Over 60 years ago our founding partner, Dick Taylor said “Our work is only as good as the minds behind it”. Dick was known as a true gentleman and brilliant engineering mind, he maintained lasting relationships because our clients understood his passion for outstanding architecture.

Throughout the decades, our consulting engineers have contributed ongoing award-winning designs to the built environment because we believe in his service philosophy; a personal approach to client relationships, developing the expertise of our team, tackling the tough jobs and leading with advanced technology.

TTW

Timber

Your Partner in Engineering

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Timber with TTW

Since TTW's inception in 1958, our founding partners saw success as engineers through the use of modern materials and designing with cutting-edge technologies. Fast forward to 2019 and we are still applying this ethos to deliver some of the largest, award-winning projects across the Asia Pacific region.

We sit at the forefront of the industry in the use of mass timber materials for construction, with the collective experience in **DELIVERING OVER 50 ADVANCED TIMBER PROJECTS** to date, and growing.

By reading this brochure, you've expressed an interest in learning more about timber, and how it can be used in your future projects. Through the in-depth experience of our TTW Timber Team, we can help you on this journey and deliver inspirational projects.

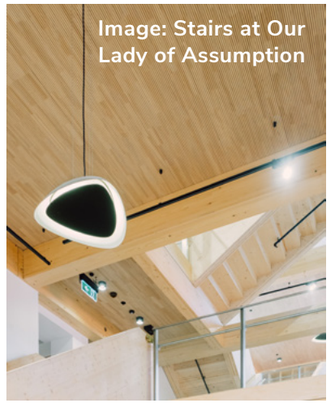


Image: Stairs at Our Lady of Assumption

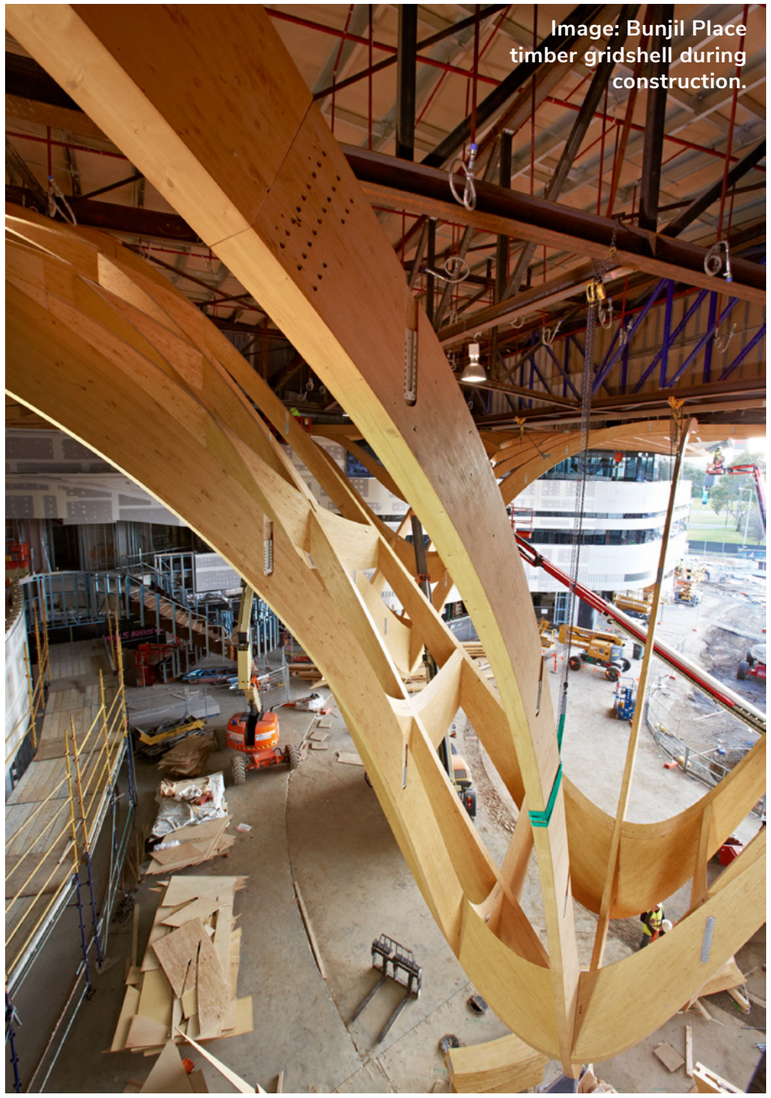


Image: Bunjil Place timber gridshell during construction.

