

**PROJECT MANAGEMENT AND DESIGN OF
PRESTON MARKET REFURBISHMENT**

by Peter Lim, Connell Barrow McCreedy Pty. Ltd.

INTRODUCTION:

This paper will look into a methodology of project management and design of tension fabric structure projects with Preston Market as its model. There are many techniques and methods for handling design and construction depending on:-

- a) client objectives
- b) size of project
- c) existing services and buildings
- d) budget
- e) time constraints
- f) planning and municipality constraints

to name a few.

Appointment of contractor for the fabric covered walkways of Preston Market, unlike conventional buildings however, had to be determined in its early stages. Fabric manufacturers' lead times play an important factor, especially with large quantities of fabric. At the moment, most architectural fabrics are imported from Europe or America and if stock availability is insufficient, there is a lead time of 4 - 6 weeks for sea freight.

From experience, the appointment of the contractor at an early stage will contribute

- a) practical erection schemes such that minimal and efficient use of both manpower and site constraints is implemented into the design
- b) advise on the practicability of different fabric forms
- c) initial costings for budget purposes
- d) time and project scheduling

This project can be defined as design and construction, using an experienced specialist contractor to successfully conduct the fabric component.

In Australia during the Victorian period there was a proliferation in construction of fruit, vegetable and produce markets throughout Australia to service the rapidly expanding population in this post-gold rush era.

Only Melbourne retains a substantial network of this form of construction which can be seen as the pre-cursor of the contemporary shopping centre and mall development which has seen an upsurge of construction activity recently.

The cones being centrally located created more space and depth to the aisles between the steel colonades.

Transparency of the fabric further enhanced an atmosphere of light to flood into the market arcades creating cool shade in the summer and shelter from the wind and rain in winter.

Natural ventilation was achieved by having the structures cantilevering beyond the existing eaves line of the market roof and use of catenary cable edges. These edges were free spanning between column supports, allowing free air movement and preventing stagnation. The water run-off was designed to shed from the edge of the fabric onto the existing roof for dispersion through the rain water system.

The final form is as shown in Figure 1 comprising 3 different modules. All modules are rectangular in plan, terminating into a ring at the top and thus forming a conical shape. The ring is held in space by a stub mast. This in turn is fixed by 4 cables projecting from the respective column supports.

In total there are 49 units of the various modules. These formed a cruciform shape in the plan layout of the market. (Figure 2).

The system thus allowed no obstruction aside from the 4 columns at ground level. The columns are 6.1m above ground level. Wind braces were placed at every second bay along the direction of the columns. The cable-mast system also acted as a cross brace for the stabilization of each individual unit.

Structurally, the loads were carried by the columns. Thus, no additional loads were transferred to the existing buildings and the need for extensive, complex excavation and footings was eliminated.

The columns consisted of CHS sections and the perimeter, universal columns. These columns and beams were designed to not only provide structural adequacy for the canopies' loads, but to act as gutters and provide drainage.

The design called for 3 basic modular forms.

- a) **Module 'A'** This is a cone on a rectangular base dimensions of 6.9 x 7.3m. Two of the edges are clamped into position and the other two consist of cable edges.
- b) **Module 'B'** This is similar to Module 'A' except for the plan dimensions of 6.7 x 6.9m.
- c) **Module 'C'** All of the edges of the base are clamped into position.

The formfinding shape analysis and cutting patterns for fabrication were achieved via TENSYL program.

In the 1970's, attention focused on the north eastern sector of Melbourne where demographic pressures prompted the construction of another market of this genus.

In 1970 the owners held a design competition which was won by a team of young and eager architects and engineers who developed and constructed what was probably Australia's first real space frame structure on a vast scale to create an architecturally contemporary complex in that era..

Eighteen years on and having been developed before the concept of department stores, hypermarkets and markets all housed under one roof, (before the shopping towns and malls of Westfield), the market looked tired and in need of extensive refurbishment.

The market comprised of cubic blocks of shops divided by open streets or lanes used for access both by shoppers and service vehicles.

