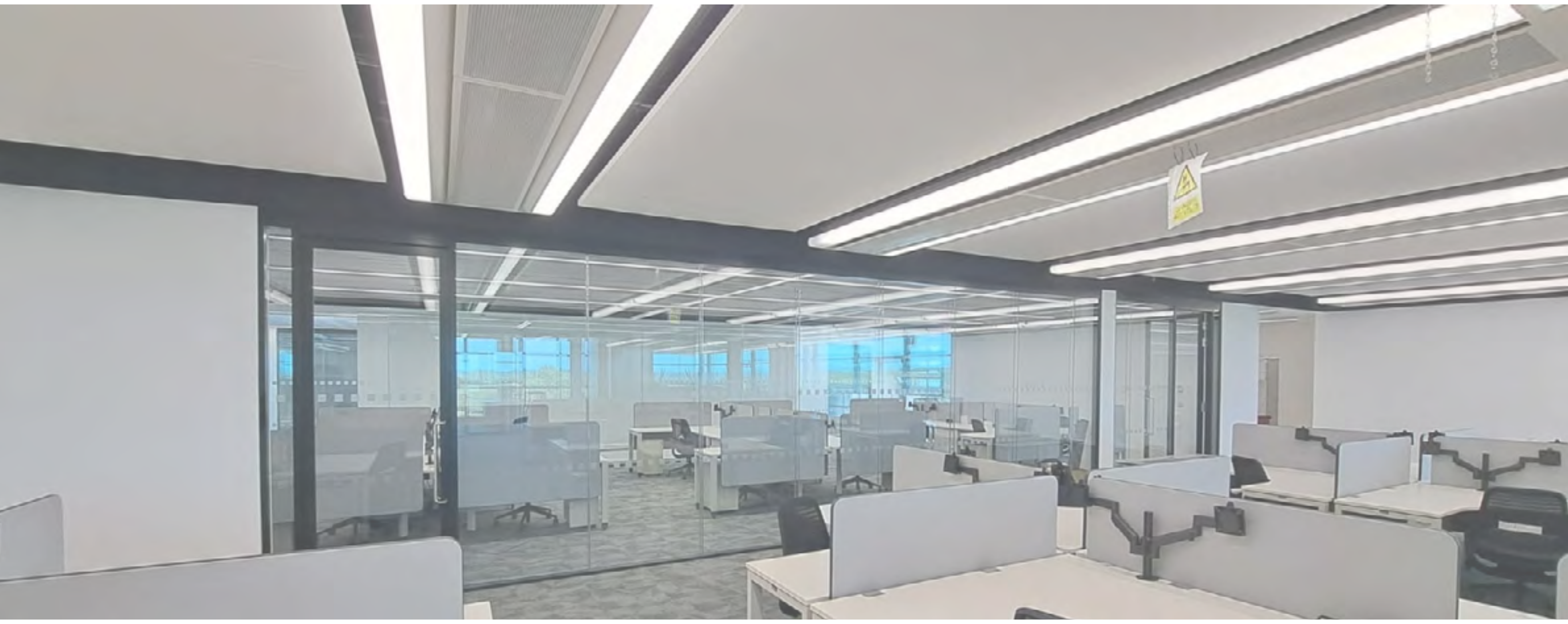
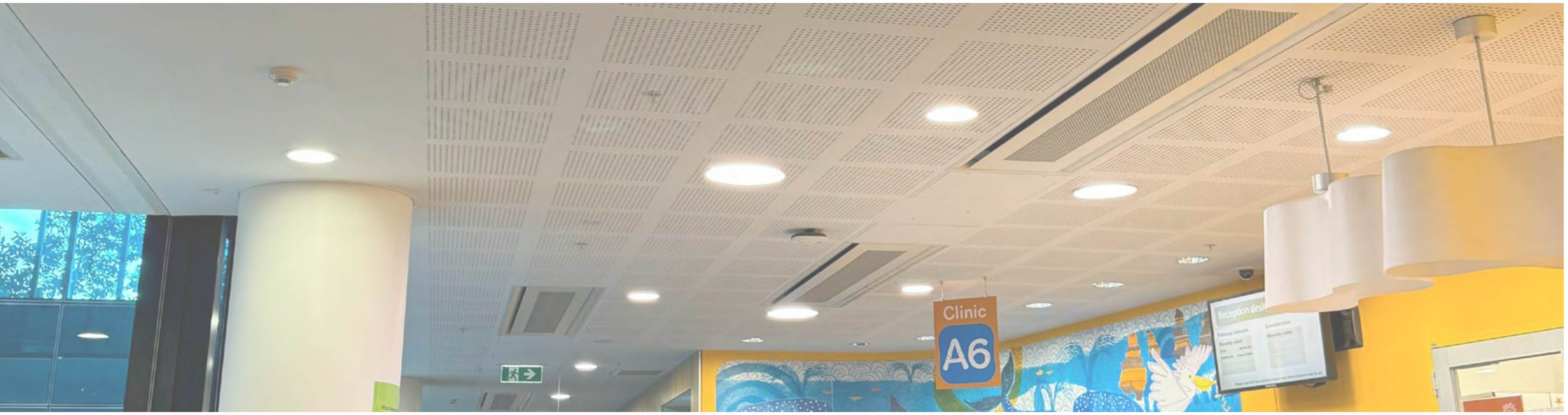


Chilled Beam

Architecture & Design

FRENGER® systems



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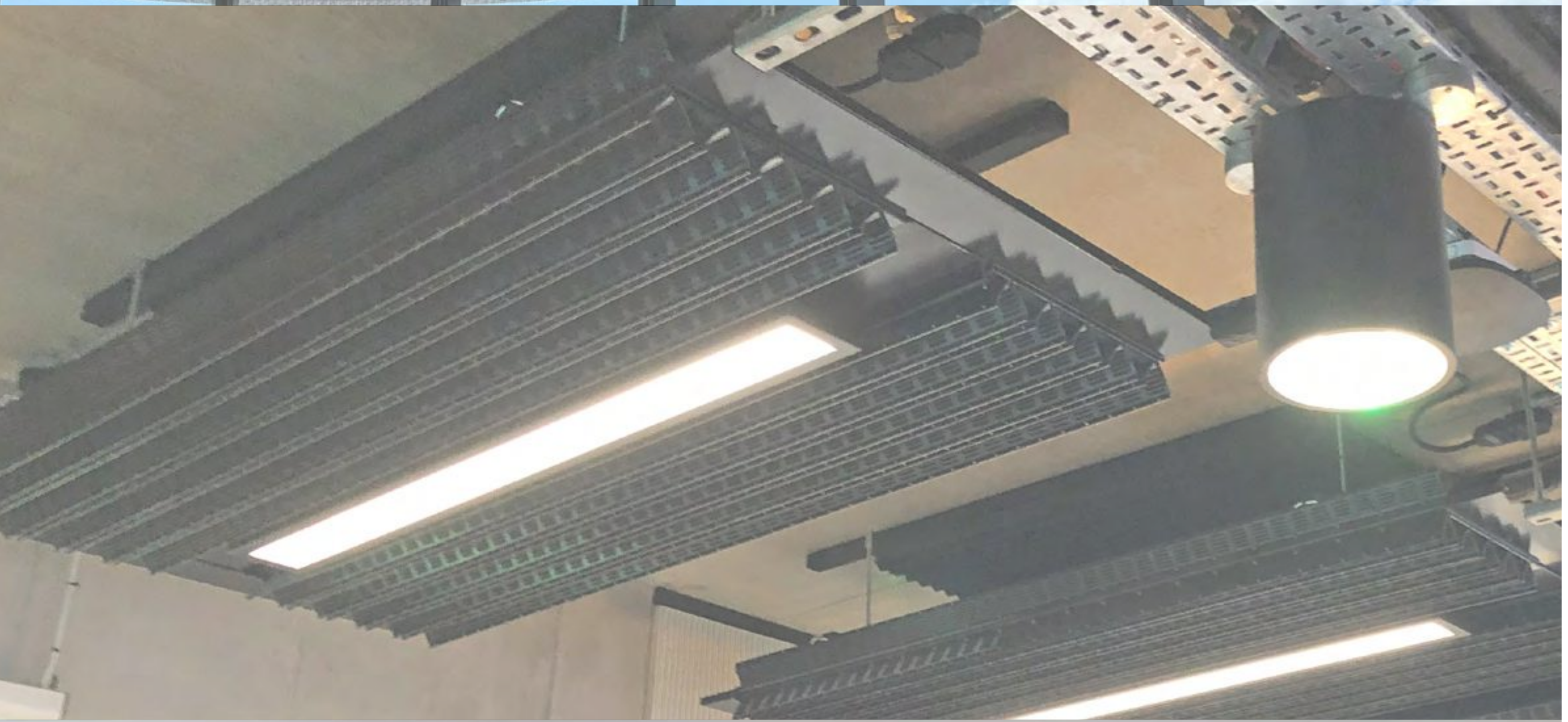


Introduction

Active Chilled Beams

Active Chilled Beams (ACB) units are water driven cooling and heating units which are additionally powered by forced ventilation, they are also known as terminal units and fit easily into the most common ceiling designs or can be installed fully exposed.

How do they work?

Chilled and/or LTHW water circulates through the heat exchanger of the ACB, while fresh air is delivered via nozzles along the lenght of the unit, creating negative pressure, this induces room air through the heat exchanger increasing the output. Induced room air is mixed with the fresh air supply then gently discharged back into the space to ensure high thermal comfort levels.

Passive Chilled Beams

Passive Chilled Beams are a static convective cooling device that are installed either exposed or concealed behind a perforated ceiling, Passive Chilled Beams provide cooling using natural convection where the spatial warm rises due to natural buoyancy, at high level the warm air is then cooled by the Passive Chilled Beams colder surfaces, as the cooler air is more dense than the warmer surrounding air it naturally descends back into the occupied space providing cooling with minimal air movement and no risk of draught.

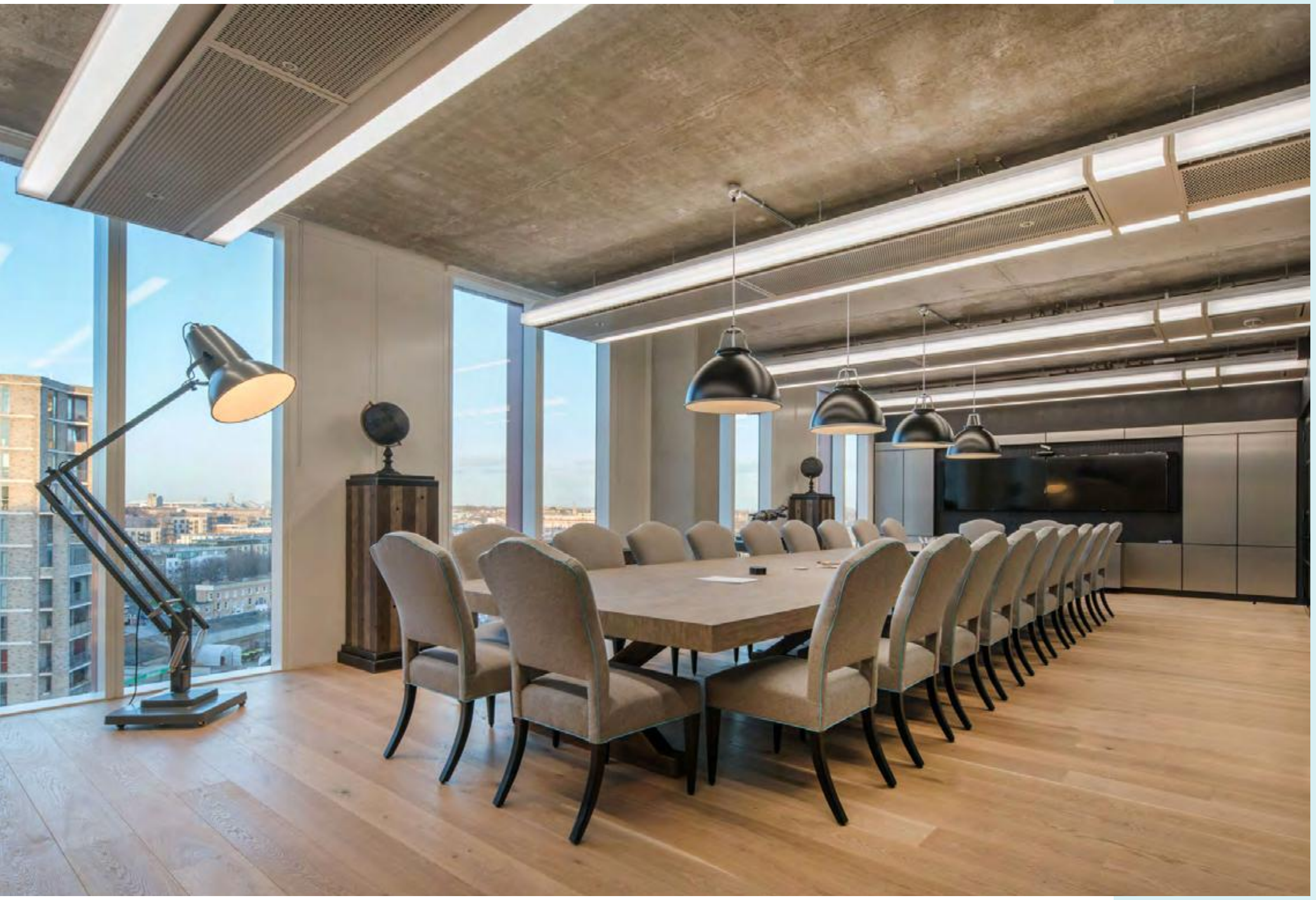
In addition to convective cooling, Frenger's X-Wing units also provide 40% of the heat exchange via radiant absorption, allowing 40% higher levels of cooling without any extra air movement and hence still achieving excellent occupant comfort and air speeds not to exceed 0.25 m/s even at 300w/m. X-Wing can also be used for heating via switch over valve from cooling to heating.