Image: Seed House, ambitious cantilevers & hidden wall to floor connections located within all exposed CLT elements.

"The TTW Way is our commitment to building long-term relationships by providing the highest level of design and service. Our collaborative and hands-on approach brings our clients back time and again."

Rob Mackellar,
Managing Director

Our Approach

It is safe to say that timber is on the rise as the go-to product within construction engineering, and timber is a material that we at TTW, are passionate about. We are excited by the industry's openness and enthusiasm to use mass timber as a viable construction material in the form of Cross Laminated Timber (CLT), glulam and LVL.

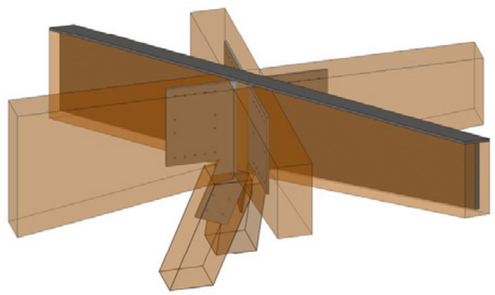
We have successfully used glulam on the **GEOMETRICALLY COMPLEX GRIDSHELL** for the award-winning Bunjil Place, which was the first of its kind built in Australia. The Incubator project at Macquarie University saw our team find smart solutions to achieve the many junctions required between cantilevering glulam beams, see below images.

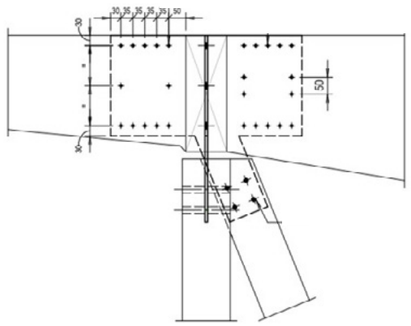
Through their **WEALTH OF KNOWLEDGE**, the Timber Team understand the strengths and limitations of using engineered wood as a material, and the intricacies of designing and delivering mass timber projects. We follow the process from the early concept stage, through to the final detail designs of the last screw or bracket holding the building together. We understand the importance of build-ability, and having materials installed and built on site in the most efficient way possible.

Our team's approach to the design and detail of structures looks to **MAXIMISE THE PROCUREMENT OPPORTUNITIES** available for your project. By developing solutions with the flexibility to be manufactured or sourced both locally and internationally, we do this through our intrinsic understanding of timber design from first principles.

This holistic and sustainable design philosophy seeks to minimise construction labour and time on site, reduce wastage of materials at fabrication, design transportable building panels and modules, and minimise crane hook time.

The Incubator, Macquarie University





WHY WE CHOOSE TIMBER

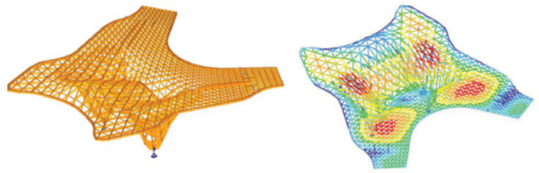
Timber is cost effective, has higher structural efficiency, delivers on sustainability goals and is resistant to corrosive environments. At TTW we have developed in-house software to cater for the varying material properties unique to timber suppliers around the world.

Our ongoing success is driven by the mutual enthusiasm and passion for timber that we share with our partners. This joint interest in revolutionising the use of timber is the foundation of our long-term **INDUSTRY PARTNERSHIPS**, both locally and internationally.

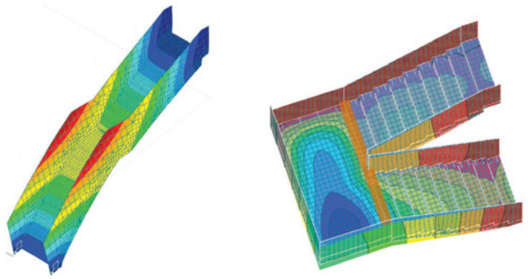
Images: Multiplex, JCB and TTW in Italy to research materials for our timber project La Trobe University.

Analysis + Testing

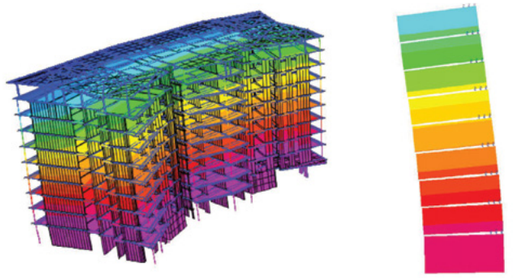
OUR INTER-DISCIPLINARY SERVICES ARE KEY to the success of our projects. The TTW Advance Team combines complex analysis and simulation with computational design methodology expertise, to provide our clients with improved project efficiencies, cost reduction and risk-mitigation.



