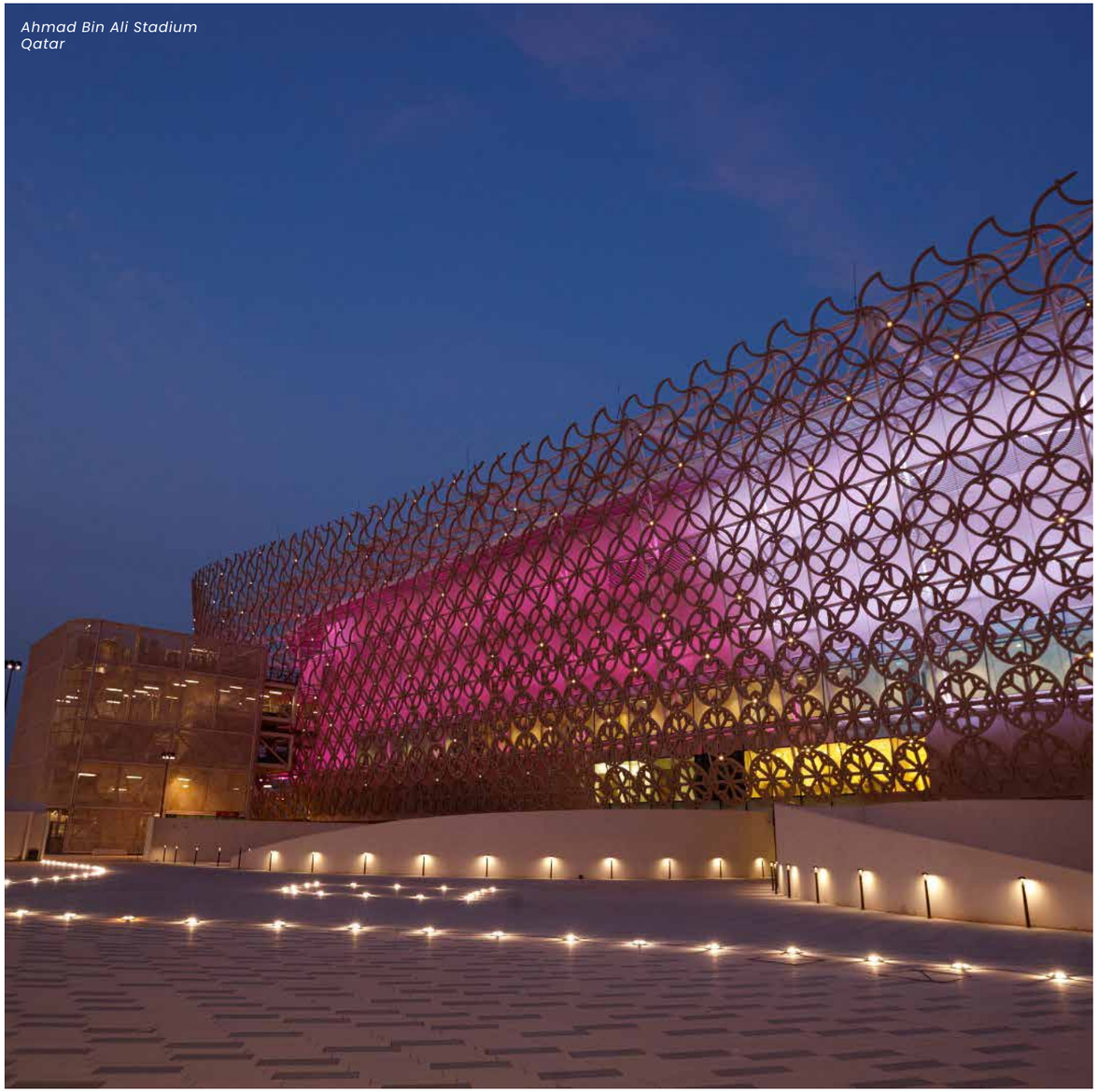
RICKARD

ENGINEERING

SYDNEY • LONDON • DUBAI • HANGZHOU • DENVER

**SKYE BY CROWN GROUP**
North Sydney NSW

# Contents



*Ahmad Bin Ali Stadium*
*Qatar*

# About

**Charles Rickard is one of Australia's most sought-after engineers who has built a solid reputation through delivering quality, trust and innovation within his field.**

## Charles Rickard

MSc, CEng, FIStruct.E, FIE (AUST), MIPENZ

Managing Director

An industry leader and well-respected professional within his field.

Charles Rickard graduated from Surrey University, UK with a Master of Science (Distinction) in Structural Engineering in 1975, having completed a Bachelor of Science in Civil Engineering the previous year.

Charles undertook his initial three years of engineering training with Taylor Woodrow, the international engineering group. By 1982, after an 18 month stay with Alan Baxter & Associates, he had achieved the position of London Associate with White Young Consulting Group (now known as White Young Green). His major responsibility with them was the engineering design and site supervision of construction for the $100 million (1980 value) Phase 2 Basildon town centre development in the UK. Charles also did a three month stint in Qatar, where he designed a new palace for the Emir.

In 1984, Charles moved to Australia and set up Rickard and Partners Pty Ltd, subsequently known as Bonacci Rickard, then Rickard Hails Moretti Pty Ltd. Over a period of 20 years, the company offered civil, structural, façade and building diagnostic consultancy services in two divisions, while utilising the very latest in design and drafting computer technology. The new company eventually enjoyed an annual fee income turnover in excess of $3 million, with clients covering the public and private sector and project values ranging up to $200 million.

