AIR TRAFFIC CONTROL TOWERS IN AUSTRALIA

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INTRODUCTION AND OVERVIEW

This paper ranges across two key themes of the conference, those of **unloved heritage** (and heritage of the recent past) and **twentieth century obsolescence**. It reviews a little-studied building type (the air traffic control tower) that, with very few exceptions, has not been identified for heritage reasons to date and which, while sometimes striking and prominent, has not been the subject of particular public interest or attachment.

By way of background, the *Environment Protection and Biodiversity Conservation Act* (EPBC Act) requires all Commonwealth Government agencies to develop a heritage strategy and to assess their assets for potential cultural heritage values, including for possible inclusion in the Commonwealth Heritage List and / or the National Heritage List. One such Commonwealth Government agency is Airservices Australia, a government-owned corporation with responsibility for the management of Australia's civilian air space. Airservices Australia was formed in 1995 when the Civil Aviation Authority was split into two separate entities (the other being the Civil Aviation Safety Authority). It operates 26 air traffic control towers across the country and has responsibility for another three non-operational towers. In 2007, in line with its heritage strategy, Airservices Australia commissioned Lovell Chen to assess the cultural heritage significance of its control towers. The project was carried out in two stages over a two-year period and represents the first large-scale heritage assessment of air traffic control towers in Australia.[1]

The first part of this paper is a brief overview of air traffic control and its history in the Australian context, and describes themes in air traffic control tower design.

The second part of the paper describes the assessment methodology and discusses its outcomes. In terms of the cultural heritage assessment process itself, this project presented a number of specific methodological and philosophical challenges. While some of these were identified at the outset of the project, others emerged as it proceeded and we learned more about the history of air traffic control practices in Australia and the design of the air traffic control towers themselves.

In a related role, over the life of the project, Lovell Chen has provided advice to Airservices Australia on issues relating to the current and future management of its air traffic control towers. As a key provider to the aviation industry and with a responsibility to deliver safe air navigation services, the agency operates within a complex operational and legislative framework which requires constant review and periodic upgrade of its facilities. In addition to its core operational responsibilities, as for all such agencies, it is also required to comply with relevant environmental legislation. In some cases operational requirements may mean that particular towers become unfit for purpose or obsolete. Where such towers have identified heritage values this may in the future pose new issues for the agency. The final section of the paper briefly discusses some of these issues.

AIR TRAFFIC CONTROL IN AUSTRALIA

For almost a century air travel has played a significant role in shaping the development of Australia. From at least the early 1920s, the potential for Australia to benefit from air travel, in terms of uniting the states and territories and combating the nation's isolation, both psychological and physical, from the outside world, was abundantly clear. Australia was at the forefront of

1 There have previously been a relatively small number of assessments for individual towers, including those at Sydney Airport and Brisbane's Archerfield Airport.

many of the early record-breaking feats of aviation, and has consistently punched above its weight as a voice on the international stage. Australia has been represented on the Council of the International Civil Aviation Organisation (ICAO) since its foundation in 1947 – ICAO was formed to oversee international cooperation on the management of civilian air transport. Australia is also recognised by ICAO as a 'State of chief importance' in air transport.

The regulation and management of air traffic depends upon a complex combination of skills and facilities, including aircraft tracking systems, global communication protocols and of course airports. The provision of air traffic control is a small but important part of the process.

Air traffic control towers provide elevated vantage points from which controllers manage the movements of aircraft on the ground and in controlled air space within a radius of between 30 and 50 miles from airports. The height of a tower is determined by the size of the airport – Australia's tallest tower is at Brisbane (71m), which is the country's largest airport in terms of surface area.

The primary factor that drives the expansion of airports is airlines seeking competitive advantage. Each time airlines have introduced larger and faster aircraft, runways have been lengthened, airports enlarged and control towers have become taller. This process moved at a particularly fast pace in the 20 or so years following World War II, when there were incredible advances in the air transport industry, related both to the speed and capability of aircraft, and to technology related to en route control, such as two-way radio and radar.

The first air traffic control towers, introduced in Australia from around the mid-1920s, were square timber structures raised only slightly off the ground, little more than enclosed starter's platforms. Contact with aircraft was purely visual, through devices including flags, flares and large cane spheres mounted on a rooftop flagstaff (Figure 1).

