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Ecolibrium

Joining the dots

Data centre heat rejection put to use.

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The antidote

The redevelopment and modernisation of CSL's headquarters building in the Melbourne suburb of Parkville has resulted in a state-of-the-art facility befitting the company's status as a global leader in specialty biotherapeutics. **Sean McGowan** reports.

In 1916, as the First World War raged into its third year, the Australian government established the Commonwealth Serum Laboratories to manufacture vaccines, sera and antitoxins to help protect the health of the nation.

An Australian government body, CSL commenced operations from a building at the Melbourne Hospital in 1918 under the leadership of Dr William Penfold, before moving to purpose-built premises in Parkville the following year.

Over the ensuing decades, CSL would come to provide Australians with rapid access to 20th century medical advances, including insulin and penicillin, and vaccines to fight infectious diseases such as influenza and polio. It also developed uniquely Australian vaccines over that time, such as snake and spider antivenoms, and ensured the country had its own supply of life-saving plasma therapies.

After being listed on the Australian Stock Exchange in 1994, the company expanded internationally and is now a leading global biotherapeutics company employing over 16,000 people in more than 30 countries.

But its global headquarters has always remained at Parkville.

REDEVELOPMENT

Resembling a university campus, CSL's Parkville site is made up of a number of buildings ranging in age and function, including laboratories and manufacturing

facilities, as well as CSL's global headquarters administration building.

Built in the 1960s, the two-storey, concrete building had long passed its useful life when the decision was made in 2011 to extend and redevelop it.

> "The data centre is in constant, 24/7 operation and in need of constant cooling"

The HVAC system, utilising a single large air-handling unit (AHU) and zone reheat coils, was the original plant installed in the 1960s. Not surprisingly, it operated inefficiently, and was well past its economic life.

The AHU used a DX cooling coil connected to a water-source compressor set located in the small basement plant room. The building's data centre was served by a dedicated AHU and water-source DX compressor set located in a separate plant room area.

At the request of CSL, Irwinconsult provided a submission for design and construction administration services. Irwinconsult was then engaged to provide structural, civil, electrical, fire, hydraulic, ESD and mechanical services design for the project.

"We have always found that carrying out a project where all services disciplines are involved, including civil and structural engineering, is beneficial both to the client and the engineers involved," says Jason Pleaner, M.AIRAH, associate director – mechanical for Irwinconsult.

"Being able to collaborate and coordinate with engineering teams – all using Revit – within our own offices, improves design engineering efficiencies. And being able to coordinate mechanical services utilising live and up-to-date structural and other services models is highly advantageous in delivering an accurately coordinated set of documentation."

CSL's brief was to upgrade and extend the existing administration building to create a world-class global headquarters building featuring a high-quality office space to accommodate the company's heads of the business.

Part of the upgrade saw single-glazed panels replaced with argon-filled double-glazed units.

The budget was extended a number of times to deliver the extremely high-quality result CSL required.

> The original, single-glazing system was replaced with new argon-filled double-glazed units

This required the building to be stripped back to its bare structure, with all existing building services decommissioned and removed during the demolition phase.

From an HVAC perspective, the new building services were required to be extremely energy-efficient and provide excellent comfort conditions.

As a science-based organisation, CSL understands that excellent thermal comfort equates to better performance.