## Amir Naderi PRINCIPAL

CPEng, MIEAust, NER, RPEQ, BEng (Civil), MEngSc (Structural), MEngSc (Geotechnical)

Amir Naderi is a senior Structural/Façade Engineer and a highly professional member of the Rickard Engineering team. With an impressive portfolio in a variety of projects ranging from commercial to residential, Amir is highly regarded within the engineering industry. He holds a Master of Structural Engineering from the University of New South Wales and a Master of Geotechnical Engineering and Engineering Geology also from University of New South Wales.Amir is a Chartered Engineer (NER) and also registered in Queensland (RPEQ) and Victoria (VBA). Amir has been with Rickard Engineering since 2014 and within this time has contributed to a range of major projects both domestically and internationally including Australia 108 (VIC), 380 Lonsdale (VIC), Wynyard Walk (Sydney), The Ribbon (Sydney), Australian Parliament House (ACT), Oman Convention Centre (Muscat, Oman) and Singapore Zoo (Singapore).

## Noman Ali DIRECTOR

APEC Engineer IntPE(Aus), CPEng, MIEAust, NER, BEng (Civil), MEngSc (Structural), MSc (Seismic)

Noman joined the Rickard Engineering team in 2017, having gained significant experience in Abu Dhabi and Pakistan. After attending university in Pakistan and completing a bachelors degree in Civil Engineering and masters in Structural Engineering, Noman extended his education at the University of Rome in Italy with a masters in Seismic Risk.

Noman's extensive portfolio includes civil and structural projects in both Abu Dhabi and Pakistan including the construction of the Sea Palace Highway and 50 MW Wind Power Plant project. For Rickard Engineering, his portfolio includes engineering for major projects such as 380 Lonsdale St Melbourne (Vic), Al Rayyan Stadium (Qatar), IICC – Exhibition Centre (India), Infinity by Crown (Sydney), Destination Gold Coast (QLD) and many others.

## Szymon Fujak DIRECTOR

AIJ, CPEng, MIEAust, NER, PE, PhD (Structural), MSc (Structural), BSc (Civil)

Szymon was born in Poland and attended Wroclaw University of Technology, BSc earning the Prize for the Bachelor Thesis (Analysis of Long-Span Steel Roofing Solutions). He studied in both Belgium (Vrije Universiteit Brussel and Université Libre de Bruxelles) as an exchange student in Germany (Universität der Bundeswehr München), also studying in Japan for the first time (Tōhoku University). His Masters thesis (completed in Poland) was titled The Influence of Changing Dynamic Characteristics of a Mass Damper onto the Effectiveness of Vibration Reduction in Slab-Column Buildings and was awarded the 'Best Graduate of the Department' and second place in the Best Graduate of the University. Szymon worked for K2 Engineering starting from the last year of his Masters, with major projects being Gliwice Arena (sports hall with PT roof [external cables], 14 000 seats), Fabryczna Station (one of major Polish railway stations) and Wroclaw Station (one of major Polish railway stations).



The Lanes,
Gold Coast, QLD

***WYNYARD WALK***
*Western Portal, Clarence Street Portal*
*Client: Townsend Group*

# Services

Façade Engineering
GRC Specialist Design
GRP Specialist Design
Structural Engineering
Swimming Pools
Civil Engineering
Diagnostics Engineering
Temporary Works
Value Engineering

***INDIA INTERNATIONAL CONVENTION CENTRE (IICC)***

## Façade Engineering

***The practice is renowned for its expertise in façades, in particular for curtain wall construction and the design of glass reinforced concrete cladding panels.***

The design of high rise building façades requires careful and detailed analysis. It is necessary to consider the "design intent" of the architect together with structural limitations and possible implications for construction. Concept design is essential to provide thermal analysis, ascertain likely wind loads, negative pressure, water-tightness and construction methodology and to work closely with owners, architects, contractors and other engineers.
Over many years we have become experts in the design of virtually every form of façade treatment including, but without being limited to:

- Curtain wall and window design and certification
- Precast concrete and GRC
- Metal clad and rain-screen systems
- Stone and terracotta
- Structural glass
- Fibre composites
- Glass awnings and skylights
- Thermal analysis of façade systems

***ST LEONARDS COLLEGE***
*Melbourne, VIC*

## Glass Reinforced Concrete (GRC)

Charles Rickard is an acknowledged world expert in the design and application of GRC technology. He was the Technical Secretary to the Cement & Concrete Association during the 1990s when he wrote the Australian Code of Practice for GRC. His pioneering use of continuous glass filament has led to much improved strength in façade structures and has been adopted as a standard throughout the world by the majority of GRC designers and fabricators.

Charles and his team are regularly invited overseas to provide GRC design services.

***GRC is widely used in the Middle East and is quickly gaining popularity in Australia. It is the logical alternative to flammable composite aluminium cladding.***



## Glass Reinforced Plastic (GRP)

Since the 1990s, zero rated fibreglass has been available and has been used in such items as the Tangara train seats (for which we also designed the injection moulds) and other areas where fire rating is essential. The strength and flexibility of GRP allows for its use in façades and other indoor and outdoor applications.

GRP is used extensively for swimming pools. Rickard Engineering was responsible for designing the first free standing fibreglass swimming pool requiring no support from any soil or other structure.

Other commissions have included the design of seats for a grandstand at Randwick Race Course, the canopy to the lookout tower in Newcastle and agitation tanks for the manufacture of gelatine.

