Sphere of influence
A peek inside a regional game-changer.
The exodus of Australian manufacturing continues to impact the economies of many regional centres. But as Sean McGowan reports, the striking $45 million domed civic building project in Geelong is representative of how such cities are reinventing themselves.

Home to 225,000 residents, the port city of Geelong is located 75km south-west of Melbourne on the shores of Corio Bay. Once one of Australia’s largest manufacturing hubs – where everything from wool mills to automobile engines, oil refining and aluminium smelting thrived – the city is experiencing significant change as it adapts to the impacts of industry heading offshore.

Deakin University’s campus at Waurn Ponds and Geelong Technology Precinct are driving innovation. And with a host of new businesses and government departments making the town home, the City of Greater Geelong is undergoing a transformation that places greater emphasis on service delivery, innovation and sustainability.

And ushering in this new era of forward-thinking is the new Geelong Library and Heritage Centre in the heart of the city’s CBD.

Completed on time and under budget, this architecturally ambitious building opened to the community late last year.

As well as being a future-proofed library for young and old, it also house the state’s largest regional archive of historical resources.

“A CIVIC REIMAGINING

The city’s ambitions were immediately evident when Melbourne-based ARM Architecture was awarded the design consultancy contract for the new Geelong Library and Heritage Centre in late 2012.

“They had an appetite for something that was going to be quite ambitious and contemporary,” says ARM’s technical director, Wayne Sanderson. “It was to be forward-looking and represent Geelong’s transformation from manufacturing to a technology and innovation centre.”

Located on the site of the former library, the building also needed to harmonise with the structures of heritage significance that surround it.

These include the 1926 Geelong Peace Memorial, Edwardian bandstand and late-Victorian drinking fountain in the adjacent Johnstone Park; and the Joseph Reed-designed Geelong Town
Hall, which remains Victoria’s earliest surviving municipal building.

Three conceptual challenges also sparked the design of the new eight-level library.

ARM wanted to celebrate the tradition of great libraries, create an ambitious, future-proof building, and design a structure that invited the natural world in.

Ultimately, the building that stands today was one of three ideas put forward, as prescribed by the city’s brief.

“Einstein only had one brilliant idea,” Sanderson says. “We were requested to come up with three.”

Although each idea was quite different, all three addressed the challenge of integrating the building with the park.

“It had to have some sort of interface,” says Sanderson. “And each of the concepts had varying degrees of materiality and integration of landscape into the scheme.”

Yet of all the schemes presented, one stood out as being the most ambitious. It was also the one scheme, Sanderson says, towards which all those with influence on the selection gravitated.

At its heart was a reimagining of the great domes that adorn civic buildings around the world – an idea born of the Renaissance period that helped signify a building’s importance.

The resulting geometric interpretation is a partially buried sphere that has been sliced, dissected and eroded away in certain areas. This lends itself to the second idea of the building being an element in the landscape.

“The form is an interpretation of a grotto in a garden, and the southern
At its heart was a reimagining of the great domes that adorn civic buildings around the world and western façade, in particular, reference an eroded and crystalline entrance to a cave,” says Sanderson. “A grotto is a place of reflection and thinking, and I suppose the library motif as a centre of knowledge works very well in this regard.” Constructed over the course of two and a half years, and visible from many vantage points around Geelong, the evolving form drew all manner of reactions from the local community.
A local Geelong resident himself, Sanderson isn’t bothered by the iconographic interpretations that have seen it described as a brain, a golf ball and even the Death Star.

“That’s one of the wonderful things about civic architecture,” Sanderson says. “People can interpret buildings however they like.”

THICK-SKINNED

Before the concept design phase, ARM Architecture engaged Umow Lai to provide full building services on the project, including mechanical, electrical, hydraulics, fire protection and engineering, ICT and audio visual.

Umow Lai was familiar with the site, having previously assisted the City of Greater Geelong with the masterplan development of the larger Geelong Arts Precinct. The firm also provided ESD and Green Star services to ensure the project achieved its 5 Star Green Star Design rating ambition.

“The City of Greater Geelong wanted the project to align with contemporary environmental performance and, of course, to minimise cost to the community over the building’s life cycle,” says Umow Lai senior sustainability consultant Nick Mulvany. Coincidentally, it was at this time that the Green Building Council of Australia (GBCA) released its Green Star Public Building v1 rating tool, making it an ideal fit for the project.

With Umow Lai and ARM having shared a healthy working relationship developed across a number of high-profile projects, including the Melbourne Recital Centre (see Ecolibrium October 2011), a collaborative approach was immediately adopted.

“Our engineers worked closely with ARM’s design and project architects to traverse the usual challenges – plant spatial, coordination, air-delivery system appearance, facade impacts, and so on,” Mulvany says.

LESSONS FROM THE CONSULTANT

Umow Lai’s Nick Mulvany provides an insight into how early façade design can influence the services design.

