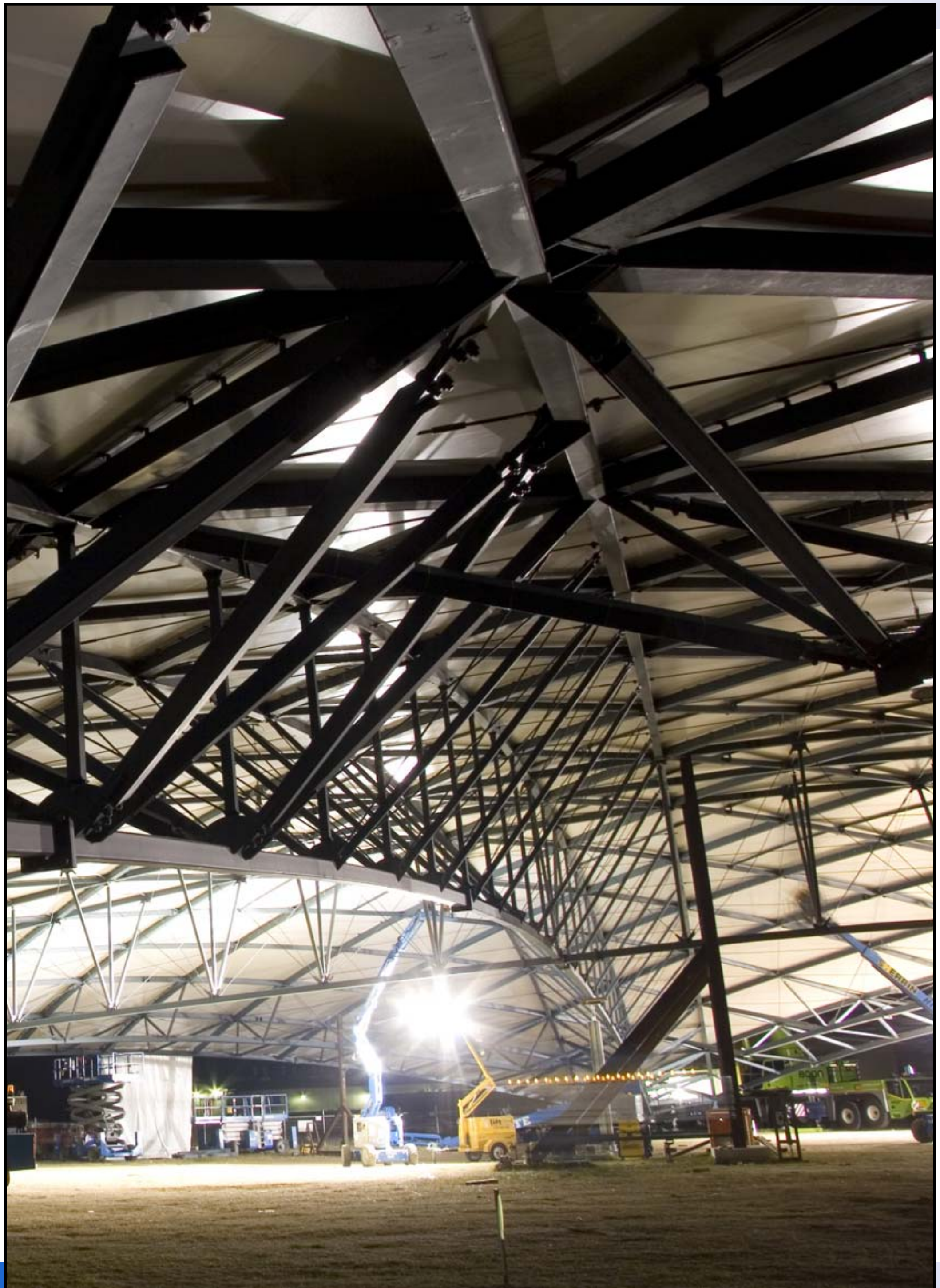
airspace

LSAA DESIGN AWARDS 2007

SPECIAL APPLICATIONS

BOEING airspace



preface

s^2 corporation is an Australian company specialising in the design, management and rental of large span facilities. s^2 occupies a unique position in the market utilising patented post-tensioned steel technology.

s^2 designed, engineered and managed the implementation of the aircraft shelter for Boeing Australia at Amberley, QLD. This roof product developed for the Aviation industry is called **air**space.