***GRP has the strength of steel and the stiffness of timber.***

***AHMAD BIN ALI STADIUM***
*Doha, Qatar*
*Client: Al Tasnim Enterprises LLC*


***PACIFIC SQUARE***
*Maroubra, NSW*

## Structural Engineering

Our services cover all classes of buildings: commercial, residential, industrial, retail, car parks, pre-fabricated and modular structures, demountable buildings, education facilities and materials handling facilities. Works include design in steel, concrete and timber materials specialising in:

- Conceptual and schematic design
- Wind analysis review
- Lateral stability optimisation
- Earthquake engineering
- Detailed design and construction documentation
- Site support
- Peer reviews and value engineering

Our staff are trained to ensure that all structural design is appropriate for purpose and to be conscious both of construction cost and construction time.

***With structural engineering we are particularly focused on the need to NOT overdesign.***



*Client: Compass Pools*

*Client: Compass Pools*

## Swimming Pools

Charles Rickard has arguably the broadest experience in the design of swimming pools in Australia. Charles has enjoyed a professional relationship with Crystal Pools since 1984 – building concrete pools. If one considers the design of fibreglass pools, he has no peer.

He has acted for Compass Pools Australia since 1984. In 1987, Charles was technical secretary to Standards Australia for the major overhaul of the Fibreglass Pool Codes, AS1838 and AS1839. In 1993, he won an Australian Design Award for the first free standing fibreglass pool "Compass Maxi".

A selection of aquatic projects include:

- Bradbury Swimming Pool, NSW
- Colmslie Aquatic Centre Brisbane, QLD
- Eagle Vale Swimming Pool, NSW
- Hilton Hotel Melbourne, VIC
- Mt Annan Leisure Centre, NSW
- Next Generation Club, ACT

***When it comes to the design of swimming pools, Charles Rickard is an acknowledged expert in the field.***

***PORT BOTANY CONTAINER PARK***
*Client: PBCP Pty Ltd.*

## Temporary Works Support

Rickard Engineering regularly provides advice to building contractors on means of stabilising existing structures during major redesign and/or refurbishment works.

Temporary works may include design of back-propping, infill slabs, adjunct footings/foundations and the like.

## Civil Engineering

Our team of professional engineers have disparate yet complementary skills enabling us to confidently design:

- Retaining walls
- Underground pits
- Deep trenches including ground stabilisation walls
- Concrete and steel tanks
- Foundations including piling and piers
- Pavements
- Civil works
- Storm water controls

Staff involvement in completed projects includes:
The new container parks in the Ports of Sydney and Brisbane, the runway pavement alterations at Sydney Airport, the design of the Dubai dry docks and the Newcastle coal terminal at Kooragang Island, the largest coal port in the world.



*Client: Brickworks Building Products*

***If you need to make it, we can design it.***

## Product Development

Rickard Engineering has been involved in the design and the development of numerous products which are integral to construction and engineering both. We have designed a number of aluminium proprietary products for the exclusive use of contractors for use in building façades, a range of GRC drainage pits for Mascot Engineering and a fire resistant GRC decking for use in country bushland areas.

We have the design skills in-house to meet most challenges for the design of specific products.

## Project Evaluation / Value Engineering

*Project evaluation* generally occurs post-design. *Value engineering* is generally conducted pre-design or during the design process.

Over design of structural engineering elements by some practitioners is, unfortunately commonplace. A peer review by an experienced structural engineer can identify whether a structure has in fact been over designed. Rickard Engineering's strict adherence to economical design within its own practice provides it with the ability to audit the work of others leading if necessary, to recommendations on design amendment and cost minimisation.

Rickard Engineering, both with project evaluation and value engineering, works in conjunction with Robert Hart who has over 50 years' experience working with architects, engineers (in all disciplines), builders and developers.


***BOURKE STREET PUBLIC SCHOOL***
*Surry Hills, NSW*

# Building Dispute Resolution, Expert Opinion

***Our team of industry experts have the experience and skills to resolve your dispute quickly, fairly and cost effectively.***

Lawyers know the law, we know building construction.
Building and construction litigation can be costly, stressful for both parties and often unnecessary. In the end, no one really wins in court except perhaps the lawyers. We have found that in reality, the root cause of a dispute can often be found in poor design or lack of effective supervision rather than in the execution of trades workmanship.

We have the proven expertise to unravel and understand complex problems and to separate and identify the design, management and construction responsibilities attaching to the particular dispute, without resorting to the law.

We confer with both parties to gain an understanding of the issues from their respective points of view. We then undertake a process known as "Early Neutral Evaluation" to guide our initial determination of the factual basis of a claim by claimant and defendant, both. When our review is complete we provide totally unbiased advice on how to resolve a dispute at a fraction of the cost of litigation.

# Diagnostic Engineering

Rickard Engineering has been providing engineering diagnostic services in Australia since 1984 and has strong ongoing relationships in the public sector, in particular, the NSW Department of Education.

Every year Rickard Engineering inspects an average of one school every calendar week. Rectification of cracking in old buildings requires pragmatism combined with a sound understanding of soil mechanics in relation to masonry and timber frame structures.

We also look at issues to do with residential strata when the enquiry is specifically to do with engineering. Such experience is also invaluable when evaluating the cause of building defects which become a matter of a building dispute.

***We have a proven track record of achieving optimum design solutions whilst minimising costs.***

***DEE WHY RSL CLUB***
*Ocean Grove Apartments, NSW*

# Featured Work

## Australia 108 Melbourne

The tallest building in the southern hemisphere, Australia 108 is a new residential development in Melbourne currently under construction by Brookfield Multiplex. Rickard Engineering is the façade engineers to Minesco who are supplying the aluminium and glass curtain wall.

The curved geometry of the façade and large displacement of the building meant it was essential for special considerations to be made with regard to façade/building movements and the interaction between the two.

The “Star Burst” design between Levels 69 and 72 is highly complicated and is constructed with aluminium panels and glazing panels installed on trusses.

