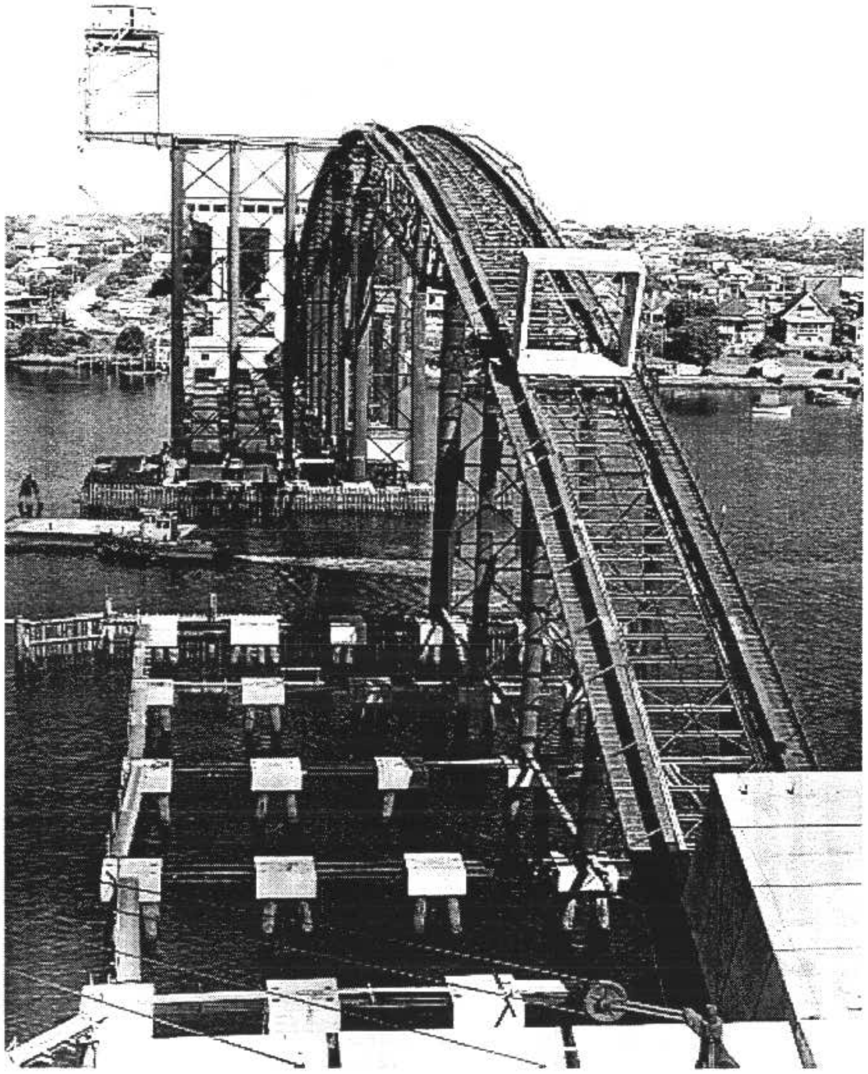

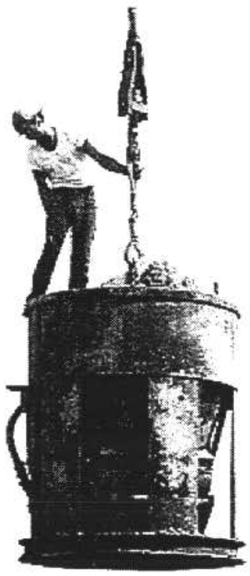