The 67.5 metre x 67.5 metre shallow domed roof is anchored to the ground by just four columns and stands 14.2 metres tall.

The 4,453m2 structure will be used to house both Wedgetail and C-17 aircraft, as well as a host of other planes currently used by the Royal Australian Air Force (RAAF).

The strong, light, demountable **air**space is unique in its ability to be easily installed where commonly used buildings aren’t practical. Key to the s2 design and assembly methodology was that the **air**space had to fit between two existing structures, and once complete, had to incorporate access for aircraft from three sides.

details

Project Name:	Boeing **air**space
Location:	Amberley RAAF Base, QLD
Date Completed:	March 2007
Span:	67.5m x 67.5m
Area under cover:	4556m^2
Concept design:	s^2 corporation Pty Ltd
Engineering Design:	s2 corporation Pty Ltd
Supply contract:	s2 corporation Pty Ltd

associated companies

Detail Structural Engineer:	Healey & Castle Associates
Steel Detailer:	CadTech
Fabric Supplier:	Universal Fabric Structures
Implementation Project Manager:	Paynter Dixon
Fabricator:	Casa Engineering
Steel Supplier:	Smorgon Steel

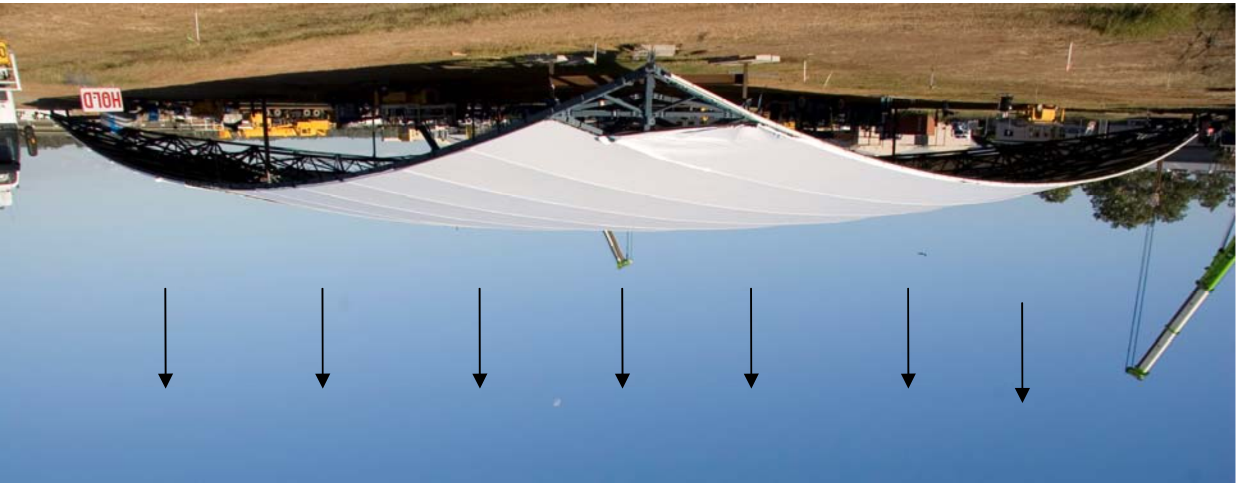

ROYAL AUSTRALIAN AIR FORCE

structural design concept

The engineering practices and principles used in the structure have been known and used by engineers for centuries, which to a certain extent in the opinion of the designer, have been lost with the advent of computing techniques. The design for the **air**space incorporates sound engineering principles of the past with new tools available to engineers today.

The principles of structural behaviour are determined by applying loads to a theoretical "net structure" in much the same way as domed structures were designed in the early 18th century. Loads were hung off the net simulating the self weight of the dome. The shape the string took up was mapped and inverted and this was the shape to which the dome was built. The tension in the net was then measured and the thickness of the dome designed.

This is just like the loading on a trampoline.