In the 1980's it was difficult for Preston Market to gain or maintain a share of the consumer market. The owners were concerned with their dilemma and commissioned **Hames Sharley Architects** to oversee refurbishment plans for this complex.

Over a period of one year an extensive development plan was produced not only to carry out various upgrades, but to utilize fabric structures to roof the arcades and create an atmosphere of lightness and decrease the phobia of congestion created by enclosed areas further perpetuated by a throng of people conducting their weekly shopping.

In the final throes of preparation for tender in April 1987, the market changed hands. Upon examination of the feasibilities of the upgrade and the cost of their purchase of \$15.3 million, the new owners, **Interwest Limited**, decided upon pursuing the fabric structure upgrade component directly.

On the recommendation of the architects, the owners were in touch with **Spacetech Pty. Ltd.**

DESIGN BRIEF:

After the documents and plans for the redevelopment were reviewed, the concept of designing a simplified modular fabric system which would vastly reduce the prime cost to the clients was introduced and put forward.

The task was set to not only create a modular unit which has sufficient variables in its configuration to allow a look of uniformity and ease of construction, but also to maintain individuality as a total project.

The main aim was to roof and provide all weather shelter for the aisles between existing shops and stalls.

A number of constraints and criteria had to be included consisting primarily of the following:

- a) The market had to remain open during construction except for three days of the week. This meant that an efficient project schedule had to be set up to ensure fast track work during these three days. This also meant that most of the work had to be co-ordinated and conducted off-site, which is most ideal for a tension fabric structure.

The ease of erection of these units therefore plays a very vital role in the conceptual design.

- b) Cost constraints on the project were to be kept within a budget as the client was looking to this refurbishment as an investment and was not intent on overcapitalizing. At the same time, the aim was to create an attractive venue for the public to congregate and shop at leisure and comfort.
- c) Most importantly, the fabric structures had to be designed to form an integral part of the market and its existing building.
- d) Structural alterations to the market had to be kept to a minimum to ensure that no heavy excavation for footings was conducted or that any intrusions into public walkways occurred.
- e) Plans for future redevelopment of the site in ten years time, which would incorporate a multi-storey carpark and discount store hypermart, had to be kept in mind as it could mean demolition of most of the structure and possibly a change to the fabric component to a different form. Thus flexibility for ease of dismantling also was an important consideration.

DESIGN CONCEPT:

To satisfy the architectural, structural and cost criteria, the concept of using a modular conical form was evolved. Utilization of steel forms an integral part of the design.

The original construction was a novel space frame grid and the use of diagonal wind bracing ties and tensengrity cable-mast arrangements formed an extension of the original conceptual evolution. One could also state that the use of traditional dark olive green steelwork reminded one of the Victorian era.

This, with the use of white prestressed fabric, further improved the market's image by drawing away from its austere 1970's style to a modernized Victorian reproduction.

The conical shape of the fabric forms also added a new dimension to the market.

CONSTRUCTION:

The construction phase consisted of a bulk of off-site works and co-ordination of the various elements:

- a) fabric manufacturer
- b) fabric convertor
- c) cables and fitment manufacturer
- d) steelwork fabricator

The fabric used is manufactured by Hammersteiner GmbH - Type I Polymer (white). This fabric was ordered prior to final design due to the long lead time for manufacture and shipment to Australia from Germany.

Conversion of the fabric was optimized due to the repetition of the units and details. This can also be said for the steelwork and cables. These were carried out by various subcontractors.

All the above being finished and packed in sequence for site assembly enabled the market to continue trading throughout the construction period and the major erection works achieved during market closure days.

Prior to production of these units, a prototype was built to study the erection techniques and further improve the design. The prototype enabled

- a) study of stressing requirements
- b) refinements of fabrication details
- c) familiarize erection crew with the structure
- d) study of creep and compensations used on the structure.
- e) investigate various steel rigging techniques

Overall, the prototype provided increased efficiencies and inevitably cost savings during the fabrication stage. The decision to undertake the prototype was influenced by the overall number of modules and the constraint of tight on-site time.