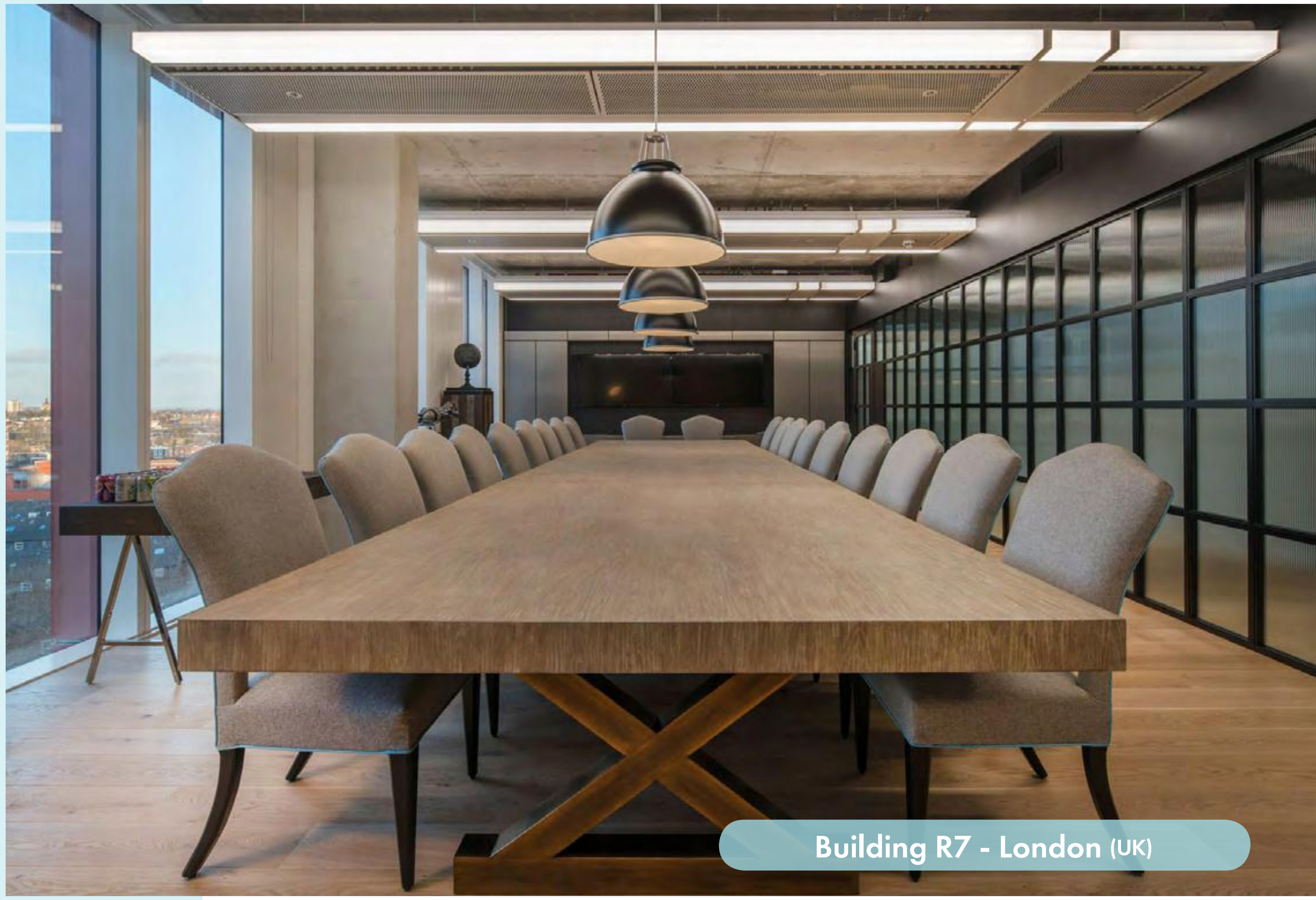
Multi-Service Chilled Beams

Multi-Service Chilled Beams (MSCB's) provide all the cooling and heating benefits of a standard Chilled Beam but also include features such as lighting, PIR sensors, smoke detectors, sprinklers or any other required building service, in a single pre-fabricated unit.

