Tall timber

Brisbane is home to Australia’s tallest CLT building.
Passive impressive

Last month, students at Monash University’s Peninsula Campus moved into a new 150-room accommodation complex built to Passivhaus standards. As Sean McGowan reports, the project forms part of the University’s commitment to producing net-zero emissions by 2030.
Monash University has applied Passivhaus design to a new, six-storey student accommodation complex built at its Peninsula Campus in Frankston, a bayside suburb about an hour south-east of the city’s CBD.

Thought to be the largest Passivhaus project to be completed in the southern hemisphere – and certainly the first Passivhaus student accommodation project of its kind in Australia – the building provides year-round accommodation for students.

The building, comprising 150 studio apartments, has been constructed using cross-laminated timber (CLT). The design is focused on occupant comfort, health and amenity, while reducing building operating energy costs.

“As a university, our aim is to create a world-class environment that supports and harnesses education and research, and encourages and enables innovation and collaboration across our community,” says manager of engineering and sustainability at Monash University, Rob Brimblecombe. “Therefore, our buildings need to offer comfort, air quality and engagement, and the Passivhaus fabric-first approach to design provides the fundamental physics and biology to realise these outcomes.”

Further to this, Brimblecombe says Passivhaus design provides a robust framework for the delivery of net-zero energy buildings with ultra-low-energy consumption and reliable performance. This supports the university’s commitment to be powered exclusively by renewable power by 2030.

“Through its ambitious design, and drawing from elements of the university’s Net Zero Initiative, Monash is redefining a university’s role in creating a sustainable future and achieving the UN Sustainable Development Goals,” Brimblecombe says. “[It’s a] blueprint to attaining a better and more sustainable future for us all.

“We anticipate that this new building will provide a new standard for comfort and indoor environment quality (IEQ) in student residences, with the rooftop solar array expected to cover a significant portion of the building’s all-electric annual energy needs.”
NO PRECEDENT

In mid-2017 – just 20 months prior to the project’s planned practical completion date – AECOM was engaged to provide building structure, services and Passivhaus engineering on the Monash University project.

Having been involved in a number of Passivhaus projects internationally, the Monash University project represented the firm’s first large-scale project built in Australia.

“As such, our team needed to revert to first-principles design and whole-of-building thermal modelling within our first month working on the project.”

Bamford says this approach allowed the AECOM team to develop confidence in the unique mechanical systems in the early stages of the project. It also led to developing confidence in the design outcome with the client.

In collaboration with Brimblecombe and other key Monash stakeholders through the early design phase, AECOM presented various ventilation and air conditioning options available to the project. A design that best suited the university and the students was then selected.

As would be expected, the university demands a high amenity standard for its apartments. This flows through to standards for appliances and other apartment fixtures, which could have proved challenging against Passivhaus standards.

“In our review of these fixtures and the Passivhaus building standards,” says Bamford, “we determined that the refrigerator alone would generate sufficient heat to warm each apartment during winter.”

HAND-IN-HAND

Although there is a common misconception that Passivhaus design does away with the need for mechanical ventilation, the reality is quite the opposite.

According to Passivhaus certifier and director at Grün Consulting, Clare Parry, M.AIRAH, Passivhaus design is based on the logical optimisation of performance.

This begins with the building envelope, where heat loads are reduced by up to 90 per cent compared to a standard building.

“Ventilation is a key concept for Passivhaus, and the most robust solutions use mechanical systems for this,” Parry says. “Rather than being designed out, HVAC is just drastically reduced.”

To achieve the reduced heat loads AECOM optimised the façade.

“We knew the façade design would be key to the success of the building,” says Bamford.

To optimise the often conflicting façade design parameters – including Passivhaus performance requirements, internal comfort conditions and the need to maximise connectivity to the outside – AECOM used parametric modelling.

“This modelling technique,” Bamford says, “allowed the team to optimise the external building shading for each design orientation.”
HEAT RECOVERY

Mechanical ventilation is provided to each apartment and common area. High-efficiency heat recovery units are used to ensure that any useful heat does not escape from the building in winter. Conversely, this design ensures unwanted heat does not enter the building in summer.

Rather than install individual heat recovery units to each apartment, the design team elected to utilise two main roof-mounted heat recovery units serving the entire building.

THE FINER DETAILS

Passivhaus air-tightness and thermal bridging performance requirements, combined with the CLT building construction (with its associated fire and acoustic performance challenges) created a significant coordination challenge for the design team.

