LSAA

LIGHTWEIGHT STRUCTURES ASSOCIATION OF AUSTRALASIA

1997 Symposium and AGM of the Lightweight Structures Association of Australasia

FRIDAY 1st AUGUST 1997
AT
RMIT STOREY HALL, MELBOURNE

Programme and Proceedings

Organisers:
Lightweight Structures Association of Australasia (LSAA)

Co-Organisers:
RMIT Department of Architecture

1997 Symposium and AGM of the

LSAA

LIGHTWEIGHT STRUCTURES ASSOCIATION OF AUSTRALASIA

1st August 1997

RMIT Storey Hall
Melbourne, Australia

Symposium Organising Committee

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PROGRAMME

RMIT Storey Hall - Friday 1st August 1997

8:30am	Registration
9:00am	Welcome and word from Sponsor
9:15am	Keynote address: **Angel Dimitroff, Designer/Architect** on the Myer Music Bowl, Melbourne; and a pioneer of cable net structures in Australia.
9:45am	MORNING TEA
10:00am	Project review: • Melbourne Sports and Aquatic Centre speakers: **Peter Brook** (Peddle Thorp Architects) **Brian Dean** (Connell Wagner) • The Ballarat Conservatory speaker: **Peter Elliott** (Peter Elliott Architects) • Exhibition Building, Sydney Showgrounds speaker: **Peter Bailey** (Ove Arup & Partners)
12:00pm	LUNCH
1:15pm	Presentation by RMIT **Dr Derham Groves**
1:30pm	• The Work of Greg Burgess - Uluru, Brambuk speaker: **Greg Burgess**
2:00pm	Developments in structural glass envelopes speakers: **Brett Woods** (Pilkington) **Lynton Wombwell** (Pilkington)
2:20pm	Fabric Forum: PVC Update • Update on issue by **Rob Faulkner,** PACIA
3:00pm	LSA '98 Update / Closing statement by **Vinzenz Sedlak,** President LSAA
3:15pm	AFTERNOON TEA
3:45pm	LSAA - Annual General Meeting
5:30pm	CLOSE
6:30pm	DINNER / AFL Football at the MCG (North Melbourne vs Essendon)

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SYMPOSIUM PROCEEDINGS

Contents

Melbourne Sports and Aquatic Centre, Melbourne

Brian Dean, Principal, Connell Wagner

MSAA 1997 Proceedings

PROJECT DESCRIPTION

The new Melbourne Sports and Aquatic Centre is the largest integrated sports and leisure facility of its type in Australia, and is shown in figure 1. The Aquatic Centre features the largest competition pool in Australia, which is over 79.5 metres long and can be sub-divided with mobile booms for international swimming, diving, waterpolo and synchronised swimming events.

The main competition pool ranges from 2.1m deep typically, to 5.0m deep at the diving tower (northern) end. In addition, a 600mm setdown is incorporated in the southern end to allow for a movable floor section approximately 17m by the full 25m width of the pool. This will enable this end of the competition pool to be used by casual lap swimmers during peak times.

Alongside the competition pool are a 5 lane 25 metre lap pool and a 12m by 10m multipurpose pool. This multipurpose pool has a movable floor so that the depth can be varied, allowing a multitude of users including wheel chair access.

Beside the lap and multipurpose pools is a 450m^2 (approx.) leisure pool which incorporates a "beach" entry and a wave machine whereby waves are generated by pumping large volumes of water into specially design reinforced concrete chambers, causing waves to run the 25 metre length of the pool to the beach. The leisure area also incorporates two spas, a sauna, and a fibreglass water slide.

The Dry Sport section of the MSAC complex houses a variety of sports and includes 8 basketball courts, 12 badminton courts, 25 table tennis courts, 10 squash courts. There is also a separate showcourt capable of being set up for various sports with a seating capacity of 2000.

Linking these facilities is a 2 storey area incorporating offices, amenities, a gymnasium, aerobics centre, creche, sports medicine, retail, cafe, and substantial atrium areas.

PROJECT TEAM

The architects were Peddle Thorp Architects and the project managers were the Office of Major Projects.

The project delivery involved a novation contract, whereby the design team was novated to the successful builder, Baulderstone Hornibrook.

Connell Wagner were responsible for the civil and structural engineering design.

SITE INFLUENCE ON STRUCTURE DESIGN

Ground Conditions

The preliminary geotechnical investigations indicated 0.3m to 2m of fill overlying very stiff to hard clays at the northern half of the site and moderately dense sands at the southern end.

These conditions permit the use of economical pad footings (allowable bearing pressure is 250 kPa on the clay and 200 kPa on the moderately dense sand) and avoids the need for piled foundations.

The ground watertable has approximately 3m to 5m below existing surface level below the general pool levels.

Wind Exposure

At a distance of approximately 1 km from the bay, the site is relatively exposed to the westerly and south-westerly winds. Wind pressures for the design were based on code values using a Terrain Category of 2% for the governing west wind, and a Terrain Category of 2 for the south-west wind.

ROOF STRUCTURE

The MSAC. Project has a floor area of 36,000m^2 which is 3,000m^2 greater than the Southbank Exhibition Centre. With such a roof area on a very tight site area, there was a desire to create an interesting structure which eliminated the danger of creating a bland expanse of metal roofing.

At the same time, the project budget was very tight. The complete centre had a building construction of cost of about $50m, ie less than $1,500/m^2 all up . Lastly the 18 month construction period required a fast erection process.

In summary the challenge was to:

- provide a signatory and readily identifiable roof design;
- provide a serviceable, durable roof design;
- meet tight budget;
- ensure fast erection.

ROOF SCHEMES

A wide range of roof schemes were examined. A key issue particularly for the 160m x 70m Dry Sports enclosure was the optimum number of internal columns. It was necessary to provide a high level of planning flexibility enabling reconfiguration of the court layouts as the demands for each sport waxes and wanes.

Detailed engineering and cost studies of options were evaluated including trusses, portal frames and spaceframes.

One of the earlier schemes examined was a diagrid roof structure similar to the Sydney Aquatic Centre which had been recently completed by Connell Wagner. This exciting building is the venue for the 2000 Olympics.

The simple truss scheme was used for cost bench-marking purposes.

ROOF DESIGN PHILOSOPHY

From an economy viewpoint the basic objectives of the roof design were to:

- Maximise economy by using simple bolted connections - avoid on site welding.
- Maximise offsite prefabrication.
- Adopt standard detailing based on a theme which carries through the whole Centre.

ELITE POOL ROOF CONCEPT

The selected concept is both innovative and economical and is best explained referring to the section through the main pool roof, see figure 2. The roofs design is unique in Australia and the way it works is as follows.

Downward dead loads and live loads are resisted by a series of rod braced roof beams which are supported by 2 masts on the west side of the pool. The rods radiate from the top of each mast creating a 3-dimensioned tension structure. On the east side the roof is propped by a series of columns.

For load reversal due to the uplift wind suction, advantage has been taken of the upward curve of the roof beams. By tying down the ends of these beams they act as an inverted catenary (ie. like an inverted suspension cable) and resist net uplift pressures by tension.

The result is that very slender beams which are only 460mm deep can be used to span over the 48m distance.

For durability purposes, all the steelwork is hot dipped galvanised.

DRY SPORTS ROOF CONCEPT

The sports enclosure is 160m x 70m. From a functional viewpoint it was necessary to minimise the number of internal columns to maximise the flexibility of the space and to enable subsequent court re-arrangements for different sports in the future.

The selected roof scheme is similar to the pool except that the masts are centrally positioned as shown in figure 3 and 4, which has the advantage that the downward loads are almost balanced. The structural behaviour is similar to the Elite Pool Roof in concept and design.