The erection sequence for each module is as follows:-

1. fabric unfolded in the centre of the perimeter beams
2. all edges are clamped to the beams and/or cables threaded through the catenary sleeves
3. the ring beam is attached to the fabric
4. flying mast cables are attached to perimeter supports and the mast itself
5. mast is attached to ring beam
6. fabric is then stressed using rigging screws at the end of cables and the length adjustment of the mast.

As the aisle was cruciform in shape, on-site erection commenced from all four ends and finished at the centre Module 'C'.

A schedule and erection technique was devised whereby the main steel columns were bolted in place and the perimeter longitudinal beams attached at the start of each on-site day (i.e. on market closure day). The fabric module was immediately attached in the sequence outlined earlier. On average, the crew were able to erect 3 complete modules per on-site day.

The ease of bolting the main supports were considered throughout the design stage for this purpose. This ensured the full utilisation of on-site time.

The actual on-site program encompassed only two months for the erection component. Thus minimal disruption and on-site costs were achieved. All site works were completed by June 1988.

PERFORMANCE:

It is very difficult to judge the performance of a shopping centre's refurbishment, but if the sale of the market of \$28 million in January 1989 by Interwest after a period of 20 months is any indication, it has been a very profitable venture. The approximate cost of all the refurbishment was \$1,000,000.

The basic aim of the brief has definitely been achieved to provide both an overall all weather shelter and a more comfortable shopping environment.

The installation of new efficient management to run the market also played a vital role in the profitability of a shopping centre. The public are not interested in places which look derelict and run down. This is in line with the consciousness of the general public in recent times to their environment and surrounds.

Aside from the fabric walkways, new seating, lightline refuse containers and concourses were put in place. An overall clean up, together with landscaping, further enhanced the image of the market.

Figures from Interwest prior to the sale shows that custom has increased 30-40% since redevelopment. The net income annually is projected to \$2.25 million at August 1985 with the owners paying the outgoings. The net annual yield therefore is 8% to the purchase price without allowance for acquisition costs.

From a sociological viewpoint, the redevelopment has improved the image of Preston tremendously and is a success.

It is only in recent years that there has been public and local government awareness on the need of refurbishing the inner city suburbs of Melbourne. It is vital that this move continues or slums will emerge from the rubble.

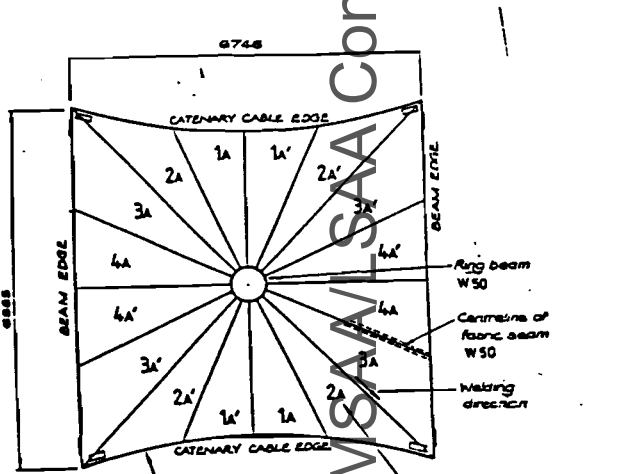
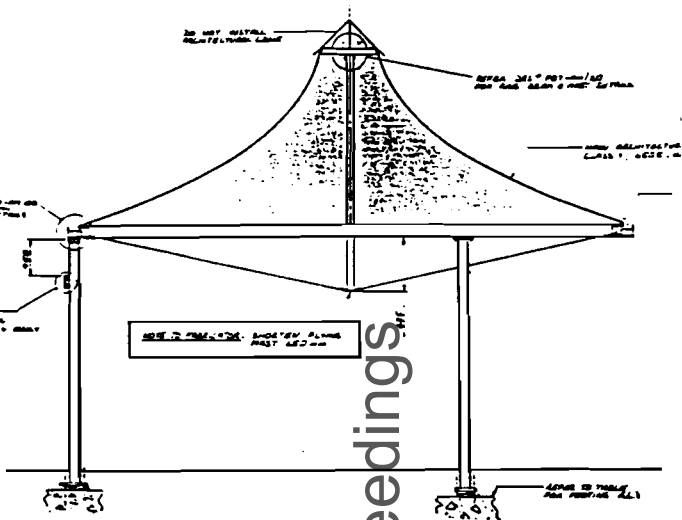
CONCLUSION:

In conclusion, this case study shows that fabric structures can successfully be a viable form of refurbishment and able to take on the quality of the site if properly designed, constructed and erected.