*Client: Minesco*
*Builder: Multiplex*
*Architect: Fender Katsalidis*
*Services: Design and certification of building façade*

# Royal Adelaide Hospital

The largest project in the southern hemisphere in the last ten years has been the new Royal Adelaide Hospital, at a cost of around $2 billion.

Yuanda Australia were the façade contractor for all of the aluminium and glass componentry. Rickard Engineering was the independent certifying engineer for the façade project. Its involvement commenced in 2013. The last revisions were certified in 2017.


*Client: Yuanda Australia*
*Builder: Hansen Yuncken Leighton Contractors*
*Services: Independent certifier for glass and aluminium façade*

*Picture Source: umowlai.com.au*


*Client: Taylor*
*Builder: Taylor*
*Architect: NBRS Architecture (concept)/BKA Architecture*
*Services: Façade engineering and certification*

# Taronga Zoo Institute of Science & Learning & Taronga Wildlife Retreat Sydney

Rickard Engineering was appointed by Taylor Construction as the design engineer for the façade at the Taronga Institute of Science and Learning.

It is a global centre of excellence for conservation science and learning and it is considered the first of its kind in the Southern Hemisphere. The original design concept was done by NBRS Architecture and further developed by BKA Architecture. Rickard Engineering worked closely with Taylor Construction, BKA Architecture and Locker Group to bring the architectural ideas to life.

Rickard Engineering was responsible for the design of the perforated hexagonal panels, glass balustrades, perforated horizontal and vertical sunshades. The biggest challenge was designing the hexagonal panels to achieve a 3D effect due to them not being on the same plane.

The facility achieved a 6 Star Green Star rating.

# Ahmad Bin Ali Stadium Doha, Qatar

Rickard Engineering provided the engineering input for the new 'Ahmad Bin Ali' Football Stadium in Qatar, together with the GRP roof panels for the 8 "dune" buildings which surround the Stadium, where the 2022 FIFA World Cup will be held. Ahmad Bin Ali is a fascinating and complex project with regard to the differing GRP shapes designed and hence variations in connections to cater for the variety of shapes.

*Client: Al Tasnim Enterprises LLC*
*Builder: Al Balagh – L&T JV*
*Architect: KSS*
*Services Design of GRP façade for stadium and eight dune roofs*

# Infinity
# by Crown Group
# Green Square, Sydney

Asurco Contracting in Adelaide engaged Rickard Engineering to design the GRC cladding, seats and planter boxes for the Green Square project, Infinity. This is a unique project, involving a curved ribbon shaped façade and ski-slope roof feature. Unique geometry and panel types are designed for construction, with a supported system on the slab edge.

*Client: Asurco Contracting*
*Builder: Crown Group*
*Architect: Koichi Takada Architects*
*Services: Design of GRC ribbons, planter boxes and seats*

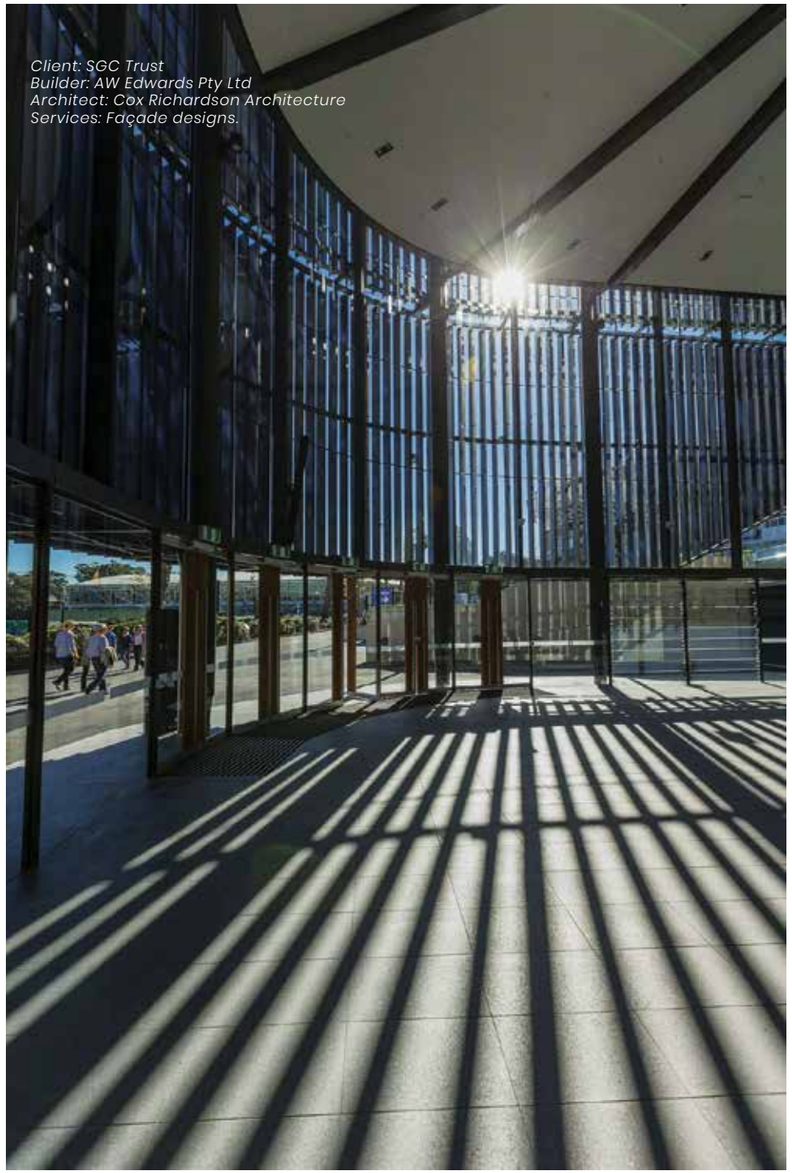
*Client: SRG Global*
*Builder: Brady Constructions Pty Ltd*
*Architect: Elenberg Fraser*
*Services: Design and certification of the building and podium façade.*

# 380 Melbourne

380 Melbourne is a recently completed project located at 380 Lonsdale Street, Melbourne. Rickard Engineering is designing the complex curved curtain wall system for the 67 storey tower and podium of the building.

