MEMBRANE STRUCTURES for RETAIL and LEISURE

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Membrane Structures have found niche markets in the retail and leisure industries. This paper explores the features offered by membrane structures to these markets by reference to several projects.

1. INTRODUCTION

Over the last three years the membrane structures industry has expanded quite rapidly into more identifiable market areas. The retail and leisure industries are in the forefront of this growth in membrane structure projects. Several projects with which the author has been involved are examined on the following broad criteria:

- Application of fabric properties.
- Comparison with alternatives.
- Relative life costs.
- Special features unique to membranes.

2. NORTH SYDNEY POOL

Located at Milson's Point at the northern end of the Sydney Harbour Bridge, North Sydney Pool has a unique place in our sporting history. Swimmers such as Dawn Fraser, Murray Rose, John Konrads set many records in North Sydney Pool.

In 1981 a decision was made to cover the pool with a pneumatic structure which would operate during the winter and be removed in summer. The removal requirement was a "must" as the pool was a major summer leisure pool with toddlers pool and outdoor lawn areas, and a magnificent outlook over the harbour and the city.

The pneumatic membrane structure was the only form of enclosure which could be easily removed without disturbing the pool surrounds.

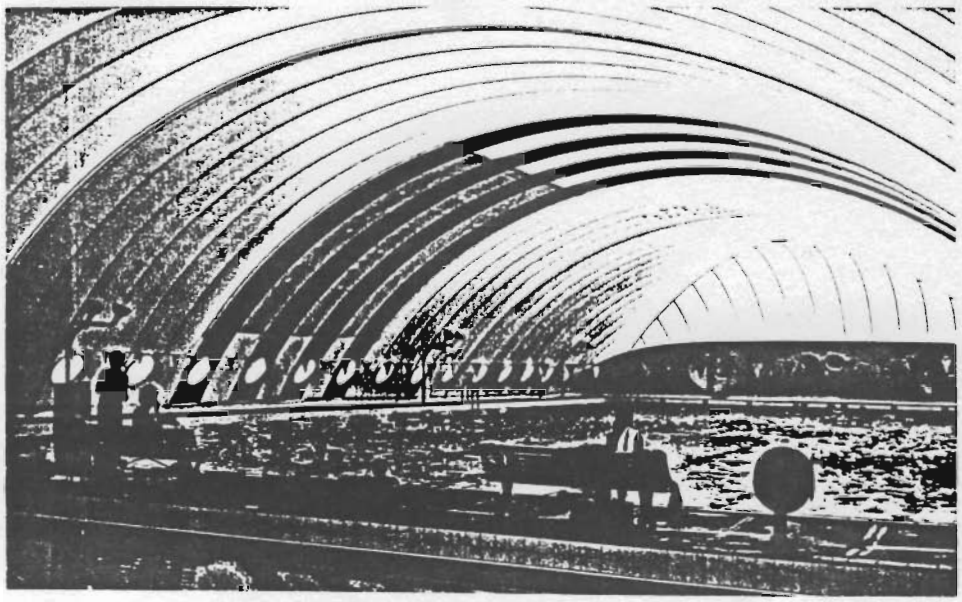
In 1986 North Sydney Council decided to replace the original pneumatic structure, and Vesl Membrane Systems was contracted to supply a new structure, dimensioned to fit the existing anchorages. The structure was installed in May 1987 and incorporated several innovative features, including clear flexible portholes, dynamic colour detailing and a giant 10m x 10m removable logo panel depicting the North Sydney Council logo.

Council chose a traditional Architect/Consulting Engineer path with a detailed specification designed to avoid the problems of the original structure e.g. prevention of fabric wicking, and mould growth, and corrosion in mechanical plant.

In short, the job was done properly with quality fabric, hardware and fittings and the structure is successfully entering its fourth season in excellent condition.

The relevance of this project is that no realistic structural alternative exists to a pneumatic membrane structure which could meet the annual removal criterion.

Client	:	North Sydney Council
Architect	:	Arnis Budlevskis, Sydney.
Engineers	:	Taylor Thompson Whitting, Sydney.
Membrane Builder	:	Vesl Membrane Systems, Brisbane.
Dimensions	:	27m x 66m x 8.5m.
Membrane Area	:	2500 sq.m.



NORTH SYDNEY POOL

PRIMARY INDUSTRY
PAVILION
EXPO 88

3. PRIMARY INDUSTRY PAVILION - EXPO 88

Expo 88 has had plenty of exposure in the last 2 years, and its theme - 'Leisure in the Age of Technology fitted well with membrane structures.