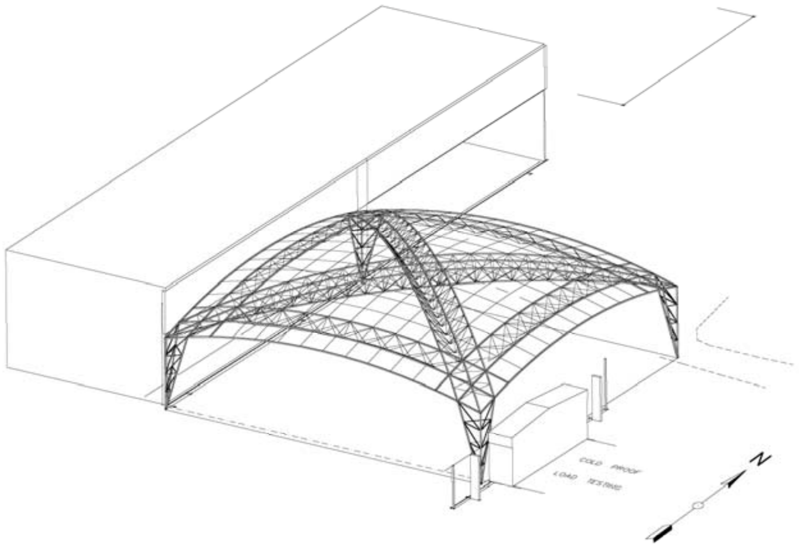


structural design concept

The **air**space roof incorporates a similar process, using the net to size members in structural steel and to determine the amount of force with which to pre-load (or store energy in) the structure.

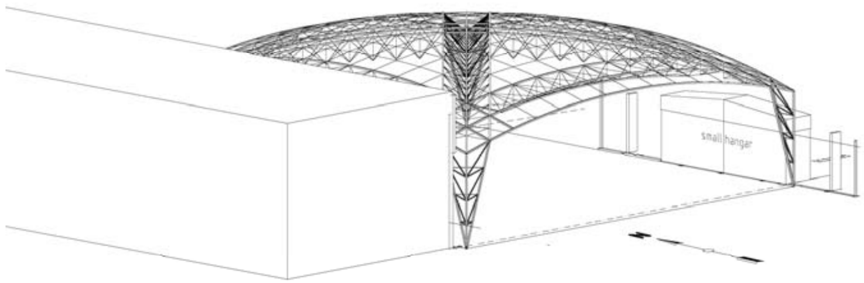
Nothing however, is known of deflections using this approach, so these members and the net members are then modelled using sophisticated software which calculates the loads in the members and the deflections of the structure.

In practice, the string line physically exists as a post-tensioned cable system and is loaded to the calculated forces by hydraulic stressing. This pre-loads energy into the structure before the application of external forces.