# SCG Stand Sydney

The North Stand at the Sydney Cricket Ground was designed by Cox Richardson Architecture and built by builder AW Edwards Pty Ltd. It was opened in 2014. The aluminium external façade was supplied by Townsend Group, design by Rickard Engineering.



*Client: SGC Trust*
*Builder: AW Edwards Pty Ltd*
*Architect: Cox Richardson Architecture*
*Services: Façade designs.*

# 108 Flinders Street Melbourne

108 Flinders Street is an office development in the heart of Melbourne. The panels do not contain any structural frame which highlights the unique ability of the GRC material to create fine detail. Designed by Rickard Engineering, the panels were built by GRC Environments for the building, which was completed in early 2014.

*Client: GRC Environments*
*Services: Design of GRC cladding*

# Museum of Contemporary Art (MCA) Sydney

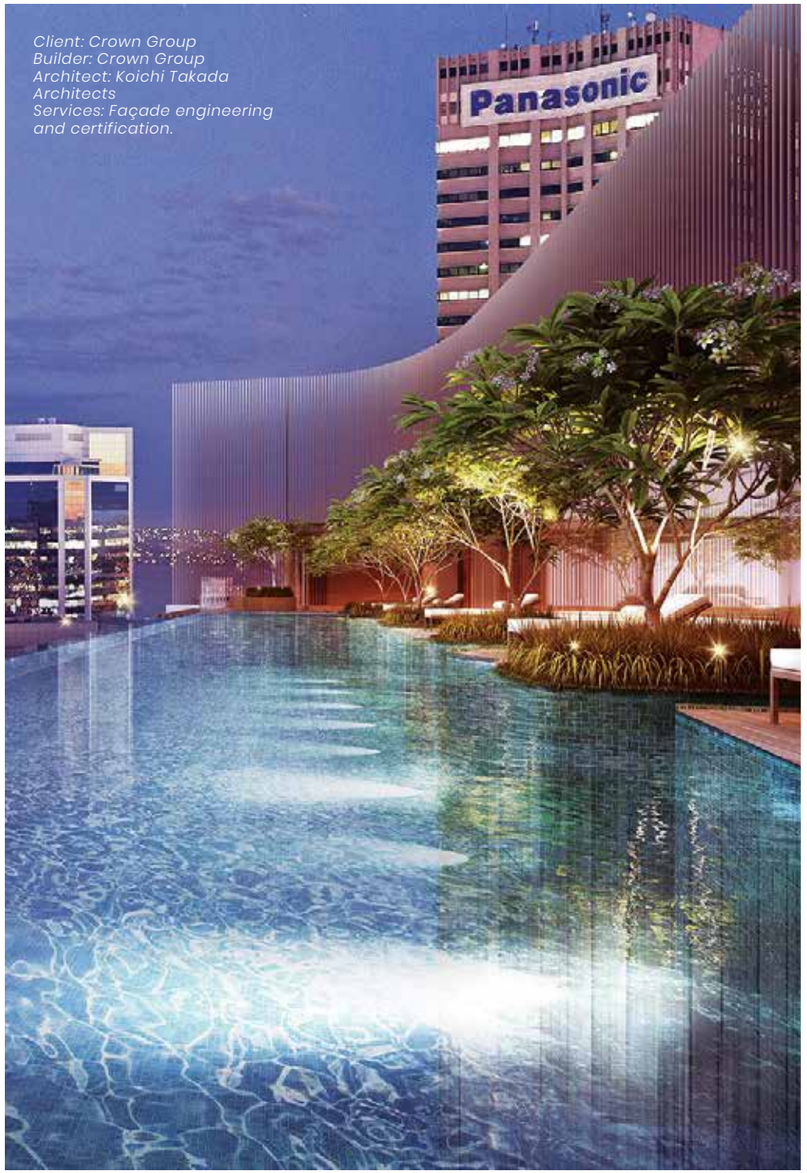
Construction for a major extension to the Museum of Contemporary Art (MCA) commenced in 2010 and opened in 2012. The competition design winner was architect, Sam Marshall. A major feature of the building design was the GRC façade.

The main contractor was Watpac Constructions, the GRC panels were manufactured by Precast Concrete of Brisbane to design by Rickard Engineering. The panels were the largest precast GRC panels ever constructed in Australia, probably the world. 11m x 3.4m with a 1.5m return was the largest panel size, supplied in a variety of different sealed stained colours. The panels incorporated a unique fixing detail to accommodate the seasonal movement for such a large panel, developed specially by Rickard Engineering. They were the subject of a paper presented by Charles Rickard at the GRCA World Conference in Istanbul in 2012.


*Client: MCA Trust*
*Builder Watpac Constructions*
*Architect: Sam Marshall*
*Services: Design of GRC façade*

# Oman Convention Centre Muscat, Oman

Rickard Engineering completed the design and certification of the GRC blue roof and glazing façade on the Oman Convention Centre. This was an extensive project comprising a GRC roof supported on a steel frame. The OCC is an iconic landmark for the City of Muscat, Oman.