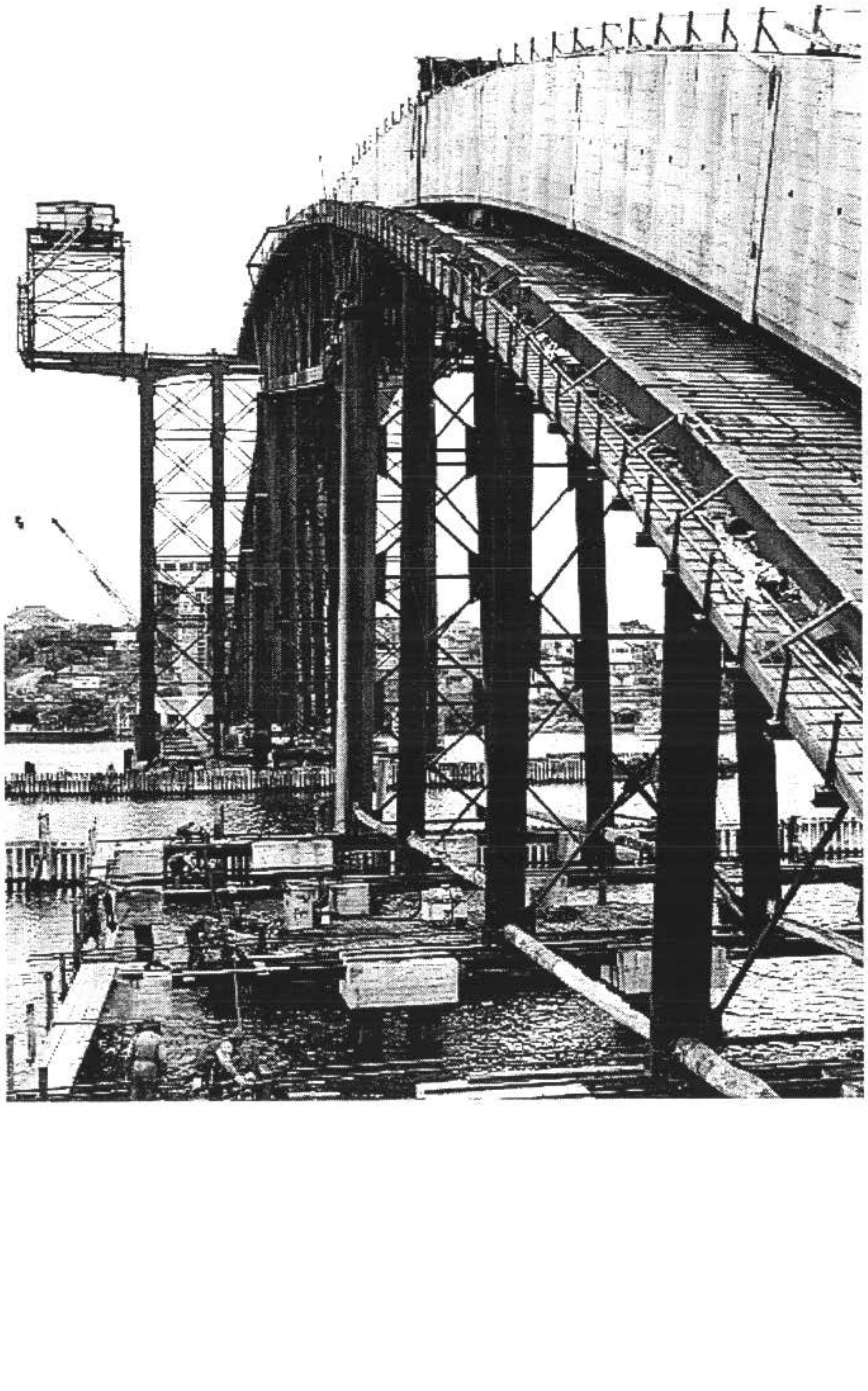

