It seems each new commercial building in Australia trumps the last, both for design and performance, and 1 Bligh Street is no exception.

The building’s elliptical double-skin façade form, conceived by German architectural firm Ingenhoven and Australian architects Architectus, was selected from a swathe of entries to an international design competition offered by owner DEXUS and the City of Sydney in 2006.

This shape came about as a way to open up the corner site, at the same time taking advantage of the views over Sydney Harbour that could be created by avoiding a standard rectangular floor plate.

And while such views were obtained across so many of the building’s 28 floors, what has also been achieved is a brilliant evolution of Sydney’s CBD skyline as seen from the harbour itself. The addition of this sparkling building has literally transformed the backdrop of the internationally recognised Circular Quay for good.

And sparkle it does, with its clear glass façade reflecting sunlight at times, while at others appearing almost transparent.

But beauty should always be more than skin deep, and 1 Bligh Street has the substance to go with its style. So much so that it was awarded Sydney and New South Wales’ highest Green Star rating score when it achieved a 6 Star Green Star Office Design v2 certified rating in 2010.

According to DEXUS CEO Darren Steinberg, every aspect of the building was designed to optimise sustainability and tenant amenity.

“As co-owners, we are delighted that our vision to deliver the next generation of sustainable office buildings has been recognised through the achievement of a world leadership 6 Star Green Star rating,” he says.

A myriad of ESD features make 1 Bligh Street what it is. Among these is a naturally ventilated full-height atrium, double-skin façade with automated solar control blinds, hybrid air conditioning system, hybrid trigeneration and rainwater recycling.

Additionally, a blackwater treatment plant will save approximately 100,000 litres of water a day. It is the first high-rise
office building in Sydney to feature such a system.

Furthermore, the embodied energy of the building was reduced during construction through the use of “cement replacement technologies” – a unique high-strength concrete with lower cement content that reduced the building’s CO₂ emissions by 5,768 tonnes.

On top of that, 94 per cent of construction waste produced on the project, representing 37,000 tonnes, was recycled.

Yet it is the unique architectural and environmentally sustainable design of this building that attracts the most attention.

THICK SKINNED

According to Architectus – one half of the architectural team behind the design of 1 Bligh Street – the work environment created has been designed around the principles of ESD: flexibility, efficiency, communication and transparency.

Although the elliptical design deals very well with maximising views and creating a new public space at the foot of the building, it was the sustainability challenge of meeting a 6 Star Green Star rating and 5 Star NABERS Energy rating that was a major catalyst behind the design.

“Collaborative design was fundamental,” says Ray Brown, managing director of Architectus.

“This shape came about as a way to open up the corner site, at the same time taking advantage of the views over Sydney Harbour that could be created by avoiding a standard rectangular floor plate.”

For example, the building has been designed from first principles to maximise the view to the north and to minimise the heat load. This led to the double-skin façade solution and automated venetian blinds that respond to the solar load only when required.

“The design is fully integrated with all parts of the façade – floor plates, lifts, structure, ventilation and shading – all working together to create the aesthetic. It really is a case of what you see is what you get.”

And what the building owners Dexus Property Group, Dexus Wholesale Property Fund and Cbus Property get are consistently large floor plates of up to 1600 sq m that achieve 92 per cent efficiency net lettable area to floor space area.

Furthermore, 40 per cent of the office space is within 4.5m of the façade, with 1000 sq m of each floor column free, offering tenants a large degree of lay-out flexibility.

Architectus says the elliptical plan is 12 per cent more efficient than a rectangular building in façade to floor area, and allows excellent natural light penetration.

“A central idea is that of transparency and functionality,” says Brown. “The building aesthetic is derived from its function in responding to the needs of the occupants in terms of light and views, shading and fresh air and connectivity.”

This theme has guided all design decisions, including to unusually expose the level 16 plant room, which can be seen from the exterior. Specialist lighting...
enhances the equipment while plenums are built from sheer glass panels.

A sophisticated acoustic treatment to the AHUs and ducting insulates the plant room from the tenants below.

“The philosophy was that they had to do the work anyway,” Brown says, “so it may as well look good.”

This plant is part of the mechanical services response to the building and its double-skin façade. While normally used in the cooler European climate to improve insulation during the winter, the double-skin became a major contributor to the building’s Green Star rating by reducing the heat load on the building.

The system comprises an inner skin of high performance double glazing and an outer skin of low iron, clear glass. The cavity between is ventilated naturally and houses an automated reflective Venetian blind system that lowers and tilts in response to the sun’s position in the sky, effectively reflecting all direct solar load.

When the sun is not directly on the building façade, the blinds are retracted to maximise daylight penetration and the views.

