Pacific Fair Redevelopment

FABRITECTURE
WHERE DREAMS TAKE SHAPE

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As part of the $670 million Pacific Fair Redevelopment in 2016, Fabritecture was contracted by Scentre Group to deliver the design and construction of the steel & fabric for two custom architectural fabric structures: The Resort Roof and Porte Cochere entry structure. The structures were designed to become key architectural features for the Resort Area of the upgrade.

The Resort Roof provides a functional weatherproof aesthetic feature that covers the first level promenade while leaving the ground level centre open, creating a bright and airy space.

The spectacular Porte Cochere crowns the main entry point of the centre, incorporating the shape of a whale's tail in the design to represent the Gold Coast.

Location	Gold Coast, QLD, Australia	**Completed**	2016
Scope	Design & construct	**Size**	5,400m^2
Fabric	Chukoh FGT-600	**Framing**	Bespoke steel

Design, Fabrication, Installation

Pacific Fair Shopping Centre is now home to the most uniquely innovative architectural fabric structures on the Gold Coast.

The client requested the fabric structure to be a statement feature to the resort area with a dia-grid style roof and lots of curvature as the main design principles. Angled Y columns required specific locations relating to shop fronts.

The latest paint system, Dulux Quantum FX, was applied to the columns.

Fabritecture was involved in the design of this project in the concept stage from 2013.