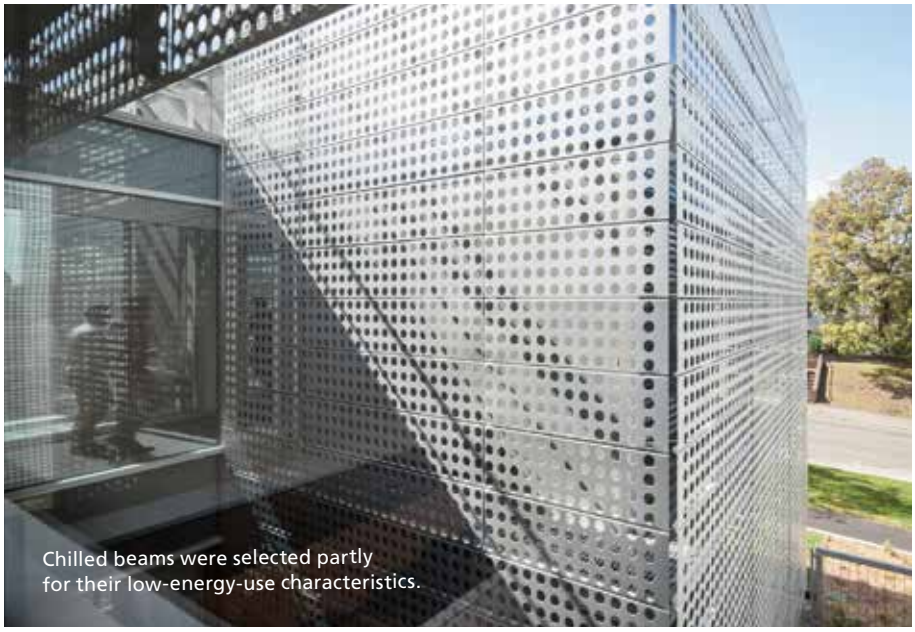
To that end, Pleaner says CSL required every office in the building to be provided with individual control to suit occupant comfort requirements to a tolerance of ±1.0°C – a tolerance close to that of the pharmaceutical cleanrooms found in the surrounding buildings.

"The budget was extended a number of times," Pleaner says, "in order to deliver the extremely high-quality result that CSL desired."

LATENT CONDITIONS

As with the redevelopment of any existing building, design challenges were many, and often stemmed from undocumented latent conditions.

Pleaner says latent conditions that were not documented in existing documentation needed to be addressed – often "on the fly" during construction – meaning certain elements needed to be flexible in their approach.



Chilled beams were selected partly for their low-energy-use characteristics.

"Particularly challenging in this project was the requirement to maintain the existing CSL global data centre in continual operation while at the same time upgrading its HVAC systems," he says.

Together with a requirement to not interrupt the operations of other departments in surrounding buildings, this required careful staging of installation activities.

Once the building was stripped back to its structure and all existing services demolished, only the existing CSL global data centre on the lower ground floor level of the building was left operational.

The data centre's original DX AHU was replaced by a new AHU coupled with a heat-recovery chiller system. Two DX CRAC (computer room air conditioning) units were also installed to provide redundancy.

"The data centre is in constant, 24/7 operation and in need of constant cooling," says Pleaner.

"The heat rejection from this cooling requirement nearly coincided with the peak heating demand for the building. So we sold the idea to CSL that the heat

LESSONS FROM THE CONSULTANT

Jason Pleaner, M.AIRAH, associate director – mechanical with Irwinconsult, offers some of the key lessons to have come from the CSL Parkville project.

"We found it remarkable how a tired old building could undergo such a significant improvement when modern technologies, innovative design techniques and current energy-efficient building elements are applied," Pleaner says.

For Irwinconsult, this was one of the first projects that involved documenting every design discipline on the project in Revit.

"We found the coordination advantages of this to be invaluable to the project," he says. "It greatly improved efficiencies when it came to contractors developing shop drawings and installation onsite, since the project was largely coordinated during design phase before getting to site.

"We also learned that systems that are typically considered appropriate for large-scale open-plan offices – such as chilled beams – can be applied to small, compartmentalised office spaces when careful planning and attention to design detail is applied."

rejected from the data centre could be used to heat the building for a large part of the year."

Pleaner says the system was designed such that the heating hot-water loop would pass – in a series – through the data centre chiller condenser, a heat exchanger connected to the building's cooling towers, and the condensing boilers.

A carefully designed control system maintains the water-loop temperatures at several locations so that the building heating demands are met while at the same time ensuring that the data centre chiller heat rejection is achieved.

When additional heating is required in the building, the condensing boilers supplement the data centre chillers.

This required a number of different scenarios to be simulated and tested to ensure the system would function under all situations.

Pleaner says that since the building's heating demand can be satisfied for 85 per cent of the year, heating energy requirements are significantly reduced by using the heat rejected from the data centre.

Each office in the CSL HQ is provided with a dedicated controller.

When the building does not require heating, the heat is rejected to the cooling towers.