The weight and cost of the roof were continually bench marked against other more conventional schemes through the schematic and design development phases. The main steelwork weighs on average about $20kg/m^2$ which is very competitive for roofs spanning 50m to 70m.

ERECTION SEQUENCE

The MSAC project had to be constructed quickly in an 18 month period. For aquatic centres the construction critical path goes through the main pool which has to be fully water-tested prior to tiling.

For ease of construction, the roofs were not designed as highly tensioned, rather they relied on the roof self-weight to tension the rods after removing the temporary propping. The props were positioned at the rod attachment locations on the rafters.

At this time the perimeter tiedowns were tensioned, the uplift forces being resisted by grout injected Campiles. Steel erection was by means of mobile cranes.

Computer program simulations analysed the theoretical movements post-depropping and these were used to back-check the member forces.

CONCLUSION

The erection sequence worked very successfully and the roof construction was completed on program.

Innovative roof structures such as the MSAC design are both visually appealing, can provide optimum internal flexibility for long spans and are, most important, economic solutions.
The success of a lightweight roof scheme requires a well integrated architectural/engineering design team.

We believe that the MSAC is an excellent example of architectural/engineering design integration from the basic concept through design development to the fine detailing exhibited by this innovative structure.

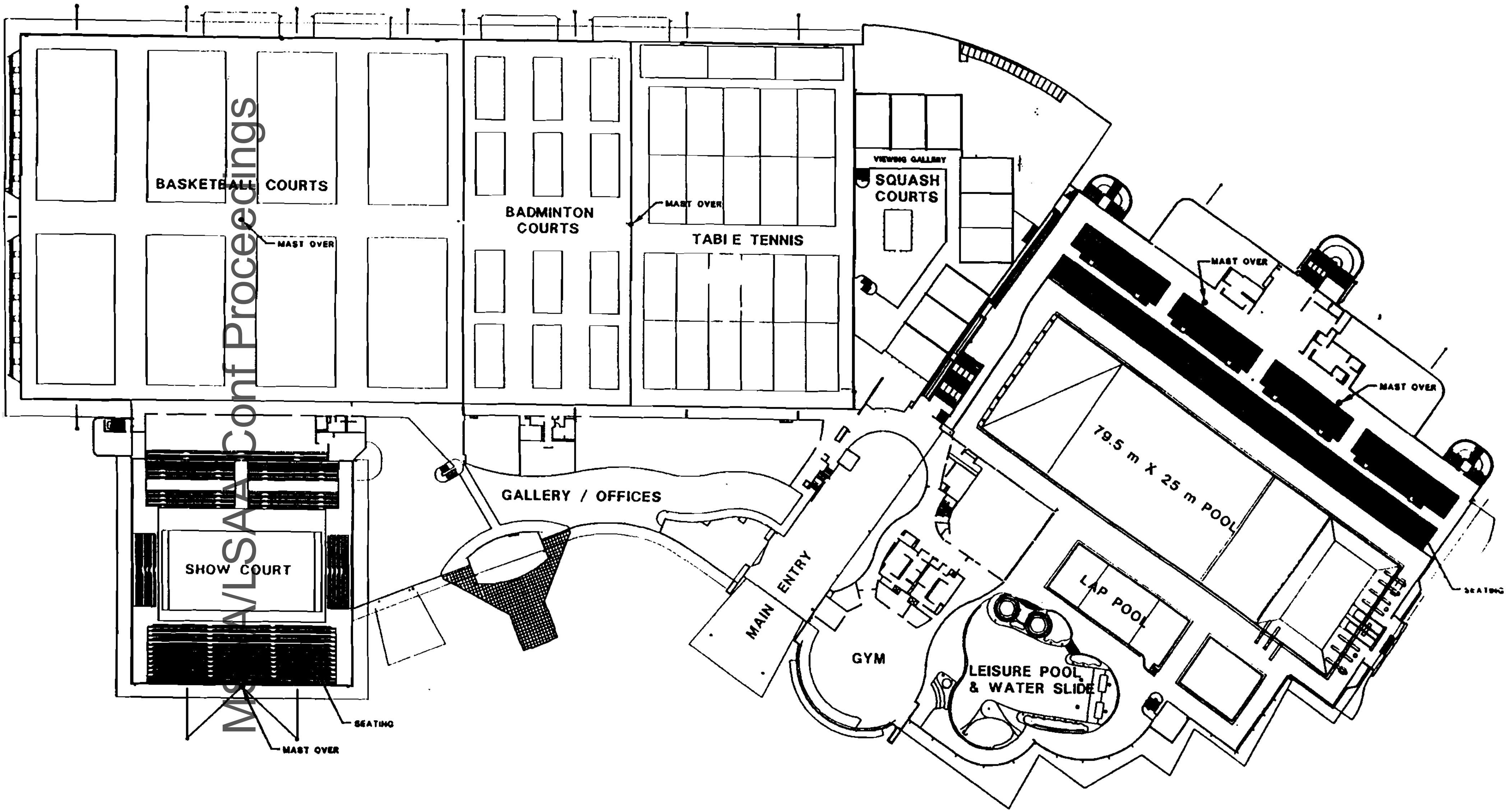


FIGURE 1 - MELBOURNE SPORTS AND AQUATIC CENTRE GENERAL LAYOUT

MSA/ASA97 Proceedings

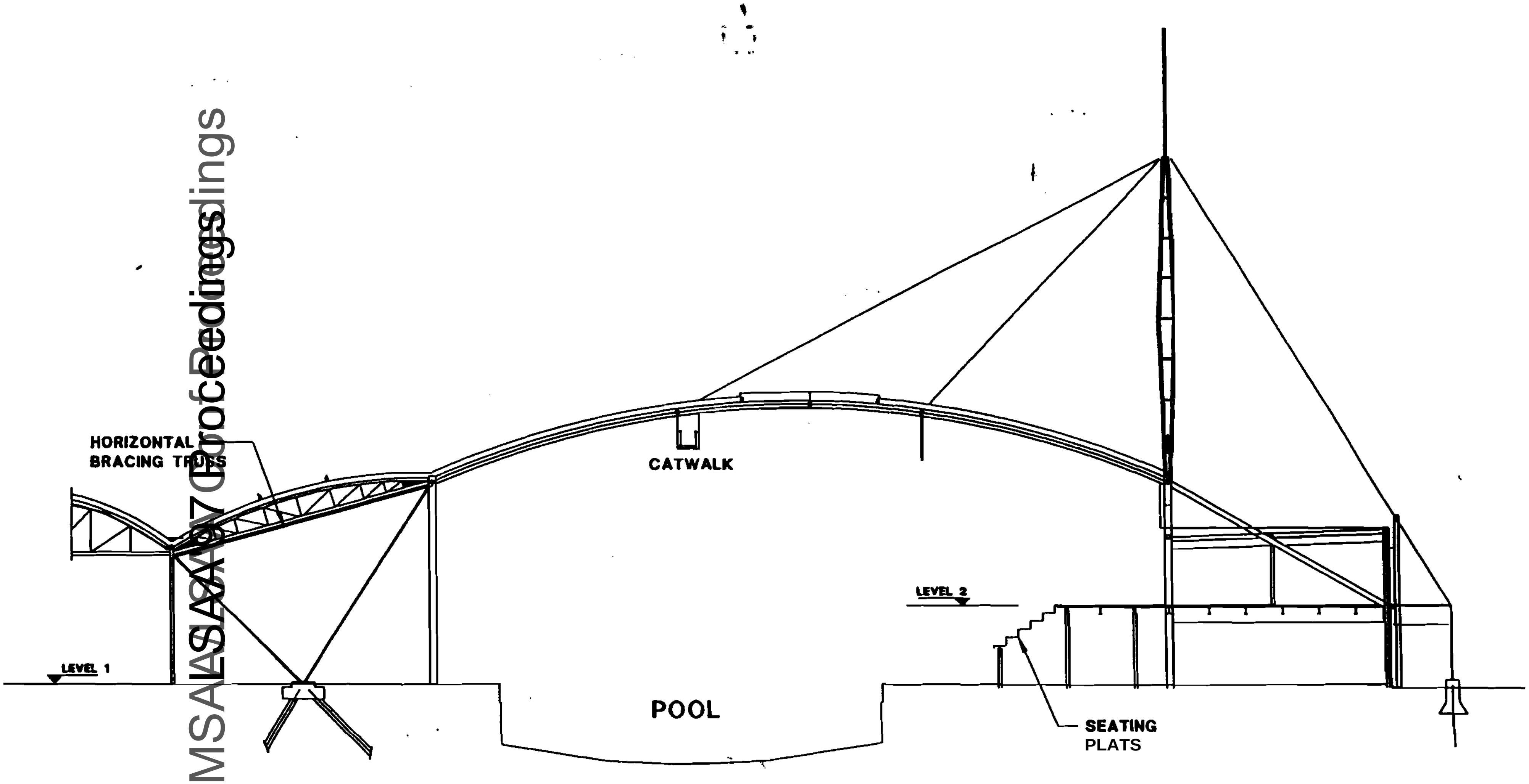
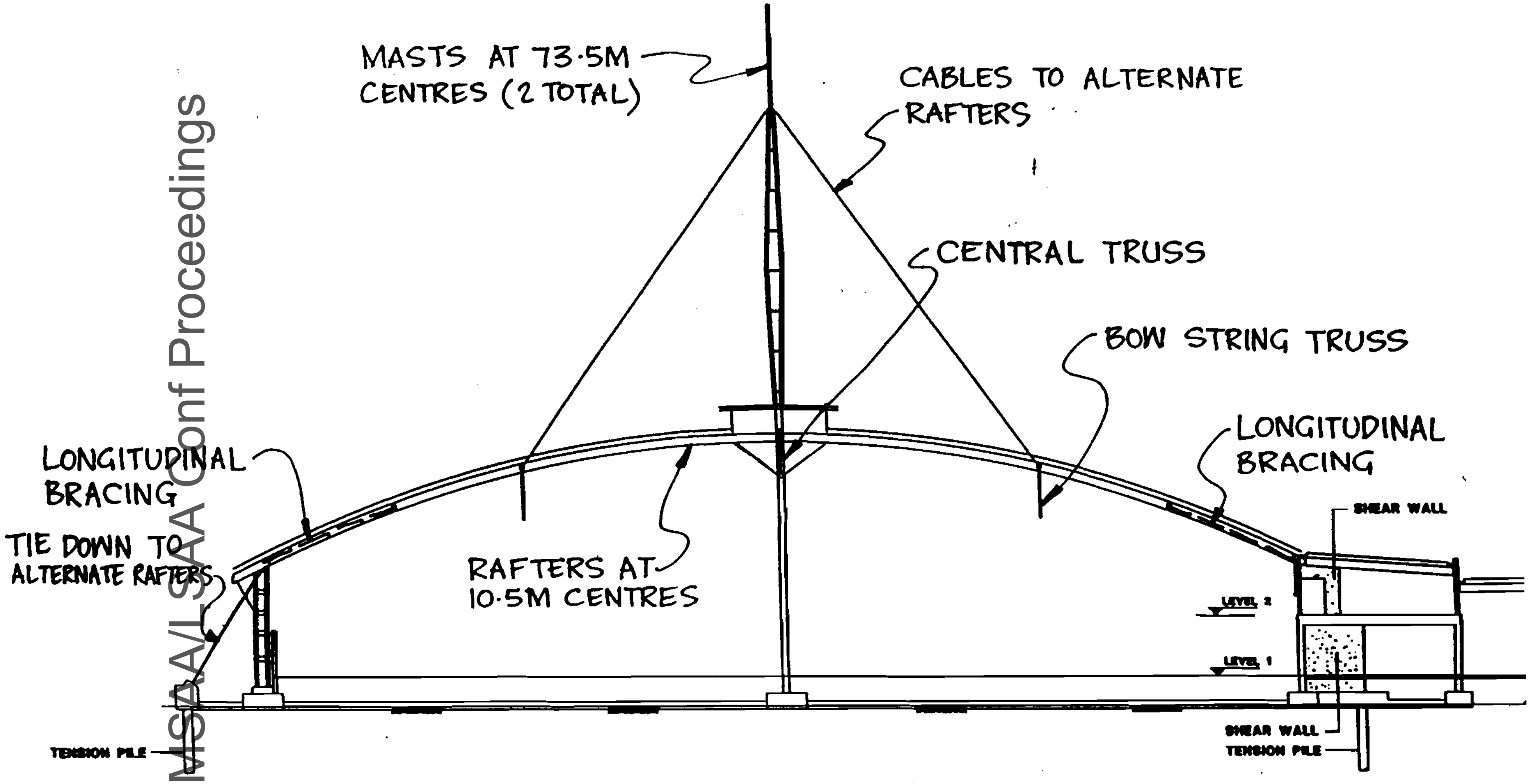


FIGURE 2 - COMPETITION POOL HALL



DRYSPORTS HALL
(TYPICAL SECTION AT MAST)

