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The house wins

As well as 5 star Green Star and 5.5 star NABERS Energy ratings, the development of an 11-storey commercial office tower in Perth has achieved a Silver LEED rating at the request of its major tenant Shell. **Sean McGowan** reports on Shell House.

As part of the larger Perth City Link masterplan development, which aims to reconnect Perth's CBD with the adjoining suburb of Northbridge for the first time in 100 years, the development of a site on Wellington Street has delivered four new commercial office buildings.

Among them is the 11-storey Shell House, owned by Dexus and Dexus Wholesale Property Fund, occupied by global energy and petrochemical company Shell.

Designed by a joint venture of local architectural firm JCY Architects and Sydney-based Crone, Shell House provides more than 18,000m² NLA (net lettable area) across its 11 office floors. This includes a ground-floor lobby, café and retail spaces, as well as one level of basement carparking.

Cundall was appointed by developer Leighton Properties as ESD consultant across the entire development. Its task was to ensure energy and sustainability targets complemented the development of each of the four buildings.

As part of the Metropolitan Redevelopment Authority's (MRA) planning conditions, the development of Shell House targeted 5 Star Green Star Office v3 ratings (Design and As-Built) as well as a 5 star NABERS Energy base-building rating.

Such targets also married with Dexus' desire to market the building with a Property Council of Australia A-grade classification.

According to Cundall associate Oliver Grimaldi, early collaboration with the architects was essential to allow key design decisions to be made while the Building's geometry was not yet locked down.

"We worked with JCY through optioneering various façade designs, including different glazing specification, heights, frit patterns and percentages and spandrel heights," Grimaldi says.

The finished façade design features a full-height curtain wall consisting of 2.7m high glazing and 0.5m of insulation spandrel above. The thermal performance of the selected glazing has a glass-only U-value of 1.6 and an SHGC (solar heat gain coefficient) of 0.19 on the north, west and east facades.

The southern façade features glazing with a SHGC of 0.23.

Horizontal shading was applied to the north, east and west facades to further reduce solar heat gains into the office space – particularly within the perimeter zones.

The 5 star Green Star Shell House (on the right of this photo) boasts a 5.5 NABERS Energy rating.

Natural ventilation and mixed-mode systems were rejected because of the building's proximity to busy streets.

But Grimaldi says the most important decision was to relocate the core to the north of the building.

"This decision was made because we knew the buildings to the east and west were able to shade Shell House from solar gains. It was therefore sensible to locate the core to the north to protect the building from the northern solar gains – and this location also worked from an architectural perspective."

This led to a shared circulation and amenity space being positioned on the north side of the building.

ON-FLOOR ZONING

Designed with building services design consultant Floth (an AIRAH company member), Shell House features a VAV (variable-air-volume) system, with heating and cooling coils within the main air-handling units, which are controlled by various sensors located on the office floors.

This system was selected over alternatives for its high energy efficiency, flexibility and ease of maintenance.

Underfloor air distribution (UFAD) was ruled out on the basis of the additional capital cost required and reduced flexibility for future fitouts. VRF (variable-refrigerant flow) compared unfavourably in terms of energy efficiency and its unlikely ability to meet the project's energy targets.

"VRF also has less flexibility for future fitouts and ongoing maintenance, and is less able to include economy cycle, which was essential for reducing energy consumption," says Grimaldi.

Natural ventilation and mixed-mode systems were also rejected due to the proximity of the building to busy

LESSONS FROM THE ESD CONSULTANT

Cundall associate Oliver Grimaldi, M.AIRAH, offers some of the key lessons from the Shell House project.

1. Early coordination and collaboration are essential between the design consultants and particularly the ESD consultant. This helps key decisions to be made early on with regards to energy reductions.
2. Follow the targets through for each design stage and do not allow compromise of the design or its targets, particularly in the tender and construction stages. A contractor who delivers on a strong and sustainable design is essential.
3. Close liaison and engagement with the potential tenant(s) is essential, so that usage profiles of the building can be considered early on (such as 24-hour use floors) and efficient operation of the HVAC systems.
4. Fine-tuning and energy monitoring are also essential to ensure the building is performing as expected. Liaison between the ESD consultant, building manager, tenant and commissioning agent allow for close scrutiny of the energy consumption of all systems to a fine detail, and errors can be easily rectified.

Wellington Street – the major road into Perth's CBD – with its vehicle pollution and noise.

On a typical office floor at Shell House, air-supply zones are split into the four perimeter orientations as well as two central zones, with each AHU (air-handling unit) optimised for the zone it serves.