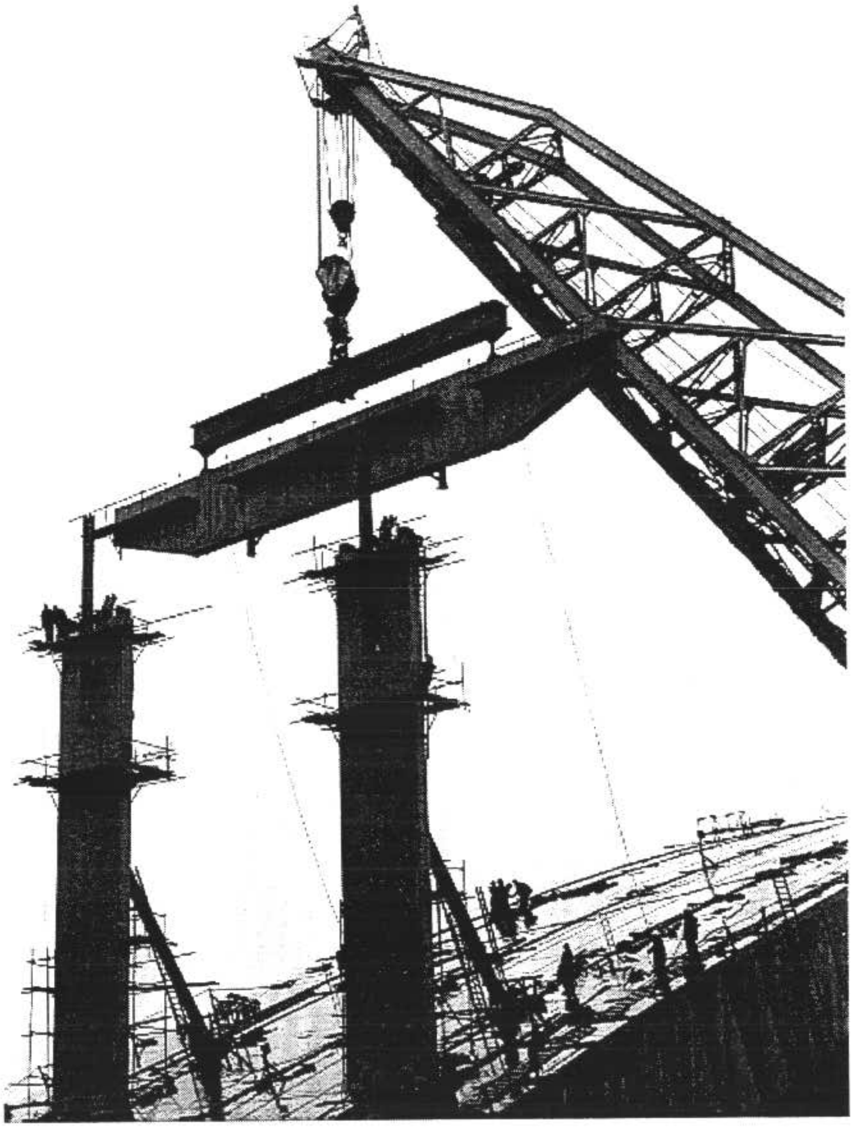

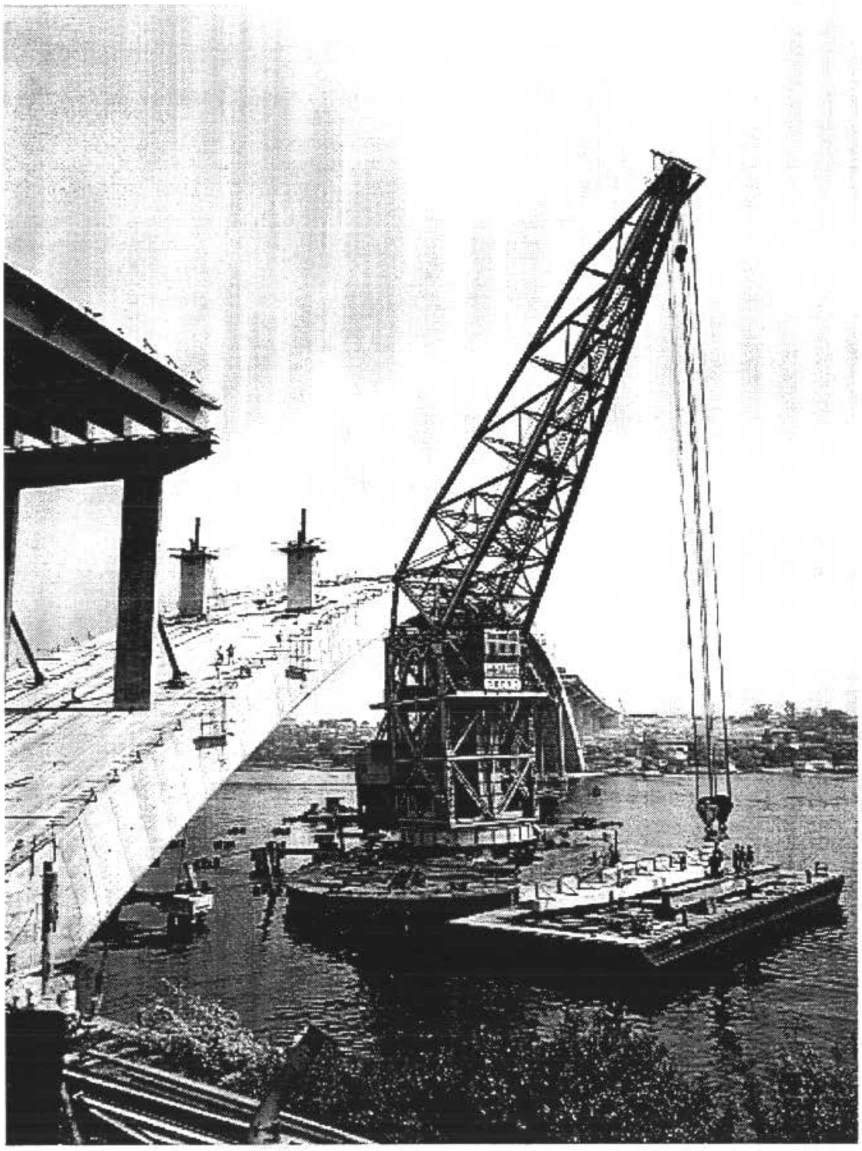