The 1930s saw significant increases in the size of aircraft and the volume of air traffic. There were also a number of serious crashes, which led to calls for improvements in air traffic management. Australia's first standardised control tower model, the Integrated Operations and Administration building, was one outcome of a review of procedures carried out in 1938. This model was based on an American prototype introduced at Newark International Airport in 1935. As developed in Australia, the model consolidated a range of activities in one three-storey Streamlined Moderne building (Figure 2). Facilities included a weather bureau, Flight Checking Department (an early form of en route control), accommodation for pilots, a restaurant, lounge and roof terrace. The air traffic control cabin was located on the roof. The small straight-sided, flat-roofed cabins were composed of steel-framed windows with curved windows facing the apron. They were fitted with radio facilities, to co-ordinate with other operational positions on the ground and to communicate with airfields locally and on routes between airfields, but communication with aircraft was still almost exclusively visual.

Three of these integrated 'Ops & Admin' facilities were built in Australia, at Parafield Aerodrome (in Adelaide, Figure 3), Archerfield Aerodrome (Brisbane), and Mascot (Sydney). Others were planned for Essendon, Melbourne, Cambridge Aerodrome, Hobart and Maylands, Perth, but World War II intervened and these were not proceeded with.

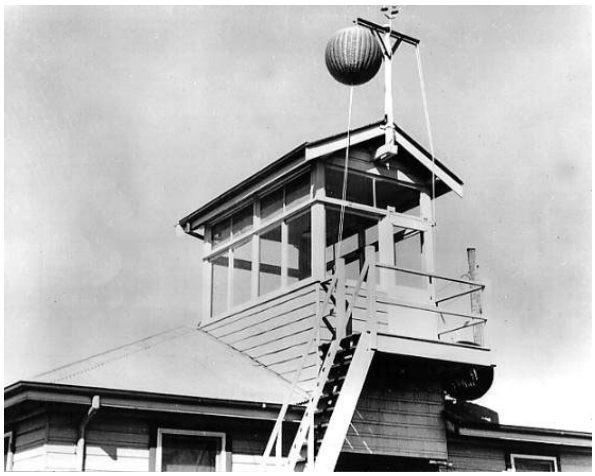

Figure 1 Sydney Mascot tower, c. 1937. (Source: Civil Aviation Historical Society).

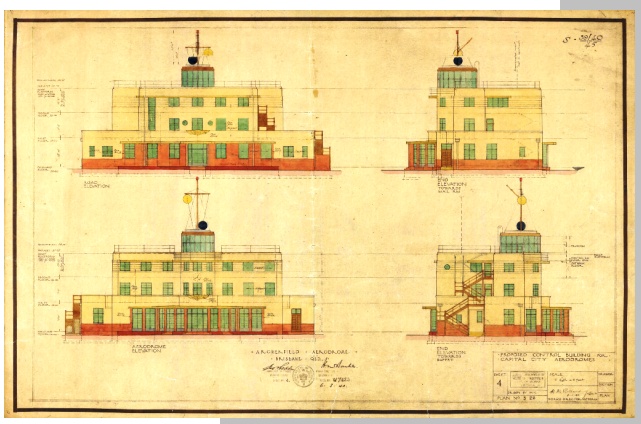

Figure 2 Design for the Integrated Operations and Administration building, 1938. (Source: National Archives of Australia)

Figure 3 Parafield control tower, Adelaide, 1940. (Source: Civil Aviation Historical Society)

The three built examples survive, in differing states of intactness. The original cabins have been removed from all of them. Of the three, only Parafield is still operational and in the study group, albeit with a 1980s cabin and a modified interior. The Archerfield building is more intact, including much of its interior fabric and layout, but it has not provided a control function since 1975, when it was replaced by a new tower. The Sydney Ops & Admin building survives but has been significantly altered.

The Ops & Admin buildings offer a rare glimpse of the pre-war experience of air travel in Australia. In terms of their design, while perhaps relatively staid when compared with more distinctive Streamlined buildings of the period, they are expressive of distinct architectural style and in this regard are somewhat unusual in terms of the building typology as a whole.

The acceleration in technological accomplishment and the expansion of air traffic volume brought about by World War II required international cooperation in air traffic control and this led to the establishment of the International Civil Aviation Organisation in 1947. For the first time air traffic was governed by rules (whereas prior to the war every country had its own system). These new rules and regulations extended to air traffic control, but here they related to procedures and technical requirements, and did not prescribe a particular form for the air traffic control towers themselves.