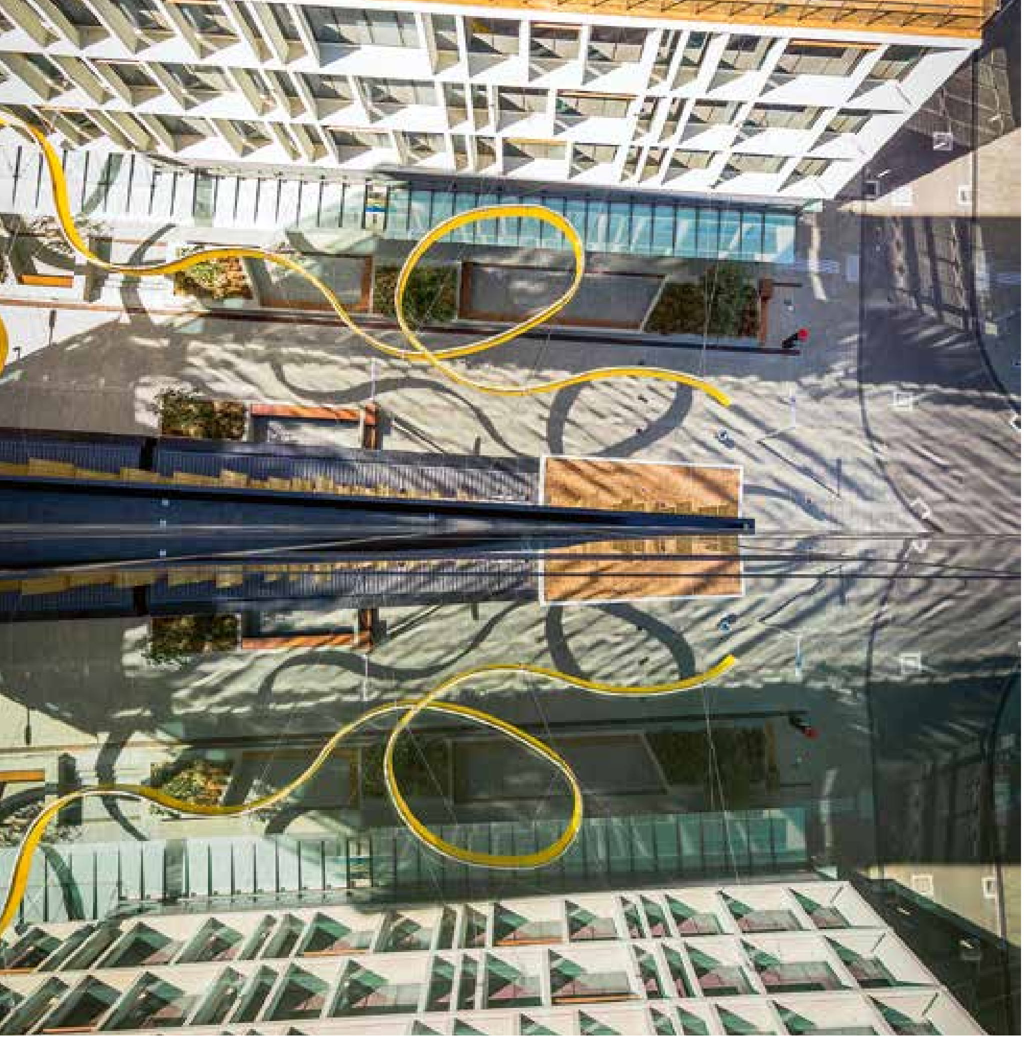
The main VAV AHUs are located in the roof plant room on level 12 of the building.

Local-zone temperature control in cooling mode is provided by dampers on VAV boxes with controlled off-zone thermostats.

The tenant was also known early in the design stages, so the HVAC design catered for Shell's open-plan fitout. It also allows for future tenants and possible sub-leasing if required at a later date.

High-efficiency chillers, AHUs, cooling towers, gas-fired boilers, pumps and fans all contribute to the energy efficiency of the HVAC systems. Pumps, fans and AHUs are fitted with variable-speed drives (VSDs).

Economy cycle is also built into the system to take advantage of suitable outside- ambient air temperatures and reduce the reliance on chillers and cooling towers.



◄ Shell House is protected from excessive solar gains by buildings to the north and east.

The HVAC system also features heat recovery. Return air is drawn from the space via the ceiling void connected to a common return-air ductwork riser, and used to reheat incoming fresh air.

Air-quality sensors are installed in the return-air systems, located in each branch take-off on each floor. These monitor contaminants to enable a reduction of outside air during periods when levels are above acceptable standards.

CO_2 monitoring is also provided.

DESIGNED FOR OCCUPANCY

Once Shell was confirmed as the major tenant, the building's HVAC design was adjusted to allow for one floor of the building to be occupied 24 hours a day.

The original design included two full-load chillers and a part-load chiller. This was changed to three full-load chillers to ensure sufficient capacity to meet around-the-clock occupancy on one floor in the building.

