

d'Arenberg Cube – a structural engineer's perspective

An account by David Reynolds – CPR Engineers, South Australia

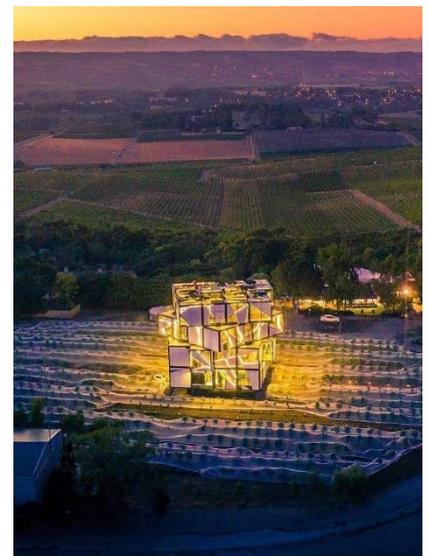
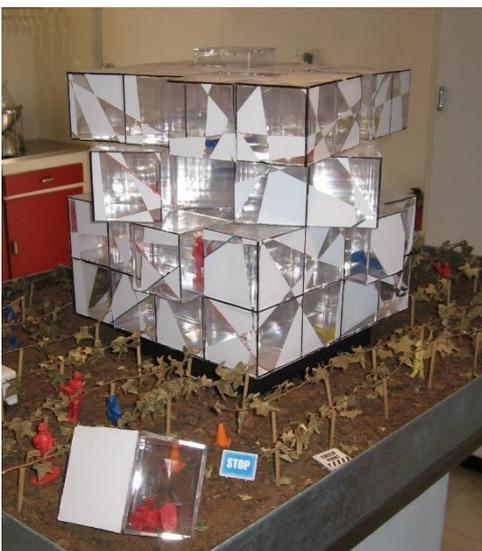
Extraordinary Client and Brief:

d'Arenberg Winery is the renowned winery of the McLaren Vale region in South Australia. It is led by outrageously flamboyant winemaker and owner Chester Osborn, the fourth generation of the Osborn family.

Chester Osborn is credited for the design of the d'Arenberg Cube - a five-storey building located on a rise within the d'Arenberg vineyards on Osborn Road. Completed in 2017, the building contains a restaurant known as the d'Arenberg Cube Restaurant, a wine sensory room, a virtual fermenter, a 360-degree video room and adventurous art pieces.

CPR Engineers was engaged to provide civil and structural engineering services and part of the project team assembled by Sarah Constructions in 2006. The team was presented the brief at the winery by Chester to include:

- Inspiration from the puzzles and complexities of making wine and in tasting wine as it can be puzzling to work through the flavours on the palate;
- a combination of 16 equally configured cubes with particular appearance to the original world famous Rubik's Cube puzzle with the exception of the striking façade;
- the fallen Cube where one of the 16 cubes appears to have been "dislodged" from the main structure to land not far away in the vineyards;
- A client created plastic model of the building complete with "soldier men" appearing on the balconies
- A site carefully situated on the rise of a hill within the Grenache vines adjacent to the d'Arenberg cellar door and famous d'Arry's Veranda Restaurant.



The striking patterns on the glass façade were laid out on a scaled paper drawing in pencil and presented to the team, for detail Architect ADS to take carriage.

As a Client, Chester was both intensely frustrating and extremely challenging in a motivating sense.

The degree of change in the make-up of the d’Arenberg Cube’s features over the 10 year period of the design phase (albeit with a 4 year break in the middle) was a source of some frustration, but so too in an endearing way, was Chester’s reluctance to compromise on quality, the aesthetic and the dimensional accuracy - in order to replicate Rubik’s cube precisely.

In an opposing emotive, Chester drove the team to embrace technical challenges and through some of the more outrageous design additions along the way (e.g. 17 roof top umbrellas) proved to motivate the team to work to his ambitious outcome. The motivation was stimulated by Chester’s drive to champion the building’s appeal that was so vividly created and etched in his extraordinary mind.

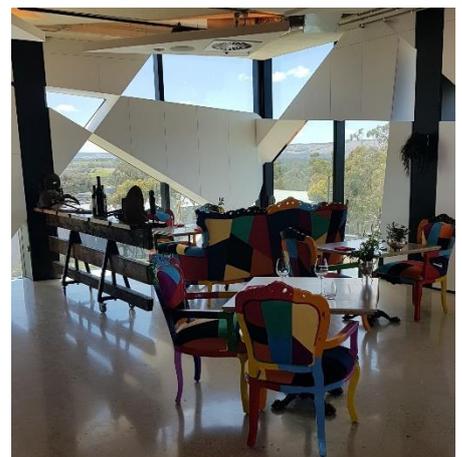
Extraordinary Design Features:

Building features

- Meticulous dimensions of each *Cube* – 4100mm x 4100mm x 4100mm with black curved edges of each cube being 290mm
- Irregular patterns of lines on the façade glass/white edge
- *Glass trafficable roof* – essentially flat with regular grid of box gutters
- 16 black and one red *hydraulically driven umbrellas* for sun shading to the glass roof



- *Internal fitout* – designed and created by Chester – to replicate the external patterns internally by crisp white joinery, including the ceiling lines, colourful furniture only matched by Chester’s wardrobe. The *bars* featured a series of glass televisions linked visually and shaped to suit spirited tasting, whilst at level 2 the bars were designed to rotate and be elevated via winches pinned to the floor structure above.

