


Introduction

## Glen Eira Aquatic Centre Tensile Canopy – a case study of insulated tension structure

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LSAA 2011 Conference on Collaborative Design  
13<sup>th</sup> – 14<sup>th</sup> October 2011



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- Why Tensile?
- Why insulate?
- Brief history, lessons to be learnt
- Performance
  - insulated tensioned membranes
  - other claddings
- Glen Eira Tensioned Membrane
  - Design Team
  - Design constraints
  - Tender documentation
  - Tender evaluation
  - Construction



Playa Vista Bandshell, Florida - Fabritec


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Why Tensile?

### Why choose Tension Membrane?

- Minimal materials - lightweight
- Large spans – dramatic forms
- Transparency – natural light and illuminated



MGM Light Rail Station, Las Vegas - Fabritec


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Why Tensile?

### Why not to choose Tension Membrane?

- Minimal materials – poor thermal insulation performance
- Large spans – large horizontal reactions
- Transparency – heat gain




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Why Tensile?

### Why not to choose Tension Membrane?




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Why Insulate?

### Enclosed spaces

- Reduce heat loss (cold environment)
- Reduce cool loss (hot environment)
- Control moisture – condensation – drips and fungal growth




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Why Insulate?


### Condensation



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Why Insulate?

### Condensation Solution


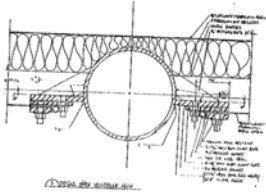


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History

Insulated tensioned membranes

- Double layer with batts
  - Moisture in insulation was a problem
  - Recommendations – vapor barrier to be less permeable than outer layer or ventilate insulation space
  - Another problem is maintaining batts in position


East Area Health Center, Detroit, Michigan, early 80's

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History

Insulated tensioned membranes

- Double Layer with Air Gap



Al Manshar Complex, Kuwait

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History

Insulated tensioned membranes

- Triple layer ETFE pillows




Welcome Pavilion, Yas Island, Abu Dhabi - TMC

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History

Insulated tensioned membranes

- Composite tension membranes



Tensotherm™ is a patent pending product of Birdair, Inc.

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Performance

### Performance Assessment

- Thermal insulation (U W/m<sup>2</sup>K)
- Visible Light transmission (400 to 700 nm)
- Solar gain – low e coatings, colour
- QUV resistance
- Vapor Permeability
- Fire
- Resistance to Fungal growth
- Long term performance
- Acoustics
- Maintenance

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Performance

### Performance Criteria

-Values are for comparison only – standard, orientation, framing  
 -Most systems can be adjusted to suit project requirements

System	Single Layer PTFE	Double PTFE Skin 400mm air gap	InTeM™ by Oasis	Tensotherm™ by MakMax
Overall Thickness (mm)	1	400	24	17
U value (W/m <sup>2</sup> K)	5.6	3.5	1.1	1.1
Light transmission (% visible light 400-700nm)	10 to 15	3	0	2

	Multicell Polycarbonate eg Dampolon	Double glazed units	3 layer ETFE cushion
Overall Thickness (mm)	16	6 + 12 + 6.4 = 25mm	1 to 500
U value (W/m <sup>2</sup> K)	1.5	2 to 3	2
Light transmission (% visible light 400-700nm)	20 to 50	0 to 75	0 to 90

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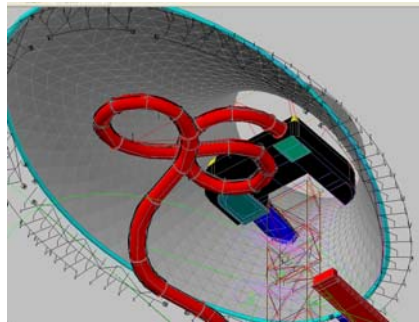
Glen Eira Design

### Glen Eira Aquatic Centre

End Client – City of Glen Eira

**Design Team**  
 Architect – Mantric Architecture  
 Structural Engineers – Cardno  
 Services Engineers – VOS Group  
 Tension Membrane Engineers – Tensys  
 Water slides – Australian Water Slides

**Construction**  
 Main Contractor – Hansen Yuncken  
 Specialist Tensioned Membrane Sub-contractor – Oasis Tension Structures

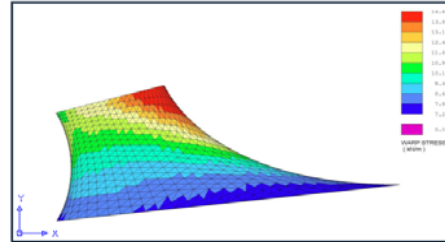


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Glen Eira - Design

### Structural Design

- Form finding – smooth conic, no ridge cables
- Unbalanced head ring – tie downs
- Tower analysed to give accurate design forces to Cardno



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Glen Eira - Tender documentation

Tender drawings show full design and proposed erection methodology.