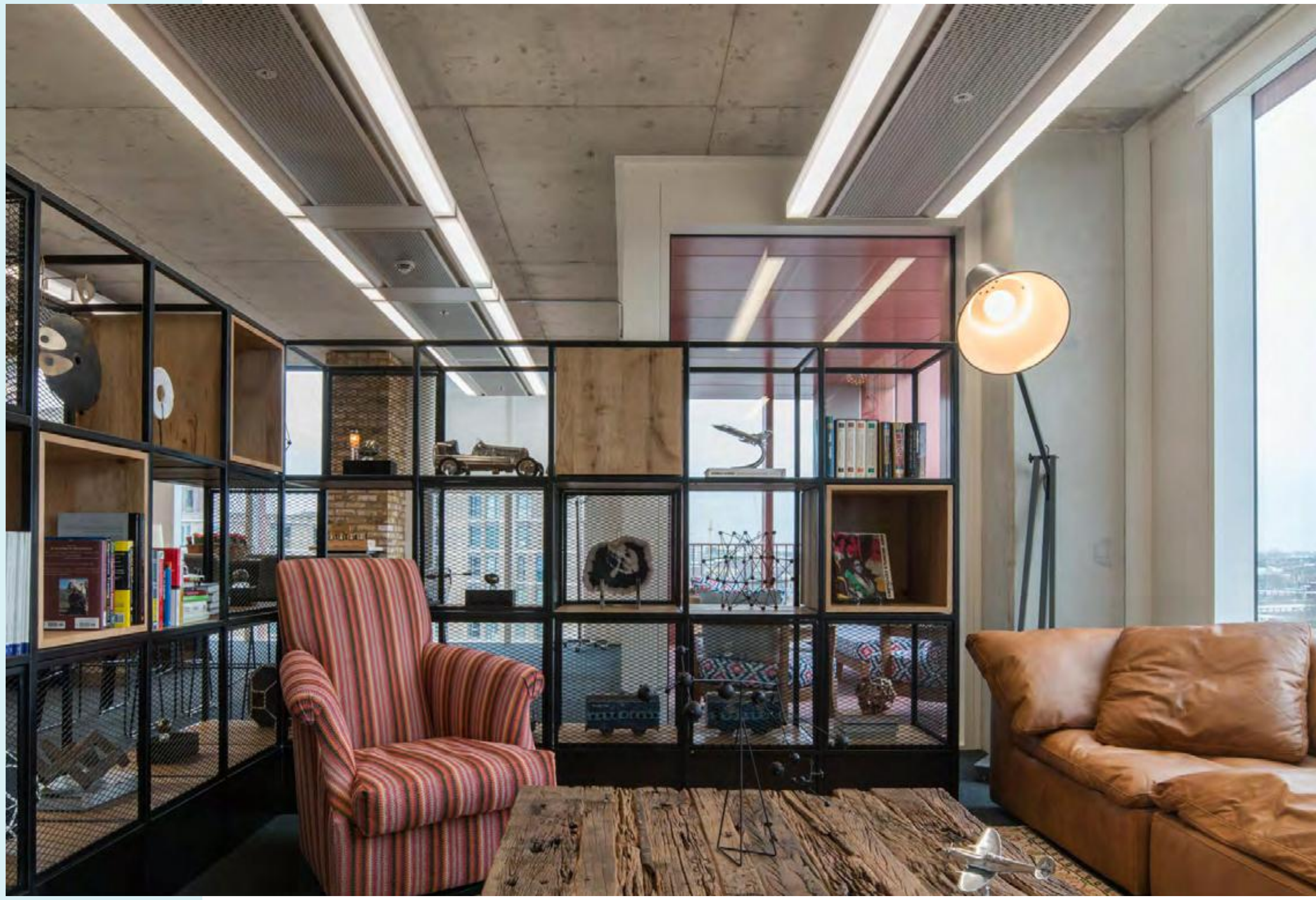
Active

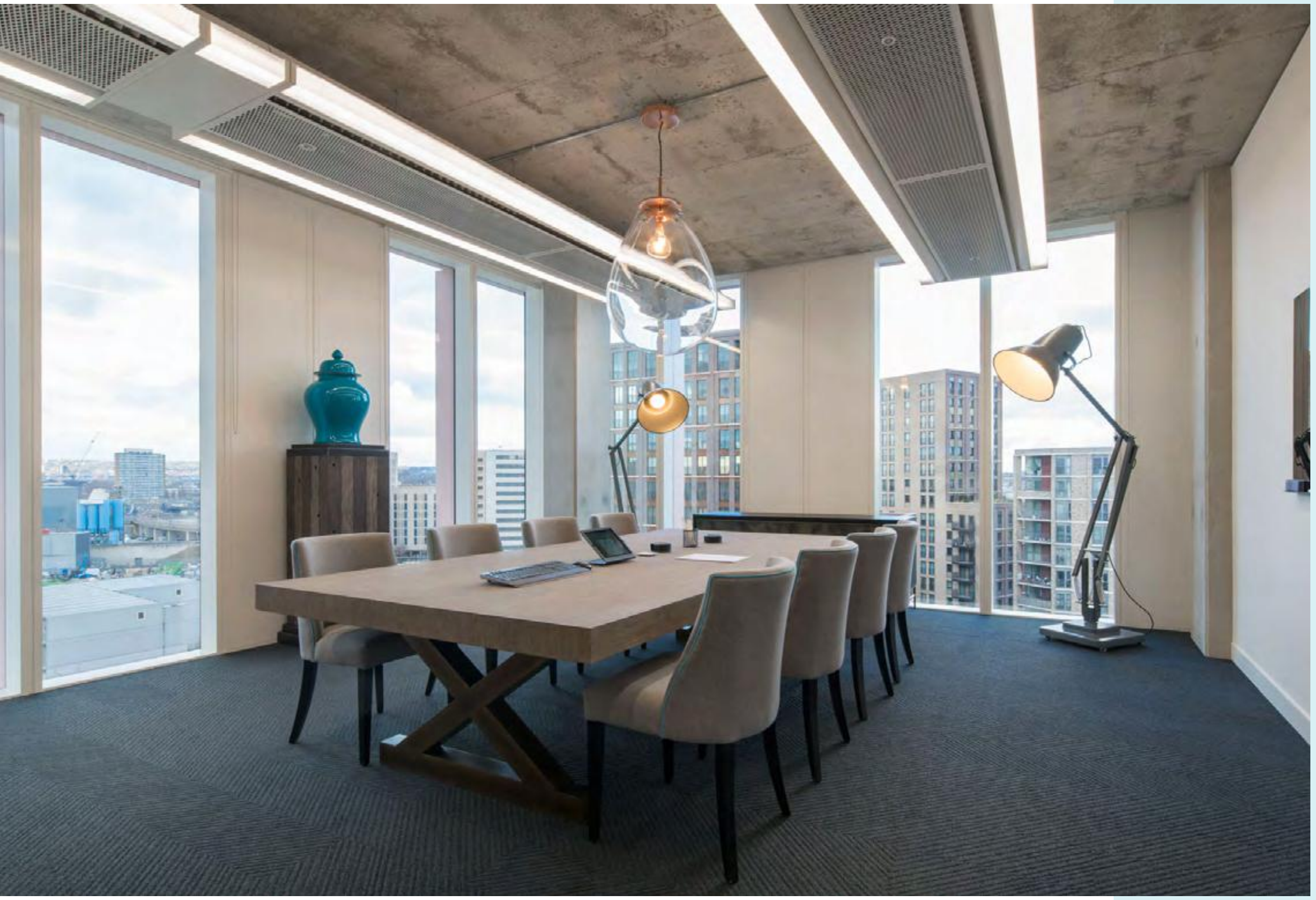
Multiservice Chilled Beams



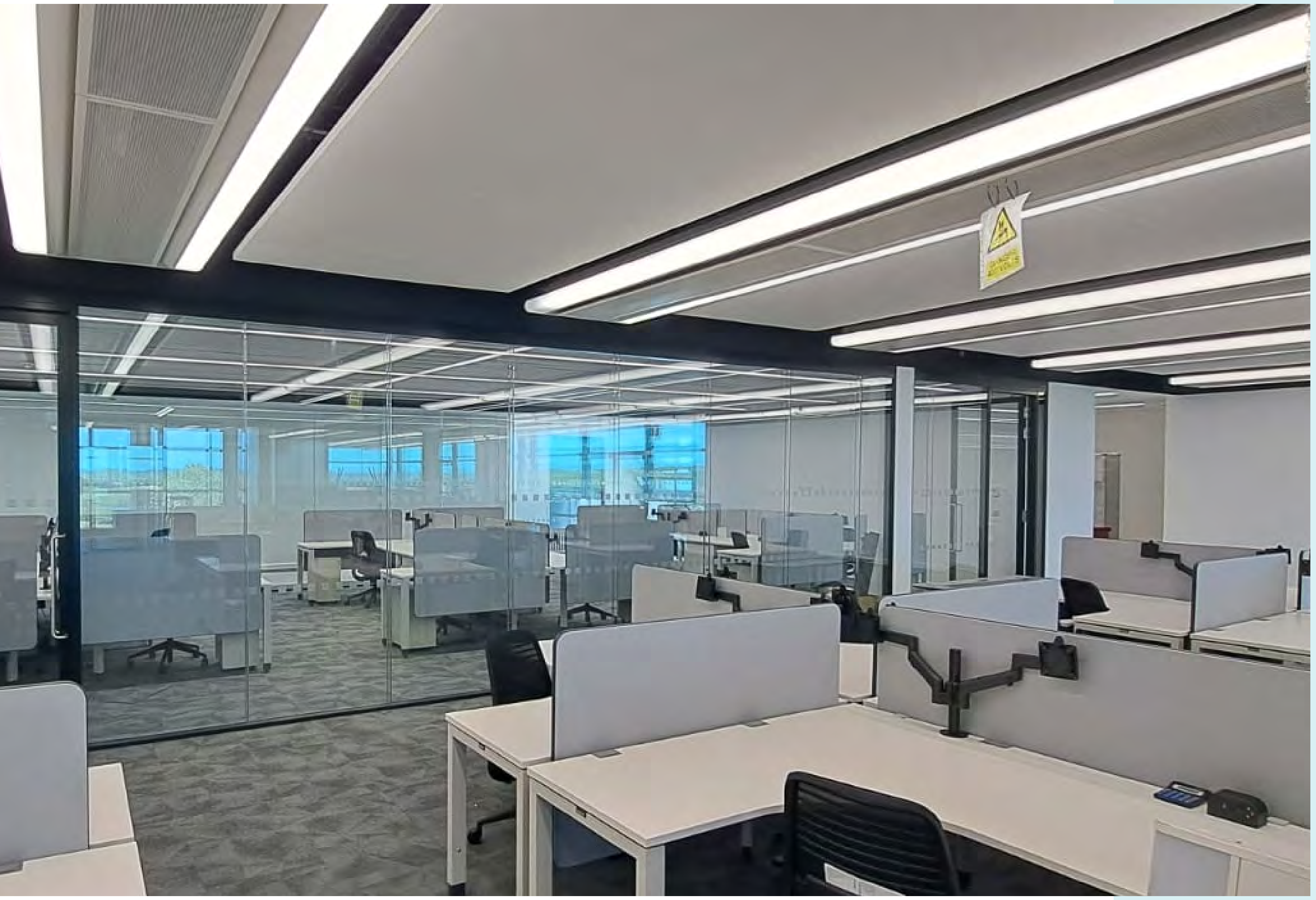


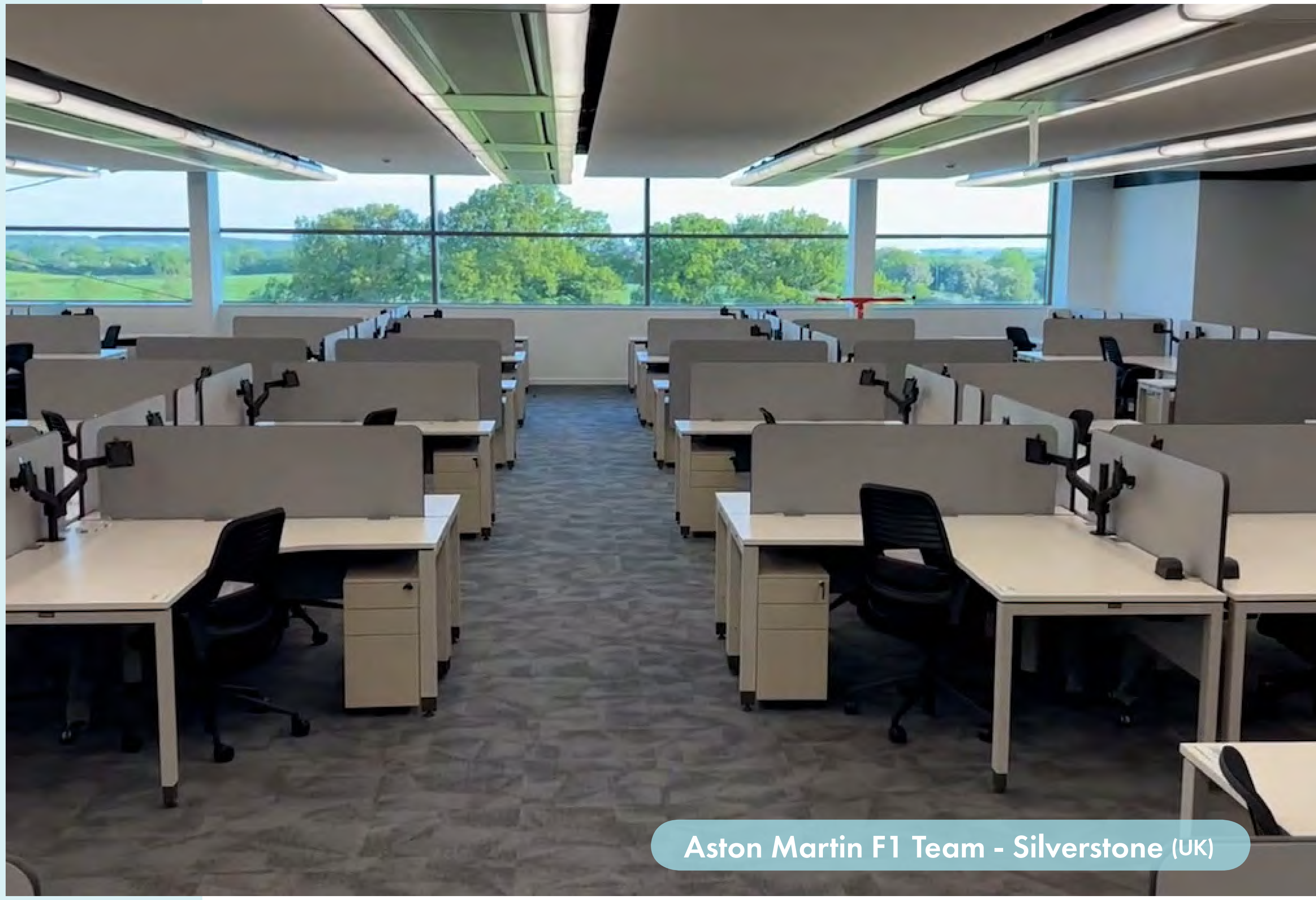
Building R7 - London (UK)



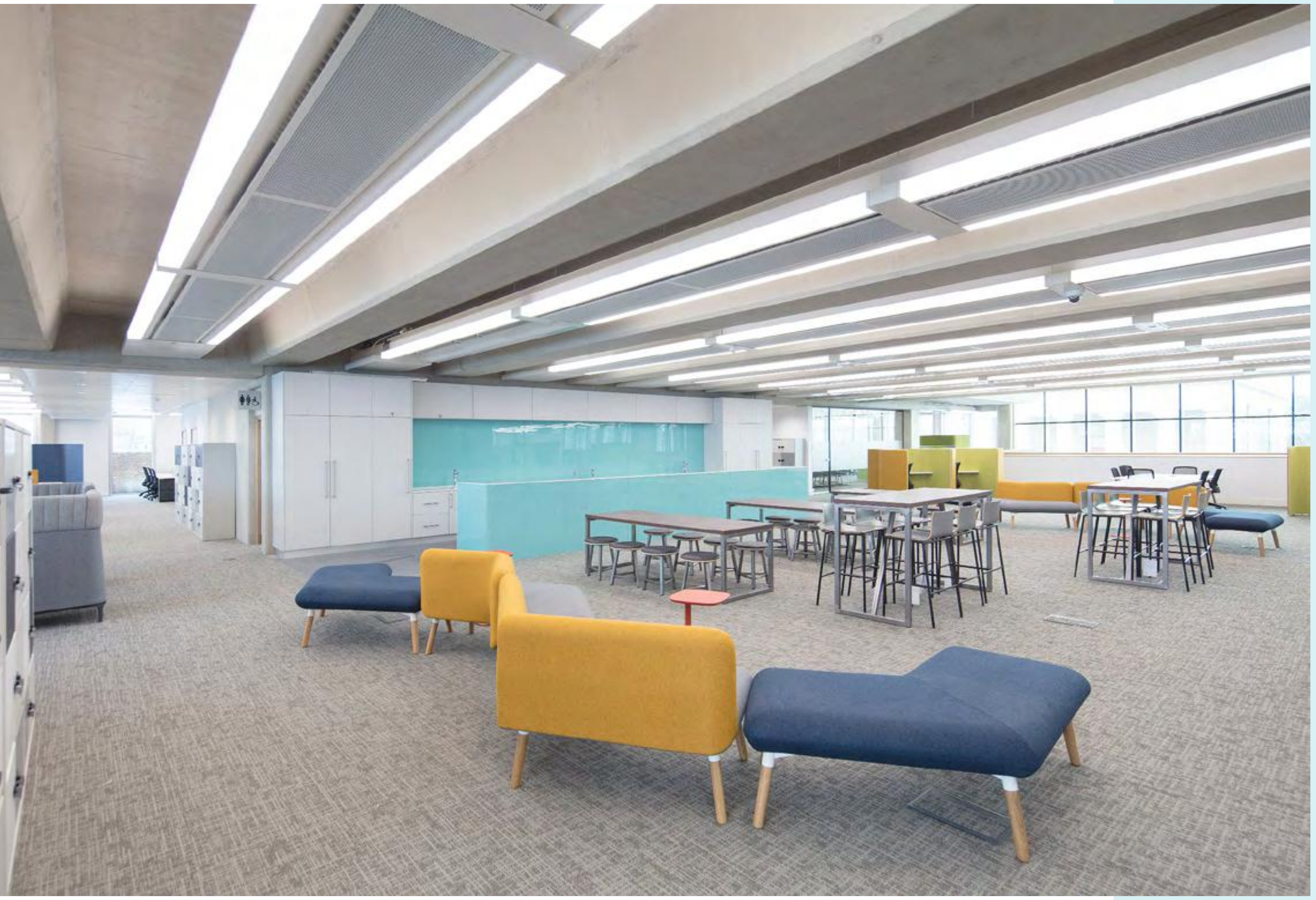


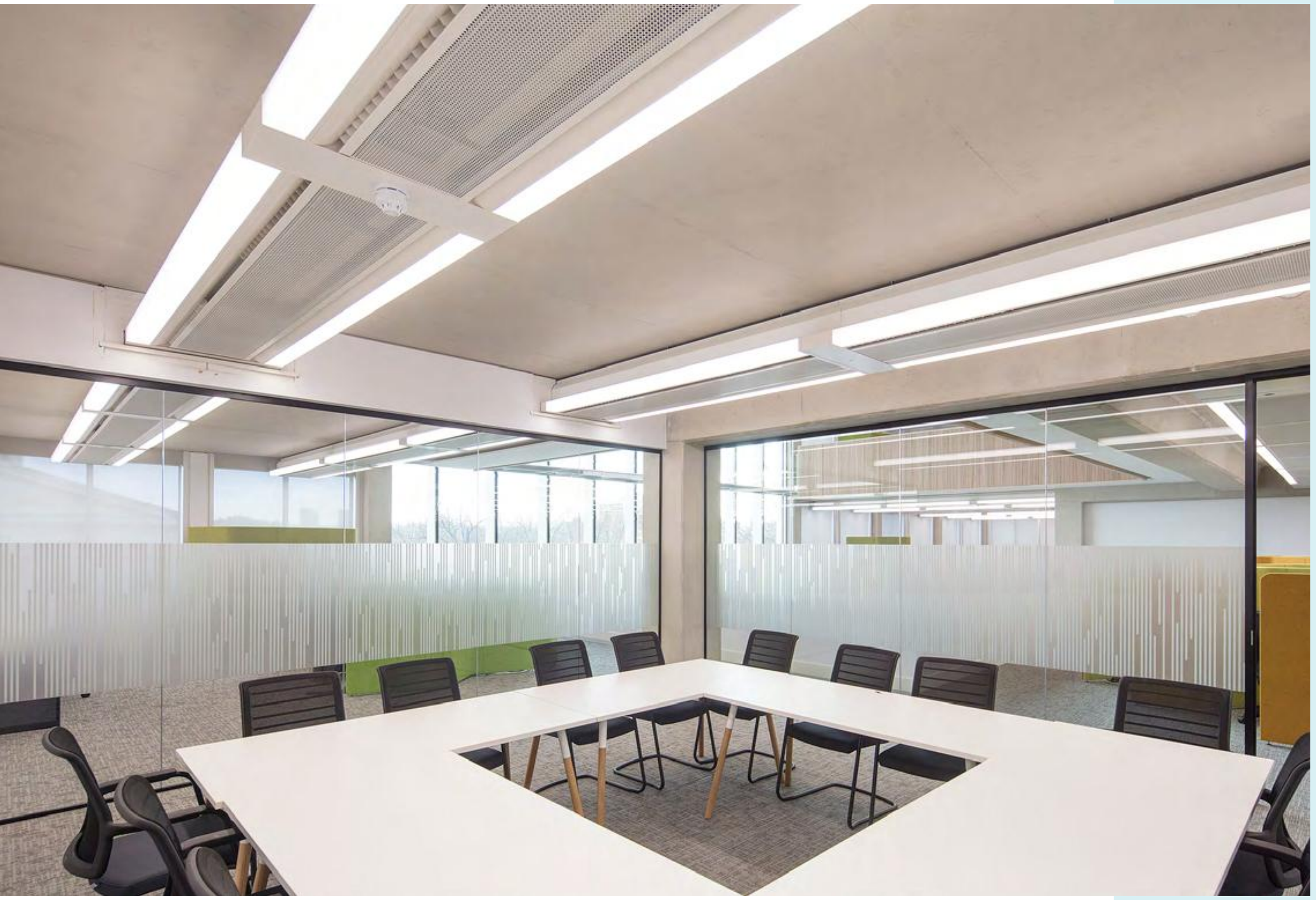
Building R7 - London (UK)





Aston Martin F1 Team - Silverstone (UK)