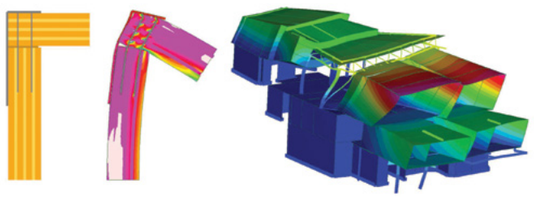
Structural analysis model of the **BUNJIL PLACE TIMBER ROOF,** showing estimated deflections under gravity load. The model considered the effects of the timber grid shell members and geometry, the long term creep movements, and the flexibility in the joints.



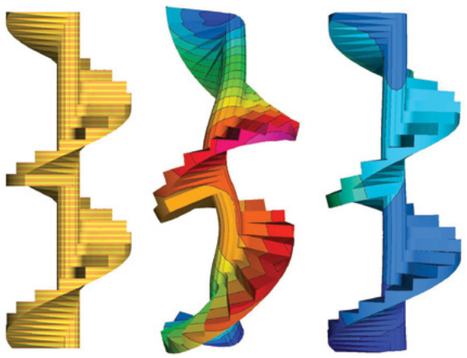
Finite element models of the **CLT STAIRS AT OUR LADY OF ASSUMPTION.** The models were used to predict the stairs' response to loads for both strength and deflections. The directional ("orthotropic") nature of the layered CLT treads and side walls had to be considered carefully in the analysis.



LATERAL ANALYSIS OF AVEO NORWEST. As the largest timber building in Australia at the time of design, the height of the structure meant that the drift movements under wind loads had to be carefully considered. CLT shear walls were used to brace the structure laterally, and their flexibility had a direct impact on the predicted movements. The flexibility of the walls was incorporated directly into the analysis, including the effects of tension anchors and the compression of the floor slabs.



Detailed finite element analysis of a **CLT PORTAL FRAME JOINT AT THE SEED HOUSE,** and the impact on global structural behaviour. The stability and robustness of the house relied almost entirely on the portal frames formed between the CLT floors and walls. The detailed joint analysis aided in estimating the joints' strength capacity and stiffness. This was then fed back into the global analysis to assess the structure's stability under gravity loads and drifts under wind loads.



Finite element model of the **CLT SPIRAL STAIR AT THE SEED HOUSE.** The central timber "core" is reinforced by a hidden circular structural steel tube member. The impact on structural behaviour was investigated by comparing the response to loads for the cases of both, with and without the tube represented in the model.

Close collaboration between our Timber and Advance teams provides our clients with creative design freedom, as we tackle the most challenging projects and make them a reality.

Our engineers are involved in **FULL-SCALE TESTS** with universities, builders and fabricators for the structural integrity of locally and internationally developed panelised systems. The challenge being that often there are no provisions available, our experts design with first principle approaches. To achieve national code compliance we understand and develop performance solutions, analyse the limits of the material and actively collaborate with testing authorities and universities to create solutions with engineered timber products.

We are involved in certifying fire performance solutions of systems and materials. This includes large-scale testing of panels and analysing the fire mode data to ensure the solutions are efficient.

Working intimately with UNSW, our engineers developed a bracing wall system using stud walls, by testing plasterboard and OSB lined walls. These were subjected to cyclic loading with numerous connection types. The results of these tests enabled us to apply these systems to low-rise buildings with engineered timber structural systems.