SAME PRINCIPLES

The design of the mechanical services plant areas used the same principles as a high-end pharmaceutical facility to enable CSL's internal engineering services department to maintain the facility.

Measures were put in place to ensure the plant was highly accessible and maintainable. This meant there are extra over-valves and strainers on all coils, and plate heat exchangers have been sized to allow the use of common plates with others on the site.

Ample space was also given around equipment to facilitate easy replacement and cleaning.

FAÇADE AND BEAMS

A number of HVAC options for the new CSL global headquarters building were considered – from a comparatively simple VRF (variable-refrigerant flow) system, to a chilled-water VAV (variable-air volume) and ultimately the selected chilled beam system.

"Chilled beams are traditionally used in large open-floorplan offices using active chilled beams on the perimeter and passive chilled beams for internal zones," says Pleaner.

The existing building did not technically lend itself to a chilled beam system due to its very narrow floor plate and heavy compartmentalisation. Chilled beams were nonetheless selected for their low-energy-use characteristics and accurate control when combined with individual zoning.

"As per the brief, the project needed to deliver a world-class building," Pleaner says. "And as per the requirement of a 6 star Green Star design, occupants should be provided with individual climate control."

This selection required the new building façade to be as thermally inert as possible, with minimal (if any) infiltration. So the original, single-glazing system was replaced with new argon-filled double-glazed units.

As a large proportion of the building is partitioned into individual offices, every office is conditioned by one or two chilled beams. Each office is provided with a dedicated controller, and the capacity of the associated chilled beams controlled using dedicated independent balancing and control valves.

"The PIBCV (pressure-independent balancing and control valves) are a two-way type, and their flow rate

PROJECT AT A GLANCE

The personnel

- **Architect:** Jacobs Group
- **Builder:** Monaco Hickey
- **Civil and structural engineer:** Irwinconsult
- **Client:** CSL Limited
- **Electrical engineer:** Irwinconsult
- **ESD:** Irwinconsult
- **Fire and hydraulics engineer:** Irwinconsult
- **Mechanical services contractor:** Collins & Graham Mechanical Services
- **Mechanical services engineer:** Irwinconsult

HVAC equipment

- **AHUs:** Air Change and GJ Walker
- **Boilers:** Modulex/ Automatic Heating
- **Chilled beams:** Trox
- **Chillers:** Carrier
- **Fans:** Fantech
- **FCUs:** GJ Walker
- **Valves:** IMI Hydronics
- **Data centre CRAC units:** Stulz

(Source: Irwinconsult)

can be factory set since field-pressure fluctuations do not impact on their flow rates," says Pleaner.

"While this significantly reduces commissioning time on site, it is important that contractors have an understanding of their operation, since problems can arise if they are installed incorrectly."

The active chilled beams are supplied with pre-conditioned primary outside air via a 100 per cent outside-air heat-recovery AHU.

The chilled beam coils are supplied with chilled water from the water-cooled chiller and a heat exchanger.

Other areas of the building, such as meeting rooms and other high-occupancy or intermittent-use spaces, are served by ceiling-concealed fan-coil units (FCUs).

Heat rejection is achieved via the use of an existing, under-utilised cooling tower on an adjacent building.

> "As per the brief, the project needed to deliver a world-class building"

"Coupled with an air-to-air heat-recovery system serving the chilled beams, the building cooling system used less energy than the original building chiller plant despite serving a 30 per cent greater floor area," says Pleaner.

Indoor air quality has also been significantly improved, with outside air rates exceeding AS1668 requirements by 200 per cent.

A GLOBAL LEADER

The redevelopment of CSL's new global headquarters at Parkville was completed in December 2014.

Although an official Green Star rating was never applied for, the building has been able to achieve a 5 star Green Star equivalent rating based on assessment by Irwinconsult's ESD consultants.

"Unfortunately, we don't have energy data to report on the overall system performance," says Pleaner.

"But reports from CSL to date have advised that the building occupants are happy with the comfort conditions and indoor air quality delivered by the system."

The renovated building's design and sustainable features have since been recognised with an award for Commercial Architecture by the Victorian Architecture Awards in June 2015.