In particular, it required the architect, Jackson Clements Burrows, as well as Passivhaus certifier Grün Consulting, the timber supplier and AECOM’s structural, ESD and services teams to work collaboratively to overcome the detailing challenges during the design stages.

The design detailing was then further developed under the early contractor involvement (ECI) to Multiplex, which provided input on constructability and the viability of using prefabricated bathroom pods.

“There were some unique challenges presented in this process, including the limited availability of fire damper and fire collar systems that are certified for use within CLT walls and floors,” says AECOM’s Nick Bamford.

This required that live performance fire testing with the timber supplier be completed for a range of penetrations.

“Not only was this all achieved within the tight project timeframes,” Bamford says, “but the process resulted in a high-performing building with air tightness exceeding the Passivhaus performance requirements.”

Additionally, riser and floor-plate efficiency was improved as a consequence of this collaboration, compared to traditional residential projects.

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According to Bamford, this reduced the number of penetrations to the building’s façade. This in turn avoided the associated challenges of air tightness and thermal bridging. “The latter ensured solar gain in the morning and evenings would be thermally distributed throughout the building for reduced heating requirements in winter,” he says. “And it mitigated a high peak load to west elevation apartments in summer.”
To take advantage of mild outdoor conditions when they occur, the heat recovery units feature a by-pass function.

When conditions are favourable outside, fresh air is simply filtered into the building, bringing these optimal conditions indoors.

Should successive warm days increase the building’s interior temperature, each apartment features operable windows, and is fitted with ceiling fans.

THE PATH TO CERTIFICATION

In the role of Passivhaus certifier (acting as agents to the Passivhaus Institut), Grün Consulting worked closely with the entire team to ensure the project was designed, documented and constructed in accordance with the standard.

According to Parry, while the Passivhaus standard does not demand any particular means or material for construction,

LESSONS FROM THE CONSULTANT

AECOM associate director of building services, Nick Bamford, shares some of the key learnings from the design and construction of Australia’s first student accommodation project to be built to Passivhaus standards.

COMPLEX PROJECTS FROM FIRST PRINCIPLES

“This project could not have been achieved if we had not thrown out the rule book before we started. We have gained plenty of valuable experience in mass timber and Passivhaus design based on how we have approached this project.”

THE DETAILING

“We had a perfect storm of detailing challenges, between Passivhaus, BCA acoustic and fire separation, timber and architectural aesthetics. It kept our engineers, timber suppliers and the building surveyor very busy during the project.”

THE IMPORTANCE OF STAKEHOLDER ENGAGEMENT

“A Passivhaus building performs differently to both a standard conditioned and unconditioned building, so we needed to work very closely with our client to develop their understanding and confidence in the design being proposed.”
the choice of CLT on this project made the path to certification somewhat easier. “The structural and thermal lines are distinct, and timber leads to more thermally efficient methods of assembly than, say, a steel structure,” she says. “Thermal bridging, for example, is less prevalent and the use of timber became more accepted in other areas such as studwork, which was almost foreign to a commercial contractor. Those regular bridges were therefore significantly reduced.”

To assist in achieving Passivhaus certification – and as a requirement for all new buildings under Monash University’s Net-Zero Initiative – the student accommodation building has been fitted with a large, rooftop solar photovoltaic (PV) array.

PROVING THE POTENTIAL

Following the successful completion of the building’s air pressure test – a key performance requirement for Passivhaus buildings – the new student accommodation complex reached practical completion in late January 2019. Consequently, students began moving into the 150 studio apartments from mid-February.

With final Passivhaus documentation set to be reviewed by Grün Consulting, official certification is expected in the coming months.

According to Bamford, the Monash University Student Accommodation project has proven the potential of Passivhaus for large residential buildings in Australia. “We commenced the design process somewhat sceptical of the validity of Passivhaus in the Australian climate,” he says.

“Timber leads to more thermally efficient methods of assembly than, say, a steel structure.”
"But having completed the design, reviewed countless energy and thermal models and now seeing the preliminary results of the building in operation, we are very enthused about the potential Passivhaus offers for reducing building energy in Australia."

Although the project challenged all stakeholders, Brimblecombe says the outcome is a building that offers healthy, comfortable and engaging spaces for university students to live and study in.

"With dedicated outside air ventilation, a consistent interior temperature, moisture management, exposed timber finishes and an outlook over the leafy campus, it should be a wonderful place to live and study," he says.

Brimblecombe expects the design of the apartments to be particularly popular with the university’s diverse population of students, many of whom herald from warmer climes.

"I am hopeful," he says, "that we can redefine the experience of living through our Victorian winters."