BL/LR 5045

MYER CENTRE MEMBRANE ROOFS

1. INTRODUCTION

The Myer Centre has two lightweight membrane roof structures and each has its own unique design purpose.

The main atrium has a teflon coated fibreglass membrane over steel arches along a strong east-west axis surmounted by a large lexan dome in the centre.

The Myer store atrium has a barrel vaulted ceiling with back lit balloon fabric (completely covered by an office tower above).

2. RETAIL LOGIC

The membrane roofs over the Myer Centre atrium respond to some basic principles of retail design.

The main atrium roof provides a large and diffuse light source without the operational and maintenance cost of equivalent electrical lighting. The polycarbonate dome provides blue sky contact at the focal point of the atrium. It is centred over the arrival bridge at Rundle Mall level below.

The strong repetition of the steel arches punctuate the east-west axis of the atrium, providing orientation towards the David Jones link as an eastern anchor and towards Lego, Best and Less, Chandlers, House & Garden and Virgin as western anchors. The central dome creates the visual hub of the east west and north south axes. The main north south axis leads from the central portico entry across Rundle Mall bridge under the dome to the Myer Store. The Myer Store has to own grand mall which leads to the secondary hub of the Myer atrium.

The vertical axis of the spaces in each atrium culminates in the fabric roofs and as such they are vital elements in multi level retailing.

The Myer Store fabric roof is designed to create an impression of sky above, in a situation where the vaults are fully enclosed. Weather, wind, rain and ultraviolet light were not factors and so balloon fabric material was used.

The Myer Centre atrium also has a night lighting function. The fabric and dome are uplighted to provide the visual reference for night time shoppers and some degree of internal diffuse reflected light. It also provides an external reference and a statement to incoming air traffic and other high vantage points from surrounding buildings.

3. STRUCTURAL LOGIC

The steel arches of the main atrium are constructed from 150 Ø CHS pipe bent to a 4.6m radius. The arches repetitively counter-balance against each other across the atrium and around the dome. The dome springs from matching vertical arches. The fabric arches spring from a substantial 250 SHS ring beam which visually floats above the column capitals.

The entire steel structure was pre-assembled in the factory. The steel was then surveyed and marked, pre-painted, dismantled and re-erected in position on site.

The barrel vault of the Myer Atrium was factory welded in two halves, prepainted, transported to site, welded into the full barrel, touched up and craned into position. Taubmans Interfine 629 paint was selected for long life and colour fastness. However it requires special ventilation during application and building unions banned it unless applied off site.

4. FABRIC CUTTING PATTERNS

The aesthetics of the structural arches suggested a leaf-form seam pattern which would compliment the leap of the arches from the column capitals.

Economy, differential stretch characteristics of the material, simplicity of design calculations, simplicity of fabrication, minimal wastage, and fabric roll widths however all suggested two straight seams rolled down the length of the atrium with no reference to the counterpoint of the arches.

Many patterns were tried and analysed until we achieved the best use of the material without any aesthetic compromise in the seam layout. I am sure Permafab are proud of the result.

5. BUILDING REGULATIONS

Before a membrane roof can become a reality in a building such as the Myer Centre, years of very detailed negotiations with the authorities is required to gain approval for an atrium.

I wish to discuss briefly some of the fire and lift safety features necessary to create this atrium space.

The atria of the Myer Centre in Adelaide have many technologically advanced fire and life safety features which are unique in the world and which will provide the basis for new statutory, regulatory and building technology standards.

Full scale fire modelling tests were conducted with the NBTC, SAMFS and CCA buildings branch. Twenty tests were conducted over three days to model, record, computer analyse and optimise the control, containment and extraction of smoke in atria fires. The data from these tests enabled the NBTC to prepare formulae for the safe management of atria smoke, so that public and staff can gain safe and orderly egress from the building, and so that the fire fighting personnel can gain safe access to the seat of the fire to minimize property damage.

Smoke from a fire in a building generally poses a greater hazard than heat because it can obscure exit paths, induce panic, contain high toxicity and it can suffocate.

A comprehensive package of passive and active systems were developed and agreed during the building approval stage of the project and these were hot smoke tested in the completed project to demonstrate full operational functioning and effectiveness of the systems.

Of particular interest are the building regulations modifications required for the non 3hr rated steel framework, sheer fill fabric and polycarbonate dome.

Architectural Passive Design Features Include :-

1. Separation of the building into six fire isolated compartments. Trading access between compartments is controlled by fire doors on magnamatic hold open devices, or drenched steel roller shutters as appropriate.

2. Plan geometry of the atrium Malls and bridges designed to provide multi-option pathways to fire exits.

3. Optional egress to adjoining buildings, David Jones store and the SGIC carpark.

4. Fire passages in the high population Themed Retail floors which provide safe holding capacity as ante chambers to the fire stairs.

5. Large capacity dual stairs, designed with efficient 50% landing area reduction and compact quadruple flights within single shafts with common stair pressurization. (Stairs also designed with prefabricated steel to duplicate as construction access stairs).

6. Minimal atrium edge baffle profiles designed to be sufficient, with active smoke extraction slots adjacent, to prevent smoke spilling into the atrium void.

7. Design of atrium edges to step back at each level and minimize ingress of smoke onto Malls above the fire floor when the atrium itself is in exhaust mode.