According to Paul Sloman, principal with Arup, which provided the building’s mechanical engineering (as well as electrical, fire engineering, façade and steel structures), when the blinds are deployed a shading coefficient approaches 0.1, or 10 per cent of the incident solar energy is transferred to the occupied zone.

“This means internal surface temperatures of the glazing are close to the internal ambient temperature, thereby improving thermal comfort,” he explains.

“It also means that perimeter cooling loads are very low, so air change rates are reduced, with the resulting avoidance of drafts.”

By dramatically reducing the perimeter solar loads the use of an energy-efficient air conditioning system was available to the designers.

A HYBRID APPROACH

This hybrid system combines passive chilled beams at the perimeter with a low-temp variable air volume (VAV) system in internal zones to provide maximum flexibility and robustness, as well as working with the unusual geometry of the floor plate.

“A number of different systems were considered at the concept stage, including underfloor displacement, mixed-mode, full chilled beams (active and passive) and a hybrid system,” says Hannah Morton, senior ESD consultant with Cundall, ESD consultants on the project.

An underfloor displacement system, while offering good energy efficiency, would have required a raised floor, adding to the floor-to-floor height at additional expense and materials. A full chilled beam system would have come at considerable expense without much added benefit to the internal zones where air conditioning loads were lower.

FACTS

- There are an estimated 30,000 cooling towers operating in Australia.
- Cooling towers can use between 5,000 and 10,000 litres per day.

You can do the maths! We did and the result is a one of a kind cooling tower water efficiency calculator available online.
“The hybrid system offered the best solution in terms of energy efficiency, flexibility, cost, practicality and spatial allowances, and met the project’s criteria for high energy efficiency,” Morton says.

Additionally, the use of passive chilled beams at the perimeter dealt with the intricacies associated with the curving façade. As each individual panel façade is at a slightly different orientation, each has a different heat load, and the chilled beams were considered ideal in responding to this variation across the façade.

Sloman says the chilled beams are arranged on a two-pipe reverse return loop, with a flow pipe in the east core and a return pipe in the west core, resulting in the chilled beam circuits self balancing on a floor-by-floor basis.

“Sloman says the chilled beams are arranged on a two-pipe reverse return loop, with a flow pipe in the east core and a return pipe in the west core, resulting in the chilled beam circuits self balancing on a floor-by-floor basis.

“The hybrid system also provides additional flexibility for tenant fit-outs in that the all-air VAV system can be extended out to the façade, or chilled water cooling system extended inwards depending on a tenant’s needs and preferences,” he says.

Conventional water-cooled chillers are supplemented by a hybrid trigeneration system utilising solar thermal technology.

Along with generating low-emissions electricity to supply base building services such as lighting, lifts and car park ventilation, the system provides waste heat that is circulated through the lobby floor slab to provide background heating on cooler days. The usual chilled water requirements of the air conditioning system are provided when required.

A 500 sq m high-efficiency solar thermal system mounted on the roof adds the hybrid component of the trigeneration system. Made up of evacuated tubes that capture the sun’s heat, this system feeds the absorption chiller to supplement the heat derived from trigeneration.

This is the first of its kind to be used in a commercial office tower in Australia, and provides 250kW to the cooling system.

“This is a small fraction of the total peak cooling load, but as a base cooling provision is one of many important components in reducing the operational carbon of the building,” says Sloman.

When combined with the electricity supplied by the trigeneration system, however, a reduction of more than 27 per cent on the peak load of grid power is achieved.

AN ATRIUM’S ATRIUM

Perhaps the most striking architectural feature of 1 Bligh Street is the full-height, heart-shaped central atrium that effectively opens the building up from within.

At a height of approximately 135m, it features curved glazing to the office perimeter as well as operable glass louvres and frameless opening glass doors on the ground floor. The doors deliver fresh air into the space and provide free pedestrian access into the building when open.
Elliptical staircases mimic the shape of the building, and balconies and bridges cut into the atrium space.

“The full-height atrium contributes much to the amenity and architectural intent of the building. However, to air condition such a large volume would consume a lot of energy, therefore a naturally ventilated solution was developed,” says Morton.

The hybrid system offered the best solution in terms of energy efficiency, flexibility, cost, practicality and spatial allowances, and met the project’s criteria for high energy efficiency.

A roof-mounted weather station in combination with internal sensors for temperature, wind speed and direction, rain and humidity determine whether to open or close the louvres at the rooftop, the lobby or even the entire southern façade.

It means on mild days, the entire atrium can be naturally ventilated. However, when conditions are too hot, windy or it is raining, the louvres close, and spill air from the office floors temper the space.

