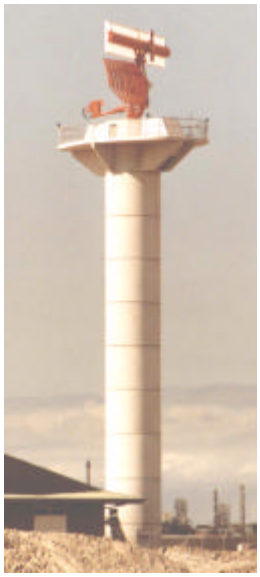
SUMMARY

Sydney's Kingsford Smith Airport
Radar Tower and Air Traffic Control Tower

The two recently completed radar and air traffic control towers at Sydney's Kingsford Smith Airport represent a unique use of very high quality precast concrete for infrastructure purposes.

Radar Tower

The radar tower, built entirely of factory produced precast concrete is a structure consisting of nine cylindrical shaft elements each 3.18m in diameter and 2.44m high. Atop the shaft is mounted a complex chamber and platform structure also of precast concrete which houses and supports the rotating antenna.



The precast concrete structure is vertically prestressed to moment capacity foundations using large diameter stressbar within minimum clearance ducts positioned within the concrete cross section. Each shaft segment weighs 11 tonnes whilst the upper chamber consisting of a central core with integral wing walls, floor, roof and stairway weighs 30 tonnes. On completion of stressing, the elliptical access platform was intrically connected to the chamber.

Air Traffic Control Tower

The major design features of the Control Tower include a cable stayed precast supporting column structure combined with an external passenger lift both of which are entwined by an enclosed sweeping spiral stairway running from ground level to the control chamber.

The control room complex is supported on a 20m high segmental precast shaft, 2.5m in diameter but with a truncated flat face against which the passenger lift structure is fixed. This shaft is also vertically stressed, but in stages to its foundation using 31 No high strength post-tensioned bars which connect directly at the top of the shaft to the upper steel control room support column, thus providing its stability.

In both structures, concrete employing off-white cement exhibit a class of surface finish with colour control which exceeds the very best intentions espoused in AS 3610 for a Class 1 finish.

The achievement of such highly durable and aesthetically pleasing surfaces in a dimensionally exacting construction is testimony that large functional and structurally important elements are able to satisfy structural complexities simultaneously with high architectural expectations.

Sydney's Kingsford Smith Airport
Radar Tower and Air Traffic Control Tower

Detailed Submission

The two towers are situated in highly exposed locations, subject to high winds in a marine environment. Further, with Sydney airport serving as the international gateway to Australia, the two structures command high visual attention from both within and without the boundary of the airport facilities.

Accordingly, both structures carried design briefs requiring high aesthetic appeal on the one hand but with a requirement to be absolutely serviceable in the environment to which they were being exposed.

Structurally, high rigidity in the tall slender structures was essential because of the sensitive electronic equipment being housed within the towers.

The two often conflicting design parameters involving structural and architectural requirements were considered ideally addressed through the use of high quality precast concrete. The required stiffness for the structures was achieved through the use of concrete with a very high compressive strength and associated high elastic modulus. Further, through the medium of specialised precasting technology an accelerated steam curing process ensured a pre-shrunk and pre-cured concrete which, after prestressing, guaranteed rigid, durable structures with superior finishes to meet the stringent architectural requirements while being maintenance free for their design lifespan.

Radar Tower

This tower was originally specified to incorporate the use of normal grey portland cement. Further, the complex chamber and platform structure at the top of the tower was designed and detailed to be cast insitu. At the same time, appearance was stated to be of prime importance and the highest standards of concrete finish, colour uniformity and workmanship were called for and accordingly the specification recognised that the achievement of such quality could only be gained through the engagement of a highly competent and experienced specialist precasting company.

Discussions ensued between the specialist precaster and the client to an end where the top chamber was re-designed by the precaster to provide a unique, fully precast structure capable of being erected as one piece. This action satisfied the client's previous concerns that their demanding

technical criteria could now be met. Further, to ensure uniformity of finish and colour, a specially designed concrete mix using off-white cement was recommended and accepted as essential for compliance.

A full height prototype panel was produced containing the design reinforcement, stressing ducts, cast-in fittings and the specially designed concrete mix. This panel was manufactured vertically using mould release agents and concrete placing and compaction techniques proposed for the tower fabrication. The finished prototype panel was thus able to demonstrate to the client the quality and uniformity of finish achievable for the tower.

Internally, the tower is fully fitted with access stairs, platforms and cable tracks all of which required close tolerance construction and location of special inserts to ensure rapid and problem-free erection on site.