The Primary Industry Pavilion Silo filled both a retail and leisure role at Expo 88. Conceived as a giant grain silo, P.I.P. could have been built of a rigid material such as plywood, concrete, steel or perhaps a rigid plastic.

For number of reasons, a tension membrane structure was chosen, these included:

- Minimal internal support members.
- Translucency admitting soft natural light and producing spectacular night lighting.
- Completely relocatable without loss of use of components.
- Fast erection and removal.
- Significantly lower cost than any conventional or rigid plastic construction.

The membrane was erected and secured in one day.

Colour flashing was added using signfacing technology in the fabrication shop, saving expensive site labour.

The fabric chosen had a Tedlar® PVF exterior finish to minimize dirt pickup. The structure was exposed from October 1987 until April 1989. When it was demounted, it was noted that the exterior was exceptionally clean and in fact more dirt was found on the inside surface, probably from interior activity during the Expo.

This project illustrates an application where a membrane structure performed all the roles of a rigid structure, did a better job due to translucency, flexibility for colour application, easy relocation, and cost far less than any alternative.

Client	:	Primary Industry Pavilion Pty Ltd.
Architect	:	Bell Puddy Aust.
Engineer	:	McLean Wade & Pnrs.
Membrane Builder	:	Vesl Membrane Systems (Tension Span Structures)
Membrane Area	:	600 sq.m.

The membrane fabric was assessed by fire authorities and found to be able to meet all requirements. All of the structures examined in this paper have been 'FR' rated and comply with NFPA- 701 and give a test result to AS1530 Part III of 16, 0, 0, 6.

4. WARANA FESTIVAL

For the 1988 Warana festival, a series of membrane structures was conceived to add visual impact to the Brisbane City Square.

The structure was temporary, to be in place for approx 10 days, and designed for re-use each year for 5 years.

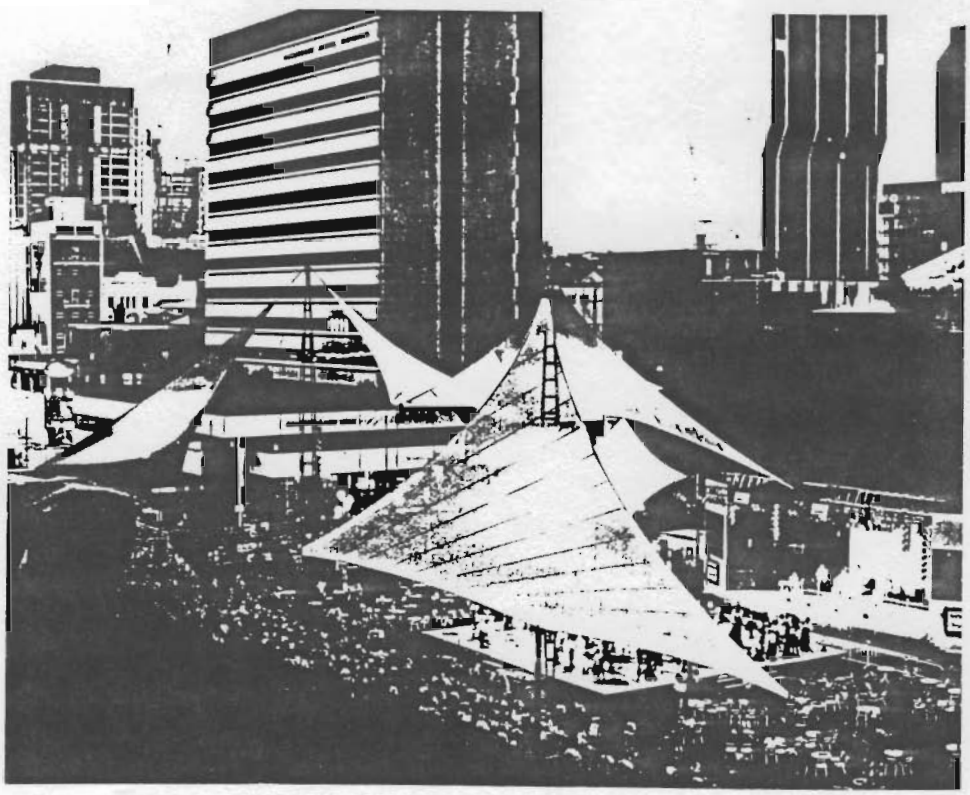
Spectacular laser light shows co-ordinated with entertainment were projected onto the sails.