The recognition of the difference in approach, both in design and construction of fabric structures, should be realized and be approached accordingly to ensure a reliable and successful project.

FIGURE 1

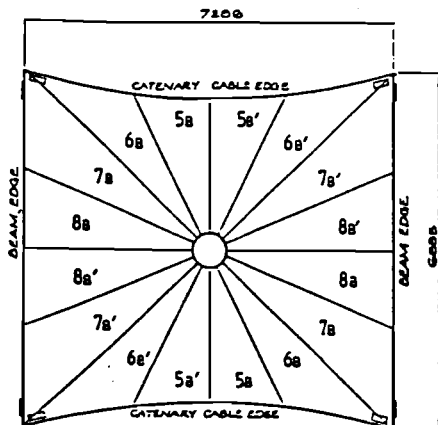
Plan and elevation of various modules.



MODULE TYPE A

Scale: 1:50

For details of pre-drilled holes for membrane panels along beam edges, refer to drawing number P27-PM/28. Typical.

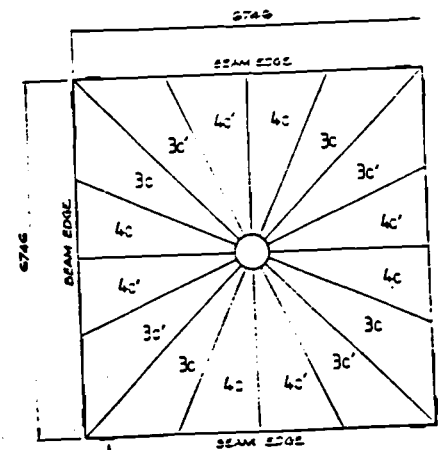


MODULE TYPE B

Scale: 1:50

ARRANGEMENT OF FABRIC PANELS

For details of pre-drilled holes along beam edges, refer to drawing number P27-PM/28. For general arrangement plan, refer to drawing number P27-PM/21.



MODULE TYPE C

Scale: 1:50

Weld reinforcing loops shown in this Sec. corner details.

MSAWI SAA Conf Proceedings

FIGURE 2

Layout plan of Preston Market fabric walkway structures.