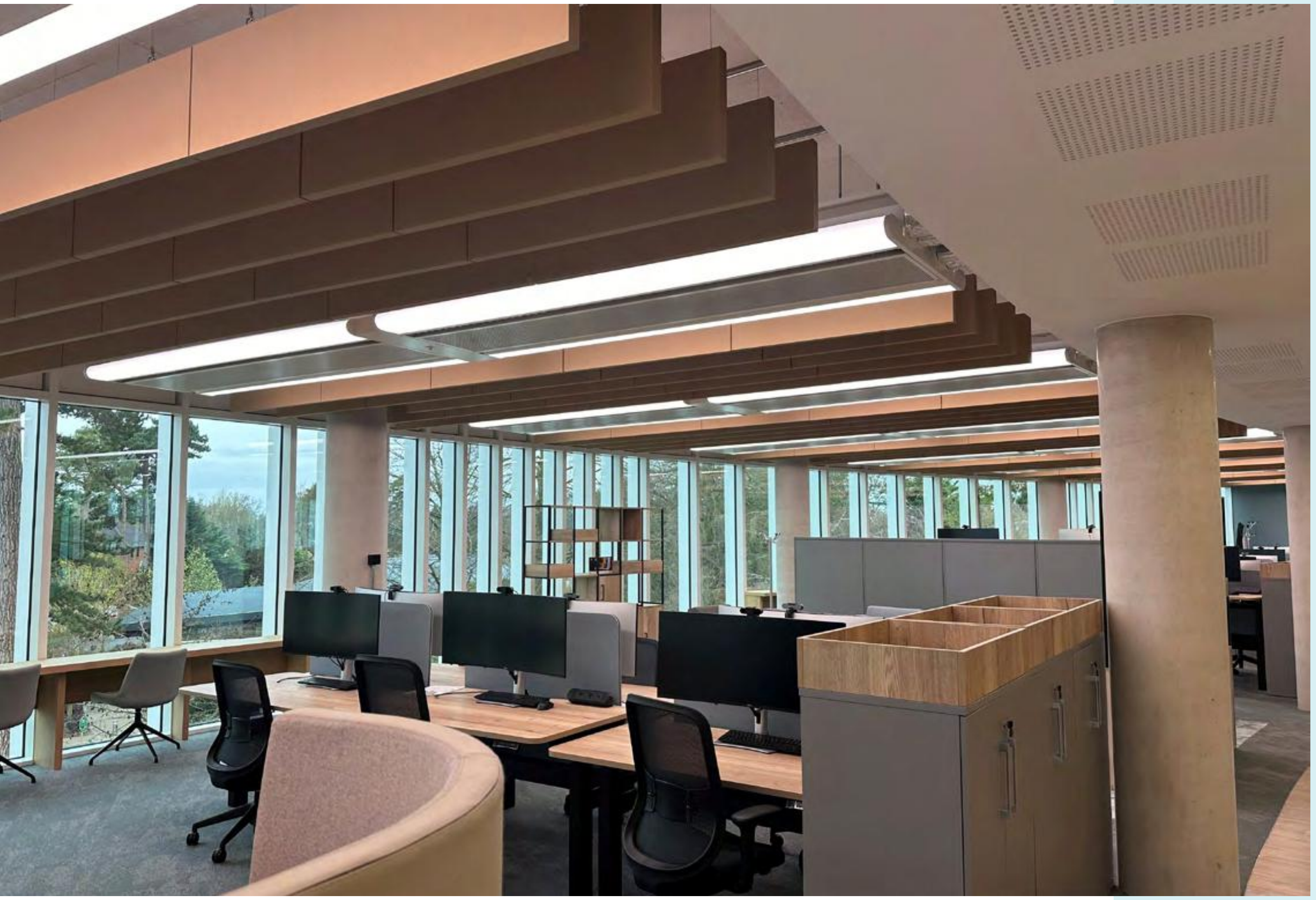




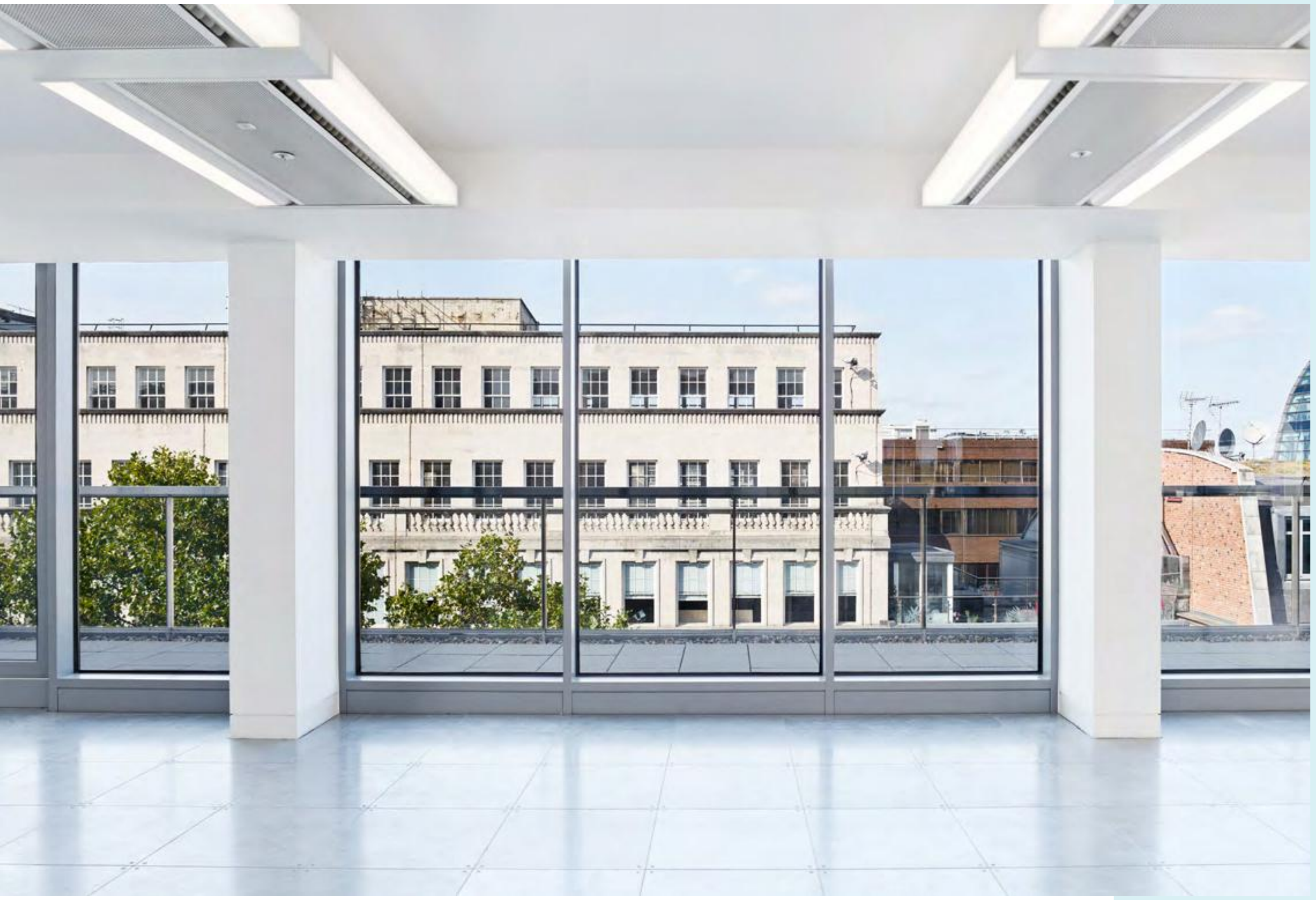
Lambeth Civic Centre - London (UK)

55 Baker Street - London (UK)

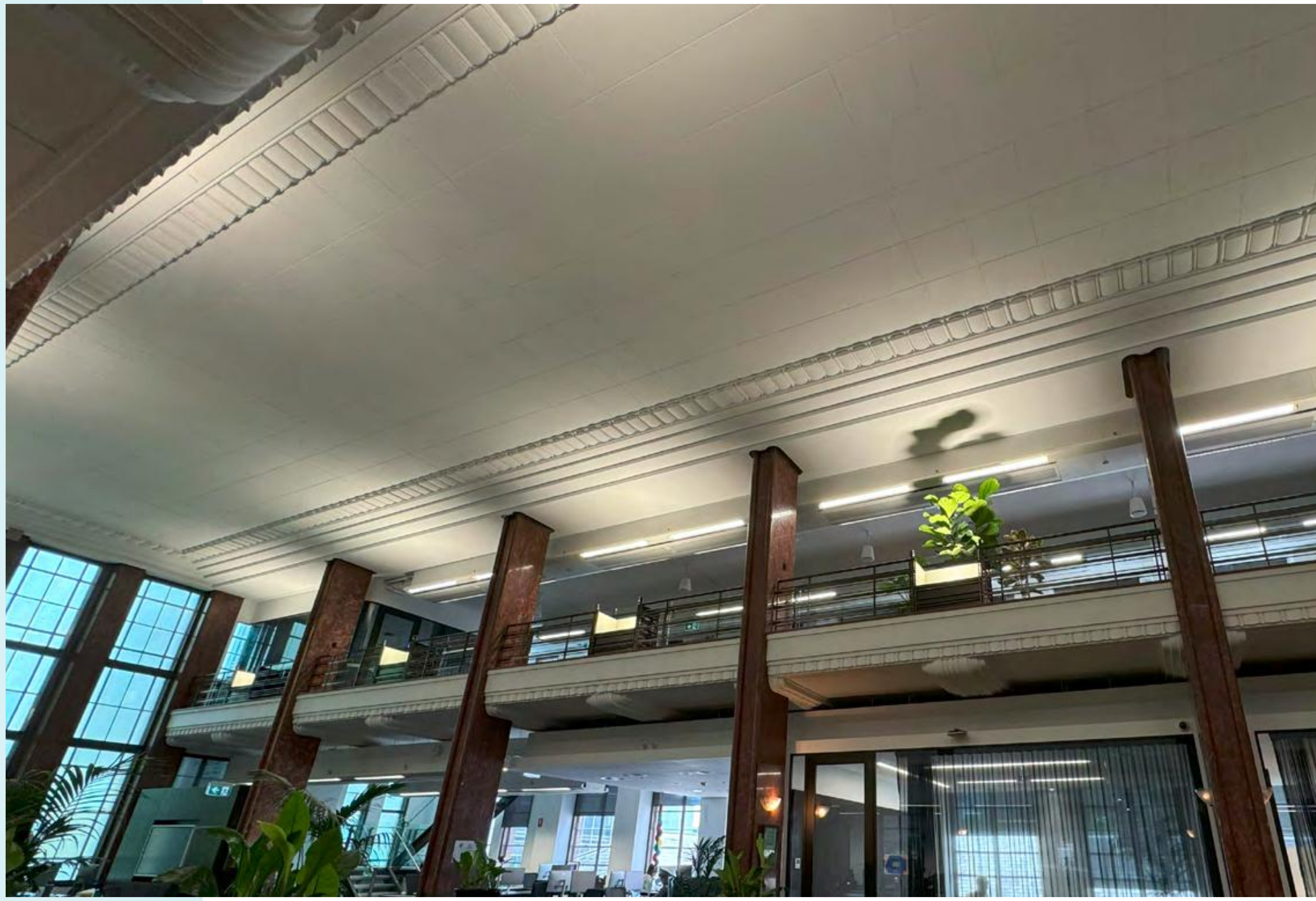
55 Baker Street - London (UK)

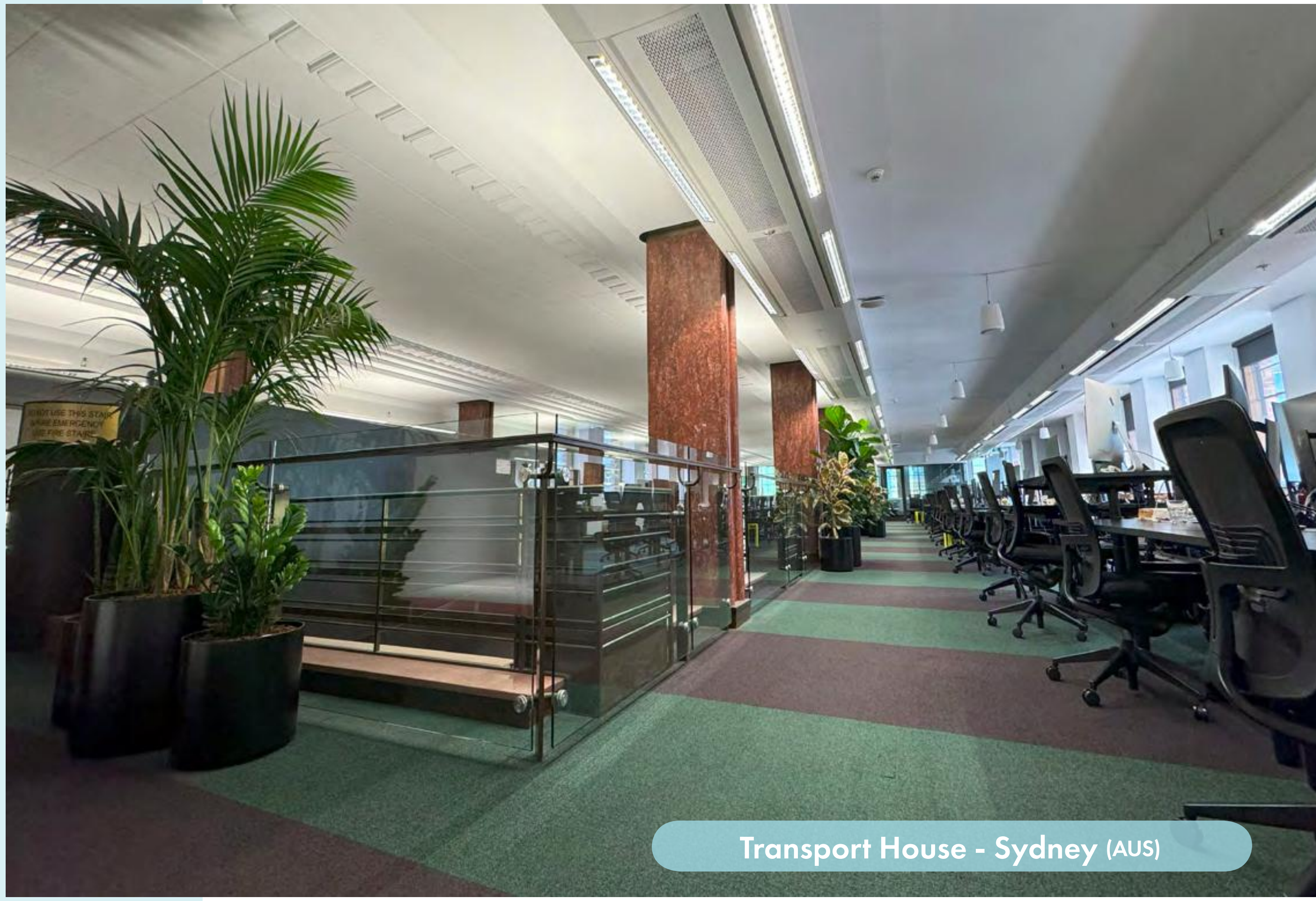


Spirax Sarco HQ - Cheltenham (UK)