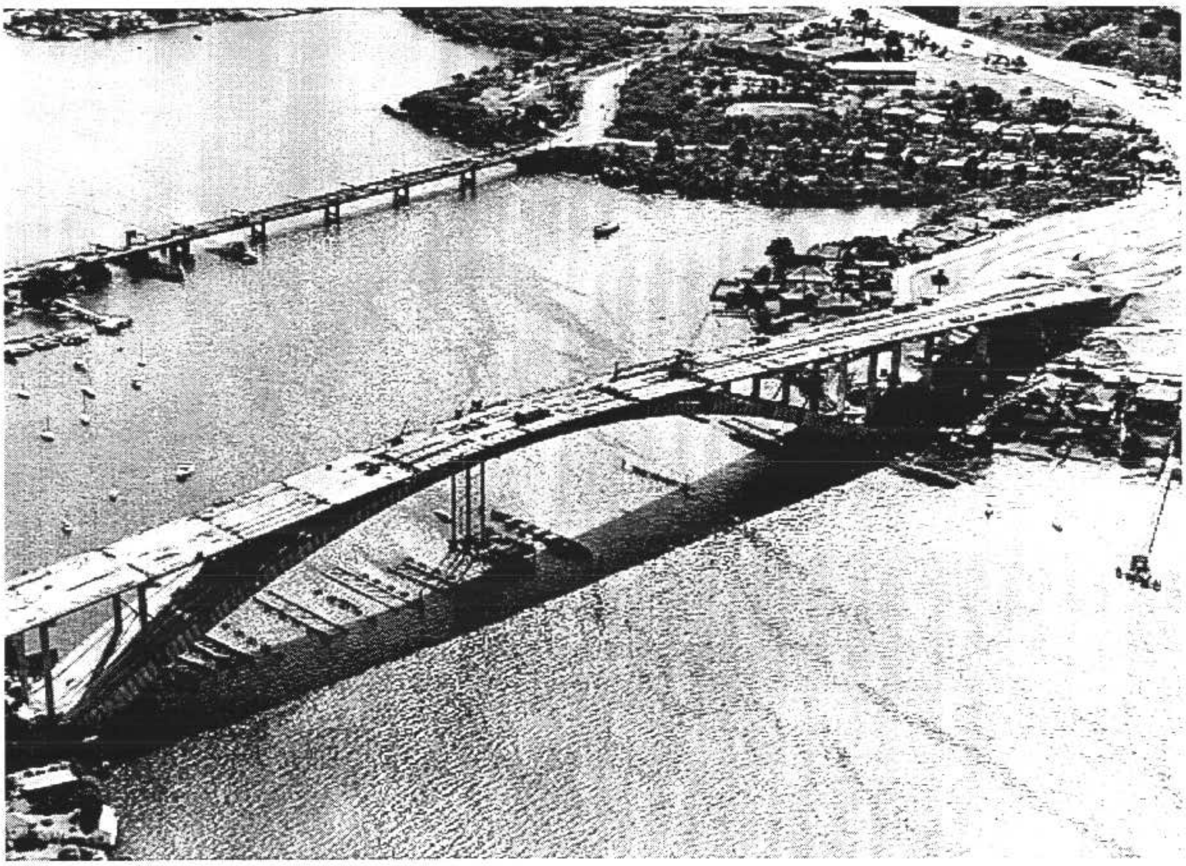