The enclosed photographs demonstrate the quality of construction and surface finish achieved through the exploitation of experience in concrete technology, and understanding of design and the employment of best practice with concrete to ensure mix design, placing, compaction and curing all resulted in a utility structure worthy of highest commendation.

Air Traffic Control Tower

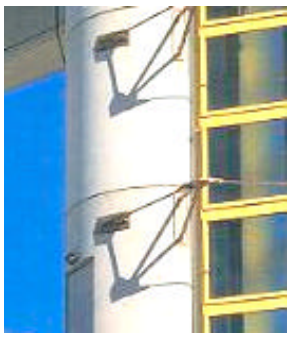
Designed by one of Australia's pre-eminent architects, this structure presents the aesthetics of a building designed for the future. While the technical function of the structure is paramount, the importance of the dramatic architecture cannot be under-stated.

With concrete as the obvious choice for the supporting column structure, the architect and consulting engineer proceeded to develop a specification to embrace their joint needs. The specification carefully addressed crack prevention, control samples and prototypes, mix design, cement type, selection of aggregates, shrinkage, water absorption, mould construction, construction tolerances, surface finish and colour control. The requirement at first seemed impossible of performance. On analysis however and through discussion with the client it was established that the architect required a finish and appearance equal to or better than that exhibited in the just- completed radar tower nearby. Accordingly, the radar tower became the prototype for the control tower.

The specification also called for galvanising of reinforcing steel. However, because of the precaster's experience with the effects of galvanised reinforcement where hydrogen ion migration creates hydrogen gas evolution causing major surface defects, use of galvanising was recommended against and accordingly this requirement was discarded. Reliance was placed on the precaster's ability to guarantee accurate cover control by employing accurate, low tolerance reinforcement assembly jigs.

Methods were then developed which ensured achievement of the very demanding requirements called for.

- A highly polished, specially constructed, watertight steel mould was designed and built. The outside face of the mould was painted white to reflect heat and ensure a cool mould surface during casting. In addition a special shade structure was
- constructed and placed over the mould during assembly and casting, again to provide cooling. The entire casting program was carried out in the hottest months of the year and the cooling measures taken ensured that premature drying out of the concrete did not occur as this would mar the surface finish.
- A job specific concrete mix was developed to permit placing the concrete into the highly congested thin walled mould.
- The shaft has wall thickness of 225mm only with cover requirements of 50mm externally and 30mm internally. With the 31 No, 72mm diameter stressing ducts spaced circumferentially at 198mm on centre, the segments were very congested indeed. In between the reinforcement and ducts, structural fitments had to be accurately positioned.
- The need for true alignment of all of the 31 ducts through the full height of the tower shaft necessitated almost zero tolerance location of the ducts in each of the eight segments.
- Judicious placement and operation of external form vibrators to provide uniform vibration to the whole mould ensured uniform surface finish and colour control.
- Strict control of water/cement ratio in the concrete was essential to guarantee durability, strength and particularly colour control.
- A carefully controlled steam curing cycle was employed to ensure optimum strength gain, durability characteristics and uniform colour control.
- Attention to detail was essential in every aspect to ensure that the eight segments aligned and interfaced with the secondary structural features such as the interconnecting safety bridges and the passenger lift structure stability struts.



These two towers form a unique pair of structures which demonstrate between them the results of meticulous application of sound, well proven concrete technology.

It is considered that the precaster has provided outstanding examples of the application of recommended concrete practice as espoused by the Concrete Institute. There has been a clear commitment to ably prove that through careful specification and choice of experienced specialists, large functional and structurally important elements can satisfy structural complexities simultaneously with high architectural expectations.

That such a class of excellence in construction and finish has been achieved on infrastructure facilities within the budgeted expenditure, it is considered that these

two towers as a unique pair of structures are worthy of the Concrete Institute of Australia's excellence in concrete award for minor structures.

Radar Tower

Owner:	Civil Aviation Authority
Client:	Thomson Radar Australia Corporation Pty Limited
Design Consultant:	Beca Simons Pty Limited
Specialist Design Consultant:	Structural Concrete Industries (Aust) Pty Limited
Specialist Precaster:	Structural Concrete Industries (Aust) Pty Limited

Air Traffic Control Tower

Owner:	Civil Aviation Authority
Architect:	Ancher Mortlock & Woolley Pty Limited
Design Consultant:	Ove Arup & Partners
Project Management:	Incoll Management Pty Limited
Builder:	Amacon Constructions Pty Limited
Specialist Design Consultant:	Structural Concrete Industries (Aust) Pty Limited
Specialist Precaster:	Structural Concrete Industries (Aust) Pty Limited