FIGURE 3

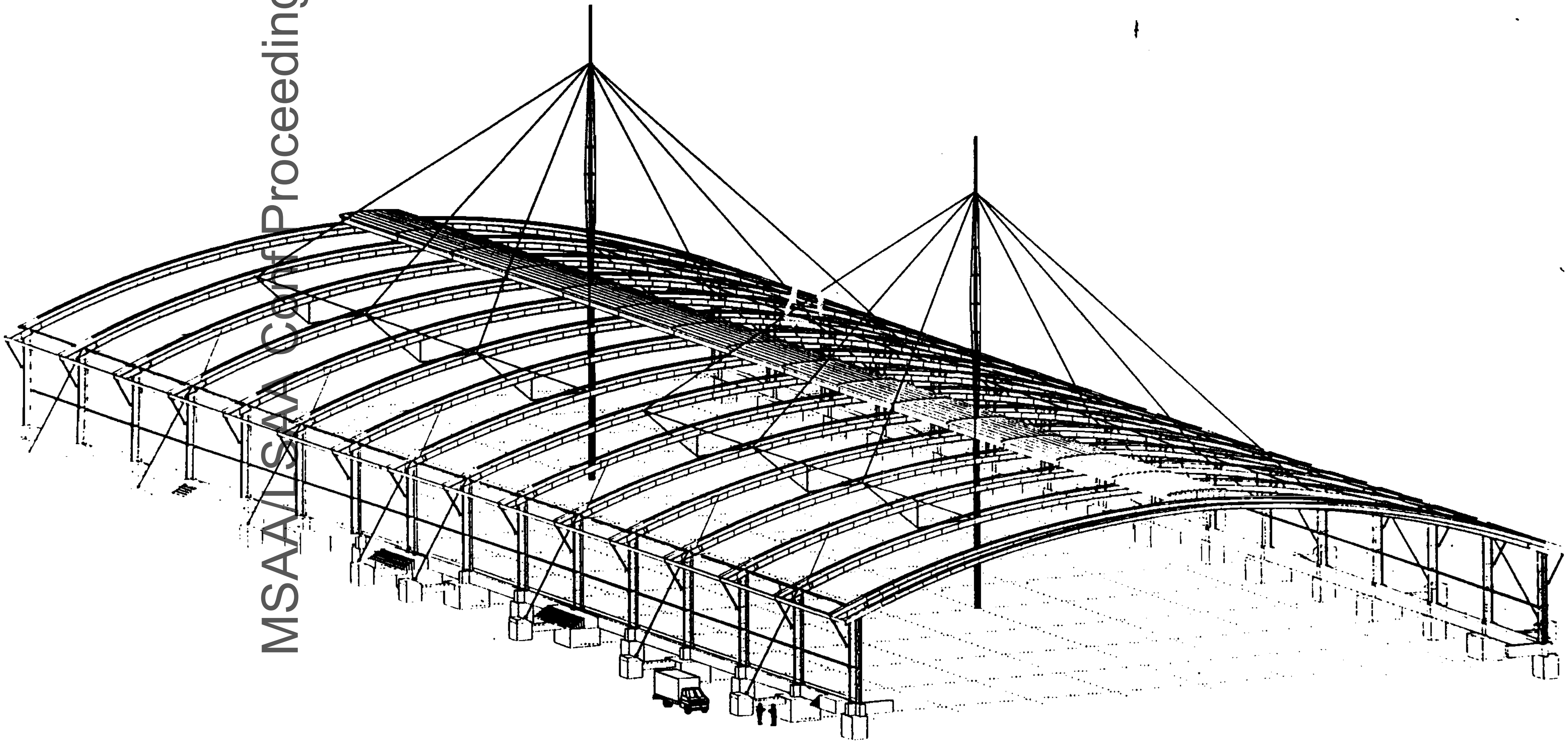


FIGURE 4 - PERSPECTIVE OF DRY SPORTS HALL

The Robert Clark Horticultural Centre Ballarat, Australia

1 PROJECT CREDITS

Project Title:	The Robert Clark Horticultural Centre
Project Location:	The Ballarat Botanic Gardens, Wendouree Parade Ballarat, Victoria, Australia.
Client:	The City of Ballarat
Benefactor:	The Robert Clark Trust
Dates:	1994-1995

<u>Consultant List</u>

Architect:	Peter Elliott Pty Ltd
Structural Engineer:	Ove Arup & Partners
Electrical & Mechanical Engineer:	P & D Clarke & Associates Pty Ltd
Hydraulics Engineer:	Hycon Design Pty Ltd
Landscape Architect:	John Patrick Pty Ltd
Glazing Consultant:	Neil Clark
Glasshouse Consultant:	Keith Garzoli
Irrigation Consultant:	Irrigation Design Consultants
Quantity Surveyor:	Slattery Australia Pty Ltd
Builder:	Hooker Cockram Pty Ltd

<u>Proiect Team</u>
Peter Elliott
Rob Trinca (Project Architect)
Tim Black
Micheal McKenna

2 Project Description: The Robert Clark Horticultural Centre

Ballarat is a major provincial city of some 90,000 people and was founded during the gold rush era of the 1850's. It has a rich and glorious history linked to the fortunes of gold. The city is 120 kilometres North West of Melbourne.

The Ballarat Botanic Gardens founded in 1867 are famed for their fine Victorian period statuary, an avenue of Prime Minister's busts and an annual floral showing of the strange but wondrous Tuberous Begonia.

In 1994 the City of Ballarat was given a $Aus2 million bequest by the Robert Clark Trust for a new floral conservatory.

Rising like a giant crystal from the ground the Conservatory is designed as flexible exhibition space, for changing displays of floral plants. Adjoining this across a paved forecourt is the Community Resource Centre. This is the support building for the conservatory for it contains, offices, public reception, exhibition space, meeting and lecture rooms, toilets, catering and storage facilities.

The program for this Conservatory was both simple and direct - a functioning flat floor flexible floral display facility, with maximum clear glass area and a full environmental control system.

The preferred plan form for such a building is a rectangle with the long axis North South. Access and entry is via one end only, allowing a loop circuit journey, exiting at the same end as entry. The interior has been designed as freespan space having a strong sense of the vertical scale as well as a progression of repetitive bays down the length. The roof pitch is 550 to maximise condensation run off and add to the drama of the space.

A modular tiered plant display rack system was designed to allow for full flexibility. Each display cycle is specially designed at least 4-6 times a year. Externally the Conservatory is freestanding, set in a field of grass with a paved public arrival and orientation forecourt at the northern entry end. The structural system is based on a series of six repeated 'A' frame bays, designed to be factory fabricated and transported to site. This not only reduces on site time, but maximises quality control. The structural steel bays were glazed on the ground then erected by crane. The glazing system is adapted from curtain wall technology, with structural silicone glazed cassettes locked onto the frame.

This project has been designed as a maintenance free structure. It is a public building with an expectation of longevity. Because all steel work is exposed to view a great deal of attention has been given to the designing of all aspects of the structure, in particular joints and connections. Corrosion protection was achieved by high build paint system, factory applied. Aluminium is natural anodised.

The Conservatory is both a public building and a working glass house, for each floral display has its own special climatic regime, requiring the controlled manipulation of daylight sunlight, shade, humidity, temperature and air movement. This is not a static building, it is an automated mechanical machine, constantly monitoring and adjusting its internal climate via a sophisticated computer program.

3 Project Design Philosophy

This project, continues the magnificent tradition of glasshouses in public Botanic Gardens. Such buildings have great physical presence, large single volume interiors and strong geometric shapes. Derived from natural forms, crystalline and faceted, the Robert Clark Conservatory is like a large transparent gem stone, held together by an intricate web of steel.

The realisation of the form of the Conservatory came from endlessly folding sheets of paper using origami technique. The result is a building whose roof and walls become one as folded plates buckle to form peaks and troughs at their junctions. It is a seamless glass tent, plastic in form, scaleless in size, skin and structure constantly oscillating. A side flanking view of the Conservatory ripples with ambiguity and visual trickery, for the folded glass skin is at once both transparent and solid, either reflecting the sky or revealing the interior.

The building is conceived of as a kit of parts, factory manufactured and site assembled, not unlike the great conservatories of the Nineteenth Century. Paxtons' Crystal Palace for the Great Exhibition of London on 1851, was remarkable not only for its imposing size and expressive power but for the methods by which it was built. Paxton used the best technologies of his time, a repetitive kit of standardised components, prefabricated, machine produced and assembled on site. For Paxton the structure and faming system predominate, the glass is always **infill**, walls and roof are separate. Late 20th Century technology allows glass to be used as a virtual seamless skin, stretched or draped over any shape. The supporting structure is a skeletal frame - eroded, honed and cut away to the minimum. For there are no columns or beams, only a continuous tracery of spidery tube.

4 Awards

1996 Royal **Australian** Institute of Architects
New Institutional Category - Award of Merit

1996 Australian Institute of Building
Professional Excellence in Building Awards
Winner, Category - Residential & Smaller Projects

1996 Master Builders' Association
Excellence in Construction of Tourism & Hospitality Facilities
Special Commendation

1995 Australian Institute of Steel Construction 1995 Victorian Architectural Steel Design Award for Buildings

ROOF STRUCTURES TO THE EXHIBITION HALLS, NEW SYDNEY SHOWGROUND

Richard Hough, Principal, Ove Arup and Partners

1. Introduction

The Exhibition Halls for the Royal Agricultural Society's new showground at Homebush Bay comprise a circular hall with a dome roof and three rectangular halls with tied vault roofs. The circular hall has a diameter about 100m and a dome rise of about 35m from springing level; the rectangular halls have spans about 67m and a total length of 216m.