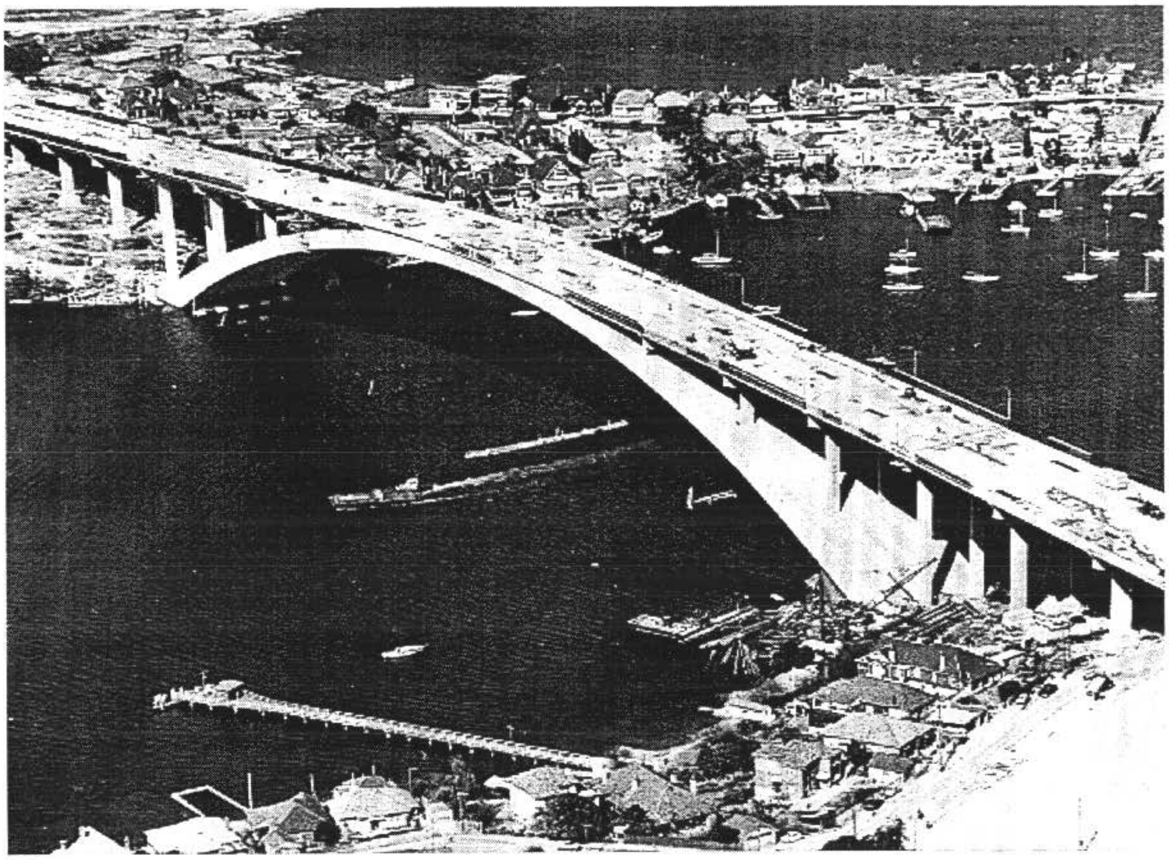

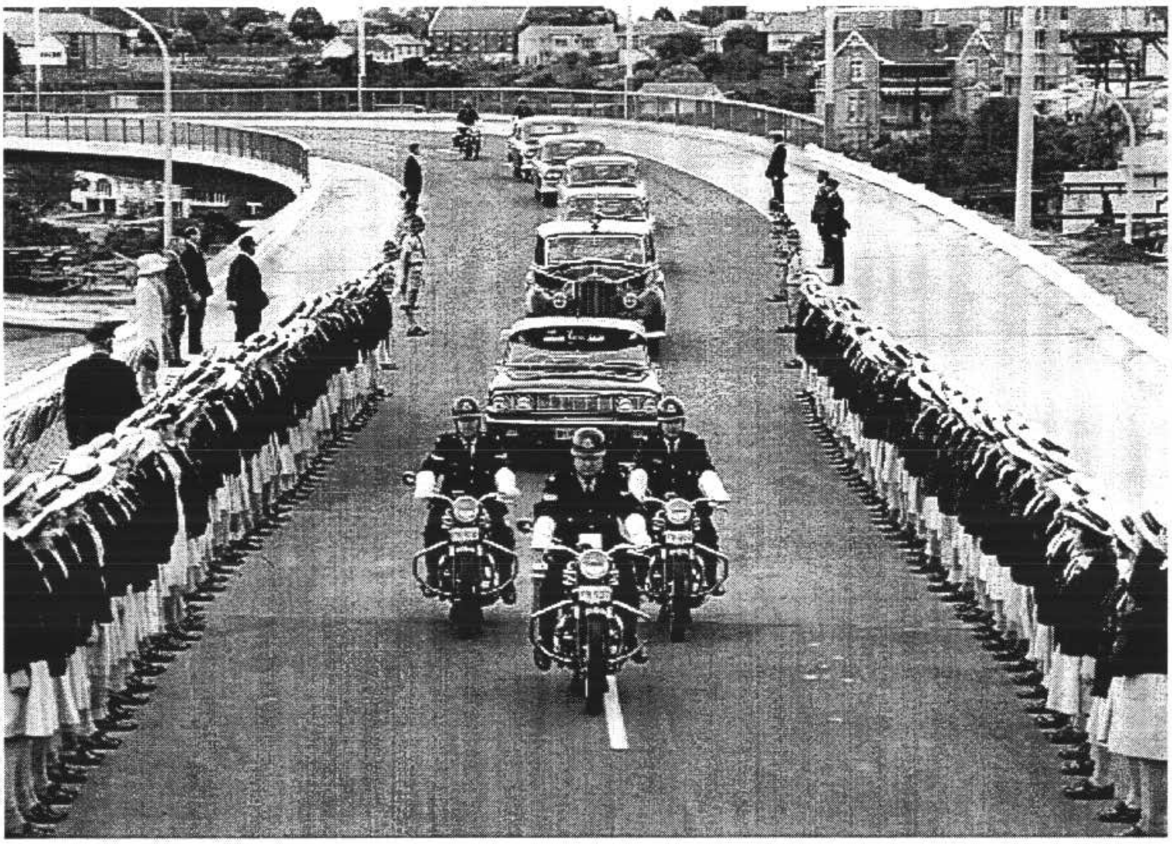