“The project reinforced Umow Lai’s standard strategy of undertaking façade workshops early in the design process to fully leverage the knock-on benefits to services design of high-performance façades,” he says.
Conventional placement of building services did not apply in the unconventionally shaped (and hued) building. Image: Emma Cross courtesy of ARM.

ARM says to achieve remarkable buildings, a collaborative approach is required. Image: John Gollings courtesy of ARM.

Considerable work was done testing the façade using daylight and thermal modelling packages. Image: John Gollings courtesy of ARM.
Surprisingly perhaps, the complexity of the building’s form did not present a major challenge to the services engineers.

“On presentation of the building’s form, one assumes it to be complex,” says Mulvany. “However, when you remove the GRC (glass-reinforced concrete) dome facade, it becomes a much more digestible form from a services perspective.”

As well as taking the time during start-up meetings to explain the concept behind the Geelong Library and Heritage Centre to all stakeholders, Sanderson says the development of close relationships minimised on-site assumptions and errors.

“There are a lot of things that are unwritten in documents,” he says. “So we explained the back story of the building to the construction team, and what we were trying to achieve. And almost without fail, they would ask the question before going and doing something, particularly if it didn’t feel right.

“For an architect, that’s as good as it gets.”

FAÇADE OPTIMISATION

Aside from the challenges created by the library’s spherical form, much time was spent on the facade design to optimise daylight levels, limit solar gain and maintain the visual connection to Johnstone Park.

“Tuning best performance out of any building’s façade has always been a collaborative starting point,” says Mulvany. “Although not facade engineers, our ESD consultants understand the influence of facade parameters on services, and test the influence of modifications using our daylight and thermal modelling packages.”

Presented with the challenge of a predominantly west-facing facade, Umow Lai ran a number of facade workshops to discuss the challenge.

“We are pretty proactive, and willingly throw up options for façade enhancement, usually to the mild amusement of architects,” Mulvany says. “For this project, design iterations focused on resolving a facade opacity (visual glazing vs opaque spandrel/wall) that was acceptable to ARM.”

ARM’s response is a zig-zag glazing profile where about 50 per cent of the glazing features a reflective shadow box. The balance features vision glass. This zig-zag profile allowed the glass to be transitioned from a purely west-facing orientation to facing north-west and south-west.

And because of that rotation, better performance from the facade was achieved.

The double-glazed units used on this project are high-performance, offering very low solar-heat-gain coefficient (SHGC), high visible light transition (VLT) and UV management, and contributing strongly to the building’s 5 Star rating.

A MECHANICAL RESPONSE

One of the consequences of a non-rectilinear building form is that conventional placement of building services equipment may not apply. And in the case of the Geelong Library and Heritage Centre, the location of heat-rejection plant was one of the first challenges confronted by Umow Lai’s engineers.

Because the form removed the usually available roof areas to locate and screen out cooling towers or air-cooled chillers, a number of options were considered.

Some early investigation into alternatives to air-based heat rejection, such as ground-source heat pumps, was ultimately deemed unfeasible, and led to a reworking of the building design to find a compromise.

The air is introduced to each floor via custom-made “clover-shaped” columns featuring various cladding treatments. Image: John Gollings courtesy of ARM.
It resulted in a rectangular subtraction near the crest of the dome being created to accommodate a plant room, with louvred walls applied to the east facade. ARM positioned the opening such that when viewed from any position at ground level, it could not be observed.

“The design allows for air to be drawn in through the east facade for both outside air provision and cooling air to the chillers,” says Mulvany.

“The condenser fans of the two air-cooled chillers discharge vertically through the apex opening of the dome, drawing in make-up air from the east facade.”

The mechanical services design for the library centres around a displacement air system, which serves the high-volume areas on the ground, first and second floors, where floor-to-ceiling heights are greatest.

The air is introduced on each floor via custom-made “clover-shaped” columns featuring various cladding treatments, as well as via a perforated MDF skin around the perimeter that conceals the air boot behind it.

“The benefits of a displacement air system for cooling include quieter acoustic performance with very low terminal velocities, improved indoor air quality within the occupied zone, and moderately reduced supply-air volumes compared to fully-mixing overhead systems.”

The displacement-air system is complemented by an in-screed hydronic floor-heating system. This addresses some of the more challenging issues associated with displacement-air systems in heating, such as the risk of stratification of warmer air at high level and correspondingly less-than-optimal thermal comfort within the occupied zone.

Mulvany says that with around two-thirds of the heat transfer to and from the human body via radiant heat transfer, the radiant-floor heating solution provides excellent thermal comfort within the occupied zone.

The decision to expose the concrete soffit and services also created the opportunity for the architects to map the ductwork as an interpretation of a computer circuit board.

“The structural support of the dome is quite impressive,” Mulvany says.