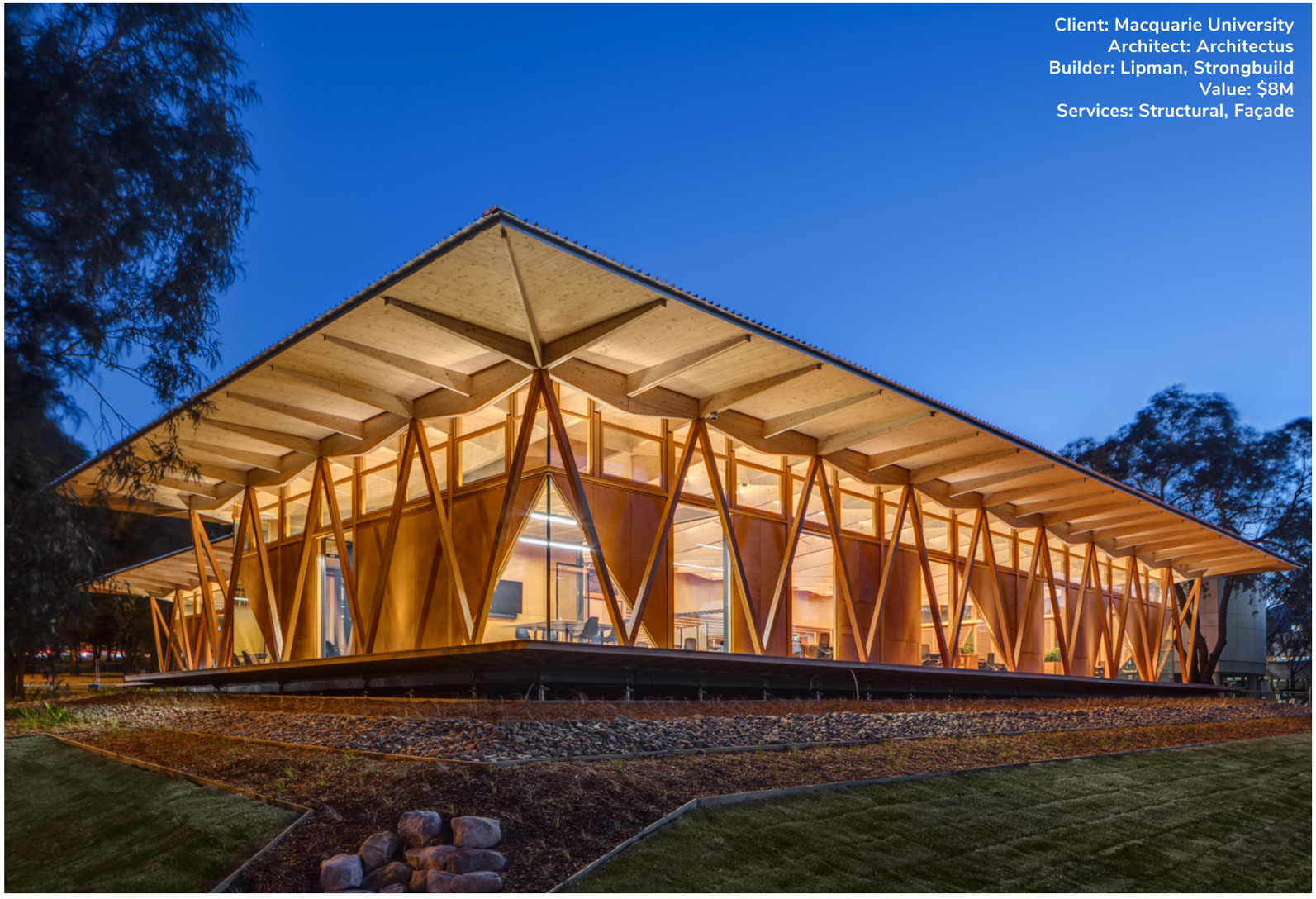
Timber Inspires

THE INCUBATOR AT MACQUARIE UNIVERSITY is an inspiring new space for students, researchers, staff, entrepreneurs and start-ups. The single-storey building is purpose-built and designed using **MODULAR CONSTRUCTION TECHNIQUES**, allowing it to be disassembled and relocated at the end of five years. It consists of two pavilions linked by a corridor, incorporating events and tutorial space, as well as meeting rooms.

The total roof length is 20m with slender tapering glulam roof beams spanning the learning space, and cantilevering a further 3m over the perimeter veranda. The beams are supported by V columns of Victorian Ash. The **ROOF TIMBERS SHIPPED FROM AUSTRIA** had to fit in 12m long containers, which presented challenges to achieve the many junctions required between glulam beams. TTW engineers determined the optimal solution involving internal flitch plates with steel dowels.

Our Timber team found solutions to deliver the architectural intent on; **CONTINUITY OF MULTIPLE TIMBER MEMBERS CROSSING EACH OTHER**, hidden connections whilst maintaining member continuity, large spans, large cantilevers, and slender members. Achieving the specified geometry, while splitting the structure into modular units for efficient transport.

Erected in just 37 days & taking home 18 award wins.



Early Delivery

The short build-time requirement for this project made it an ideal project for showcasing the innovative Cross-Laminated Timber (CLT) material.