The basic form was unsymmetrical hypars, suspended on cables and masts.

An interesting feature was the attachment of backstay cables to the main corinthian columns of the Brisbane City Hall.

The fabric chosen was a PVC coated Polyester mesh which could accept a back projected image and display it on both sides.

Client	:	Brisbane City Council
Design/Engineer	:	McWilliam Consulting Engineer
Membrane Builder	:	Vesl Membrane Systems (Tension Span Structures)
Membrane Area	:	1000 sq.m.



WARANA FESTIVAL SAILS

5. MARINA MIRAGE

The tension membrane sails at Marina Mirage, Gold Coast Qld, could be regarded as both a retail and leisure application of membrane structures.

Appearing like a fleet of yachts on the water, the sails, of differing heights and spatial arrangement, float above a 3 level retail, restaurant and marina complex.

The 'back to back' hypar forms are supported by flying masts in ten (10) modules.

Environmental conditions are relatively hostile, with the ocean on one side and Southport broadwater on the other. Salt air, high winds, and sub-tropicial weather posed a tough combination for finishes and materials.

The membrane fabric chosen was a Class IV Tedlar® PVF PVC/Polyester carrying a 10 year warranty.

After exposure of now over 2 years the fabric surface is as clean and bright as when installed.

This project is regarded as a significant application of membrane structure technology in world terms. Visitors from Japan, U.K. U.S.A. are impressed with the advanced state of an industry which can produce such quality structures.

On our criteria, rigid construction was feasible, and could have produced similar shapes, however the fabric translucency, smooth curves, and self-cleaning finishes would be hard to match.

Relative costs over life indicate that the project as built, would be of the order of half the cost of any feasible alternative.

Client	=	Mirage Management Pty Ltd.
Architect	=	Media Five (Gold Coast)
Engineers	=	McWilliam Consulting Eng.
Membrane Builder	=	Vesl Membrane Systems (Tension Span Structures)
Membrane Area	=	3500 sq.m.

MARINA MIRAGE SAILS

6. SEAWORLD NARA RESORT

Created as a family resort style accommodation next to Seaworld on the Gold Coast, this project involves over 4500 sq.m. of tension membrane roofing to a central courtyard formed between three storey condominiums.

The structural system used conventional pitched roof steel frames with tension membrane elements of various types in between.

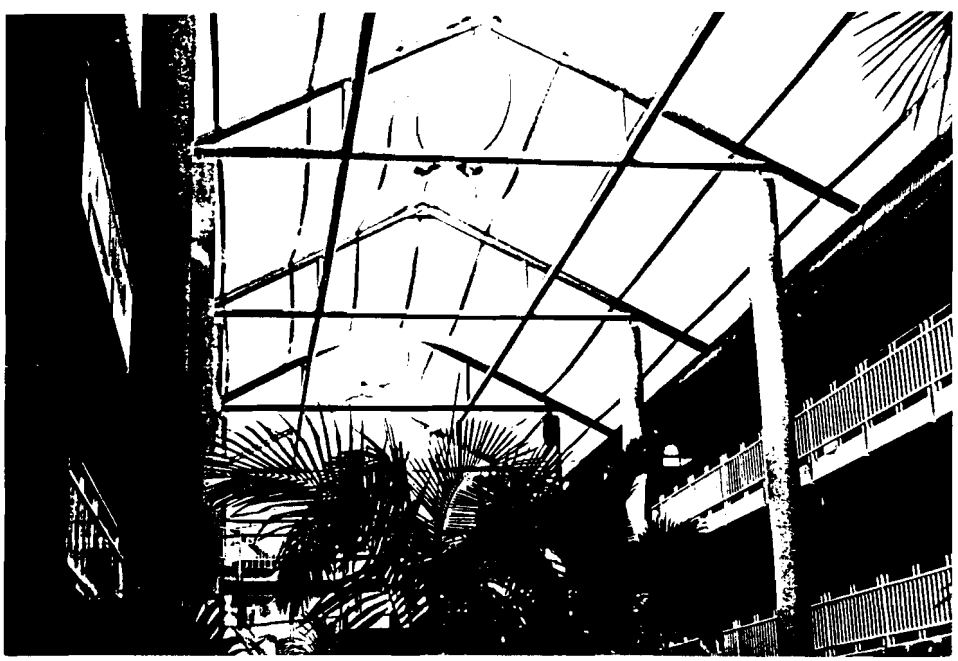
Membrane elements included teardrop openings at the ridge to allow light directly onto plant growth in the courtyards and single bay elements shaped to form a continuous cover.