To achieve the dome and façade, structural and civic engineer Irwinconsult used longitudinal and latitudinal structural steel elements.

Due to its widest point being several levels above ground, a substantial amount of cantilevering was also required. Parts of levels three, four and five on the north-west and south-west facades are suspended from the roof system.

The domed facade consists of 332 large GRC panels, made up of 18 typical hexagonal tiles and one pentagram. These have been arranged in a repetitive, mirrored pattern to form the dome, in much the same way a soccer ball is created.

The use of GRC came about through the architect’s desire for the façade to have a sense of mass, without the implications of using heavy material.

“The GRC allows us to do something an order of magnitude lighter than if it was done in situ concrete or precast concrete,” Sanderson explains. “And because it was spherical, we had an opportunity to achieve repetition in the casting of the GRC tiles.”

The tiles were also designed to allow for them to be both fixed and sealed internally, eliminating any need for scaffolding and exterior water-proofing. And because the facade is a weather skin, the GRC acts as the primary weather barrier too.

Sometimes engineers don’t fully appreciate the position of those designing such brave architecture
**ENERGY EFFICIENCY**

In keeping with the project’s sustainability objectives, energy efficiency was at the core of the mechanical services design.

Based on the project’s size and ESD requirements, air-cooled chillers were selected. Particular attention was given to overall annual energy efficiency and assessment of chiller part-load and ambient performance. Attention was also paid to performance at very high ambient conditions, and the contribution this may have on peak electrical demand.

Mulvany says this represents a sizable proportion of total electrical costs for the facility.

The adoption of outside-air, air-to-air heat recovery (via cross-flow plate heat exchangers) and CO₂ demand-controlled ventilation also ensured peak electrical demand was minimised.

In line with the city’s ongoing commitment to reduce its reliance on non-renewable energy supplies, the City of Greater Geelong also required some form of alternative power generation on site. This resulted in a 30kWp photovoltaic (PV) array being integrated into the project.

Naturally, the form of the building once again posed some challenges to the design team. Among the alternatives to traditional PV panels that were investigated was a hexagonal PV module manufactured in the US that could have been embedded into the sphere elements.

However, due to concerns regarding the maturity of such technology, a decision was made to use standard PV modules and locate the array within the adjoining Peace Memorial.

Consisting of 92 monocrystalline PV modules with string inverters, the array is estimated to displace approximately 36,000kWh of grid electricity – or about 11 per cent of the building’s annual electricity demand based on Green Star modelling.

“We are witnessing a significant revolution with the democratisation of energy generation,” says Mulvany. “It is an era that will be looked back on in the future as a very unique point in the history of the built environment.”

Other sustainability initiatives adopted in the Geelong Library and Heritage Centre include rainwater harvesting and grey-water treatment and reuse.

**A NEW CHAPTER IN GEELONG’S HISTORY**

Completed on time and under budget, the Geelong Library and Heritage Centre has received overwhelming public support and nation-wide publicity since it opened to the public last year.

According to Mulvany, the building’s architecture has created sufficient intrigue to lure people down the Princes Freeway from Melbourne. In doing so, it has fulfilled one of the project’s key objectives of portraying Geelong as an exciting place to be.

And to this end, he applauds ARM Architecture for its brave design, and contrasts the sometimes precarious public position architects must occupy compared with the relative anonymity engineers enjoy.

“Sometimes engineers don’t fully appreciate the position of those designing such brave architecture,” he says. “Although it may seem that social media has given voice to anybody who wants to be a critic, architects have been lauded or lampooned by the public since the evolution of architecture itself.

“But I don’t think many mechanical engineers will wake up with night sweats any time soon, worrying about the public response to their decision to run with a particular type of HVAC system.”

Although it’s too early to report how the building performs, a formalised building tuning program, in accordance with Green Star requirements, was due to commence at the time of publication.

**GEELONG LIBRARY AND HERITAGE CENTRE AT A GLANCE**

**The personnel**

- **Architect:** ARM Architecture
- **Building services:** Umow Lai
- **Client:** City of Greater Geelong
- **Contractor:** KANE
- **ESD:** Umow Lai
- **Independent commissioning agent:** A.G. Coombs
- **Mechanical contractor:** D&E Air Conditioning
- **Project manager:** Davis Langdon
- **Structural and civil engineer:** Irwinconsult

**HVAC equipment**

- **AHUs:** Air Change
- **BMS:** Elliot Controls (Tridium Niagara AX)
- **Chillers:** Smardt-PowerPax
- **Diffusers:** Krantz
- **Fans:** Fantech
- **FCUs:** Colair
- **Grilles:** Krantz
- **Pumps:** Grundfos (with VSDs)
- **Hydronic heating (in-screed):** Rehau
- **Boiler (HHW):** Modulex
- **HEX:** Alfa Laval
- **PV array:** Sunpower E20-327 and Fronius Symo
- **Sustainability display:** Greensense