The **AVEO NORWEST** building consists of ten storeys and was **THE COUNTRY'S LARGEST USE OF CLT TECHNOLOGY AT THE TIME**. Approximately 3,000m^3 of CLT, the equivalent 4,156 panels, have been installed to produce a complex timber retirement village.

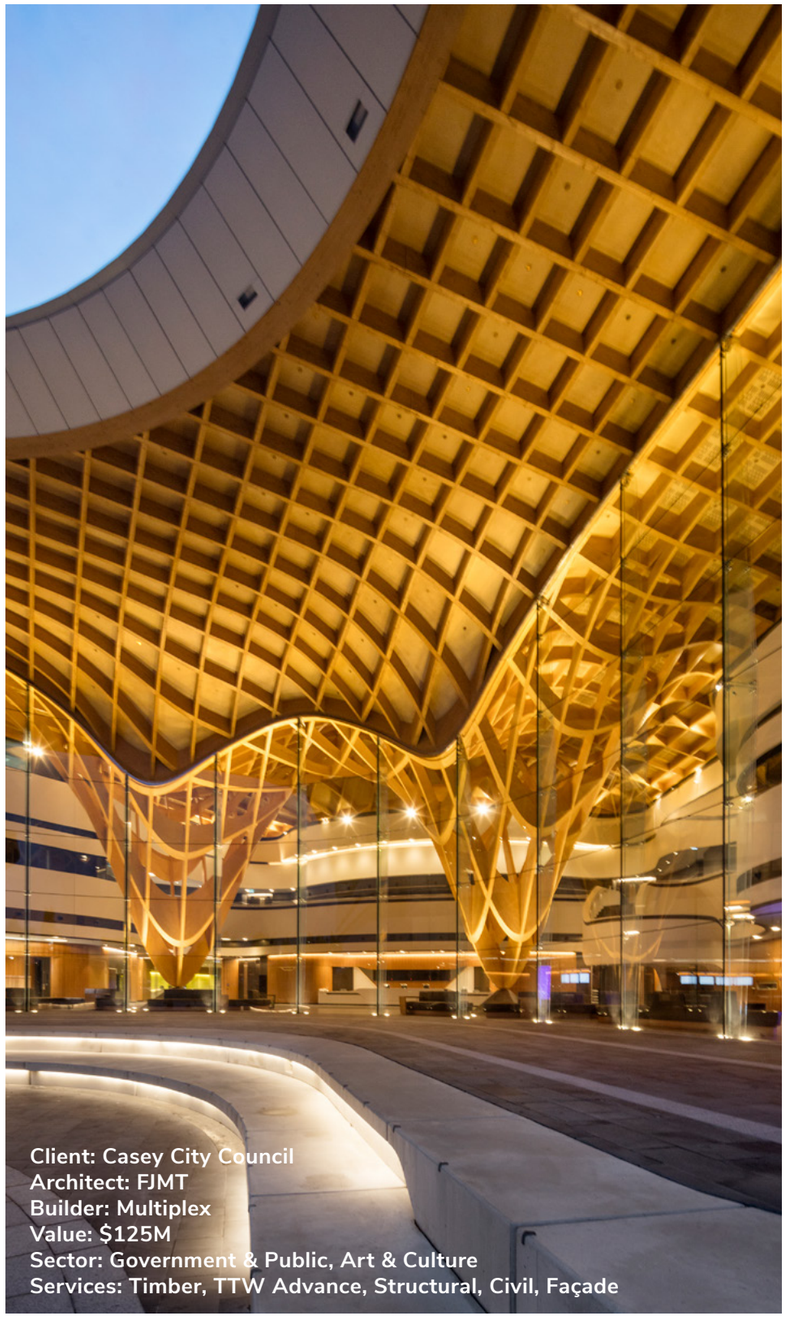
TTW engineers delivered a high-quality structure beyond a "standard box". The CLT floor had **A HIGH NUMBER OF COMPLEX JUNCTIONS** in response to the unique apartment layouts.

The design of curved and seemingly cantilevered balconies required a hybrid construction approach incorporating glulam beams and structural steel.

WINNER OF THE 2018 AUSTRALIAN TIMBER DESIGN AWARD MERIT - SUSTAINABILITY

Using CLT enabled the project to be completed 13 weeks ahead of schedule compared with the option to utilise a concrete conventionally framed structure.