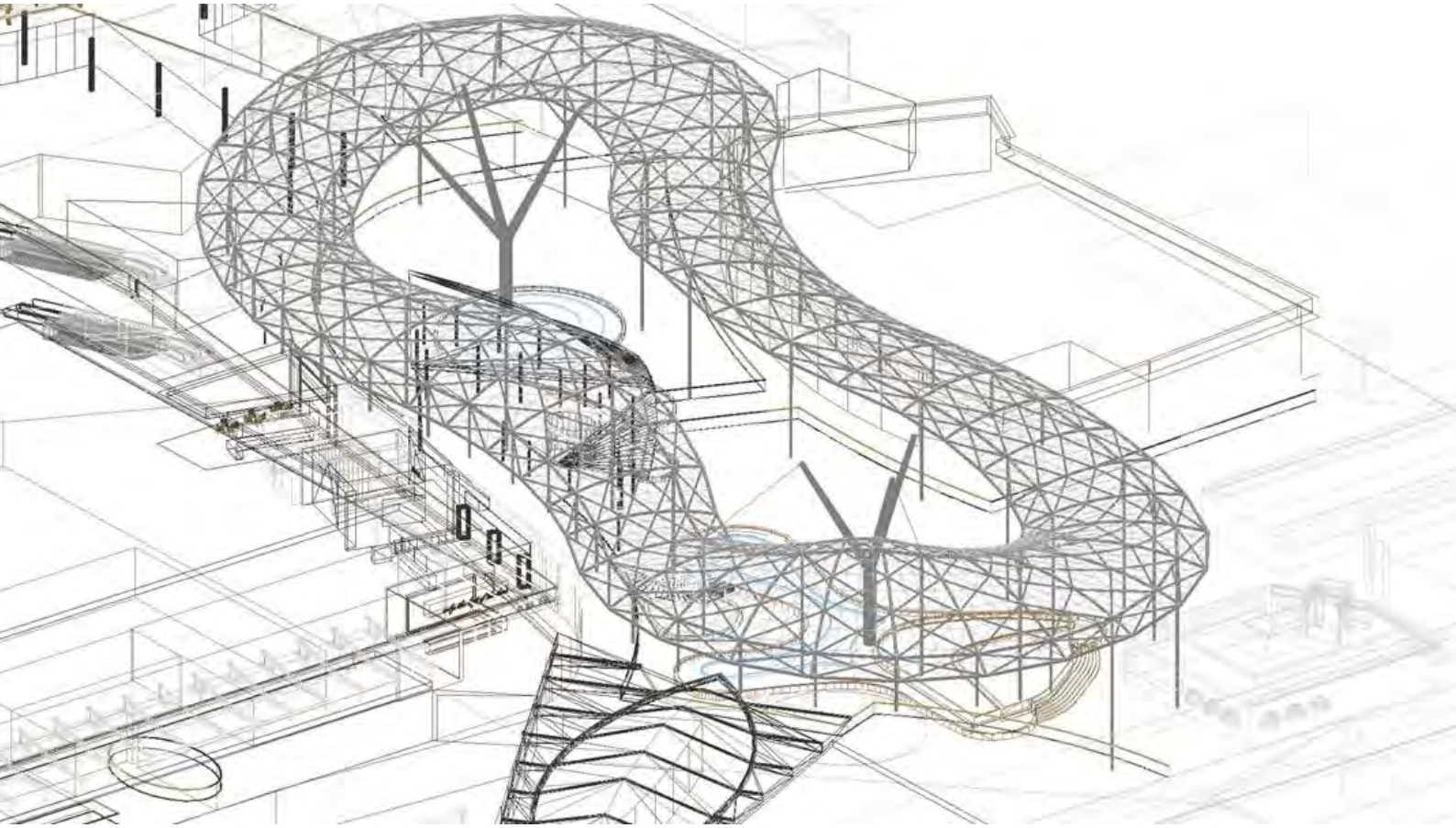
Structural Systems

From the outset, the Westfield Creative team wanted to push the boundaries of the geometry. To explore different options, the geometry was modelled using Grasshopper Parametric 3D modelling software. Two options were finalised, being the Wave Orthogonal and the Wave Diagonal.

Fabritecture completed preliminary engineering on the fabric and provided advice on the build-ability of each design. The Wave Diagonal was deemed to be beyond the boundaries of steel fabrication possibilities and the Wave Orthogonal was selected. This design comprised of the following:

- Outer Perimeter 3D curved edge beam (363m long)
- Outer Edge 3D curved edge beam (265m long)
- 80 curved rafters spanning from inner to outer edge
- 316 Struts connecting the rafters in 4 rings
- 198 Diagonal struts to create the dia-grid
- 18 Full height Y columns supporting the inner and outer edges
- 19 other support points around the outer edge comprising of 1-3 support struts
- 200 tonne steel weight total for the Resort Roof (40T for the Porte Cochere)

By far the most complex challenge geometry wise is the inner and outer edge. These are created using a large number of tangential curves (40 for outer edge and 41 for the inner edge) which, when connected together, create the undulating curved geometry required. The entire structure was modelled in Teklar and AutoCAD and then fed back into the client's master Revit Model to do a final check for geometry and clashes.



Patterning

The architect required that the seams in the roof match with the steelwork ring beams. To achieve this we used 9 concentric seams lines that were aligned parallel with the struts connecting the rafters. This resulted in 10 patterns per bay with a total of 790 different patterns.

Details

The architect did not want to see any connections in the steelwork throughout the roof. The only allowed visible connections were pinned connections at the base of some outer struts. To meet this requirement all connections were designed to fit within the overall shape of the member and then sheet metal cover plates were installed to conceal the connections. Approximately 1,400 cover plates were installed in total.

Drainage and Guttering

300 half round gutters were to be installed on the inner and outer. This posed a challenge because 300 half round sheet metal cannot be rolled. To overcome this, the gutter was fabricated in approximately 900mm lengths that join of a gutter bracket, creating a faceted gutter. A best fit method was used and each gutter section was 3D modelled and shop detailed. Each section is a wedge shape in plan to allow for the change in angle at each bracket. The gutter feed water into downpipes which are fabricated and concealed within the columns that are plumbed directly into the stormwater drainage system.

Installation Method

Particular emphasis was placed on the installation being perfect due to the resort roof being a ribbon ring structure.

There was a highly technical process followed during the installation of the steelwork to ensure that structure met at the join accurately to complete the ring.

To achieve this, all lifts, connection points and landing points (i.e. columns and base plates and primary lifts) were carefully surveyed prior to being put into place.

The edge beam was also surveyed throughout the whole build to ensure a successful join. The install team were very particular to be sure the process was followed throughout the install.