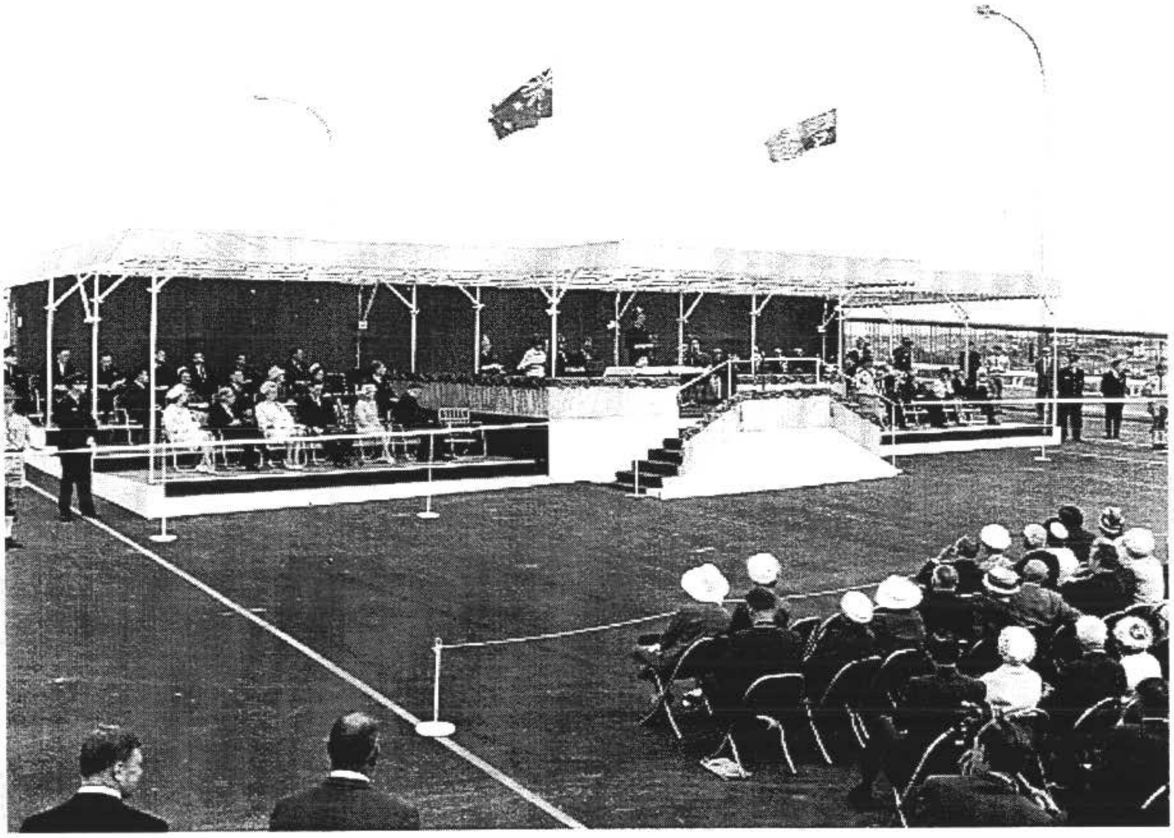