With an environment indentical to Marina Mirage a Class III Tedlar® PVF fabric was chosen and after nearly two years exposure is bright and clean despite much flatter membrane profiles.

The tension membrane solution fulfilled the requirements of a short erection time under typical builder's fast track programme; translucency which enabled plant growth, pleasant light conditions in the courtyard, and great economy compared with any alternative skylight system and all but the most basic metal clad systems.

The visual effect complements the entertainment and leisure resort nature of the project and on all criteria is an ideal use of membrane structures:

Client	=	Seaworld Nara Resort
Architect	=	Alan Griffith Architect (Gold Coast)
Engineers	=	Weathered Howe (Gold Coast)
Membrane Builder	=	Vesl Membrane Systems (Tension Span Structures)
Membrane Area	=	4500 sq.m.



SEAWORLD NARA ROOF

7. BEATON PARK LEISURE CENTRE

As part of an overall recreation plan Wollongong Council resolved to maximize use of an existing heated outdoor pool by installing an all weather enclosure. Council's performance specification called for:

- Clear span permanent structure.
- Natural light to the interior.
- Openable sidewalls to half the perimeter.
- Integration with existing amenities.
- Low maintenance, low capital cost.
- Minimum ten (10) year warranty.

The solution was an arch truss supported, tensioned membrane dome, sprung from 2.4m high columns and walls of conventional shop front type glazing.

The translucency of the membrane brought a soft inviting brightness to the interior while eliminating the need for daytime lighting.

At night artificial lighting was minimized due to the white reflective interior while creating a bright exterior glow of brilliant visual effect.

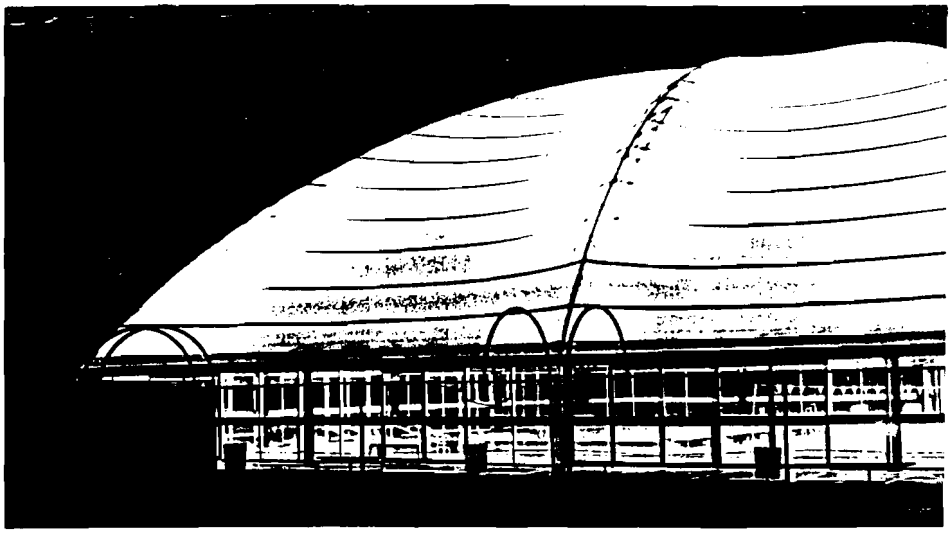
Heat load was minimized due to the high exterior reflectivity and the Class III Tedlar® PVF surface provided very good self-cleaning properties under normal rainfall.

The combination of inert fabric and well protected steelwork provides surfaces highly resistant to the pool atmosphere.

Alternatives to fabric structures in pool environments are typically 50% higher in cost at the lower end of the range and to provide similar levels of natural light, and visual appeal, the costs rise much higher.

The result is an economical but high quality structure using the membrane form to its maximum advantage.

Client	=	Wollongong City Council
Membrane Design & Construction	=	Vesl Membrane Systems (Tension Span® Structures)
Membrane Area	=	1600 sq.m.



BEATON PARK ENCLOSURE

8. LOGAN HYDERDOME SHOPPING CENTRE

Situated on the southern corridor to Brisbane, the Loganholme Hyperdome is a large new retail centre development.