The 1950s was a period of experimentation in the design of control towers, but ultimately also led to a more standardised approach. In Darwin a control cabin was built beneath a water tower. Sydney's new tower (demolished) comprised a two-storey base of reinforced concrete finished in face brick surmounted by a square cabin with sloping windows to deflect glare. It was integrated with a fire station and located at the intersection of two runways.

Figure 4 Essendon, 1956 (Source: Civil Aviation Historical Society).

Essendon (1956, Figure 4) was a three-storey steel framed tower finished in asbestos cement panels. This tower is basically intact and has operated continuously since being commissioned, as have the towers at Launceston and Hobart, also of this period and of a similar design. By the end of the 1950s, a standard control tower format based on the Essendon design had been established. It consisted of a square base – typically of between two and four storeys – of reinforced concrete with a face brick cladding, below a perimeter walkway, also in reinforced concrete, around an octagonal cabin with sloping glass panels fixed in steel mullions. Depending

on the nature of the airport, the cabins were fitted with two, three or four-person consoles, and featured a range of noise abatement and cooling devices. The 1960s was a period of continuing advances in the size and speed of aircraft and affordability of air travel. During this period the number of airports with control towers proliferated, and the equipment used to manage aircraft improved exponentially, but the control towers themselves barely changed from the format of the 1950s. Towers based on this model, but refined and improved over time, continued to be built throughout Australia until the early 1970s (see, for example, Bankstown, 1970, Figure 5).

The first major shift from the post- World War II model was seen at Melbourne in 1969, as part of the new airport at Tullamarine. The site identified for the tower was a depression in a fenced compound a long way from the apron of what was then the largest ground-up airport constructed in Australia. This siting and airport layout required an unusually tall tower. Until then most cabins were around 15 metres above ground level, but at Melbourne a cabin at a height of 47 metres (to the cabin roof) was required. The outcome was an integrated cabin and services pod on top of a slender concrete column (Figure 6); this was a groundbreaking building in air traffic control tower design in Australia.

Figure 5 Bankstown, commissioned 1970.

Figure 6 Melbourne Tullamarine, 1969 (Source: CAHS).

Soon after the completion of the Melbourne tower, from the early-1970s, the Department of Civil Aviation became interested in developing new forms of low-cost and transportable towers. This new model comprised a perimeter frame in a triangular plan, with a central access staircase enclosed with corrugated steel sheeting and small single-glazed cabins (Figure 7). This model was built in numbers at secondary and general aviation airports throughout Australia from the mid-1970s until the early-1990s. The towers were expected to have an operational life of ten years.

In more recent times, control towers have generally followed the Melbourne model. The ongoing process of technical refinement and expanding airports has seen new concepts in the layout of cabins – notably peripheral consoles, as opposed to fixed consoles in the centre of cabins. The challenge of creating unimpeded sightlines has also seen the introduction of cabins with roofs carried on a single central column. But there have been no wholesale shifts in the articulation of control towers.

One interesting trend in recent years has been the growth of towers as designed landmarks. At the outset of the project it was thought that control towers, as the tallest structures in generally flat areas, would have an established status as local landmarks. Interestingly, this is rarely the case, as control towers are necessarily generally peripheral buildings in necessarily peripheral places (airports). But since the mid-1990s, perhaps led by the current Sydney tower, there has been a marked international trend in the design of control towers as conspicuous landmarks by name architects. In the past five or six years examples have been built at Vienna, Milan, London Heathrow and Bangkok airports. All of them post-date the Sydney tower, designed by Ken Woolley in 1995, which bears comparison with the Centrepoint tower (cable-stayed) and aspects of British 'Hi-Tech'. It is certainly a marked departure in design terms from any of its predecessors.

Figure 7 Moorabbin, commissioned 1977.

Figure 8 Sydney tower, designed by Ken Woolley.

THE ASSESSMENT PROCESS

The methodological challenges particular to this project arose in part from the fact the building typology itself had been the subject of relatively limited attention, not so much in terms of historical research,[2] but in a cultural heritage assessment context. As noted, the relatively small number of assessments previously undertaken had tended to focus on individual towers and included only limited comparative analysis.