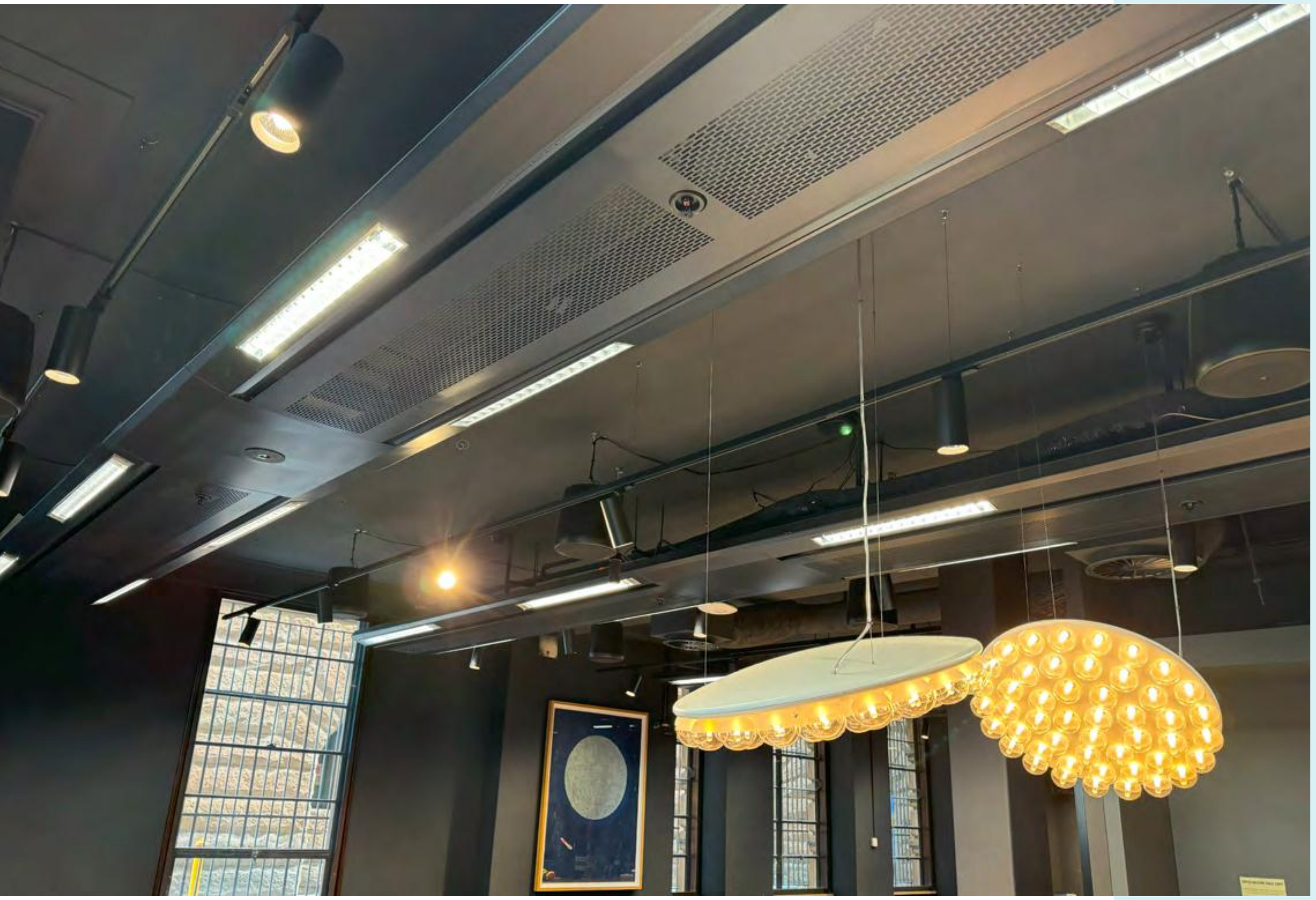


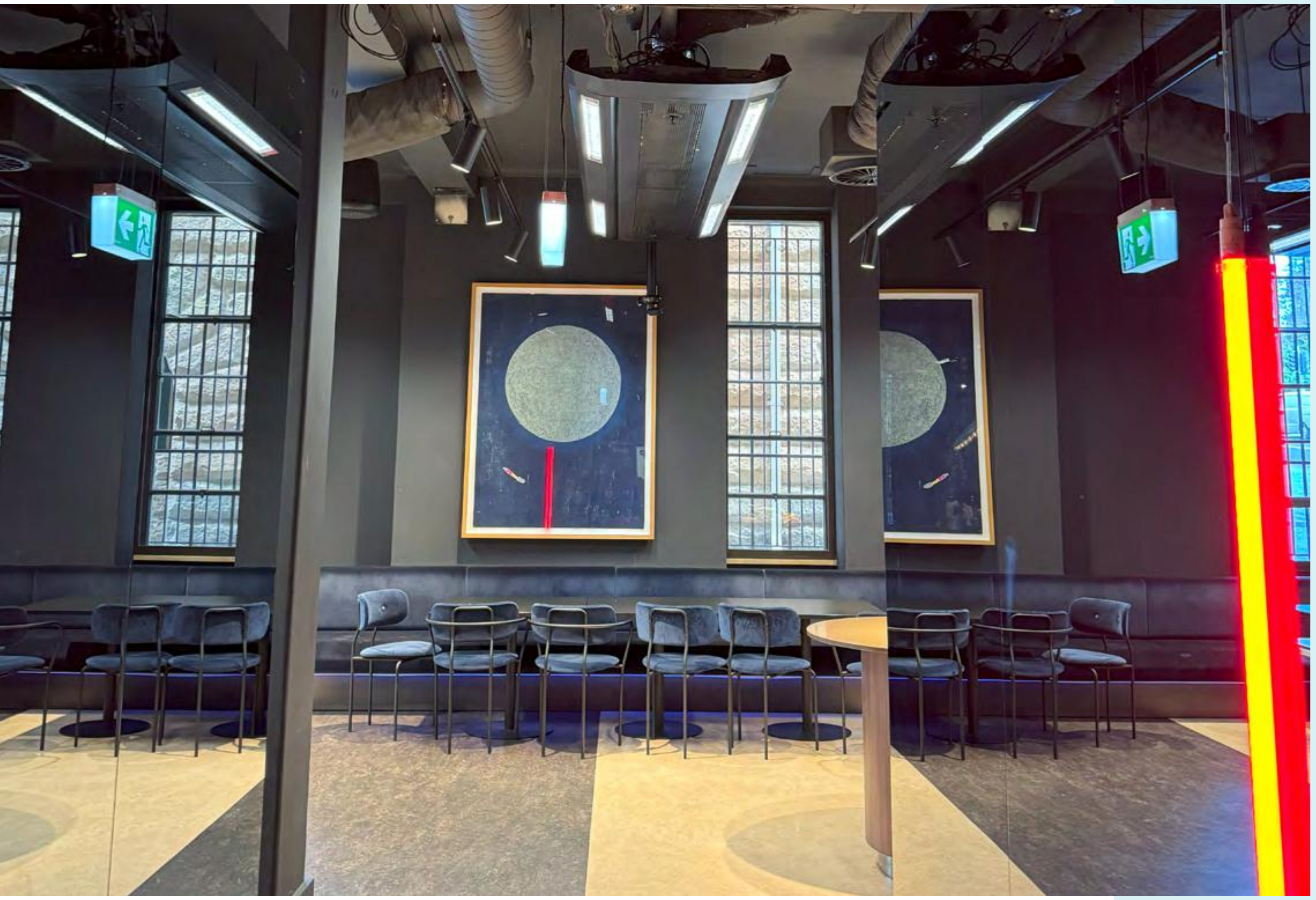
262 High Holborn - London (UK)



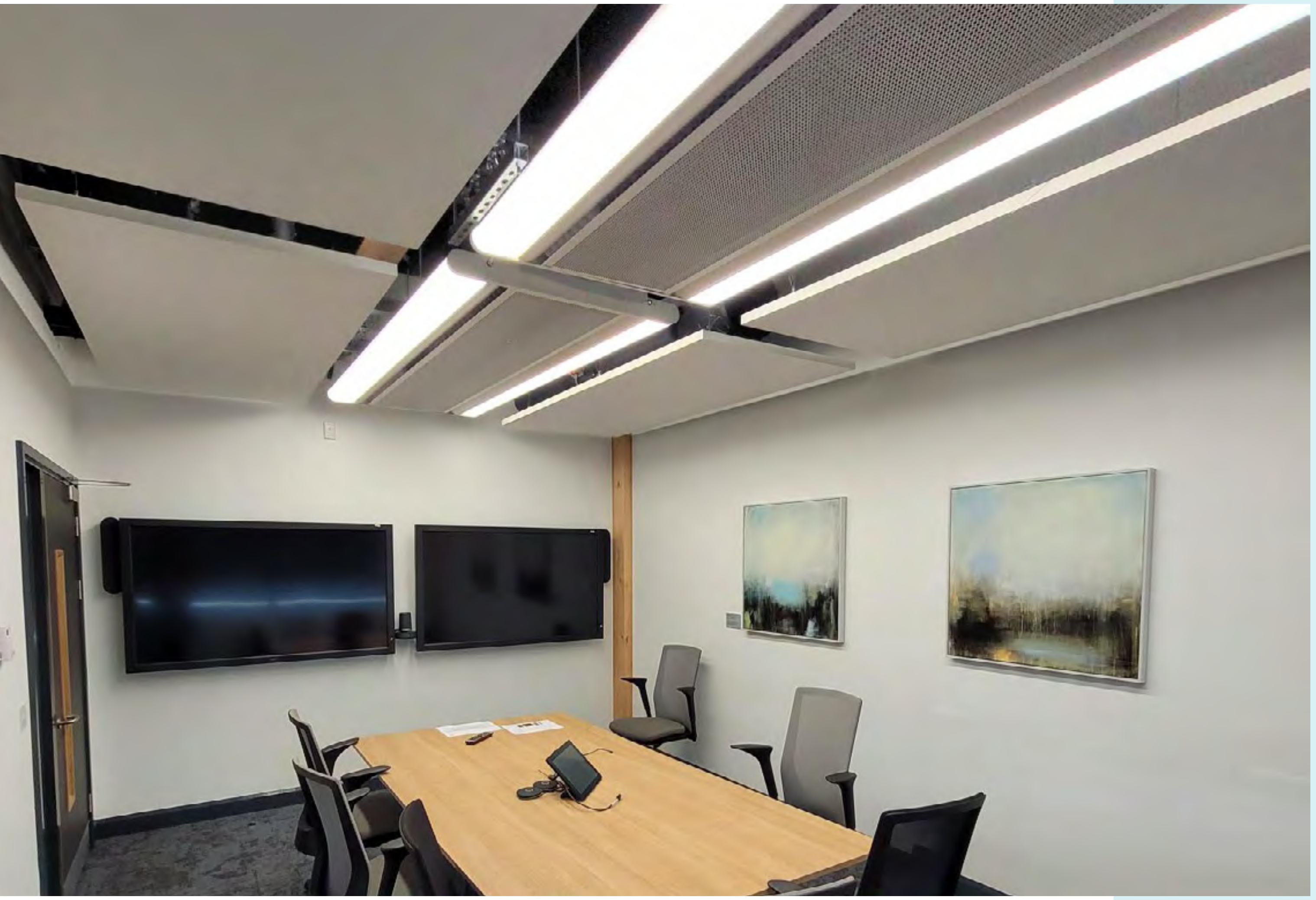


Transport House - Sydney (AUS)



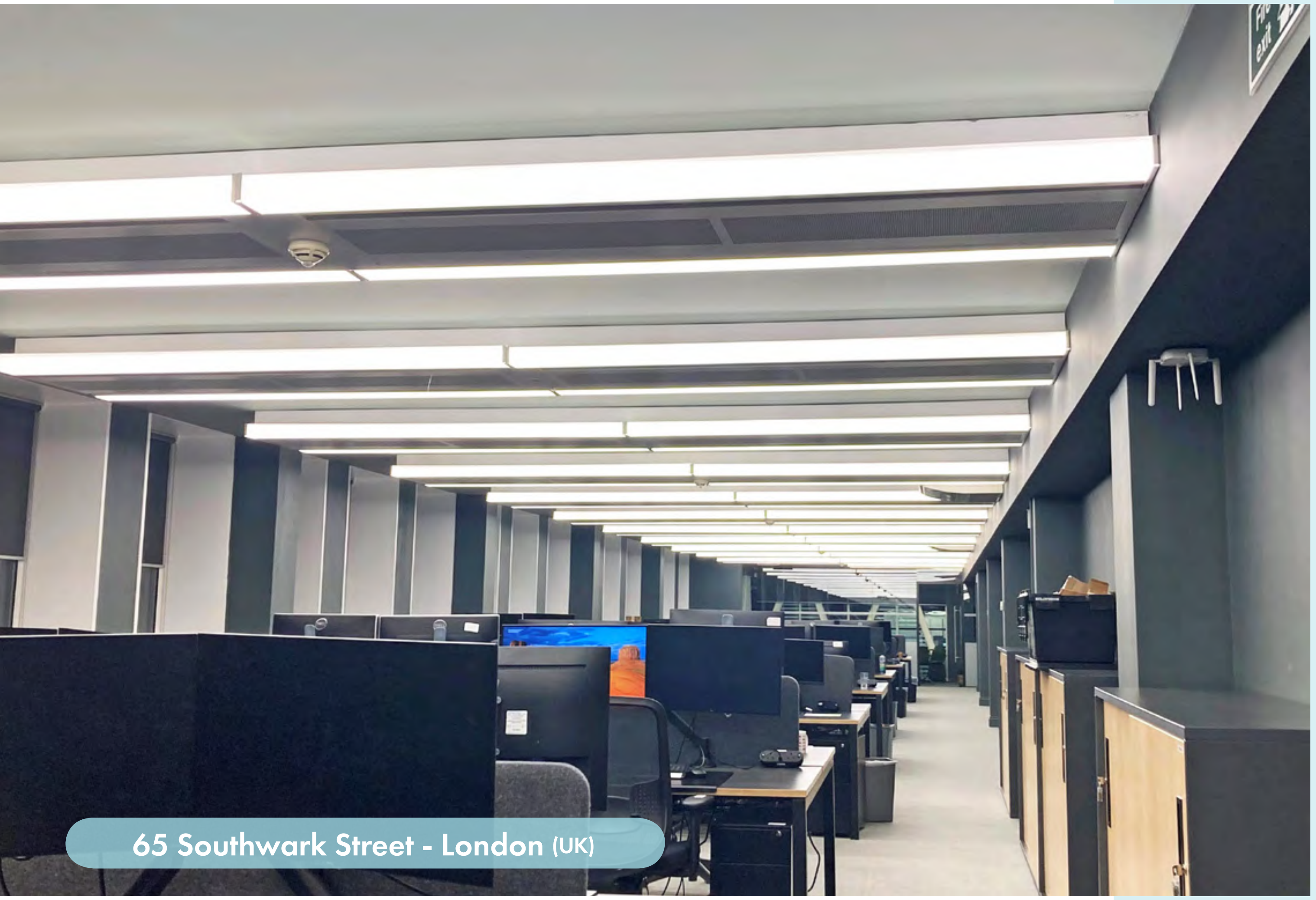



Transport House - Sydney (AUS)



Dogger Bank Windfarm - Port of Tyne (UK)

65 Southwark Street - London (UK)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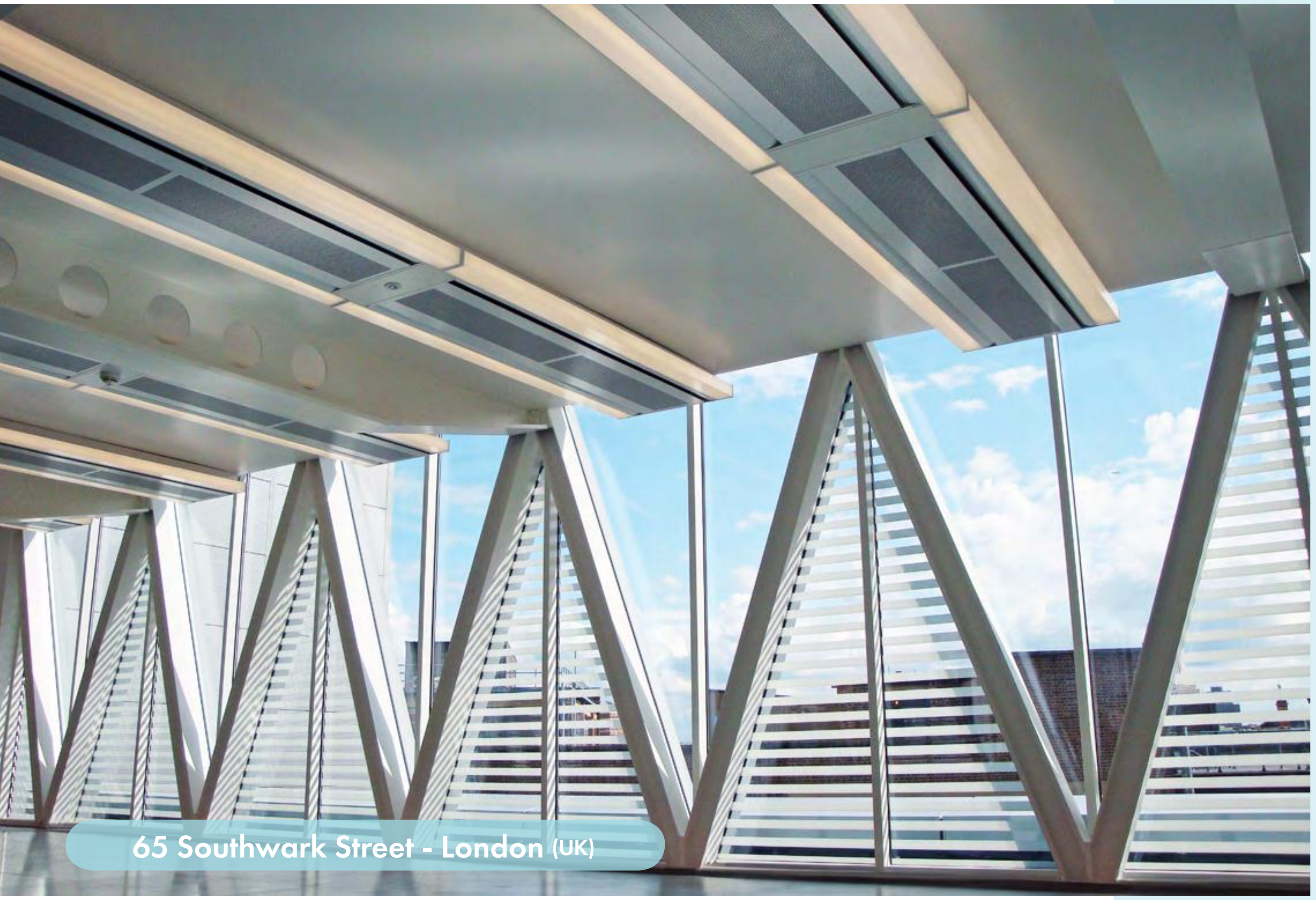