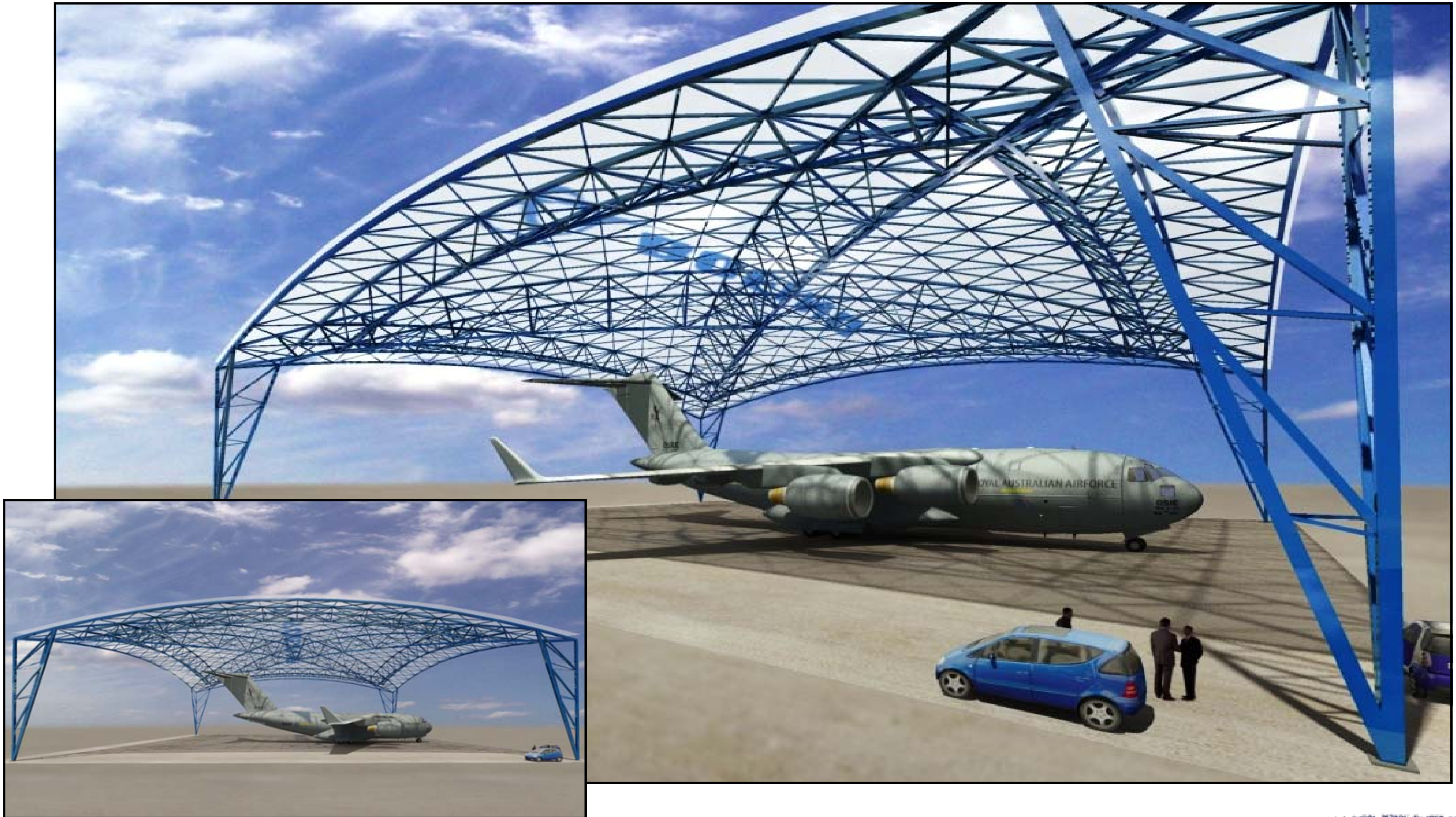


structural design concept

Key reasoning behind this design concept was to deliver productivity gains and unlimited flexibility to the client enabling a space resisting wind loads, point loads and live loads.



concept



fabric membrane and materials

The fabric membrane that was employed on the airspace was chosen because of its ease of installation and lightweight properties. Key to this selection was the requirement for the hole facility to be demounted and relocated in 6 years time.

Steel was chosen as a primary supporting structural supporting members and with s2 technology this vast lightweight structure weighed less than 60% of a conventional design.

construction

In creating a vast, column free work environment on time and on budget, **s^2** developed a highly efficient construction methodology.

All truss members were designed to be pre-fabricated in 12m lengths which could be easily assembled on site. This took 6 weeks.

Once in position, stressing strand was fed through the bottom chord of each truss and edge members and then stressed to precise loads.

This created a shell 67 x 67 meters.

The whole shell was then lifted onto Prime Movers and transported 450 meters to its final location and lifted 24 meters vertically.

This whole activity took place in 12 hours.

design efficiency

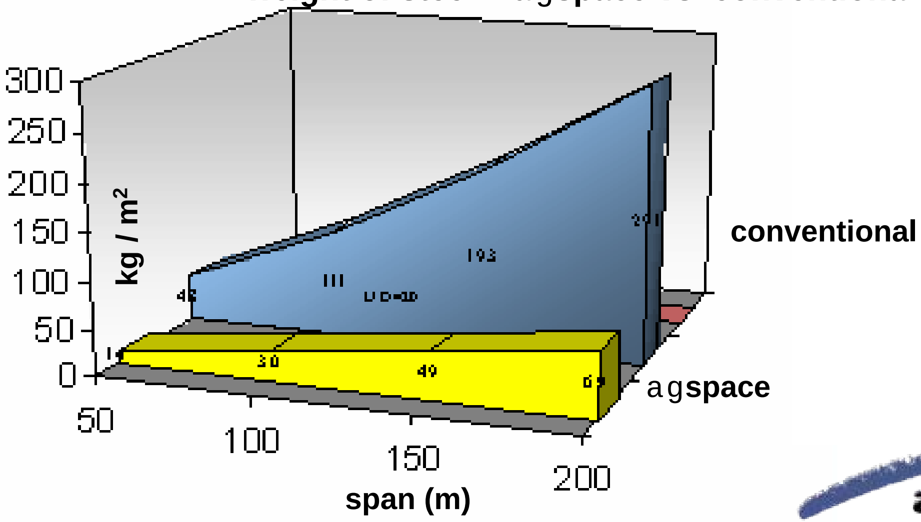
The design concept resulted in a significant reduction in the tonnage of structural steel due to the degree of deflection control provided by the stressed structural form.