In many respects, the scope and nature of the task required also necessarily reflected the specific requirements of the *Environment Protection and Biodiversity Conservation Act* whereby individual Commonwealth agencies are required to assess the heritage value of their own assets notwithstanding the scope or definition of these assets may not accord with a Burra Charter concept of 'place'. In this case, while historically and physically the control towers inevitably form part of a broader airport complex, air traffic control towers are typically located on limited Airservices Australia leaseholds within those airport complexes. Australia's major city airports are generally now the subject of long-term leases from the Commonwealth Government to the private sector. Because the scope of the project was limited to Airservices Australia's assets, the significance of the airport complexes themselves was not assessed and so the assessment of the towers as a component within these evolved places was necessarily constrained. This is no reflection on Airservices Australia, which is committed to undertaking full and proper assessments under the EPBC Act; it is more an observation on the way in which particular administrative arrangements do not necessarily always lend themselves to best practice in cultural heritage management

In this context, the approach adopted in the study was one where the history of each airport site was researched as far as possible and the role of the air traffic control towers in this history identified. Almost invariably it was found that individual air traffic control towers had been constructed in association with significant expansion and/or upgrade projects at their airports.

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2 Significant historical research into the history of air traffic control has been undertaken by the Civil Aviation Historical Society, (which is supported by Airservices Australia) and based at the Airways Museum at Essendon Airport and by others. The CAHS gave generously of its information and expertise over the life of the project.

This is because as noted, the most common reason for replacing air traffic control towers (both historically and currently) is, straightforwardly, the physical expansion of an airport requiring greater visual site coverage. While of interest in terms of the history of each individual airport, this kind of association was not considered sufficient to elevate one air traffic control tower over other examples within the study group.

It is interesting to note that through the research phase of the project it also became clear that despite their obvious importance and interesting associations with concepts of modernity, technology, and of course travel, air traffic control towers generally do not loom large in the public's consciousness, even that of the traveling public. In part this may be because they are fundamentally not publicly accessible facilities. To the extent that they are viewed by the public, this is generally from planes or airport terminals and sometimes at some distance. Like many defence facilities and other restricted access sites, for most people they do not form part of their direct experience of their physical environment. In this regard, they differ fundamentally from places such as post offices where there is often a complex series of local and other historical and social associations deriving from the prominence of the place itself and the service provided to the community. Air traffic control towers are essentially there as a key functional element in the operation of airport complexes and the provision of air services. They are generally not the focus of community or other sentiment.

The issue of equipment and technologies associated with the towers was one which absorbed considerable effort in the earlier phases of the project, when it was anticipated this might prove to be a key factor in the assessment process. In actual fact, however, this proved not to be the case. Because the function of the towers is control aircraft and vehicle movements on taxiways, runways and the immediate vicinity of the airport, the controllers rely on visual contact (with the naked eye) and communications systems (which replaced the use of visual signals such as flags and lights). While the communications systems have had to be accommodated within the towers or in associated equipment rooms, in their own right they are of limited interest (using standard componentry not specific to air traffic control) and in any case have generally been upgraded over time. The towers have generally not accommodated any other technology or equipment of particular interest, the one exception being the consoles within the towers, a clearly purpose-built item of equipment and one which demonstrates in a visual and emblematic sense the activity of air traffic control. A number of towers retain their original consoles, but these tend to be the more recent towers and there are relatively few consoles of any age still in service.

There was also a need to look beyond the study group in undertaking the project and establish a comparative context. With 29 towers scattered across the country, the study group was reasonably large, however it by no means represented all air traffic control towers constructed in Australia nor even all surviving operational towers. As noted, since the 1920s, hundreds of control towers have been erected in Australia and her off-shore islands and dependencies. These towers have been a mix of military and civilian (with many towers being dual purpose), with the RAAF arguably the most prolific builder of control towers in the twentieth century. Unsurprisingly for a group of operational towers, while it did contain a number of relatively early examples, the study group was also skewed very much towards the later period of air traffic control tower design. More than 40% of the towers under consideration were constructed after 1980.

Having regard for all these factors, and particularly given the national focus of the study, as the methodology was developed in the early stages of the project, it was clear there was a need to place the towers in a broader context relating to the major theme of air navigation in Australia. Specifically, there was a need to underpin the study with a historical and typological framework within which a judgement could be made as to whether any particular tower met the assessment criteria at a level indicative of Commonwealth Heritage value under the Act. The typological framework was developed based on research into the history of civil aviation and air traffic control in Australia since the 1920s and an investigation of air traffic control tower design from this time up until the end of the twentieth century. Gradually a picture was built up of the variety of towers

both surviving and not and both within the study group and outside it.[3] The work also involved some research into developments and precedents in the international context.