2. Dome Structure

Both dome and vault roofs were conceived as single-layer grid-shell structures, with fully triangulated surfaces to maximise shear stiffness and so to minimise displacements, moments, effective lengths, and consequent second order effects. Joints were generally conceived as moment-capable, again to maximise stiffness and minimise second order effects.

A range of grids was considered for the dome members, including orthogonal (radial/circumferential) to minimise the potential consequences of tolerance. The fully-triangulated pattern chosen has the advantage of a high inherent shear stiffness, and accuracy of fabrication and erection has not proved an issue. It was preferred visually over straight radial, or geodesic patterns. It was also judged visually acceptable to use straight timber elements between nodes, in both dome and vaults.

Buckling modes and effective lengths were analysed, and spreadsheets used to check combined stresses in both timber and steel members. Continuously curved CHS purlins stabilise the timber sections via cleats which grip their top edges. At major joints, circumferential CHS ties (straight between joints) provide hoop forces to maintain the shape of the dome against non-funicular and asymmetric loads.

At tender, main joints were shown with steel shoes attached to the ends of each glulam member, and split radially and circumferentially, to allow any sequence of member subassembly and erection. Of all the methods available, that finally chosen by the Contractor was very unusual, but very effective. Starting with the central monitor structure propped off the slab at low level, successive rings of timber members were installed, closed with their CHS tie rings, and lifted on cables attached to jacks at the top of twelve scaffold towers. The sequence required re-analysis of the structure to check that circumferential CHS members and their joints could provide the large tie force needed at each stage of lifting (but which disappeared upon subsequent depropping onto the slab, prior to relocating the towers and jacks).

The method required a minimum number of purlins to be in place prior to lifting, to stabilise the timber members. It had the major attraction for the Contractor of allowing the cladding system to be installed ring by ring at much lower elevations than for most other methods.

3. Vault Structure

The vaults comprise timber arches running diagonally, tied at 36m centres by horizontal CHS members. Arches that do not terminate directly on ties, deliver their thrusts to the ties via the triangulation inherent in the diagonal pattern. This means that most roof loads are concentrated on the four corner columns of each structural bay.

The shear stiffness of the structural grid relies also on longitudinal CHS members, plus crossed tie rods inserted in the trapezium-shaped bays of the grid. As for the dome, the purlins are attached to the timber members via stiff cleats which cantilever down and stabilise the timber sections.

Vault erection was initially intended to be by lifting of completed 67m x 36m bays, but a more piecemeal approach, with four lines of props across the 67m span, proved more flexible and effective. Again, joints were designed to be split on various axes, and this proved a useful facility in the erection method finally chosen.

4. Timber Procurement and Fabrication

The mixture of timber and steel in the roofs generally puts timber in compression and steel in tension, under gravity loads. Under wind uplift, this is reversed, so peak tension in the timber occurs typically under short-term loading, to which it responds more favourably.

The demands placed on the timber were thus for a minimum E and Fc for compression behaviour, and minimum Ft for wind conditions, with various major and minor axis bending conditions superimposed. Shear was not a big concern.

Timber for the vault structures is radiata pine from plantation forests in the NW part of the South Island of New Zealand. For the dome it is mainly slash pine from Queensland, plus radiata pine from the Mt. gambier area of South Australia.

Given the size and importance of the structure, it was decided to carry out in-grade testing of all sources to AS 4063. In instances where the results cast doubt on the strength or stiffness properties of the source relative to specified values, the structure was re-analysed to check for spare capacity, and generally speaking a good fit was found between the product available and the structural requirements.

Machine stress grading was used for the bulk of the material, supplemented with visual grading. Of the various companies involved in timber supply and fabrication, some used finger-joint proofing (and supplementary timber grading) by direct axial tension testing of laminates, and others used bending tests on laminates. In all cases, at least the outer zones of beams were subjected to some kind of proofing, for reassurance of both stock and finger-joint properties, beyond minimum AS quality control requirements. A percentage of beams was subjected to full size tests, either bending or eccentric axial tension.

Anchors to connect the timber beams to the steel nodes were contractor-design items, and were generally provided as end-grain embedded threaded rods, with a coupler at the timber end face, to allow bolting on of the steel shoes. Small-scale and full-size prototype joints were tested to destruction to understand their behaviour, particularly the clusters of **4M24** grade 8.8 bolts. Strain gauges indicated a delivery of load into the timber close to the coupler. Pullout and failure loads indicated load factors adequate for the anchor groups in their designed condition.

For design of the glulam members, reference was made to a range of sources, including AS 1328 Draft, and North American research, but staying within the envelope of AS 1720.1 There is difference of opinion as to the best method for translating the properties of individual laminates into those of a glued laminated assembly.

5. Environmental Controls

There are many ways in which the Halls contribute to the State Government's plan to provide the "Green Olympics". The use of timber as the major structural material is one key aspect; given its low embodied energy hence low C02 generation, plus high carbon fixing potential assuming replacement of plantation trees.

Daylighting is available through monitors (dome and vaults), and wall and clerestory windows, and reduces reliance on artificial lighting during set-up and take-down of exhibits.

The rectangular halls are naturally ventilated, with low and high level motorised louvres. Their thermal performance was the subject of much study by computational fluid dynamics methods.

The circular hall has an energy efficient low-level air displacement a/c system, with a central chilled slab to enhance air movement towards the middle of the hall. The hall can also be used in natural ventilation mode.

6. Credits

Stakeholders:	OCA (Principal) RAS SOCOG
Architects:	Ancher Mortlock Woolley
Consulting Engineers:	Ove Arup and Partners (Structural, Civil, Mechanical, Electrical, Hydraulic, Passive Energy Studies, Fire Engineering Studies, Acoustics)
Project Manager:	Australia Pacific Projects
Construction Manager:	John Holland CE
Main Contractor:	Thiess CPL
Superstructure Contractor:	Alfasi Constructions
Timber Supply and Fabn:	Hunter Laminates Gunns Timber

PILKINGTON

LIGHT WEIGHT STRUCTURES DEVELOPMENTS IN STRCUTURAL GLASS ENVELOPES

INTRODUCTION

The term "Lightweight Structure" suggests a structure that is not heavy.

Whilst a light weight structure may use membranes and shells that are not heavy, it must also have an aesthetic that looks light to truly be called a lightweight structure.

Glass and the framing elements are relatively dense as materials. However, when used as large panels with slender framing elements, provide transparency to a structure so that glass cannot be considered as anything other than "light". In any case as nature would have it "Glass", because it is thin and it's reaction under load is more a membrane than a plate.

To follow is a discussion in the development of structural glazed assemblies using the Pilkington Planar Fitting, and the development of low energy buildings using the facade as a passive solar element, presented as two case studies, and the evolution to photovolataic or solar power generation.

A. STRUCTURAL TRANSPARENCY

Introduction

The process of toughening glass allowed the span of glass under load to be increased substantially and the development of fixing methods beyond the traditional framed systems dramatically increased the transparency of entire walls. The study of the behaviour of these system enabled the improvement and refinement of the fixing method in sympathy with the behaviour glass plates under load. The Pilkington Planar system is the result of more than 20 years of continued research in this field.

The Planar bolt is the key to the behaviour of the system. It is countersunk into the external face of the glass so from the outside there are no physical protrusions to interrupt the plane of the glass face. The wall is shear in extent from top to bottom and from left to right. What the Planar bolt is fixed to is where the imagination begins as there are potentially very few limits to what can be done. Several systems have been developed over the years.

Fin Support Systems

The most transparent of the systems is achieved with the replacement of traditional mullions with transparent glass fins. This allowed the structural support component to become transparent while still having sufficient strength. The connection is achieved by the use of stainless steel fittings. The most simple form would be a small stainless steel angle which is bolted through the glass fin. The Planar bolt from the glass panel is fixed to this angle and the system is assembled from the individual pieces.