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Glen Eira - Tender Evaluation

Four alternatives considered

- Tensotherm™
- InTeM™
- Double Layer
- 4 Layer EFTE cushion

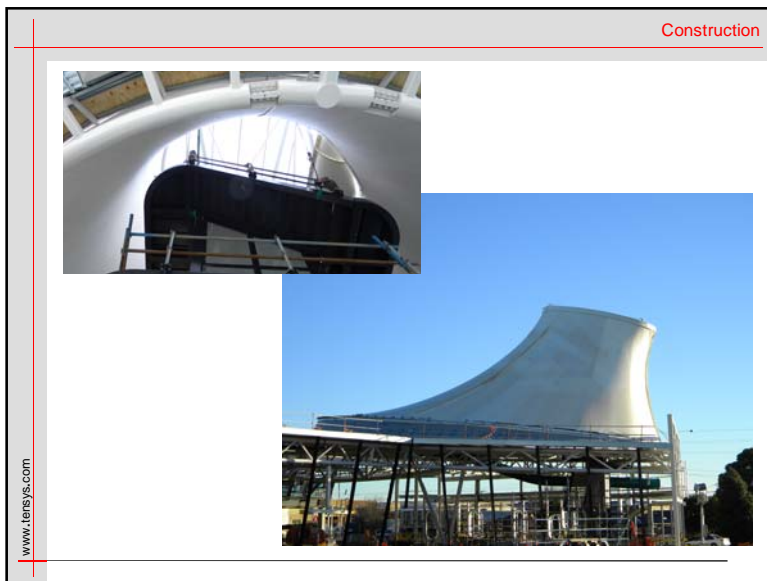
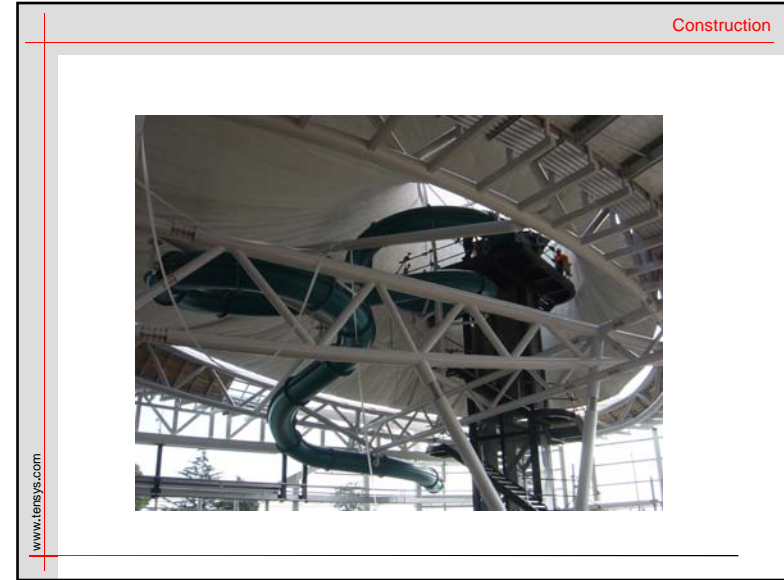
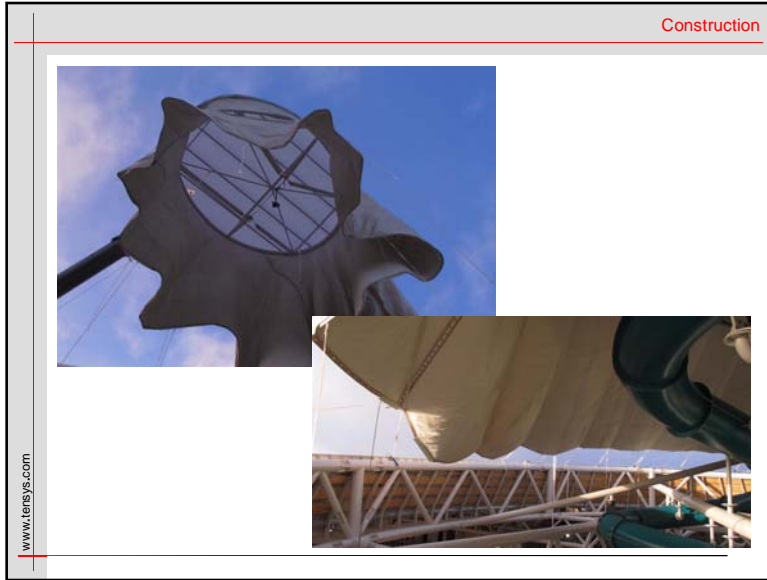
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Construction

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Construction

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Concluding comments

**Conclusions**

- Insulated Membranes provide Opportunities
  - Enclosed spaces (part or full)
  - Complex geometry insulated cladding
- Getting the Design Right
  - Longevity
  - Efficiency
  
- Where next – insulated ETFE

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