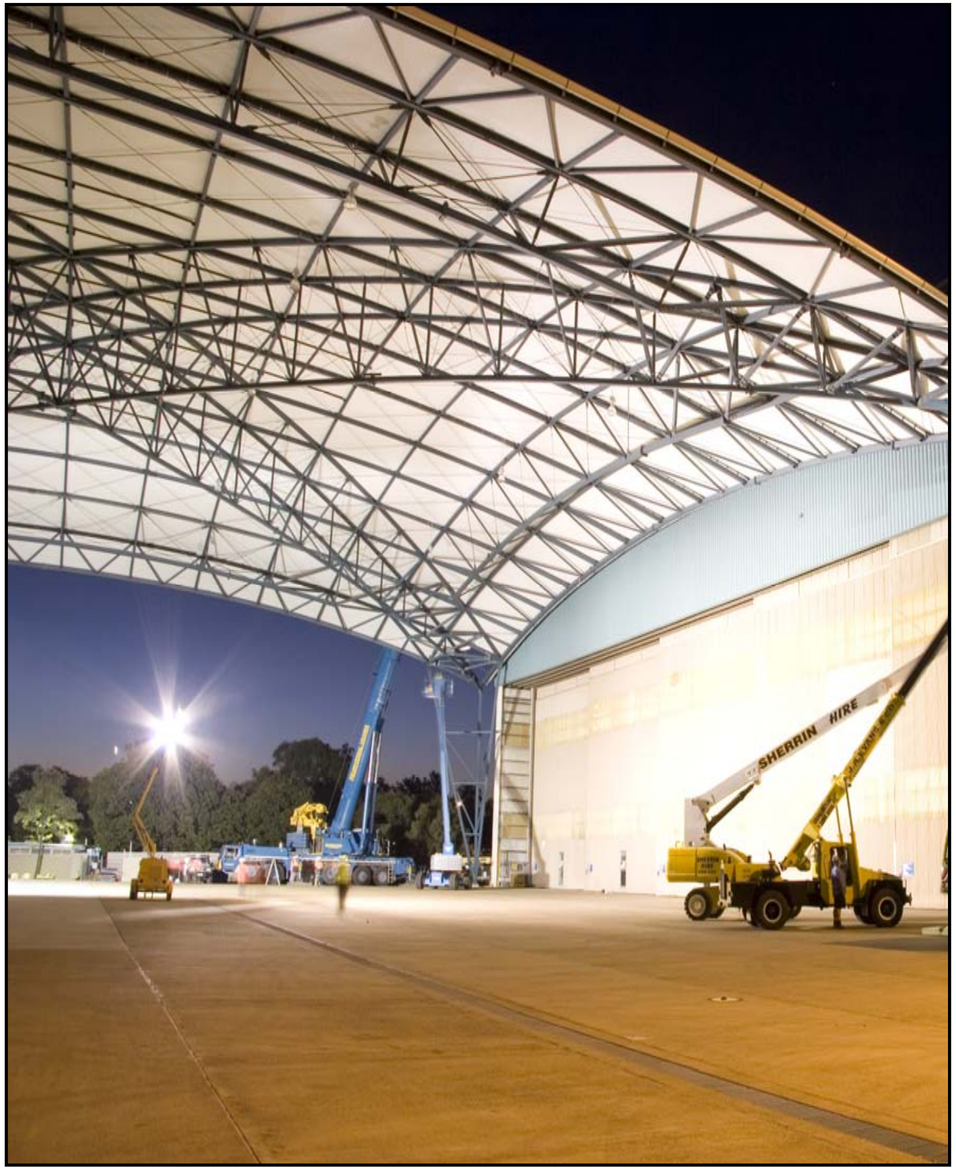
The post-tensioned steel solution resulted in an approximate **saving of 60% in overall steel weight** when compared to a conventional design of the same span, a critical issue impacting on both fabrication and the assembly process.

Further, because of the ability to store energy, an increased span is possible providing major productivity gains to Boeing.

Specifically, the bottom chord of each 95.5m truss was 150 x 150 SHS which is not achievable without s2 technology.

weight of steel – agspace vs. conventional





achievement of client brief

airspace was deemed not only to be a unique, cost effective roof solution, but instrumental in delivering design efficiencies and benefits throughout the entire project.

A unique, safe methodology coupled with high strength post-tensioned steel delivered to Boeing the only facility of its type in Australia, if not the world, on time and on budget.

In the process, **air**space has provided the aviation industry with a blueprint for the future.