The scale of the fittings is very small when compared to the finished structure so when looking at the wall as a whole, the fittings become visually insignificant and are often not noticed.

The maximum dimensions for a system of this type are normally limited in the height with the current limits in the order of 18 meters to 22 meters. The width can almost be endless as the system spans in the vertical direction. This system has proved popular for grandstand applications but has been used for many other applications. There are many examples of this type of system used throughout Australia and some recent examples are Deakin University, Burwood campus, Rialto and 303 Collins street Melbourne. The cost for this system is in the order of $450 to $550 per m^2.

Cable and Rod Systems

The most recent method of replacing the traditional frame system involves an assembly using cables or rods in various forms to provide the lateral and at times vertical support to the glass. The systems maximum dimensions and applicability will vary with load and surrounding structure. The systems can be equally applied to both in plane and out of plane structures and can be applied to small as well as large structures. The system provides a unique way of achieving a transparent structure. These types of structures can be quite sophisticated and the cost of the system is in the order of $ 1400 to $1600 dollars per m^2.

Fixed to Traditional Structure

The closest to the traditional system involves the use of typically a steel structure with the planar bolts fixed directly to it. There may simply be a steel cleat attached to the structure or a special steel bracket developed to which the glass is fixed. This enables the glass plane to be set away from the structure so the shear uninterrupted glass face can be achieved. The distance away from the structure can be varied with the design of the bracket. The Melbourne Exhibition Centre is an example of this type of assembly. This is the lower cost level of the systems as the cost of the support structure is not included in the glass contract. The current cost for this type of system $300 to $350 per m^2.

Considerations

The use of toughened glass for structural support requires careful design. Glass is a brittle material therefore subject to impact damage. Each design should contain a degree of redundancy to ensure that fracture of any glass component does not lead to the fracture of other components or the entire assembly. Impurities can be present in glass that may cause spontaneous fracture after the glass is toughened. The chance of this happening can be greatly minimised by having the glass heat soaked. The heat soak process is a quality control process which detects defective panels and those that may contain nickel sulphide impurities.

At some point a planar system is going to connect to the structure of the building and it is important that the structure is designed to carry the weight and loads transferred from the planar system without undergoing significant deflection. Large deflections are the enemy of brittle materials as stress can be developed very quickly and fracture may soon follow.

The Planar system has been developed over 20 years with extensive on going testing of new developments. It is important that any system which is offered by other suppliers has the full testing to backup its use.

Summary

The Planar System provides a variety of support systems for a transparent wall which permit different expression and approach to design. The system has been continually developed and will continue to be developed into the future.

Considerations such as heat soaking and deflection of the surrounding structure must be carefully investigated.

B. PASSIVE SOLAR FACADES

Commercial buildings now use more energy and rely heavily on mechanical environmental control and artificial lighting. The greatest energy consumption is by far heating and cooling followed by lighting, and services only accounting for about less than 10%.

The objective of the UN Earth Summit in Rio 1990, designated 2000 as the year in which signatories, Australia being one, agreed CO_2 emissions would be returned to 1990 levels.

A 13% reduction is required by Australia and there is strong evidence to suggest this will be well less than 10% (Wilkenfield, Hamilton and Saddler 1995 : Australia Green House Strategy).

Approximately 1000kg of CO_2 is produced for every 1MW/hr per annum of energy.

A BRE report estimates energy use for the following:

- a typical office as - 415kwh/m^2 per annum
- suggests good practice as - 223kwh/m^2 per annum
- energy and future efficiency offices as - 90kwh/m^2 per annum

The Building Envelope is a critical element in the design of energy efficient building no less the role of Glass in regards to:

- Passive solar ventilation and heat gains.
- Solar transmission and control.
- Daylight.

CASE STUDY 1.
Rhine - Elbe Science Park, Germany

The aim of the new technology here is to save energy.

The building is 300m long east/west axis with the west elevation fully glazed as an arcade to which office pavilions open onto.

The large trussed facade, 3 stories high, are passive solar energy collectors. An exterior sunscreen system together with a draught free ventilation system prevents the hall of the arcade overheating. The ventilation achieved by evaporative cooling from a man made pond adjacent the building, where the facade acts as a solar stack to draw air across the water and throughout the building.

The glass is a Pilkington Germany Low "E" Double Glazed Unit, with 62% solar transmission. Energy consumption in the arcade is 85KWH/p.a. and less in the pavilion.

Photo electric solar cells are used in the roof to generate 200MWH of energy.

CASE STUDY 2.
Refurbishment. Telecom Administration Building in Cologne.

By installing a second skin, a passive ventilation system was achieved. Between the exterior outer weather protection facade of clear and colourback glass and the functional interior facade of solar control class.

There is a space of 250mm which is designed as a system of vertical shafts over the height of the 7 level building. Every third window axis cannot be opened and acts as a shaft where the air rises in a flue due to thermal updraught. The spandrel windows between are designed as box units with excess air openings into the "flues". With this system, waste air from inside the building is suctioned off and offices are provided fresh air via the slits provided.

Features include:

- natural ventilation from the flue effect.
- the second skin provides protection from noise and climatic influences.
- the windows can be opened in all weathers.
- the solar protection devices (moveable blinds) are protected between the glass.

C. PHOTOVOLTAIC CELLS

The solar energy that reaches the earth in one year corresponds to more than 5000 times the present world energy demand.

Solar Cells

The raw material is crystalline silicon and a 100mm x 100mm cell produces 1.5 watts with direct voltage of .5V and a current of 3A.

The cells are encapsulated in glass laminates which achieves a 20 to 30 year life.

Several hundred solar cells are required to connect installations into the mains.

Integration into Buildings

Pilkington solar international produces cells up to 2m x 3.2m. They can be shaped without restriction and light transmission can be varied by layout of the cells and type of glass incorporated into the glass laminate.

Features:

- solar control used as a shading device.
- light transmission.
- sound insulation.
  thermal insulation.
- on site electrical generation.

The cost of the cells is currently high but reducing as technology develops. Cost of electricity generation is between 55 and 90 cents per KWH, but when eombined in the facade elements of a building become more economical.

For the environment about 1900 kg of CO, reduction per m^2 over the life of the building.

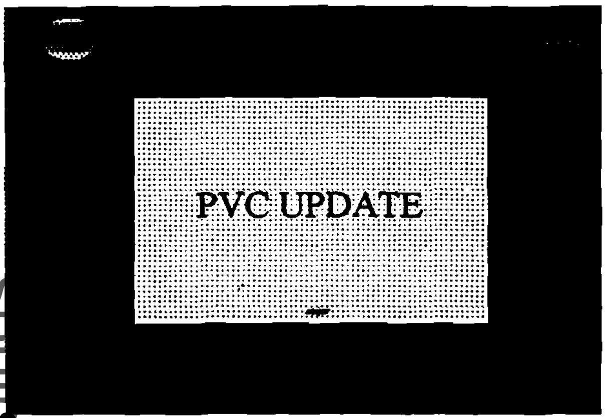
D. SUMMARY

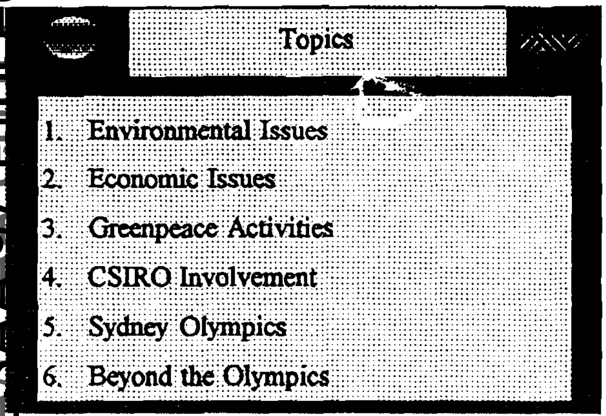
The incorporation of economical and innovative structural glass facades has a strong history in Australia and the development of the Pilkington planar fitting has assisted this.