65 Southwark Street - London (UK)


110 High Holborn - London (UK)


110 High Holborn - London (UK)

Three Haddington Building - Dublin (IR)

101 New Cavendish Street - London (UK)

Passive

Multiservice Chilled Beams

Ofcom, Riverside House - London (UK)

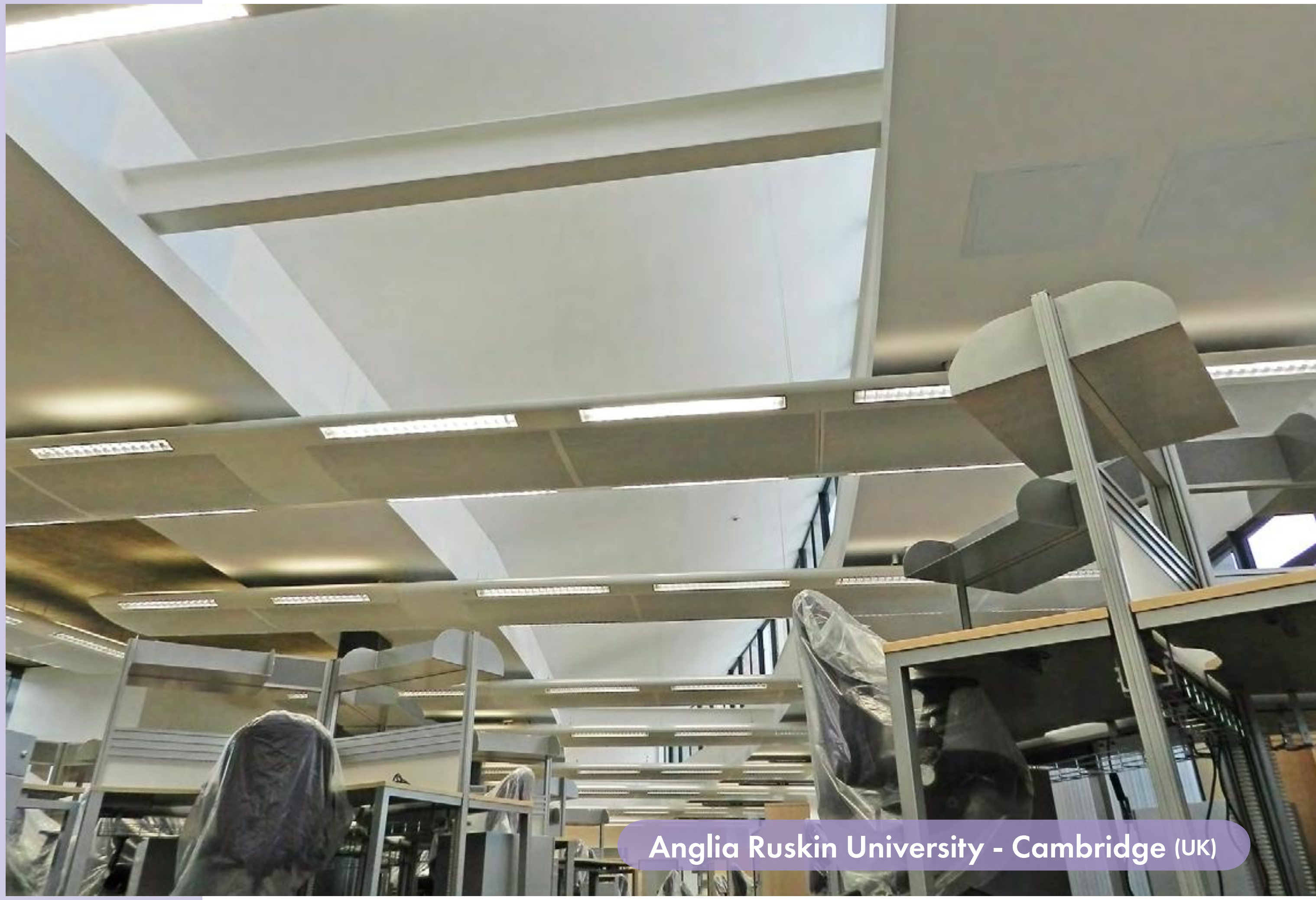

1 Lancaster Circus - Birmingham (UK)


1 Lancaster Circus - Birmingham (UK)


Lambeth Civic Centre - London (UK)

University College Birmingham - Birmingham (UK)

Skipton Building Society - Skipton (UK)



Anglia Ruskin University - Cambridge (UK)

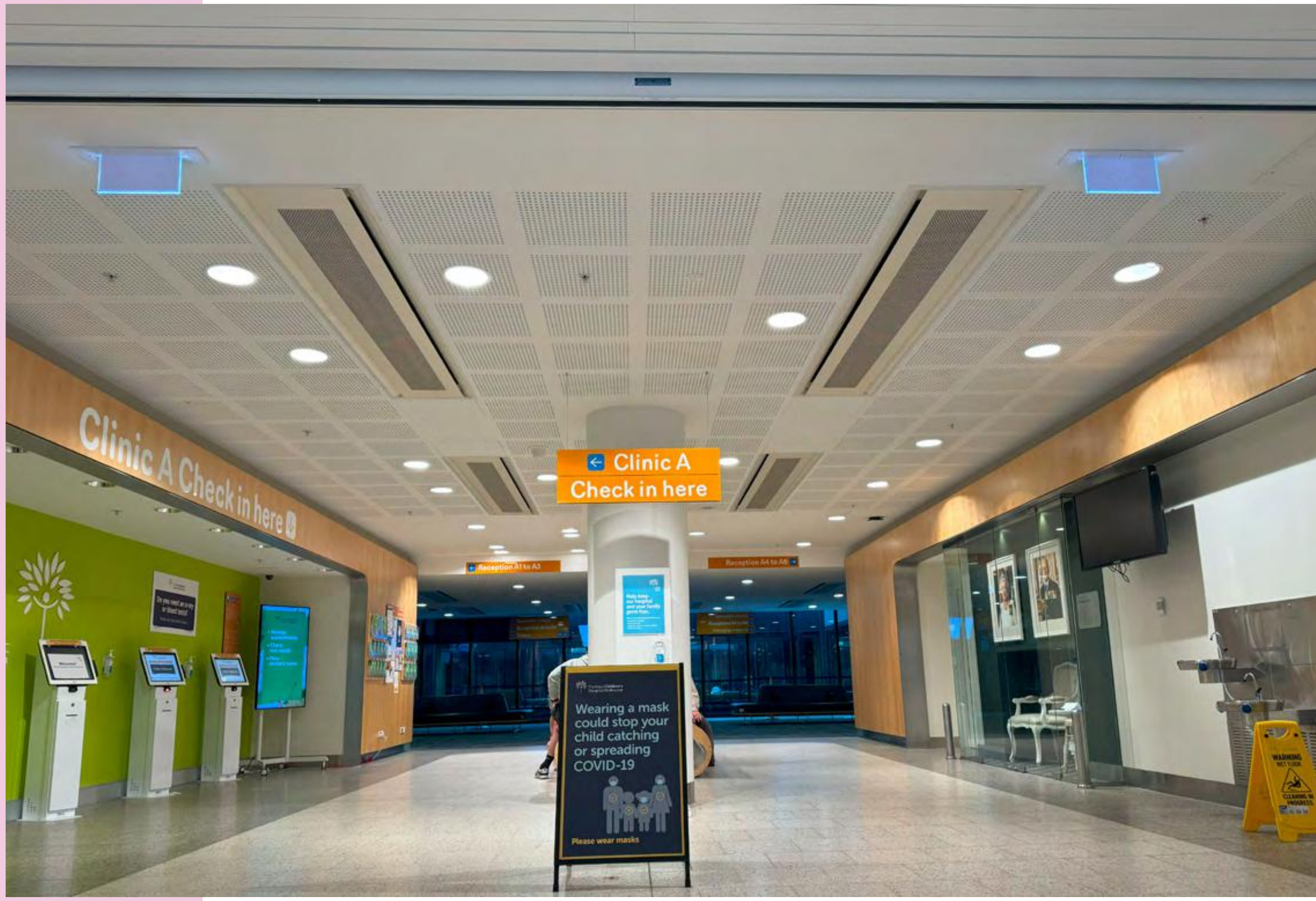
CEC Edinburgh - Edinburgh (UK)

National Farmers Union - Warwickshire (UK)

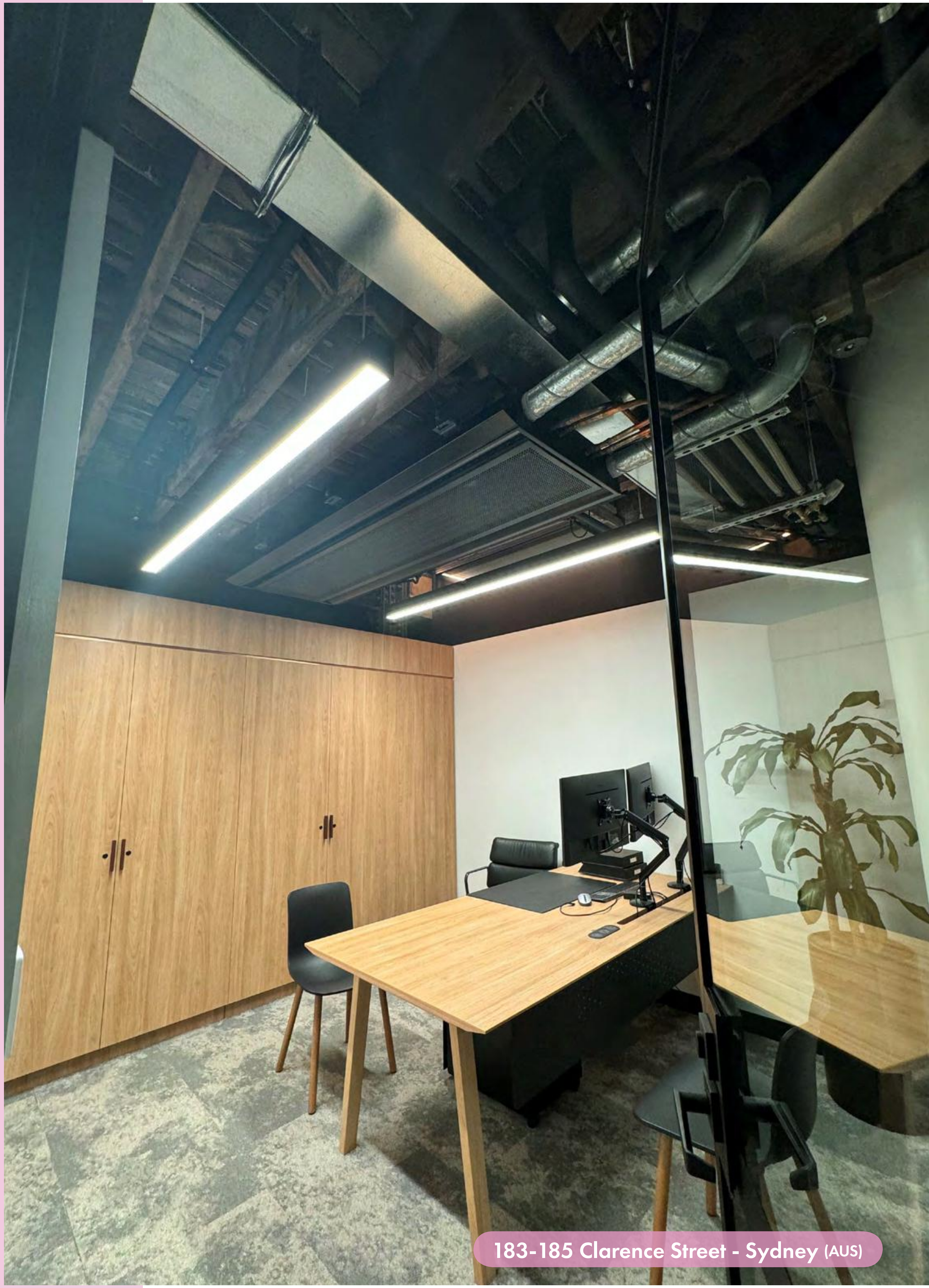
50 Grosvenor Hill - London (UK)