As a result of this work, five broad major typologies were established.

Summary description	Approx. date range	Examples in study group (dates relate to commissioning of towers)
Raised booth - Lightly framed box or booth on open timber or steel truss frames, with a landing or walkway platform around it	1938-1948	None
Integrated terminal Cabins and bays integrated in terminal buildings	1928-1948	Parafield SA (1940)
Two/three storey base building surmounted by an octagonal cabin	1950-1976	Essendon (1956) Hobart (1958) Launceston (1958) Rockhampton (1961) Jandakot (1965) Alice Springs (1968) Bankstown (1970) Canberra (1975)
Exposed frame Partly exposed steel frame, steel cladding, relatively inexpensive and light, partly prefabricated	1972-1986	Moorabbin (1977) Avalon (1978) Adelaide No. 2 (1981) Maroochydore (1982) Albury (1983) Wagga Wagga (1986)
Cabin and service rooms as an integrated pod on a single column	1966-present	Melbourne (1969) Mackay (1972) Camden (1972) Archerfield (1975) Perth (1986) Brisbane (1988) Coolangatta (1990) Cairns (1990) Sydney (1996) Tamworth (1997)
Hybrid (no clear typology)		Sydney 4 (1972) Hamilton Island (1984) Coffs Harbour (1986) Karratha (1987)

3 As for all such projects there were also limitations arising from budgetry constraints; despite a strong emphasis on typological and comparative research, there necessarily were limitations to this work and it was not possible to identify all of the non-Airservices Australia towers nor was it possible to undertake site visits to all of the towers.

Summary description	Approx. date range	Examples in study group (dates relate to commissioning of towers)

Within some of these typologies there was considerable variation depending on the specific date of construction and individual siting and site requirements (including integration of particular facilities which might be required at one site and not at another).

Particular examples within the typologies were assessed as having greater or lesser levels of interest/significance in some cases as prototypes, in others as variants. The usual considerations of age and intactness came into play.

At the time of writing the conclusions of the study are in draft form and under final review, however it is likely that up to six air traffic control towers will be recommended to Airservices Australia for nomination to the Commonwealth Heritage List.

FUTURE MANAGEMENT AND OBSOLESCENCE

Where heritage values are identified for individual air traffic control towers a number of management issues may arise in the future.

While the nature of these issues obviously will vary depending on the particular heritage values, as a general comment the key issue which may arise is likely to be around obsolescence and the need to replace individual towers for functional reasons.

Regardless of the projected life of any particular tower when constructed, it is generally considered for replacement only when the expansion or reorientation of its airport poses a problem in terms of sightlines. The survival and continued operation of the 1956 tower at Essendon, reaffirms the relative simplicity of these buildings and illustrates this point. In the early 1960s, just a few years after the completion of the new tower at Essendon, plans were announced for a new airport at Tullamarine. From that time on there was periodic uncertainty about the future of Essendon as an airfield and no major expansion occurred. If airports are not expanded, and the tower allows sightlines over the entire airport, there is often no functional reason to replace it. Equipment and power supply systems have generally shrunk over time, so increased space is not generally a problem.

In this context, where towers are retained as operational, any alterations and upgrade work required are unlikely to fundamentally compromise the heritage values of the towers and generally could be undertaken in a manner which has regard for these values. Possible works could include changes to cabins (many of which are already altered), the replacement of equipment and the introduction of peripheral consoles. In most cases, the interiors of the towers have been assessed as of little or no interest, and these could be modified without impacting on identified values. Depending on their scope, even quite major external changes could also be contemplated to allow for ongoing operation without necessarily diminishing the understanding of the overall form and design of the towers, the majority of which have been identified for reasons of history and design as examples of particular typologies of air traffic control towers.

Where there is a major change or expansion of airport runway, however, generally the issues posed are likely to be the need to increase height and/or alter the siting of the towers. In both cases this would render existing towers obsolete and require the construction of new towers, whether on the same site or a new site. The issue in a management sense then becomes one of the long-term retention of obsolete buildings that with few exceptions do not lend themselves to adaptation for new uses and which are located on strategic sites within secure airport complexes.