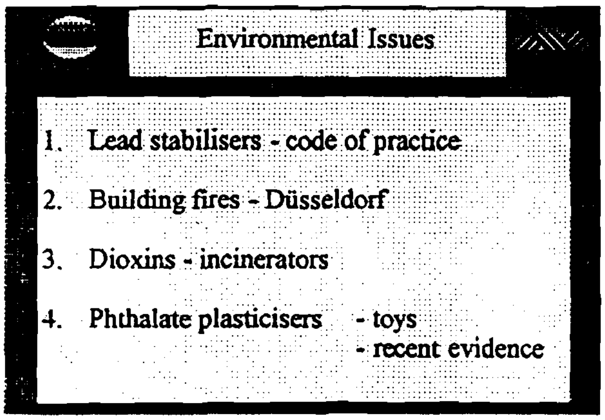
The incorporation of passive solar structural glass design is waiting in the wings to become the next facade development.

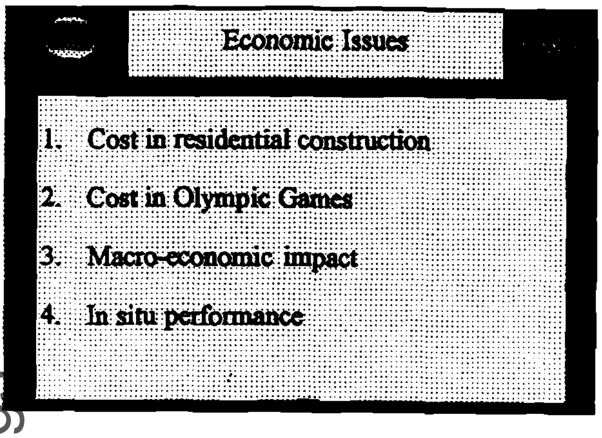
Rob Faulkner
General Manager Corporate and Environmental Affairs
Australian Vinyls Corporation Limited

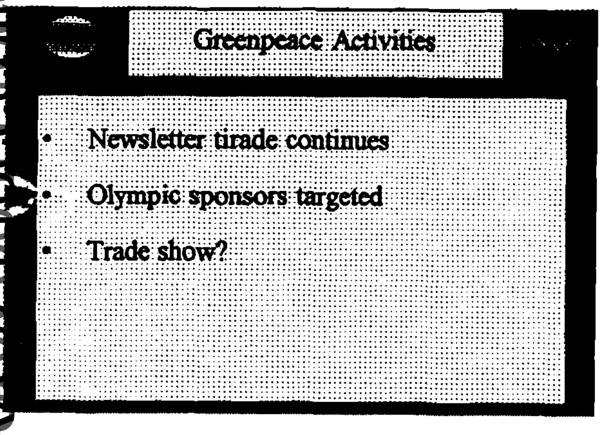
1 August 1997

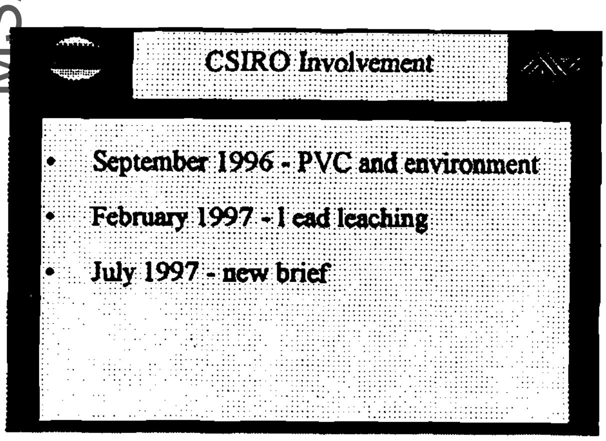


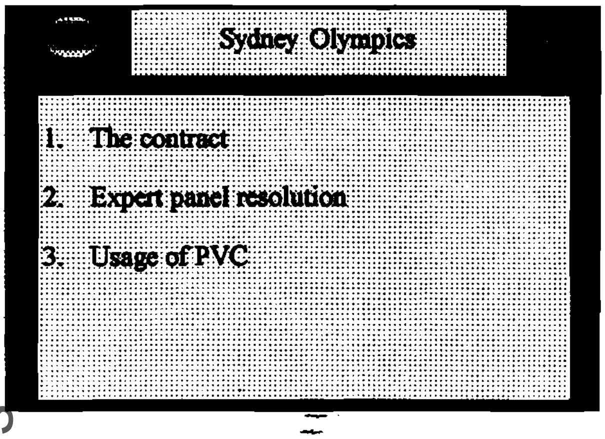


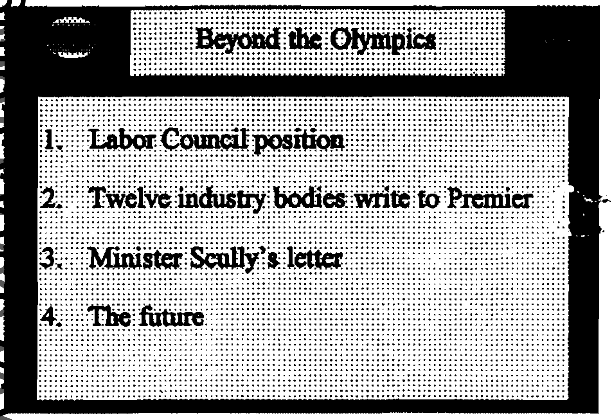



Economic Issues
1. Cost in residential construction
2. Cost in Olympic Games
3. Macro-economic impact
4. In situ performance


Greenpeace Activities
• Newsletter tirade continues
• Olympic sponsors targeted
• Trade show?


CSIRO Involvement
• September 1996 - PVC and environment
• February 1997 - l ead leaching
• July 1997 - new brief


Sydney Olympics
1. The contract
2. Expert panel resolution
3. Usage of PVC


Beyond the Olympics
1. Labor Council position
2. Twelve industry bodies write to Premier
3. Minister Scully's letter
4. The future

OLYMPIC
CO-ORDINATION
AUTHORITY

CMEAP RESOLUTION ON :

THE APPLICATION OF THE ENVIRONMENTAL GUIDELINES AS THEY EFFECT CONSTRUCTION MATERIALS, PRODUCTS, AND THEIR APPLICATIONS

The Construction Materials Expert Advisory Panel (CMEAP) ***recommends*** *that the Olympic Co-ordination Authority foster an approach to design and* ***specification*** *within the tendering community encompassing the following principles :*

- *Construction design and specification should be developed within the principles of Ecologically Sustainable Development to* ***optimise*** *environmental outcomes,*
- *Innovative design and product concepts should be encouraged,*
- *Materials, products, and designs must* ***be fit*** *for purpose and should be assessed on merit in terms of cost, performance, and environmental impact,*
- *In the selection of materials and products the Precautionary Principle, as endorsed by the Government of Australia, should be* ***observed*** *at all times ; "Where there are threats of serious or irreversible environmental damage, lack* ***of full*** *scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation", and*
- *Designs and specifications must be economically viable and* ***offer*** *a value for money solution.*

OCA Environment Branch — February, 1997

MEDIA RELEASE

"Labor Council supports continued use of PVC"

The **Labor** Council of **NSW** last night endorsed a campaign by unions in the building and construction **sectors** to ensure the continued use of **PVC** products. Labor Council **affiliates** are concerned that moves to eliminate **PVC,** on environmental grounds, will lead to thousands of job **losses** in **industries** associated with **the manufacturing of PVC** products, and lead to an increase in workplace injuries.