Complex Gridshell



Client: Casey City Council
Architect: FJMT
Builder: Multiplex
Value: $125M
Sector: Government & Public, Art & Culture
Services: Timber, TTW Advance, Structural, Civil, Façade

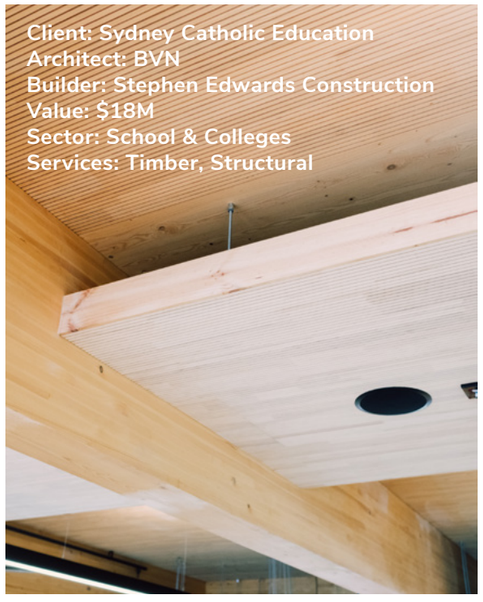
BUNJIL PLACE provides the community with a cultural hub in East Melbourne. This innovative project has nine major award wins to date, including the **2018 AUSTRALIAN TIMBER DESIGN AWARDS – EXCELLENCE IN TIMBER DESIGN**.

The building's dominant feature is a timber gridshell, the first of its kind in Australia, that defines the main atrium. This impressive central area incorporates a 12m high glass Façade facing a large community plaza area beyond.

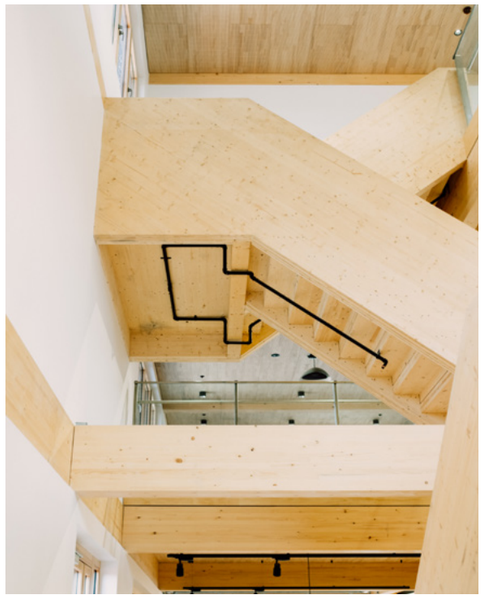
With the shell made from geometrically complex 3D forms, our team undertook a **DETAILED FORM-FINDING INVESTIGATION**, which required modelling of the timber grillage as a structural load-bearing element supporting the roof.

Our team collaborated with the chosen fabricator, Hess Timber, to develop a construction methodology that dealt with tight tolerances, a large number of connecting interfaces while protecting the exposed timber surfaces.

Sustainable Development



Client: Sydney Catholic Education
Architect: BVN
Builder: Stephen Edwards Construction
Value: $18M
Sector: School & Colleges
Services: Timber, Structural



Sydney's first multi-storey school development constructed with engineered timber.

The **OUR LADY OF ASSUMPTION SCHOOL** in North Strathfield utilises an existing three-storey concrete frame base built in the 1970s (previously the Telstra Training Centre) and delivers four levels of flexible learning spaces and facilities, constructed using Cross Laminated Timber (CLT) and glulam post and beam structure.

Committed to **CUTTING-EDGE MATERIALS AND TECHNOLOGIES** the design team were eager to implement the innovative multi-level engineered timber system for the project. Associated time efficiencies and minimisation of on-site labour was another driver for the use of prefabricated mass timber construction technology. First designs were completed in 2014, so the introduction of the new timber structure system to Australia required extensive research, material investigations and collaboration with mass timber experts.

Catering for 450 students, the development showcases **THE BEST SUSTAINABILITY PRACTICES**, with a focus on natural ventilation and high-performance timber products. Movable screens and joinery allows for a multitude of teaching configurations, and large bi-fold doors open to the timber deck, bringing the outside and inside together to create an inspiring learning environment.

Timber Showcase

SEED HOUSE is a five-level development consisting of part new build. Built predominantly in timber, the Cross Laminated Timber (CLT) panels were sourced locally and pushed to their absolute limits with the lower pods of the house extended as far out as possible on the steep construction site.

The **CLT STRUCTURE** has ambitious cantilevers exposed internally, with hidden wall to floor connections located within all exposed CLT elements. A highly architecturally refined roof truss supports the kitchen with a top chord of composite CLT and steel. Large cantilevers and thin elegant structure is showcased through the building, utilising hybrid structural steel components where possible.