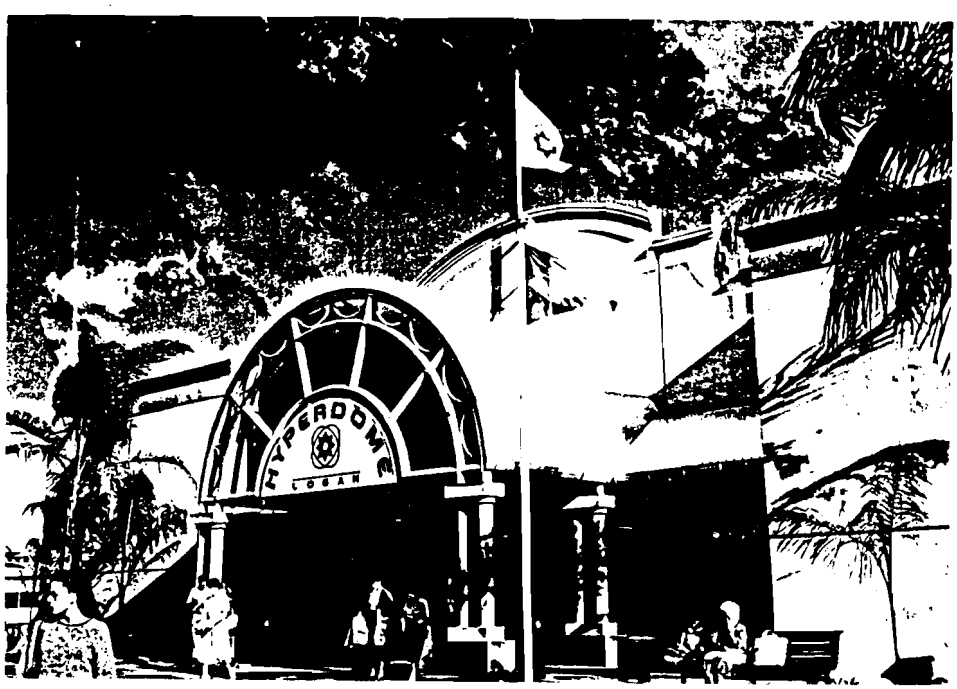
The design included six (6) entrances of barrel arch design with 'wings' of similar curvature intersecting at right angles.

The steelwork design involved a series of colour variations at various entrances, and the membranes were fixed and tensioned with a continuous clamp plate system.

The membrane fabric was a Class II Tedlar® PVF PVC Polyester fabric. Fittings were powder coated with stainless steel bolts.

On our criteria, this project could have been done with rigid materials at a higher but not greatly different cost. Tension membranes were used mainly for visual and translucency reasons, and the method of intersecting the wings with the barrel membrane in a smooth and interesting way.

Client	:	LEDA Constructions.
Architect	:	Malone Buchan Laird Bawden (Brisbane)
Engineers	:	Moir Harding & Pnrs (Brisbane)
Membrane Builder	:	Vesl Membrane Systems (Tension Span Structures)
Membrane Area	:	1000 sq.m.



LOGAN HYPERDOME ENTRANCES

9. PENINSULA FAIR SHOPPING CENTRE

The redevelopment of a major retail shopping centre at Kippa-Ring north of Brisbane involved the choice of membrane structure skylight domes.

In all, six tension membrane domes were installed varying in size from 9.5m square (2), 11.5m square (3) to the main atrium of 20.5m square capped by a 6m diameter clear polycarbonate bubble.

The large volume created within the main atrium space combined with the soft shadow free light creates an ambience unique to tension membrane enclosures, without the heat load of conventional glazing systems.

The difficulty of planning the installation programme is eased when the structure can be erected in a very short time.

Each of the six (6) structures was erected on schedule, with no delays to other areas of construction. This allowed rapid sealing of the roof area and progress on interior works.

It is thought that no other skylight system on such a scale could have matched this performance.

Again on all criteria the use of tension membrane structures offers positive advantages in physical features and cost savings against conventional systems.

Client	:	Wilson Group Pty Ltd
Architect	:	Bell Puddy (Melbourne)
Engineer	:	Mattefy Perl Nagy (Brisbane)
Membrane Builder	:	Vesl Membrane Systems (Tension Span Structures)
Membrane Area	:	1800 sq.m.

PENINSULA FAIR ATRIUM