*Client: Crown Group*
*Builder: Crown Group*
*Architect: Koichi Takada Architects*
*Services: Façade engineering and certification.*

# Skye by Crown Group North Sydney NSW

Skye by Crown was a fascinating project in North Sydney.

Rickard Engineering was responsible for designing the curvilinear façade with detailed aluminium tubular sections for the luxury apartments.

# India International Convention Centre (IICC)

Rickard Engineering delivered the design for GRC solid and perforated panels for the façade and internal ceiling of three buildings in the complex.


*Client: GRC Environments*
*Services: Design of GRC cladding*

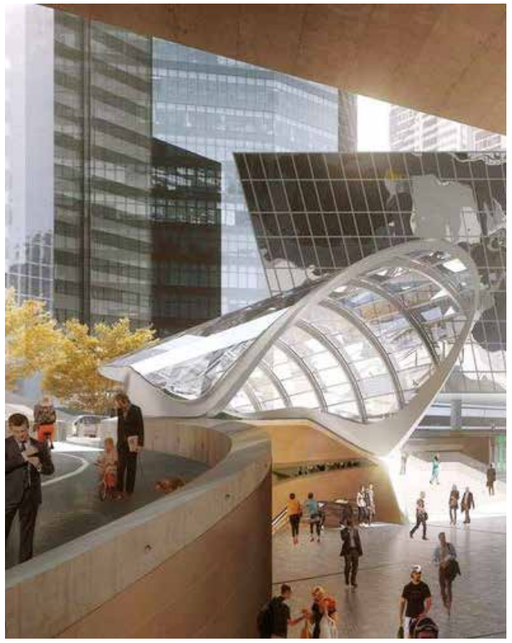
# Wynyard Walk Sydney, NSW

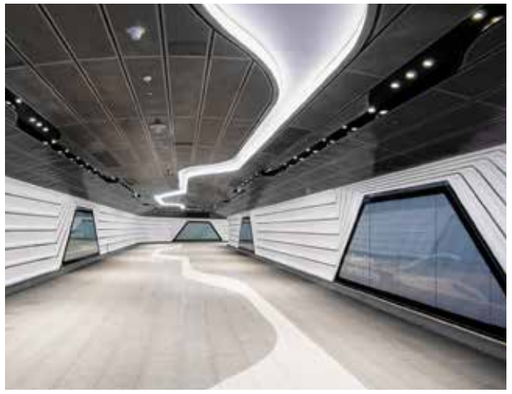
## Western Portal / Clarence Street Portal

Situated in Sydney's CBD, Wynyard Walk is a pedestrian walkway which connects Barangaroo with Wynyard train station. Rickard Engineering designed the glass, stainless steel, aluminium and sandstone cladding with provision for potential impact of a bomb explosion.

Some other design work included the glazed façade, awnings and perforated stainless steel façade of the Clarence Street building, including the glazed canopy, glass lift shaft and sandstone cladding of the Western Portal. We also designed the perforated stainless steel ceiling and glass balustrade of the Pedestrian Bridge over Sussex Street, alongside the perforated stainless steel ceiling of the main tunnel.

*Client: Townsend Group/CPB Contractors*
*Builder: CPB Contractors*
*Architect: Woods Bagot*
*Services: Façade engineering and certification.*



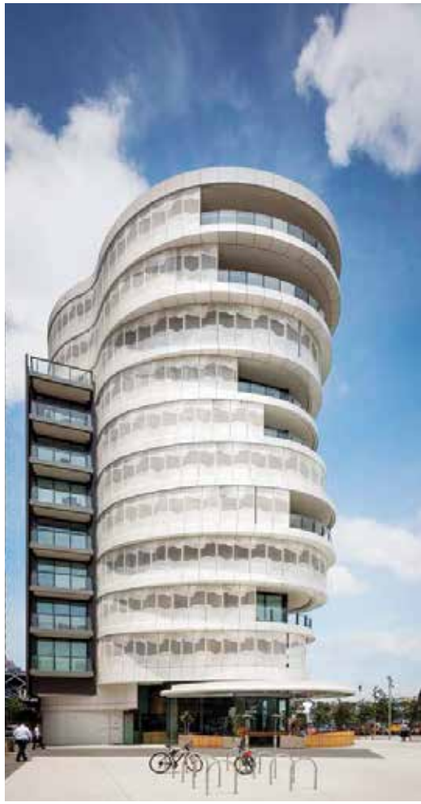





# Alexander Apartments Barangaroo, Sydney

Alexander Apartments is positioned on the waterfront within the Barangaroo precinct. Rickard Engineering designed and detailed the curved sliding screen panels, adjustable louvres and the bifold sliding screens. We were responsible for the façade engineering and certification of both the Anadara and Alexander buildings at Barangaroo South.

Both buildings feature manually operated perforated sliding shutters on the balconies, which open inwards, thus not obstructing balcony space. Anadara building also has motorised sliding shutters. The most distinguished part of Anadara building is the Cloud – the curved portion of the building with façade comprising of manually operated sliding perforated screens which stack in parking bays. Rickard Engineering was also responsible for the vertical and horizontal adjustable louvres, as well as the wall and ceiling cladding.



*Client: Townsend Group/Lend Lease*
*Builder Lend Lease*
*Architect: FJMT (Anadara Building)*
*and PTW Architects (Alexander Building)*
*Services: Façade engineering and certification.*

# Ceremonial Court

Qatar

Charles Rickard first visited Qatar in 1980. His first project was a royal palace for the Emir built around 1980. Working for White Young in London, Charles spent time in Rome working with architect Sandro Petti. The palace was built on a new island just off the coast of Qatar. Since that time he has revisited Doha on many occasions.