A key feature to the house is an exposed **CLT TREAD SPIRAL STAIRCASE**. Each tread was CNC machined and connected using hidden screw locations. Each tread was threaded over a central slim steel circular hollow section, creating the timber core through the centre of the stair.

The side walls wrapping the **CLT CANTILEVERED PODS** used both the longitudinal layer direction and the transverse layer direction, acting as very deep beams to cantilever off steel portal frames.

Our engineers undertook vibration studies of the panels to ensure the bounciness of the cantilevered edge was minimised. CLT panels were created as a portal frame to stabilise the pod against lateral loads. The portal frame connection used a stiff steel angle and double fully-threaded screws.

Client: James Fitzpatrick
Architect: Fitzpatrick & Partners
Builder: David Campbell Building Pty Ltd
Value: $5M
Sector: Residential
Services: Timber, Structural

Lightweight Extension

Client: Inner West Council
Architect: BVN
Builder: CD Construction Group - Mirvac
Value: $23M
Sector: Government & Public, Art & Culture
Services: Structural, Civil, Façade
Images: © CD Construction Group

A new library built on an old heritage site in Sydney's inner west.

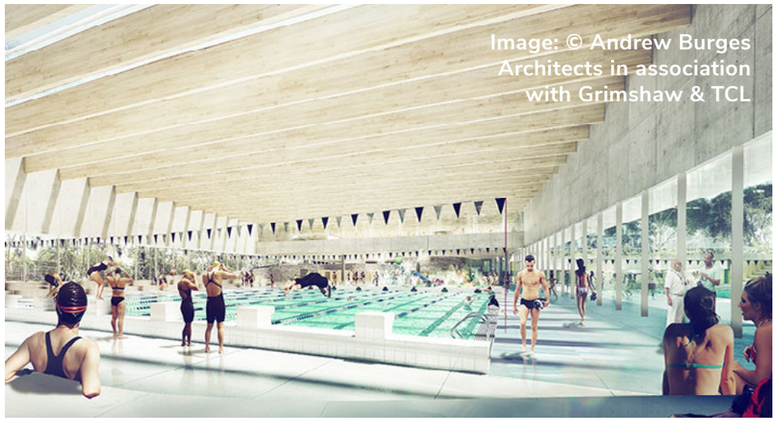
The **MARRICKVILLE LIBRARY** was an original heritage-listed hospital building and has been revived and incorporated into an expansive new library and community centre.

Fabricated in Italy, the TTW Timber team **DESIGNED THE CIRCULAR TIMBER STRUCTURAL COLUMNS** with steel end connection as per Eurocodes. Our timber experts undertook gap analysis checks to confirm compliance with Australian codes.

The columns, some over 2 storeys tall, support the distinctive floating zig-zag roof at the valleys but in an irregular grid. The sectional shape of the roof takes its cue from the pitched roof of the old hospital building with the amplitude of each successive pitch reducing across the width of the roof.

Long-Span Timber

Currently under construction and set to become the largest pool complex constructed in Sydney since the 2000 Olympics.



Client: City of Sydney
Architect: Andrew Burges Architects in association with Grimshaw & TCL
Builder: CPB
Value: $83M
Sector: Sports & Leisure
Services: Timber, Structural

GUNYAMA PARK AQUATIC AND RECREATION CENTRE is a new public community space in Green Square, Sydney. The facility will feature 50m and 25m pools, hydrotherapy and leisure pools, a gym, café, outdoor sports field and running track.

Unique to the project are 50m long steel trusses either side of the pool hall which support 36m long glulam mass timber beams. These beams are **THE LONGEST FREE-SPANNING MASS TIMBER BEAMS IN AUSTRALIA**.

Gunyama showcases innovation with the use of pressurised ETFE 'pillows' which form a translucent roofing membrane between glulam beams. This structural membrane for the roof, allows natural light to pass through into the pool hall.

Glulam beams have been used in a composite section with a CLT top panel to form a U-section which results in a more efficient structure over the large spans.

Accelerated Programme

LA TROBE UNIVERSITY STUDENT ACCOMMODATION project, valued at $100M, will provide over 600 new beds and new student amenities, for the university's growing Bundoora Campus.