An intricate temporary bracing system was provided as an engineering solution to assist the install. This was required for all of the columns to control where the structure was positioned during installation, but before completion. This limited the dynamic movement of the structure during installation.

The end result was very satisfying with only 2 struts being half a bolt hole out.

The structural system of the Porte Cochere is a dia-grid shell structure with both convex and concave parts to the shell, taking the form of a 'whale tail'. This creates very complicated geometry for both 3D modelling and steel fabrication.

For the convex parts of the shell, the PTFE fabric was offset from the primary dia-grid using steel T sections welded to the top of the dia-grid members. For the concave area, the natural double curvature of the fabric lifts the fabric off the top of the steelwork until it meets the edge beam. Here it is connected via an aluminium extrusion and steel cleats on the steelwork.

The roof structure is supported by two branched tri-columns at the front which spring from ground level and at the rear overhead. Steel struts provide support from two points on the third level rooftop car park. A perimeter gutter collects water run-off, which is then diverted into downpipes. These downpipes are concealed with the tri -columns to ground level.

Materials Used

White Chukoh FGT-600 PTFE was the preferred fabric as it offered the necessary translucency, longevity and tensile strength, and paired well with the LED lighting system. Tensile strength and a 20-year manufacturer's warranty were also factors.

The steelwork was comprised of a dia-grid structural system with tri-tree columns on the front, expanding to existing infrastructure.

The columns of the steelwork for both structures were coated in a Dulux Quantum FX paint system, delivering a metallic protective coating with a semi-gloss finish.

Fabrication

Fabricating the steelwork for the roof posed a major risk for the project. To overcome this challenge, the entire roof - excluding column - was trial assembled during fabrication in sections.

Each section was surveyed after trial assembly, and cross-checked against the theoretical geometry using the 3D model. The trial assembly was completed before final welding of all components.

After fabrication, the steelwork was painted and then loaded into purpose-built cradles for freight to site. The 200 tonne of steel was delivered to site to match the installation sequence in 27 cradles.

Collaboration, Construction & Maintenance

An integrated fall arrest system has been incorporated into the design of the Resort Roof structure for inspections and maintenance systems as required.

Collaboration with the storm water was designed to flow inside the columns and down through footings of the Porte Cochere. The rear of the entry structure is fixed into building infrastructure therefore loads and connections details where carefully considered.

The Roof is 5,400m^2 and took approximately 11,000 man hours to complete. The Porte Cochere is 600m^2 816 man hours to complete.

Other Information

The Resort Roof incorporates a state-of-the-art LED system capable of illuminating the structure in both solid and alternating colours.

There is also a flowing gutter system to the edge beam that follows the system on both sides. The final steel link-up of the Resort Roof was almost perfect at only 7mm out, which is an incredible success for the installation!

The Porte Cochere is a breathtaking entry structure that is an iconic representation of what is possible when building with tensile fabric.

The results exceeded the needs of the brief and resulted in being awarded another million-dollar shopping centre redevelopment project with the client.

Industry Recognition

The Pacific Fair project took home several industry awards during 2016 and 2017.

2017 STA Award for Excellence (Category 11): Pacific Fair Porte Cochere

2016 STA Award for Excellence (Category 12): Pacific Fair Resort Roof

2016 LSAA High Commendation: Pacific Fair Resort Roof

2016 IFAI Outstanding Achievement Award: Pacific Fair Resort Roof

2016 IFAI Outstanding Achievement Award: Pacific Fair Porte Cochere

About Fabritecture

Fabritecture Australia Pty Ltd (ABN 66 104 929 071) is an Australian-headquartered designer, manufacturer, supplier and installer of custom designed “bespoke” and modular tensile fabric structures for private and public clients in Australia, South East Asia, and the USA.

CONTACT US

Address: Unit 14/15 John Duncan Court, Varsity Lakes QLD Australia 4227

Email: info@fabritecture.com

Website: www.fabritecture.com

Phone: +61 7 5587 7000

ABN: 66 104 929 071