Active

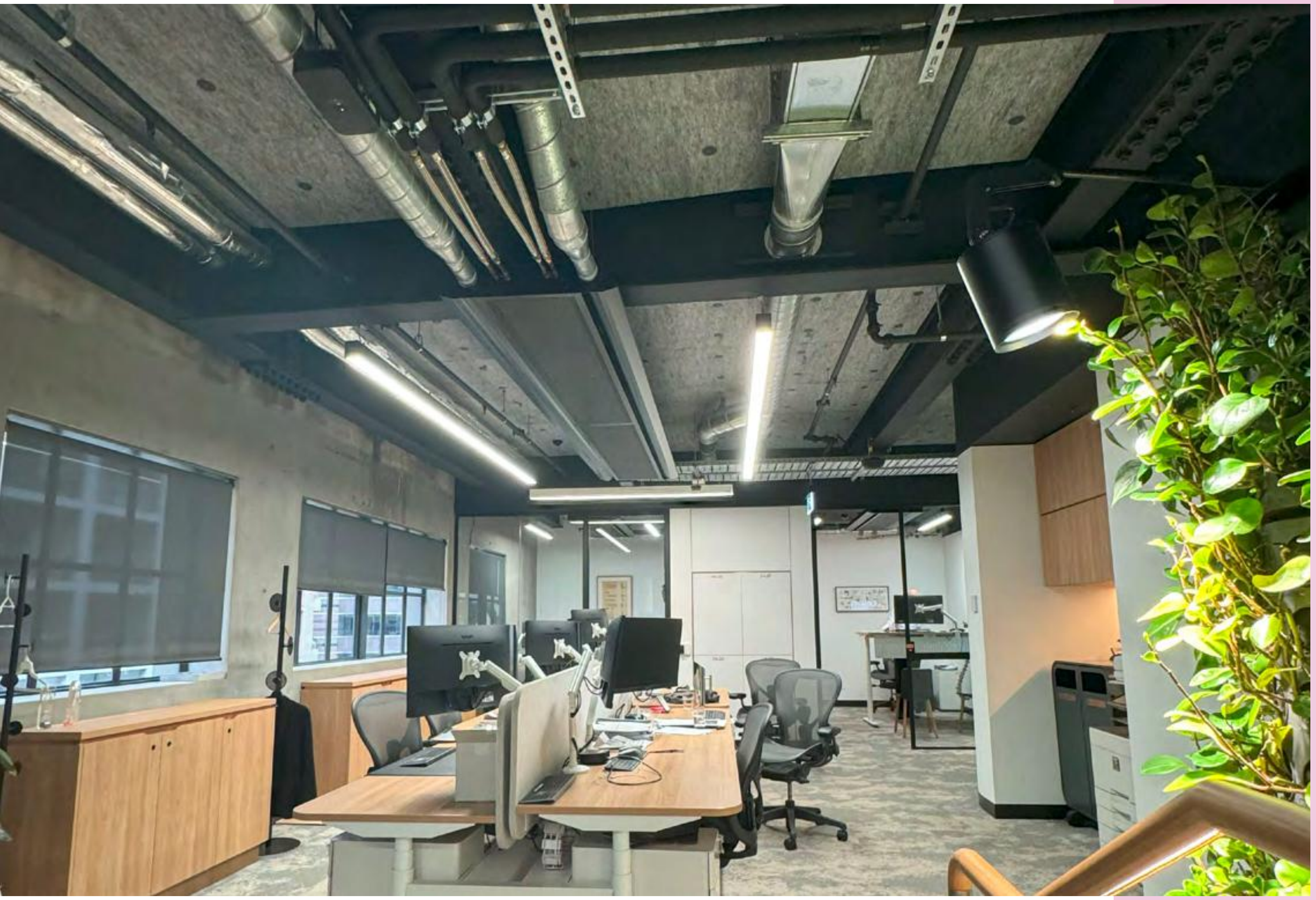
Chilled Beams



Royal Childrens Hospital - Melbourne (AUS)

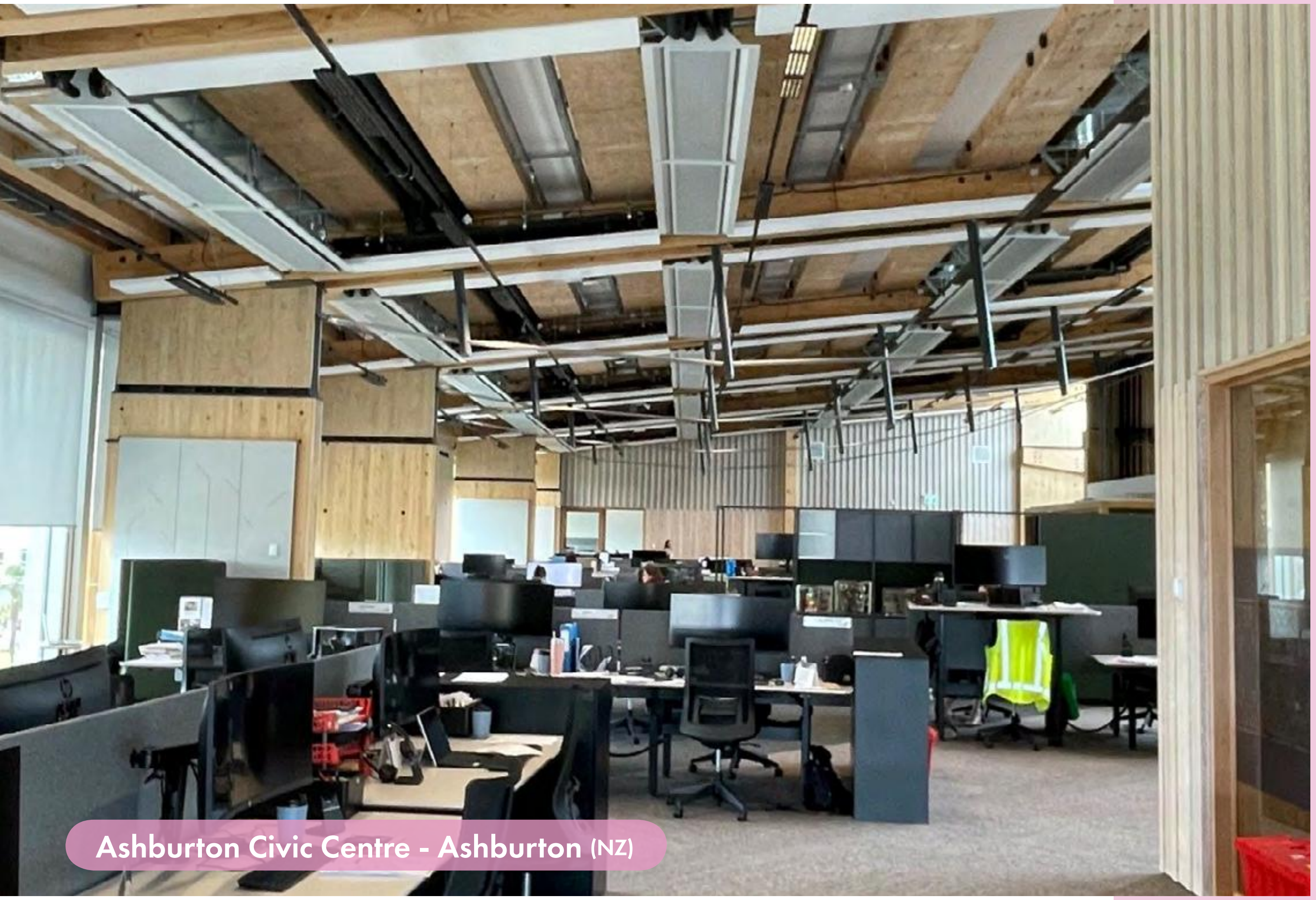


183-185 Clarence Street - Sydney (AUS)



183-185 Clarence Street - Sydney (AUS)

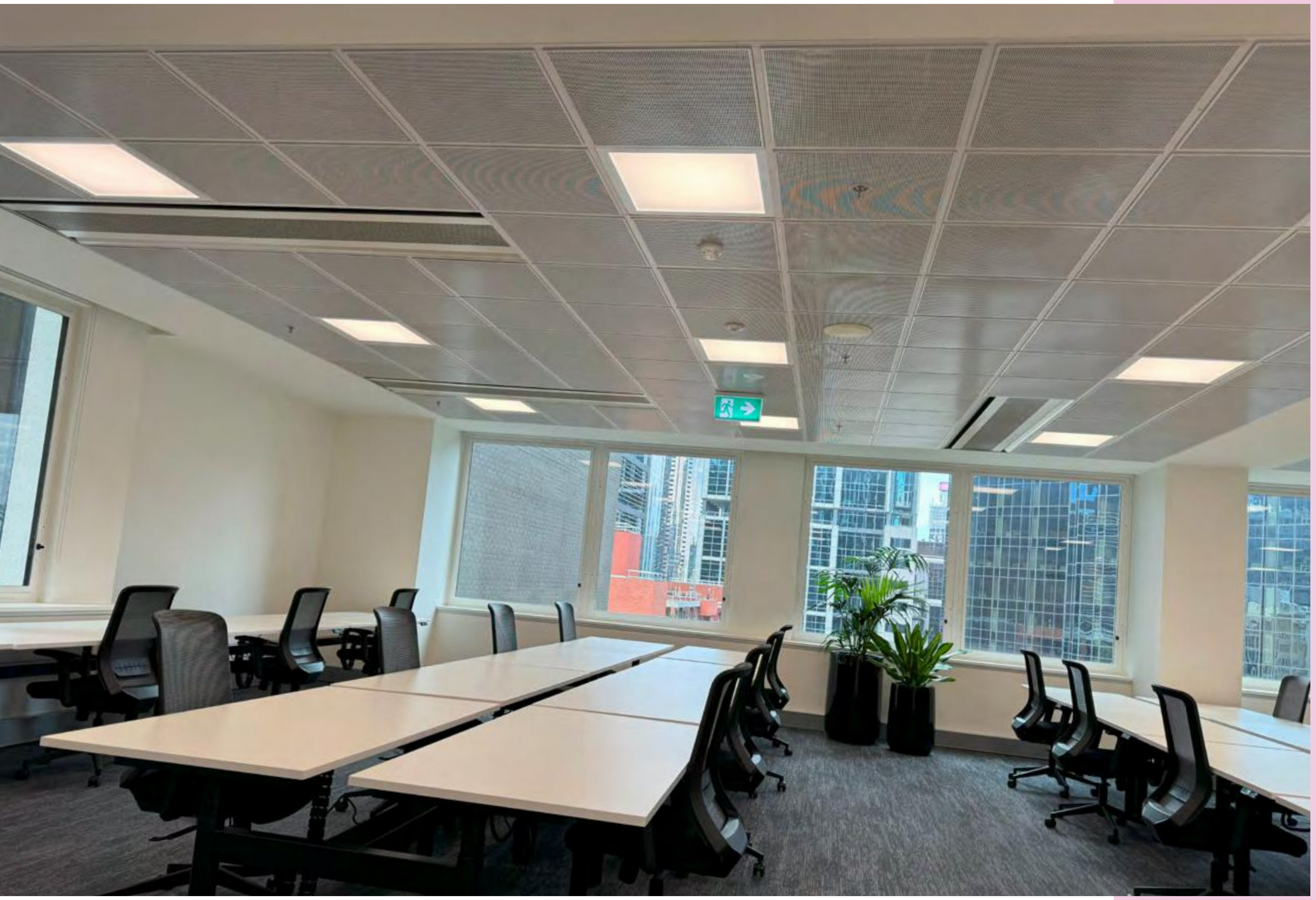
Ashburton Civic Centre - Ashburton (NZ)



Ashburton Civic Centre - Ashburton (NZ)

Ofcom, Riverside House - London (UK)

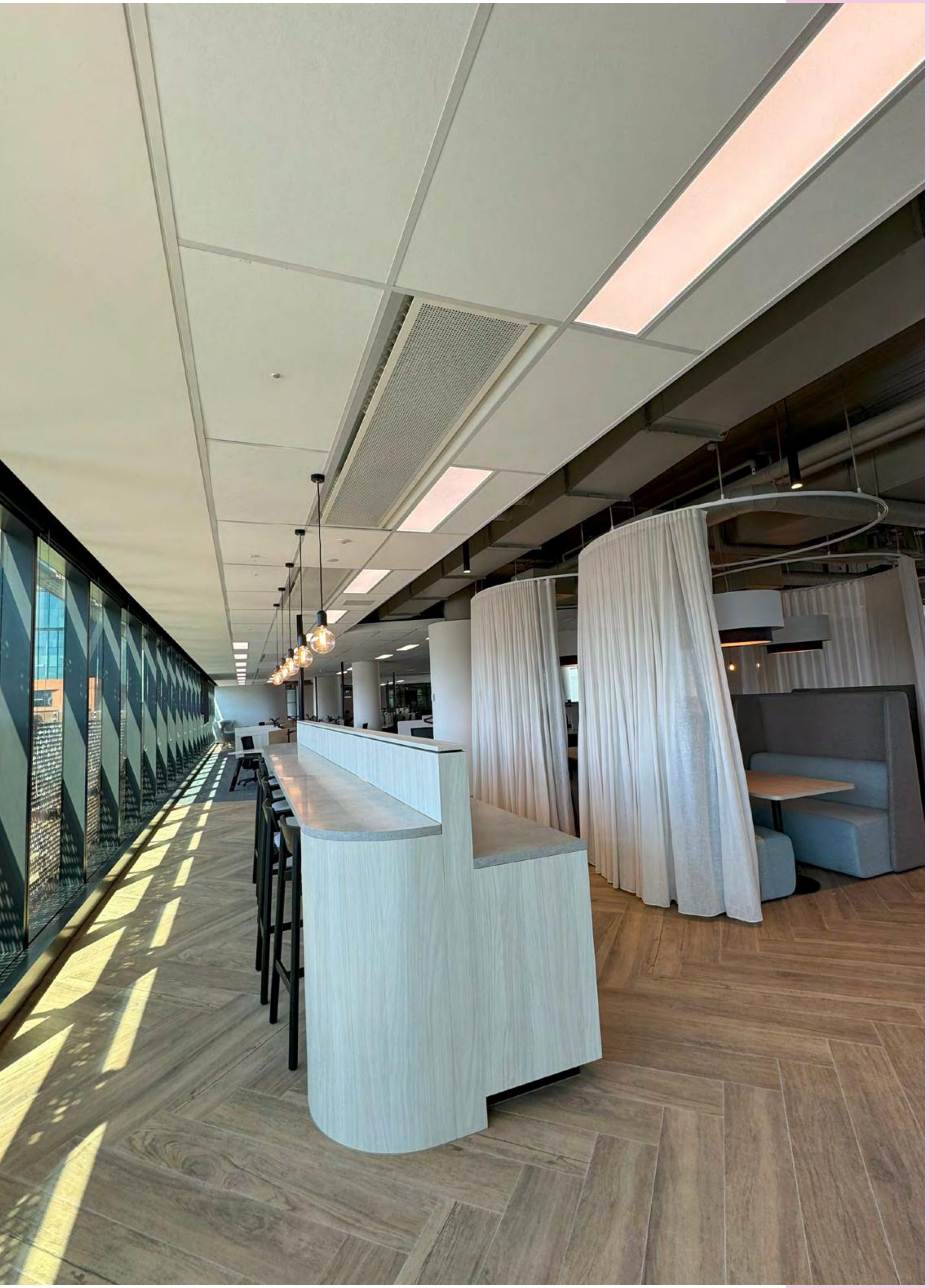
500 Collins Street - Melbourne (AUS)