TTW was engaged by Multiplex as the principal structural engineer, following our earlier value engineering advice during the tender period. Leveraging our significant timber expertise and in-house bespoke design tools, our engineers developed innovative structural solutions that resulted in **SIGNIFICANT MATERIAL AND PROGRAMMATIC SAVINGS** without compromising the architectural design intent, which assisted Multiplex in their successful tender. Notably, our holistic design approach allowed all pile foundations to be removed, as compared to the reference design.

TTW delivered all key structural packages, including CLT and glulam, as well as concrete substructure packages, in less than two months from appointment, in order to meet the fast-tracked procurement and construction programme. **OUR TEAM ATTENDED DESIGN WORKSHOPS IN EUROPE WITH THE TIMBER SUPPLIER, TO FAST TRACK THE DESIGN** coordination and shop drawing process – underpinning our commitment to service our clients.

Client: La Trobe University
Architect: JCB Architects
Builder: Multiplex
Sector: Universities, Residential
Services: Timber, Structural, Façade
Images: © JCB Architects

Victoria's largest timber building, currently under construction.

Timber Landmarks

Client: Taronga Conservation Society Australia
Architect: Cox Architecture
Builder: Taylor Construction
Sector: Hotels & Resorts, Government & Public
Services: Timber, Structural, Civil, Façade

The new **WILDLIFE RETREAT AT TARONGA** was designed to showcase Australia's biodiversity and promote conservation education. The development features a new native Australian wildlife sanctuary, along with an elegant eco-retreat, building on the popularity of the Zoo's existing Roar and Snore and Zoofari Lodge overnight experiences.

Our engineers undertook the structural design which features extensive use of exposed timber materials. The five accommodation "pods" comprise of 62 guest rooms in total. The pods vary in height between two and four storeys **UTILISE LOAD-BEARING CLT WALLS AND CLT FLOOR PANEL FRAMING,** fully integrated with structural steel and in-situ concrete elements externally.

The central guest lodge, the focal point of the Retreat, was designed with a composite glulam timber and structural steel framed roof, clad with zinc sheeting.

The refurbishment of this prominent heritage structure, **CAMPBELL'S STORES IN THE ROCKS,** encountered complex challenges demanding expert heritage engineering. Our primary focus was the overriding concern for the conservation of the existing State Heritage Register listed building. This involved input and design considerations from many stakeholders, design and heritage professionals and builders.

The timber work comprised of major rectification to the existing timber columns, timber bearers, joists, and timber floor boards. These were often the original structure built circa 1850. **THE TIMBER COLUMNS AND BEARERS UNDERWENT SEVERAL ROUNDS OF INVESTIGATIONS**, both destructive and non-destructive to determine the level of deterioration, including rot, decay and termite damage.

Client: Tallawoladah Pty Ltd
Architect: JPW
Builder: Buildcorp
Value: $32M
Sector: Commercial, Retail
Services: Heritage, Timber, Structural, Civil, Façade

Timber Pipeline

Keeping our team busy are the many large-scale Timber projects in our pipeline. We are currently applying this material to the designs of upcoming commercial, residential, community spaces, education, airport, and major aquatic developments.

Client: Mulpha Norwest
Architect: Fitzpatrick & Partners
Value: $55M
Sector: Commercial, Retail
Services: Timber, Structural, Civil, Façade
Image: © Architects Fitzpatrick & Partners, and David Duloy

THE BOND, NORWEST features seven storeys of mass timber glulam frame supporting Cross Laminated Timber (CLT) floor and roof panels.

The 13,000 m^2 mass timber structure sits on top a 17,000 m^2 concrete podium, intended for the two levels of mixed-use retail and childcare, and three levels of basement car parking.

It will offer unique adaptable office space in the Norwest Business Park area, with the use of **NEATLY DETAILED AND EXPOSED MASS TIMBER INTERIORS**.

PHOENIX APARTMENTS IN ROUSE HILL, consists of five and six storey apartment buildings and is **ONE OF AUSTRALIA'S LARGEST RESIDENTIAL TIMBER BUILDINGS, BY VOLUME**. The structure utilises a lightweight timber wall frame system using high strength LVL studs which allow a stud wall building to reach greater heights than traditionally achieved using MGP10 residential stud walls.

The walls were prefabricated at Strongbuild's factory with plasterboard and wall insulation thereby allowing wall panels to simply be craned into place once arriving on site. Manufactured in Europe by timber giant Binderholz, the Cross Laminated Timber (CLT) floors were shipped to Australia for final processing in Strongbuild's factory.

Client: Arris Group
Architect: Turner Associates
Builder: Westbourne Construction
Value: $36M
Sector: Residential
Services: Timber, Structural
Image: © Architects Turner Associates