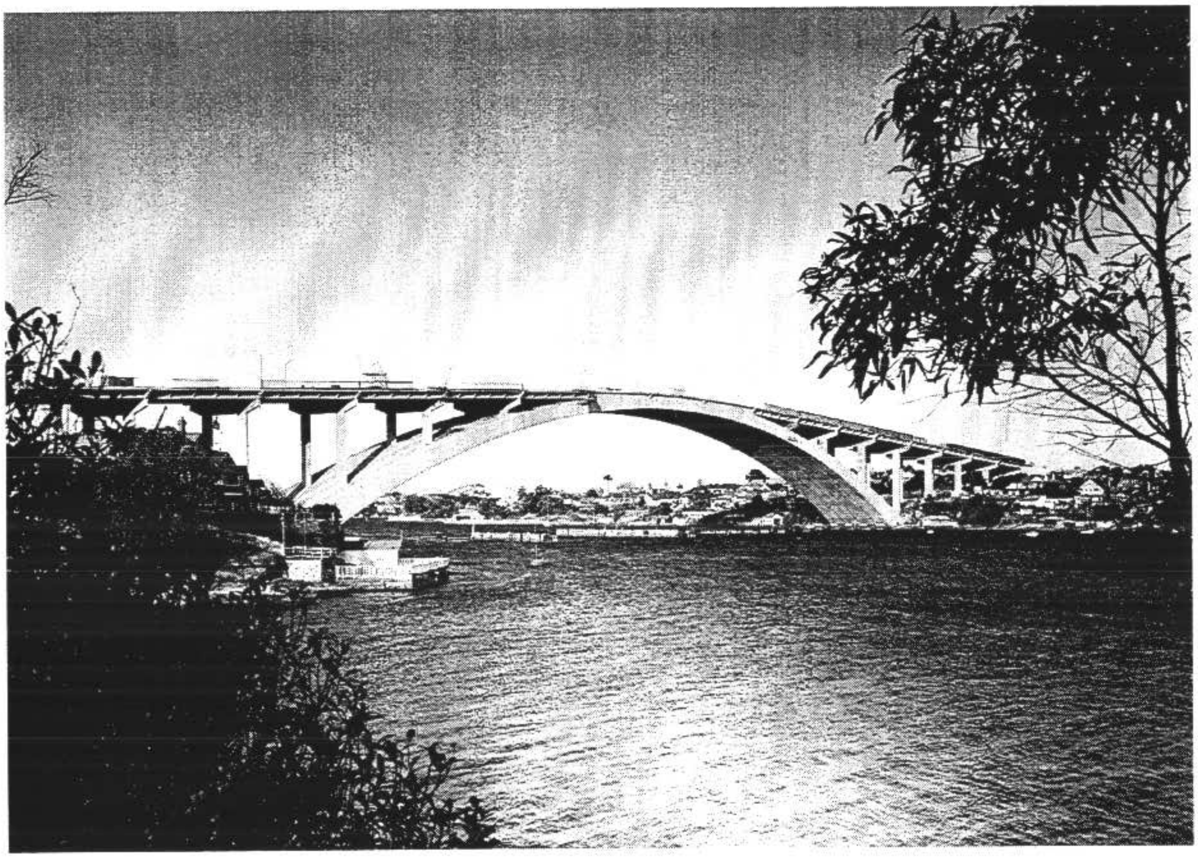

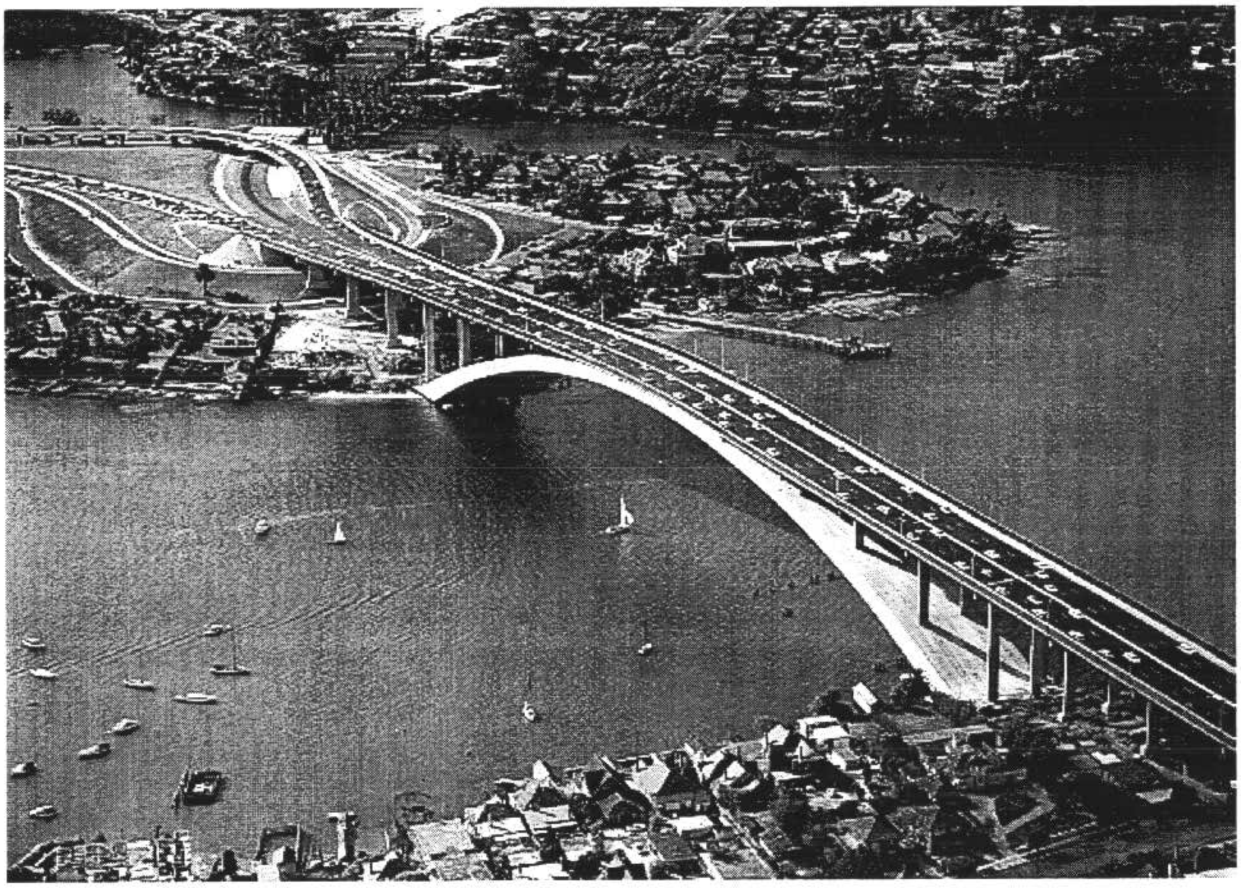

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