“A great deal of air-flow modelling was undertaken to determine comfort conditions in the atrium at different times of the year, as well as the impacts on energy consumption, daylight, views and comfort,” Morton explains.

“This informed the control strategy for the automated louvres as well as their location, openable area and glass type.”

A clear glazed skylight roof spanning 25m caps the atrium. Made up of differently shaped triangular glass panels.

The outdoor timber terrace features real banksia trees and astonishing views.

A CONTRACTOR VIEW

According to Zoran Stevanovic, M.AIRAH, engineering manager at Hastie Australia – the appointed mechanical contractor on the project – the unusual architectural design of the building posed a difficult challenge for the mechanical services design and installation.

“We can highlight one atypical challenge we faced during the construction – the elliptical shape of the building,” Stevanovic says. “It was almost impossible to provide a set-out based on the traditional way we used to have in other square buildings where the lift shaft or building core was used as a reference point.”

In response, GPS technology was used to provide a set-out plan for ductwork, pipework and the chilled beam configuration.

Stevanovic says other challenges included the coordination of major plant such as the trigeneration system, blackwater recycling plant and evacuated solar tubes.

The precise coordination of diffusers was particularly critical in avoiding disruption of passive chilled beam operation, and the use of BIM therefore proved a particularly useful tool.

“With the elliptical building shape and complex structure, BIM landed itself as natural solution for efficient services coordination,” Stevanovic says.

“We have an experienced BIM team who assisted the builder and other trades to resolve all issues. In our opinion, this level of coordination could not have been accomplished successfully in traditional 2D format.”
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the optimised geometry of the roof, engineered by Arup, is both lightweight and rigid. Efficiencies have been achieved by minimising the differences in lengths of the 89mm tubes used, thereby allowing the use of standardised glazing panels.

Being the tallest atrium in a commercial building in Australia presented a number of challenges not only in terms of conditioning the space, but also developing a fire engineering strategy that would not impede on the aesthetic design. Among these was omitting the BCA requirement for wall-wetting sprinklers on both sides of the atrium glazing for the entire height, as well as utilising natural ventilation in lieu of mechanical smoke extract. Arup undertook advanced modelling to demonstrate that appropriate fire safety could be achieved.

Collaboration and Commissioning

Achieving the 6 Star Green Star rating, as well as receiving the highest number of points ever awarded to a Sydney or New South Wales project, speaks volumes for the dedication and collaboration displayed by all parties.

“1 Bligh Street was a complex project and required the entire design team to work together very closely in order to ensure the various design challenges could be overcome,” says Morton.
"Achieving a 6 Star Green Star rating required a great deal of collaboration, and an integrated design approach that allowed all of the building’s services to work together, connected by a sophisticated BMS system and dedicated commissioning, tuning and monitoring practices."

As appointed independent commissioning agent on the project, Norman Disney & Young assisted the project team to “knock down barriers” in order to discuss, identify and deal with factors affecting commissioning, dependencies between services trades and considerations on proving systems.

Perhaps the most striking architectural feature of 1 Bligh Street is the full-height, heart-shaped central atrium that opens the building up from within.

NDY’s senior commissioning manager for this project Robert Simic, App. AIRAH – who more recently joined NDY’s specialist company Engineering Commissioning Services – says this led to a better understanding and appreciation by all parties of the complexities faced by the contractors in commissioning and verifying the complex systems deployed in the building.

"With the advancement in building technologies and the shift towards automation and integration of systems within buildings, inevitably there is a greater challenge faced by project teams to test and verify the integration of such systems under all credible scenarios," he says.

“This is where effective communication, project teamwork and commissioning management play a significant role in the success of proving building systems operating concurrently.”

Simic says the process ultimately provided a reduction in the overall operational risk for the building owners and managers, and is a demonstration of where effective commissioning management can add value to a project.

Having achieved five innovation points out of a possible five reflects 1 Bligh Street’s position in Australia’s growing green building stock.

According to Sloman, taking a proactive approach to the design and developing multiple concept options for engineering ultimately led to the best set of technical and organisational solutions to meet the clients’ needs and architectural intent.

“We like to think we are trying to find the best set of compromises for all, rather than the ultimate solution for any one discipline,” he says.

Little more than a year old, the building is attracting a number of high-profile tenants to join anchor tenant Clayton Utz, among them the Commonwealth Parliament Offices, including the Prime Minister’s Sydney office. Bloomberg has also been reported as a potential tenant for the building’s top two floors.

With 1 Bligh Street setting a new benchmark for A-grade sustainable office space, it proves that no matter the economy, demand for such buildings remains.