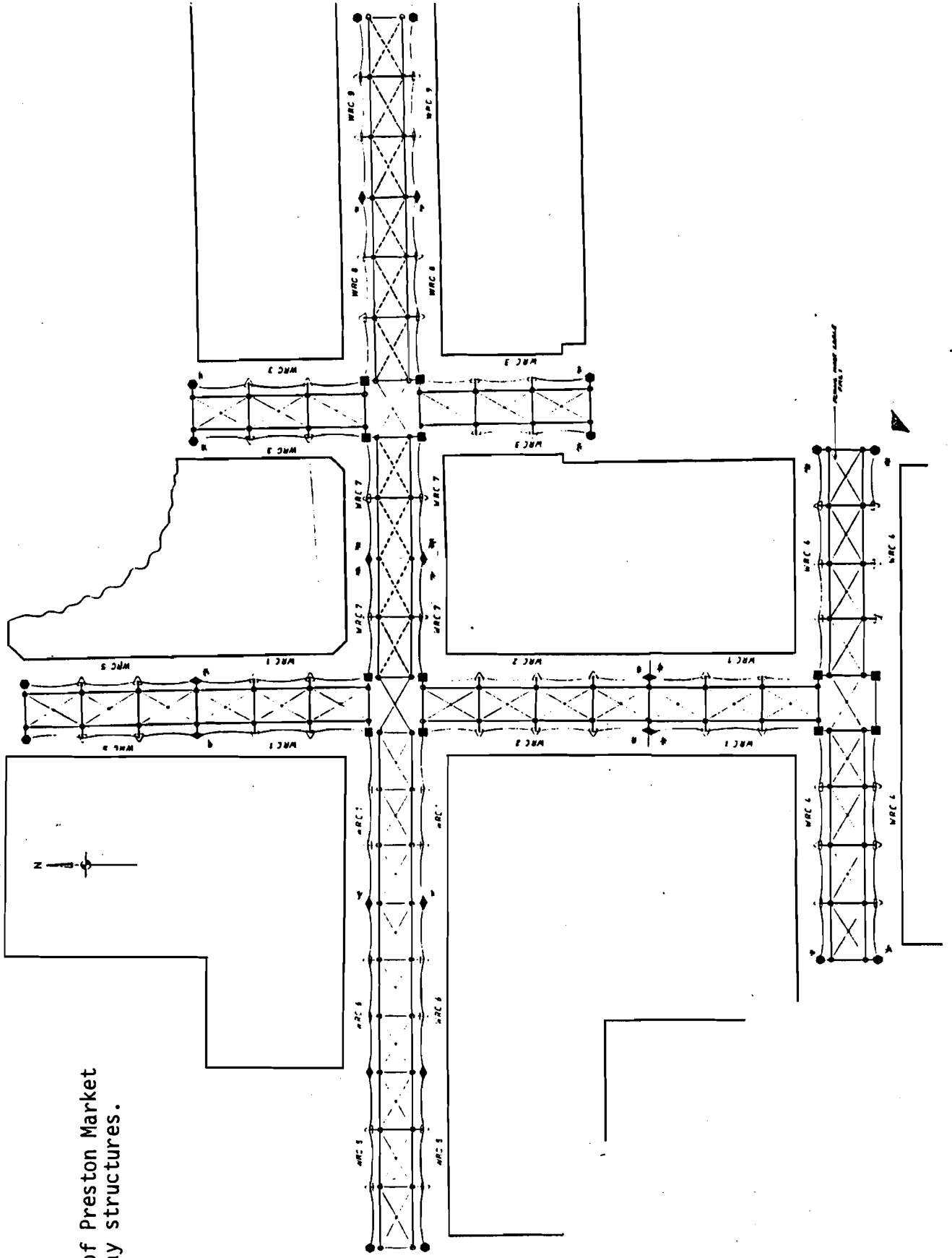


FIGURE 3



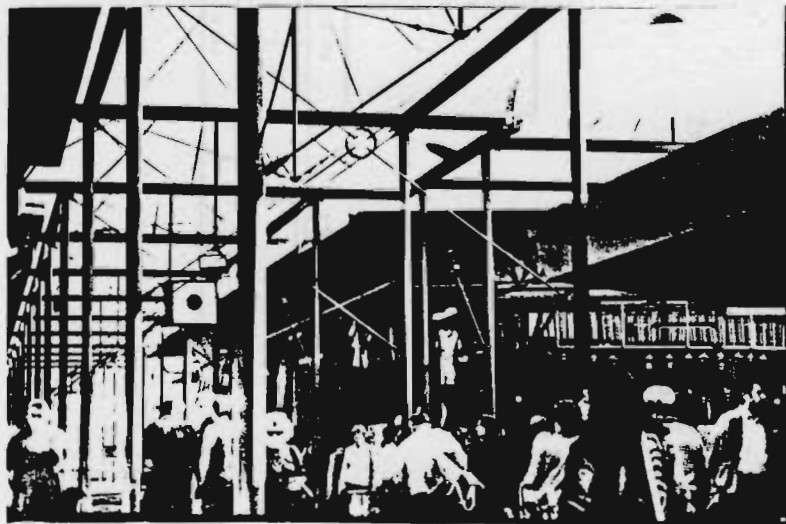
Prototype Module

FIGURE 4



Aerial view of Preston Market fabric walkways

FIGURE 5



Interaction of existing buildings, general public and fabric walkways