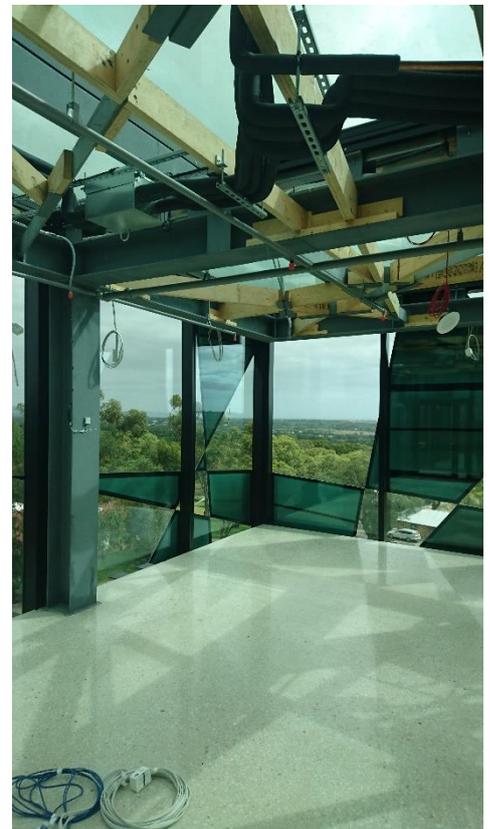


Structural features

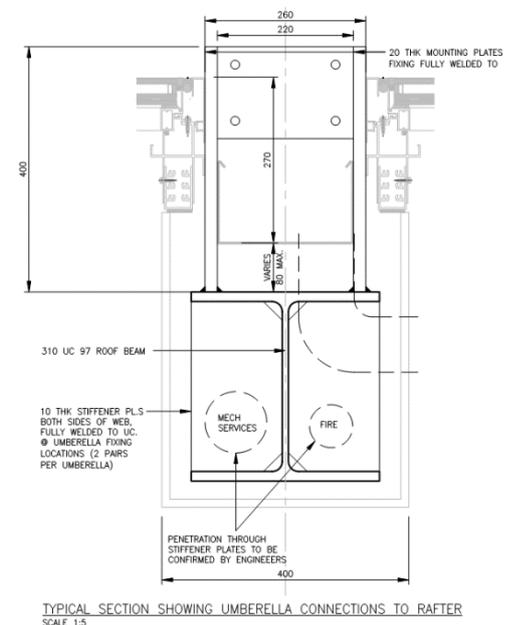
- One single huge reinforced concrete pad founding the building on rock to withstand overturning under lateral loads
- Post-tensioned concrete framed building on reinforced columns and in-situ reinforced concrete lift shaft
- 4 only columns were able to be linked from the first suspended floor at level 2 to run to the top roof level
- Level 1 floor structure was suspended over the lower ground floor
- Level 2 floor stacked reasonably well above
- At level 3 the floor plate twisted to provide cantilever balcony spaces, below the level 4 floorplate that twisted back the other way to provide more structural challenges;



- the ceiling framing required a combination of timber laminated veneer lumbar beams and steel plates to span the 4.1m structural grid whilst respecting the fine point detailing of the join of the white ceiling junctions
- The concrete mix was hand-picked by Chester Osborn and included Brighton light cement and local sandstone based aggregate, when combined with the additional stressing of the post tensioned slab and beams, provides an exceptional finish to the floors surfaces;
- CPR Engineers commenced documentation of the building in AutoCAD and then to uplift the BIM capabilities created a Revit Model from the Architects 2D AutoCAD layouts



- The roof structure comprised a grid (where possible) of 310UC sections that acted as a 2 way moment resisting frame and catered for:
 - Deflection control to cater for the trafficable glass roof
 - Torsional effects of the 17 point loaded umbrellas and the associated load from the hydraulic rams
 - The geometry of a roof plane that only slopes 20mm in 4.1m and
 - the grid of box gutters which needed to accommodate guides and cleats to house the folded down umbrellas – as well as the structural detailing necessary to transfer moments from the umbrella fixing points.
- Infusing some steel plate into the layout of the fixed bars at Level 4 to allow the layout of televisions to form the top and front surfaces of the bars.



The Extraordinary Ride:

Initial site visit and briefing – 11 September 2006

Structural concepts revealed and progressed in October and November 2006

First pass drawing issues over various iterations for design development and cost reviews to the end of 2008 with initial trade pricing in March 2009

Not much happened after the GFC hit until March 2014

Drawings issued For Construction:

- civil stormwater and levels Feb 2015
- Footings March 2015 – first reinforcement inspection on 31 March 2015
- concrete frame to Level 4 in June 2015 with the roof and façade still unresolved
- concrete pour to Level four floor on 1st February 2016
- roof design and glazing façade design interface resolved in good time to suit the construction progress

Project Team consisted:

- Client and Building design – **Chester Osborn, d’Arenberg Winery**
- Managing Contractor (cost plus model to complete Base Building) – **Sarah Constructions**
- Architect in documentation – **ADS Architects**
- Civil and Structural Engineer – **CPR Engineers**
- Building Services – **BESTEC**
- Specialists trades – **Kingswood Aluminium and Construction Glazing with Arup** on façade design.

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