In more recent years his involvement has been related to GRC. The Ceremonial Court was part of a technical educational facility project for the Queen. Built by Redco, a local Qatar GRC company, Charles undertook the design on behalf Rickard Hails Moretti in 2005.



# Rosewood

Doha

Setting the benchmark for ultra-luxury hotels in the region, Doha's 'Rosewood' is a key focal point of the city's skyline. Rickard Engineering is proud to have provided the structural design for the striking GRP facades of the two towers, which were inspired by the coral reefs in the seas surrounding it. The complex will be one of the city's most dynamic culinary and hotel destinations and introduces 300 residences boasting modern luxury.

# St Leonards College
Melbourne

*Client: Asurco Contracting Pty Ltd*
*Builder: ADCO Construction*
*Architect: ARM Architecture*

Rickard Engineering's scope of works was the Design and Certification of the GRC façade for the new buildings. The large, curved panels are designed to clad the buildings with a water tight joint in the GRC panel. Ten metre long GRC panels are strengthened with steel frames to withstand applicable wind loads.




# Destination Gold Coast

Rickard Engineering completed the concept to design for the Glass Reinforced Concrete (GRC) podiums panels on this project. The GRC panels are up to 4m long x 4m wide. Transport, lift and installation had its challenges. GRC was shop drawn and manufactured by Precast Concrete Brisbane. The GRC panels are supported by a steel frame with a GRC skin.

The façade consisted of all different shapes and sizes to meet the architectural intent.

# The Lanes

The Lanes Phase 2 is a recently completed residential development involving two towers on the waterfront of Mermaid Waters, Gold Coast. Rickard Engineering provided the engineering input, from concept and detailed design to certification, for the GRC podium panels and GRC fins up to the roof for this project. This is an appealing and complex project concerning all different 3D irregular curved shapes and, hence, variations in connections to cater to them. Transportation, lifting, and installation had their challenges because of the unique geometry and considerable panel size.

*Client: Hutchinson Builders*
*Builder: Hutchinson Builders*
*Architect: Contreras Earl Architecture*

# SINGAPORE ZOO

***SINGAPORE ZOO, BIRD PARK WATERFALL***

*Owner: Mandai Project Development*
*Client: Pico Play Pty Ltd*
*Builder: Obayashi Singapore*
*Architect: RSP Singapore*
*Services: Design and certification of GRC walls and features.*
*Design and certification of supporting steel frame.*

# Pools

When it comes to the design of swimming pools, Charles Rickard is an acknowledged expert in the field. His expertise covers both fibreglass and concrete pools, and his designs include over 20 Aquatic centres in Australia and Asia. Pictured are some examples of his designs.

***COLMSLIE SWIM CENTRE***

*Brisbane Qld*

*Client: Crystal Pools*
*Builder: Crystal Pools*
*Services: Structural engineer design of the pools.*



# Car Parks

## Canberra Hospital / Liverpool Hospital / Padstow Railway Station / Wollongong Railway Station / Sydney Domestic Airport

Rickard Engineering has provided design support for a large number of car park projects throughout NSW and the ACT.

One example is the Canberra Hospital car park built in 2012. Others include the Liverpool Hospital car park built in 2012, Padstow Railway Station in 2015, Wollongong Railway Station in 2012, Revesby car park in 2012 and the Sydney Domestic Airport car park No. 3 built in 2013.

Rickard Engineering has designed aluminium/steel façades for a variety of clients, working with a number of different architects and builders. Rickard Engineering enjoyed a close relationship with Townsend Group on a whole range of different projects until the company sadly closed in 2017. Other significant manufacturers and installers whom we continue to work with are Minesco, Hitec, Façade Concepts, Gallery Façades, Windtech Façade Solutions, Lidco, Yintec, Aambianz and Concept Windows.

***SYDNEY DOMESTIC AIRPORT CAR PARK - 2013***

*Client: SACL*

*Builder: Townsend Group*
*Services: Design and certification of façade system.*

***CANBERRA HOSPITAL CAR PARK - 2012***

*Client: ACT Health*

*Builder: Townsend Group*
*Services: Design and certification of façade system.*

*Client: MAB Corporation, Michael & Andrew Buxton*
*GRC monument supply and installation by GRC Environments*
*Architect: McBride Charles Ryan*
*Artist: Callum Morton*
*Landscape Architects: Oculus*
*Services: Design of GRC*



# GRC

## Why GRC?

Glass Reinforced Concrete (GRC) was invented in the 1960s by the Building Research Establishment (BRE) in the UK, though it dates back to Ancient Greece and Rome who used horse hair to reinforce mortar. They found a way to coat glass fibre in “zirconia” to make it resistant to alkali attack. Pilkington Bros Ltd was the company which created a commercial product ready for market, but only after exhaustive testing around the world was completed.

***GRC can be used as:***

- Façade on a new building.
- Renovate as an over-cladding on an old façade on existing buildings.
- Permanent formwork on which you pour concrete, thereby gaining a very durable long-term soffit surface to your slab.
- Used to form sculptured structures: the 37-metre-high Merlion on Sentosa Island, Singapore or the Big Ram, the Big Prawn and the Big Oyster in Australia.
- Awnings or sunscreens on the face of a building.
- In or above ground drainage pits; oil or grease separators.
- Robust on the ground service ducts planter boxes .
- Street furniture.
- Computer flooring systems.
- A big attractive advantage of the material is that you can create a fire-resistant structural product to suit any shape, subject to engineer approval.