8. Atrium edge profiles designed to maximize floor to floor sight lines for maximum public orientation.

9. Glass lift shafts designed to maximize sight lines and orientation.

10. Ceiling plenums in Malls and shops, subdivided into discreet quadrants for smoke extractions.

11. Combined kitchen hood and smoke spill shafts for maximum area efficiency.

12. Nominal fire enclosure of storage and cooking areas.

13. Control of the fire load of base building materials in the atria.

14. Chevron graphics along paths of egress and on exit doors.

15. Earthquake resistant 100,000 litre water reservoir in the basement.

16. Hydrants in the fire stairs for safe access to the fire source by fire fighters.

17. Hose reels within 3 metres of fire stairs for safe access by fire fighters.

18. Labelling of all external exit doors to clearly designate to fire fighters which floors are accessible through each stair exit door.

19. Smoke plenums at plant room level for collection and extraction of atria smoke.

Active Services Design Features Include:-

1. 'State of the art' integrated computer systems for BMS (Building Management Services), fire control, vertical transport and security.

2. Detection systems with microprocessor addressable analogue smoke detectors and VESDA (very early smoke detection apparatus)

3. Alarm Signals systems provided from smoke detectors; independent "Deltec" alarms; fire sprinklers; and manual call points.

4. Compartmentation systems with automatic fire mode operation by magnamatic door closure and drenched steel roller shutters operated by fire fighters.

5. Automatic smoke extraction systems interlinked to fire location detection systems giving the following smoke exhaust rates:-

carparks total 138,500 l/s
spec. shops 24,000 1/s per zone (4 zones per floor)
Myer store 20,000 1/s per zone (4 zones per floor)
spec shop atrium. 250,000 l/s
Myer atrium 120,000 l/s

Total 62 smoke exhaust fans with a total capacity of 800,000 l/s

6. Evacuation and Warden Intercommunication System (EWIS) which includes:- Warden intercoms; a PA system giving evaucation instructions to the public throughout the building, green strobe lights which highlight exit locations, and flashing escalator warning lights which are unique to this project.

7. Emergency and exit lighting all with emergency back up power supply.

8. Automatic stair pressurization to prevent smoke logging in fire escapes.

9. Automatic fire protection features include an integrated combined fire main system with 56 incoming mains to service sprinklers, drenchers, hydrants and hose reels, fire main reticulation interfeed for increased water density and independent maintenance isolation of floor mains

   Four standby pump sets - 2 electric and 2 diesel.

   A 100,000 litre water storage reservoir interfed into the mains reticulation.

   BMS monitored stop and interfeed control valves, automatic kitchen hood gas fire suppression systems, and automatic gas reticulation shut down

10. Vertical Transport systems include two world first technologies. They are the soft stop of escalators form a remote control, with pan-tilt zoom video surveillance cameras, and the automatic by-pass of the fire floor for all lifts.

11. Emergency Power Generation has a total of 5.3 MVA standby power with automatic start up within 10-15 seconds and 30,000 litres of diesel fuel.

6. CLEANING GANTRY

The sheerfill fabric is self cleaning externally and gets a good wash down in every rain. However internally it is much more difficult to clear away dust, spider webs and half deflated balloons, especially with 40 metres of free space below.

The difficulty has been overcome at some considerable cost in the Myer Centre by installing a major motorized maintenance gantry which travels the length of the atrium and two hand wheel operated wing gantries.

The gantries serve many purposes. Firstly they are a maintenance and cleaning platform for the fabric roof and dome. Secondly, the main gantry has a rotating maintenance cradle which is rigged below the gantry for maintenance and cleaning of lights, columns, balustrades, escalator sides and bridges in the atrium. The gantry proved a great boon during the final stages of construction, allowing the early removal of scaffold with final finishes and cleaning being carried out from the gantry and cradle.

7. STATISTICS & DATA

Specialty Shop Atrium

a)	Plan Area -	Fabric and Dome	643m^2
		Dome diameter	8700 mm
b)	Surface Area	Fabric only	723 m^2
c)	Material	Fabric - Sheerfill 2 HT	
		Teflon coated glass fibre	
d)	Weight		1.3 Kg/m^2
	Thickness		0.8mm
e)	Design maintenance load		0.25 PKa
f)		Dome - Lexan XL clear	
		Polycarbonate 4.5mm with acrylic	
		coating both sides	

For the polycarbonate dome Permafab recommend the restriction of one person per segmented panel at any one time.

Myer Atrium

a)	Plan Area	69m^2
b)	Surface Area	110 m^2
c)	Maintenance Load	NIL
d)	Material -	N19 WLUBB
	Balloon Fabric	1.903

70 x 70 denier nylon fabric with a durable water resistant polyurethane coating in 0.75oz with a fire retarded UV coating as the final finish.

The Early Fire Hazard Properties of the fabrics and polycarbate were very significant in successfully negotiating the atrium modifications to the Building Regulations:

	Range	Sheef fill	Lexan	Balloon Fabric
Ignitability Index	0-20	0	0	0
Spread of Flame Index	0-10	0	0	0
Head Evolved Index	0-10	0	0	0
Smoke Developed Index	0-10	0-1	2	0-1

Costs:

Fabric roofs and dome - Approx. $380,000

Gantry - Approx. $245,000

Atrium Roof Steelwork - approx. $3,750/tonne

Gantry Rail Steelwork - approx. $3,000/tonne

8. SUMMARY

In conclusion, as retail architects, we are convinced that the membrane roofs in the Myer Centre answered all the functional and aesthetic design parameters of the brief.

The technology for non-sterile tube atria is becoming increasingly sophisticated, but can be incorporated into the architecture of the space unobrusively and with simple elegance.

The atrium needs, and responds to, the soft lighting and blue sky of the Myer Centre membrane roofs.