Predicted energy targets were also modified to reflect the change in the building's occupancy. (See breakout "Targeting LEED".)

NO RENEWABLES

Renewable technology such as a solar photovoltaic (PV) array was not pursued due to the minimal amount of rooftop space available and the capital cost required.

Additionally, overshadowing from neighbouring buildings would have shaded the PV array for a significant part of the day.

Rather, significant focus was placed on energy modelling at every design stage, as well as through construction. This ensured the project's sustainability targets could be achieved through smart, energy-efficient design of building services.

TARGETING LEED

Cundall associate Oliver Grimaldi, M.AIRAH, offers some of the key lessons from the Shell House project.

LEED (Leadership in Energy and Environmental Design) is a rating system designed and administered by the US Green Building Council (USGBC). Like the Australian Green Building Council's Green Star program, LEED evaluates the environmental performance of a building across a variety of metrics.

"As the project was already designed to achieve 5 star Green Star, many of the LEED requirements were being met, and the building was on its way to achieving a Silver rating," says Grimaldi.

"A few additional reports and modelling were required to be undertaken to ensure the rating was met, but on the whole the building's design did not need to fundamentally change."

For instance, modelling was used to set benchmarks for the façade and HVAC design, with each major design decision re-run in the energy simulation to assess its impact against the sustainability targets.

A decision was then reasoned and thought out based on the energy simulation results, and either implemented or rejected.

"Without setting these specific energy benchmarks through the modelling simulation process, the design could have moved further away from its energy targets," Grimaldi says. "And it may not have met the minimum 5 star NABERS Energy target set for the building."

The building also features a low-density-level lighting design, with LEDs installed throughout.

After Shell took occupancy, occupancy patterns were analysed and systems optimised to meet the tenant's specific needs.

PIR-based motion sensing is used throughout the office floors, and daylight sensing is used in perimeter zones to dim lighting when it is not required. Lighting in common areas, including stairwells, operates on a time switch to ensure lights are not left on when not required.

POST-OCCUPANCY FINE TUNING

After Shell took occupancy of the building, occupancy patterns were analysed and systems optimised to meet the tenant's specific needs.

Start times and time settings for the chillers were optimised to allow for a smoother transition and more efficient operation.

"Reassignment of some of the sub-meters in some of the systems, such as carpark fans and housing lighting, was also done to ensure energy measurements were in line with what was predicted in the simulation modelling," says Grimaldi.

The original sub-metering arrangement had incorrectly combined more than one energy source. BMS records for various gas meters were also rectified.

In the basement level carpark, after-hours lighting "on" periods was also reduced from 30 minutes to 10 minutes.

During the energy monitoring phase, it was also noted that the house lighting energy consumption was significantly above estimates. It was later found that this was due to the tenant's regular security patrols after hours, leading to lighting being on 24 hours a day.

Says Grimaldi: "This was rectified by having patrol times altered, while the switcher timer was also reduced."

The energy consumption of the domestic hot water (DHW) – particularly that used within the end-of-trip facilities – was also found to be higher than modelled.

Post-occupancy fine-tuning has delivered better-than predicted energy consumption for Shell House.

The building has achieved a 5.5 star NABERS Energy base building rating. Building energy consumption is about 30 per cent better than simulated.

"Dexus is very pleased with the outcome of the NABERS assessment and 5.5 star rating," says John Monahan, regional facilities manager WA at CBRE/Dexus.

"It is a great team effort combining design, construction, commissioning, fitout and operational elements."

PROJECT AT A GLANCE

The personnel

- **Architect:** JCY Architects + Crone (Joint Venture)
- **Building owner:** Dexus & Dexus Wholesale Property Fund
- **Building services (base building):** Floth
- **Developer:** Leighton Properties
- **ESD consultant:** Cundall
- **Independent commissioning agent (ICA):** Cundall
- **Main contractor:** Broad Construction
- **Structural engineer:** BG&E

The equipment

- **AHUs:** GJ Walker
- **Air and dirt separators:** Automatic Heating
- **BMS:** Alerton Australia
- **Boilers:** Automatic Heating
- **Chemical treatment:** Hydrochem
- **Chillers:** Smardt (Formerly Smardt-Powerpax)
- **Cooling tower:** Baltimore Aircoil
- **Duct:** TRP Ductwork
- **DX split AC units:** Mitsubishi Electric
- **Fans:** Systemaire/Fantech
- **Heat exchangers:** Automatic Heating/Alfa Laval
- **Pumps:** Malcolm Thompson Pumps
- **VAV boxes:** Celmec
- **VSDs:** Alerton Australia/ ABB & Danfoss
- **Water-cooled packaged units:** Air Skills/Temperzone

(Source: Cundall)