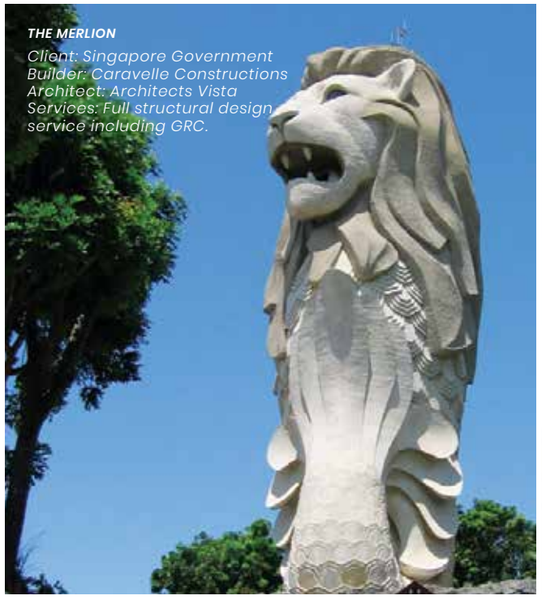
## GRC advantages

It is typically made in a thickness of around 12mm, either framed with steel or using GRC integral ribs. This typically gives a panel weight less than 50 kilograms per square metre. You compare that with conventional reinforced concrete, which weighs 360kg per square metre from a 150mm panel. This means that the GRC panel will be seven times lighter.

GRC can achieve a fire rating. A single skin of GRC can achieve a fire rating of up to one and a half hours. A greater fire rating is achieved through introducing a Styropor (polystyrene beads, sand and cement) core to create a sandwich panel that can provide a fire rating of up to three hours. (Refer to PCI (USA), GRCA (UK) or NPCAA (AUS) codes for further details).

It is an extremely durable product: GRC has the compressive strength of typically 60mpa, which therefore makes it the perfect material for an exposed application. It has durability far better than most reinforced concrete and note, no steel reinforcement to create spalling. Credit Lyonnais Bank building in London has a GRC façade, built in the 1970s. When cleaned after 50 years in the UK climate, it was found to be in perfect condition.

GRC is made in a mould, so one can create any shape you wish within reason, dictated only by engineering design to utilise its inherent ability. In fact, the biggest restriction on the successful commercial use of GRC has been the fact that people too often try to emulate solutions possible in a different material, instead of aiming for a solution that is unique to the ability of the material. Recent developments in technology now allows the GRC product to be used in a full structural application, subject to engineering design. Note the energy footprint of a building can be significantly improved by an “overclad” in GRC.



***THE MERLION***

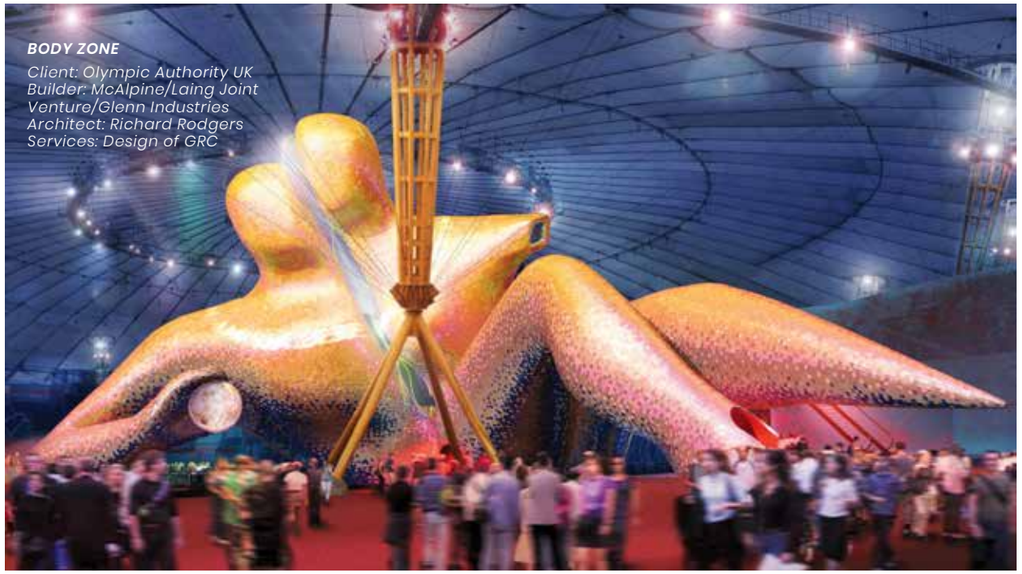
*Client: Singapore Government*
*Builder: Caravelle Constructions*
*Architect: Architects Vista*
*Services: Full structural design service including GRC.*

***BIG PRAWN***

*Client: Mokany Brothers*
*Builder: Glenn Industries*
*Services: GRC design*


***BIG OYSTER***

*Client: Mokany Brothers*
*Builder: Glenn Industries*
*Services: GRC design*



***BODY ZONE***

*Client: Olympic Authority UK*
*Builder: McAlpine/Laing Joint Venture/Glenn Industries*
*Architect: Richard Rodgers*
*Services: Design of GRC*

***BIG RAM***

*Client: Mokany Brothers*
*Builder: Glenn Industries*
*Services: GRC design*

# Iconic GRC Projects

The Merlion / Body Zone / Big Ram / Big Prawn / Big Oyster

Commencing in 1984 with the “Big Ram” in Goulburn NSW and continuing on with projects such as the “Big Prawn” in Ballina, the “Big Oyster” in Taree in 1987 and then in 1993 the 37 metre high “Merlion” on Sentosa Island in Singapore, Charles became recognised as the expert in free-form GRC resulting in him being responsible in 1999 for the GRC element of the “Bodyzone” in the Millennium Dome Greenwich London, as part of the Millennium celebrations.

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