*"**Based on the best scientific evidence, environmental concerns about** the **effects** of PVC appear to be over stated"* **Assistant** Secretary, Michael Costa, said. Mr Costa pointed to research conducted by the **CSIRO** which had concluded *"**that** the **adverse** environmental **effects of** using PVC **in** building **products are very** small and no **greater** than **those** for **other materials**"*

Mr Costa said *"what **appears** to **have** been overlooked by those proposing **the** elimination of **PVC is** the **impact on workers' jobs and** safety **in** the workplace. The current **alternatives** to PVC; **clay** and concrete **piping,** would require **work** methods that **are outdated and likely** to lead to a greater incidence of back injuries.*

*The inclusion of Green Guidelines in **the** Sydney 2000 **bid** was a **key** component in **the** success **of** the bid and the Labor Council would honour Government commitments in relation **to** the Sydney **Olympics project,** but would seek **to ensure** that all other Government **funded projects utilise** PVC where it war the **appropriate product.**"*

Labor Council would be **seeking** an urgent meeting with **the** Minister for Public Works, the Hon. Carl Scully, MP, to discuss its concerns about proposals lo extend Olympic Green Guidelines to other **NSW** public works. The Council will consider whether **further** industrial action is appropriate **after meeting with the Minister.**

For further **information:**
Michael Costa
Wk: 02.9286.1603
Mobile: 0418.442.719

Labor Council of New South Wales
State Branch of the Australian Council of Trade Unions
Secretary: Peter Sams
10th Floor, Labor Council Building, 377.383 Sussex Street Sydney NSW 2000
Telephone: (02) 264 1691 Facsimile: (02) 261 3505

6 Dec '96

Australian Aluminium Council
Australian Business Chamber
Australian Chamber of Commerce and Industry
Australian Chamber of Manufactures
Business Council of Australia
Employers' Federation of New South Wales
Housing Industry Association
Master Builders Association of Australia
Master Plumbers Australia
Metal Trades Industry Association
Plastics and Chemicals Industries Association
State Chamber of Commerce, New South Wales

9 December 1996

The Honourable R J Carr MP
Premier of New South Wales
Parliament House
Room 805
Legislative Assembly
Macquarie Street
SYDNEY NSW 2000

Dear Premier,

On behalf of a wide cross section of Australian industry, we wish to register with the NSW Government our strong concern about the process of selecting building and construction materials for the Sydney Olympics, and about the future implications in the wider arena of NSW Government purchasing policy.

While it is clearly appropriate for Government to be concerned with the environmental impacts of building and construction materials, it is also important that this be done in a scientific and equitable manner. We are particularly concerned about the way in which one particular material, PVC, has been singled out for restriction, and about the potential flow on of this precedent beyond the Olympic Games, and to other materials.

As you know, the PVC minimisation guideline adopted for the Sydney Olympics derives from an anti-chlorine clause in the Environmental Guidelines adopted by the Sydney Bid Team in September 1993 at the specific behest of an environment group. This was done without consultation with scientific experts in the field, the PVC industry, or the building industry.

The poor scientific basis for the guideline is confirmed by the recent report of the CSIRO entitled "The Environmental Aspects of the Use of PVC in Building Products", a detailed and scientifically independent study, which finds that:

> "... the adverse environment effects of using PVC in building products are very small, and no greater than those for other materials."

We believe there is an urgent need for the Government to officially acknowledge the central importance of scientific rigour in policy formulation regarding environmental evaluation of materials and products. All products, indeed all human activities, have environmental consequences. These must be weighed against the benefits of the product and the benefits and environmental consequences of alternatives. In all cases, such assessment should be based on scientific fact and realistic estimates of comparative benefitand risk.

Industry is concerned not only about PVC, but that the arbitrary restriction imposed on this product sets a precedent for similar treatment of other proven and valuable products - such as aluminium. If well known materials like these can be undermined without consultation or scientific input, the same can clearly occur with any material. Unless the principle of selection on merit exists and is seen to exist, Australian industry must face an uncertain future.

The potential impact on industries which are significant producers of value-added Australian products and major employers in NSW could be most damaging. Prejudicial, non-scientific discrimination leads to significant disruption to industry and cost imposition on the community, with no guarantee of environmental gain.

We seek your consideration of these issues, and prompt action from the Government to ensure that products are afforded fair treatment under Government procurement, and that the principle of selection on merit is restored. It would be of great value to see a clear statement from the NSW Government confirming this principle.

In addition to the above, we understand your Government is committed to establishing sound procedures for environmental assessment in future public procurement.

We would welcome dialogue with the Government on these two important matters.

Yours sincerely,

David Coutts
Executive Director
Australian Aluminium Council

Philip Holt
Managing Director
Australian Business Chamber

Mark Paterson
Chief Executive
Australian Chamber of Commerce & Industry

Allan Handberg
National Chief Executive
Australian Chamber of Manufactures

David Buckingham
Executive Director.
Business Council of Australia

Garry Brack
Executive Director
Employers' Federation of NSW

David Duncan
Executive Director, Services
Housing Industry Association Limited

Wilhelm Harnisch
Acting National Executive Director
Master Builders Australia Inc

Robert Hutt
General Manager / Secretary
Master Plumbers Australia

Robert Herbert
Chief Executive
MTIA

Michael Ma
Chief Executive Officer
Plastics and Chemicals Industries Association

Katie Lahey
Chief Executive
State Chamber of Commerce (New South Wales)

New South Wales

Minister for Roads
Minister for Public Works and Services
Minister for Ports
Assistant Minister for Energy
Assistant Minister for State and Regional Development

RECEIVED
02 JUL 1997

Mr Mark Paterson
Chief Executive
Australian Chamber of Commerce and Industry
PO BOX E14
Kingston ACT 2604

26 JUN 1997

Dear Mr Paterson

I refer to your letter of 26 May 1997 to the Premier in respect of the use PVC on New South Wales construction projects. The Premier has asked me to respond as the matter falls within my portfolio responsibilities.

I have been informed of continuing concerns in respect of the need to clarify the Government's procurement policy on the selection of products for government construction projects.

I have noted the conclusions of the expert CSIRO report " The Environmental Aspects of Use of PVC In Building Products", particularly:

> "...the adverse environmental effects of using PVC in building products are very small, and no greater then those of other products."

As you would be aware the Government will continue to observe its contractual commitment regarding the use of W C In the Olympic Games. However, the Government's policy on non-Olympic projects will be maintained in that all products, including PVC are assessed on their merits. In respect of PVC the CSIRO report would form a component of that assessment process.

PVC is a proven material which has contributed much to the community in performance and economy, The CSIRO's recent report confirms its environmental profile Is sound.

You may be aware that I intend to release a draft Procurement .Policy Statement in the next few months.

Level 34, Governor Macquarie Tower, 1 Farrer Place, Sydney NSW 2000 Tel: (02) 9228 4455 Fax: (02) 9228 4633

The Statement will address significant issues in respect of procurement policy and reiterate the Government's policy that products will be assessed equally and impartially on their demonstrated comparative merits In terms of performance. cost and environmental impacts. Expert scientific opinion, where available, should form the basis for such comparisons. especially on questions of environmental impact.

I trust that the above clarifies your concerns end look forward lo your comments on the draft Procurement Policy Statement following its release.

Yours sincerely

CARL SCULLY MP
Minister *for* Public Works and Services