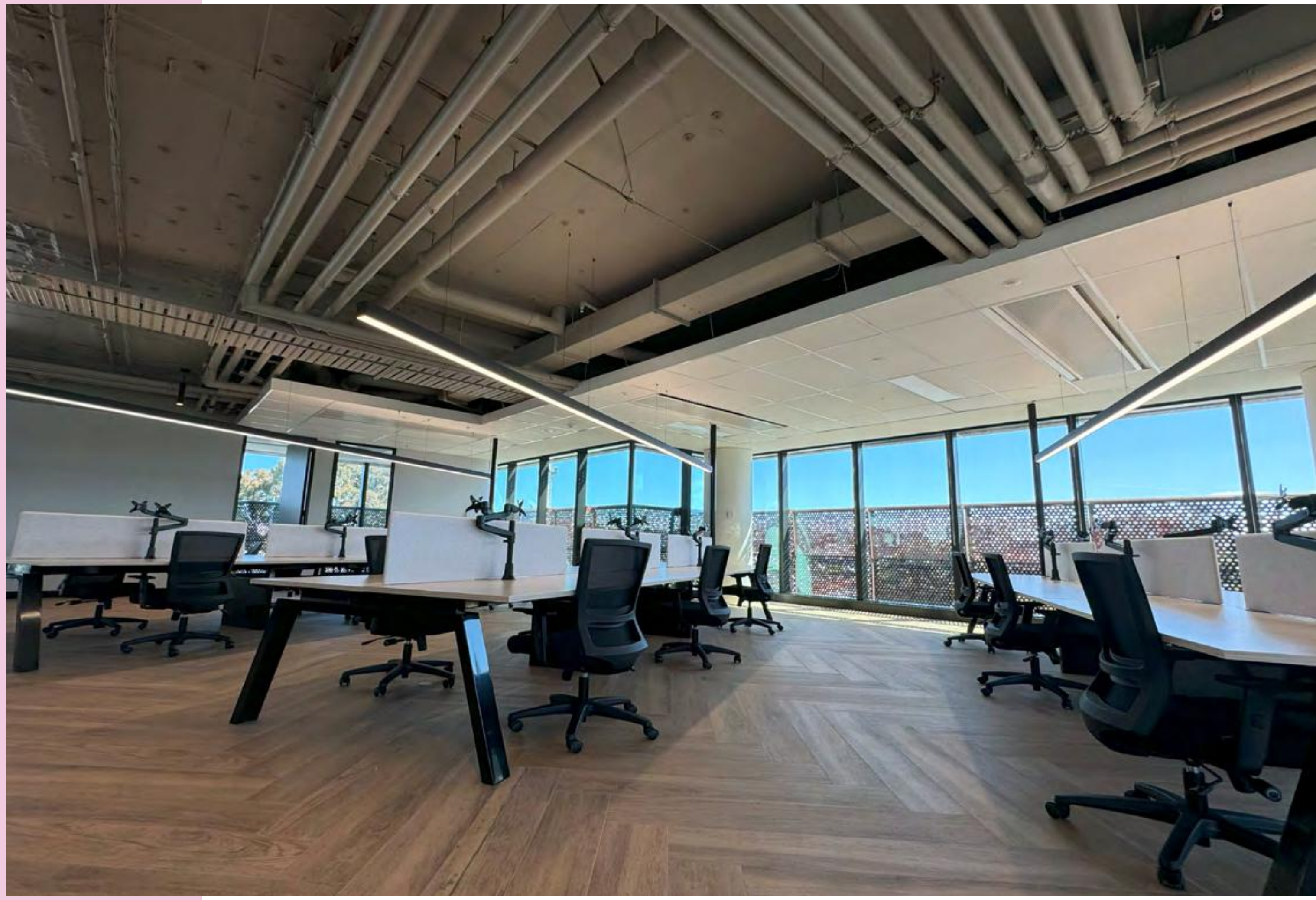


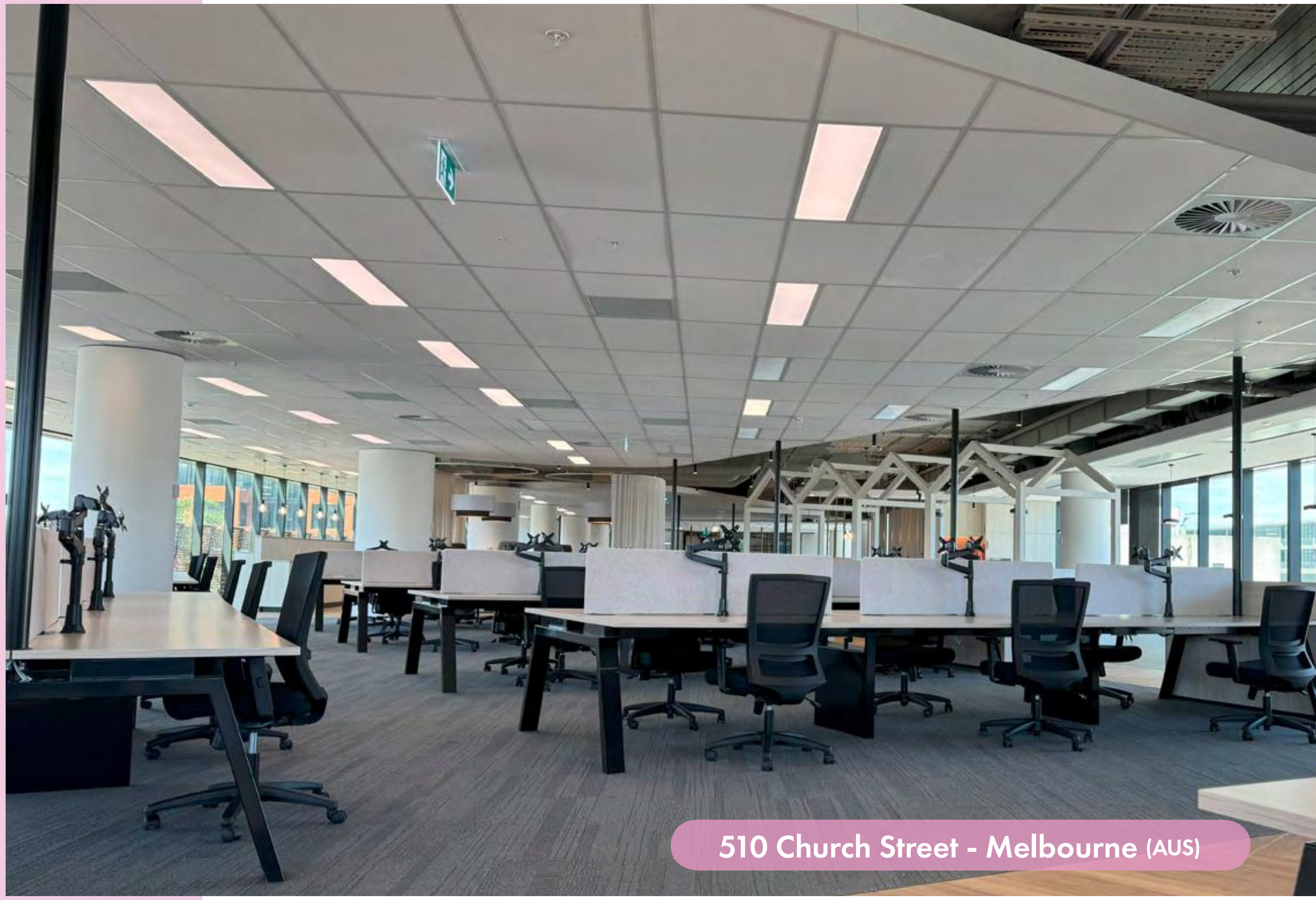
500 Collins Street - Melbourne (AUS)

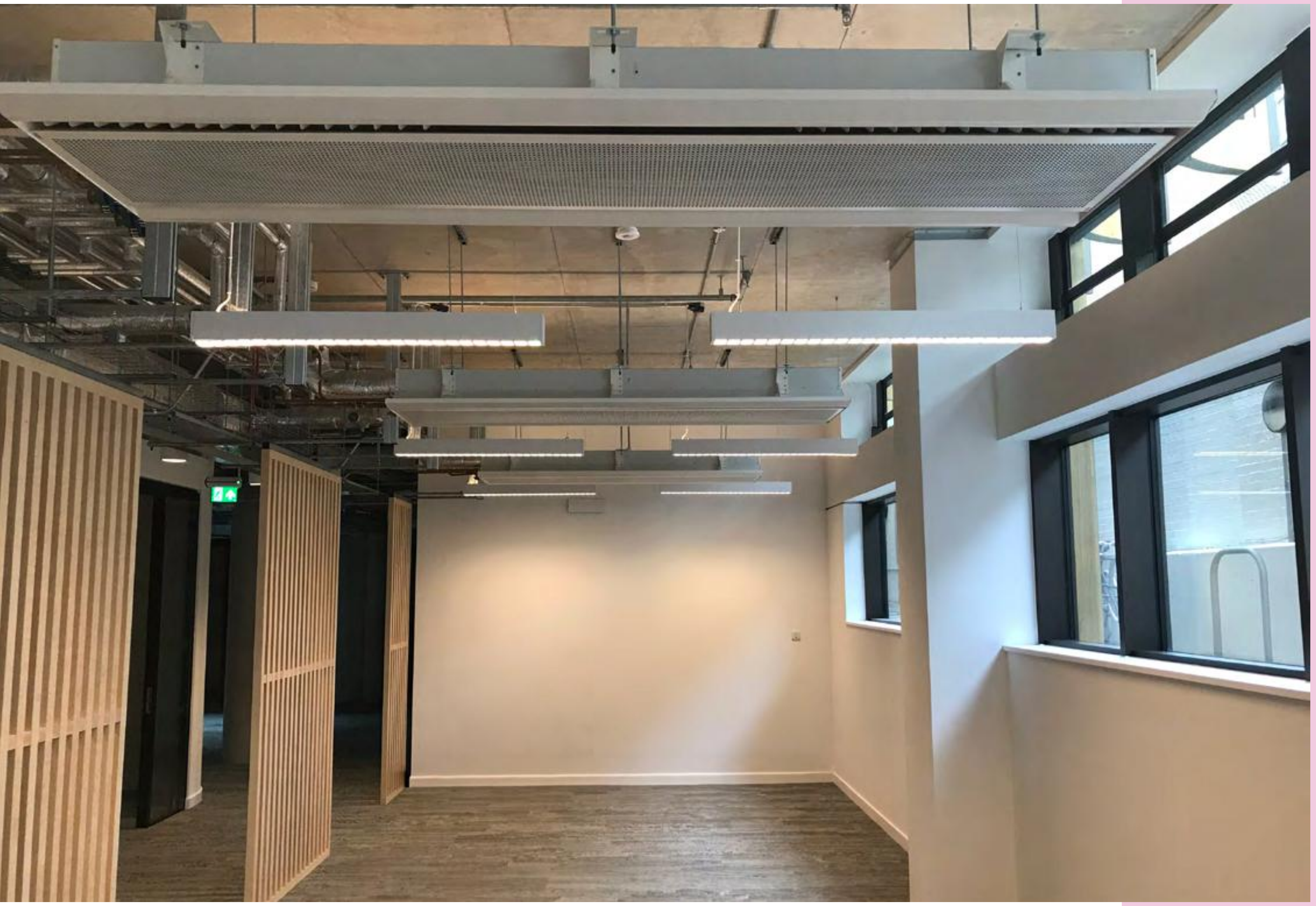

510
MOBILIA
HUTCHINGS ST

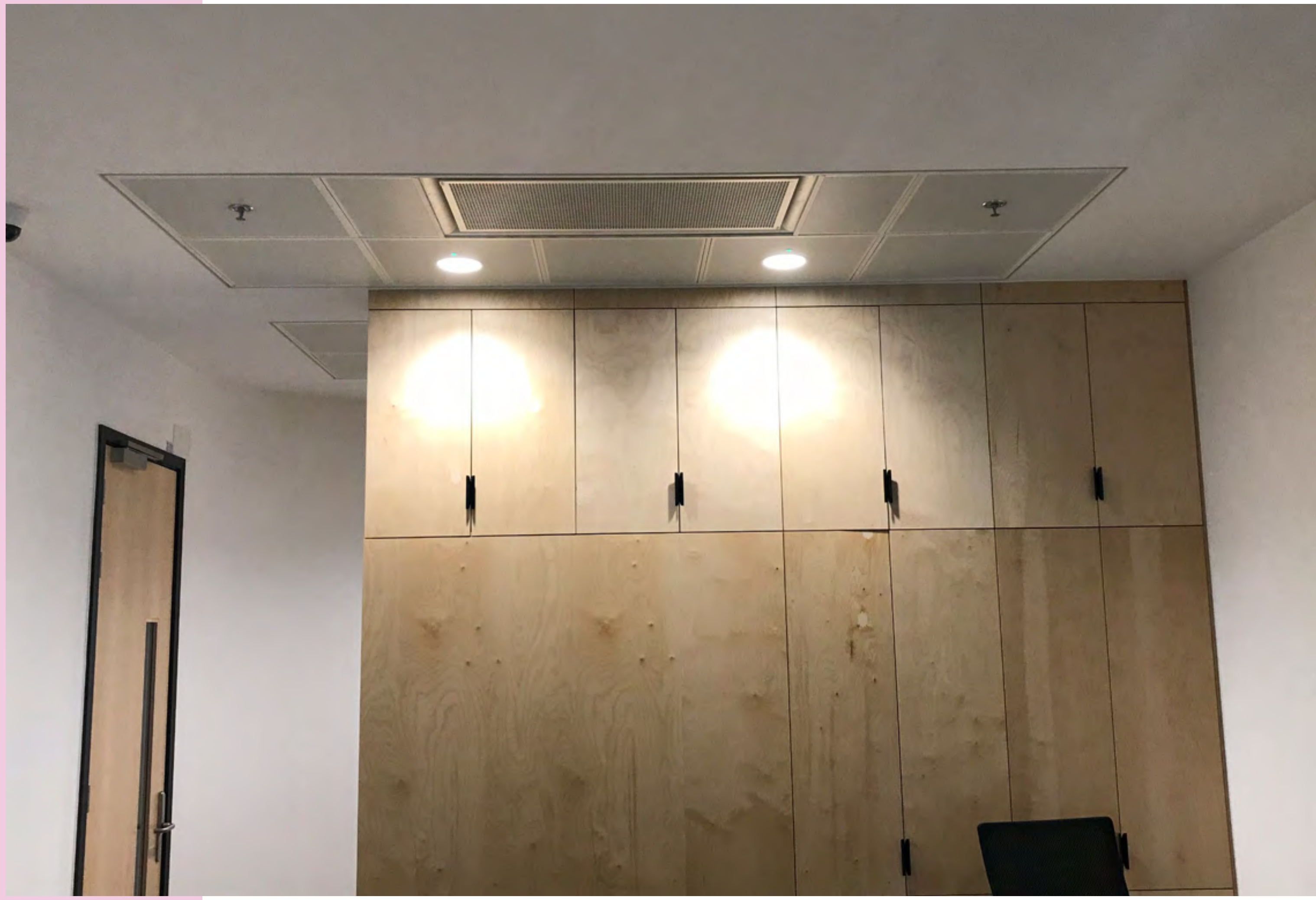

510 Church Street - Melbourne (AUS)



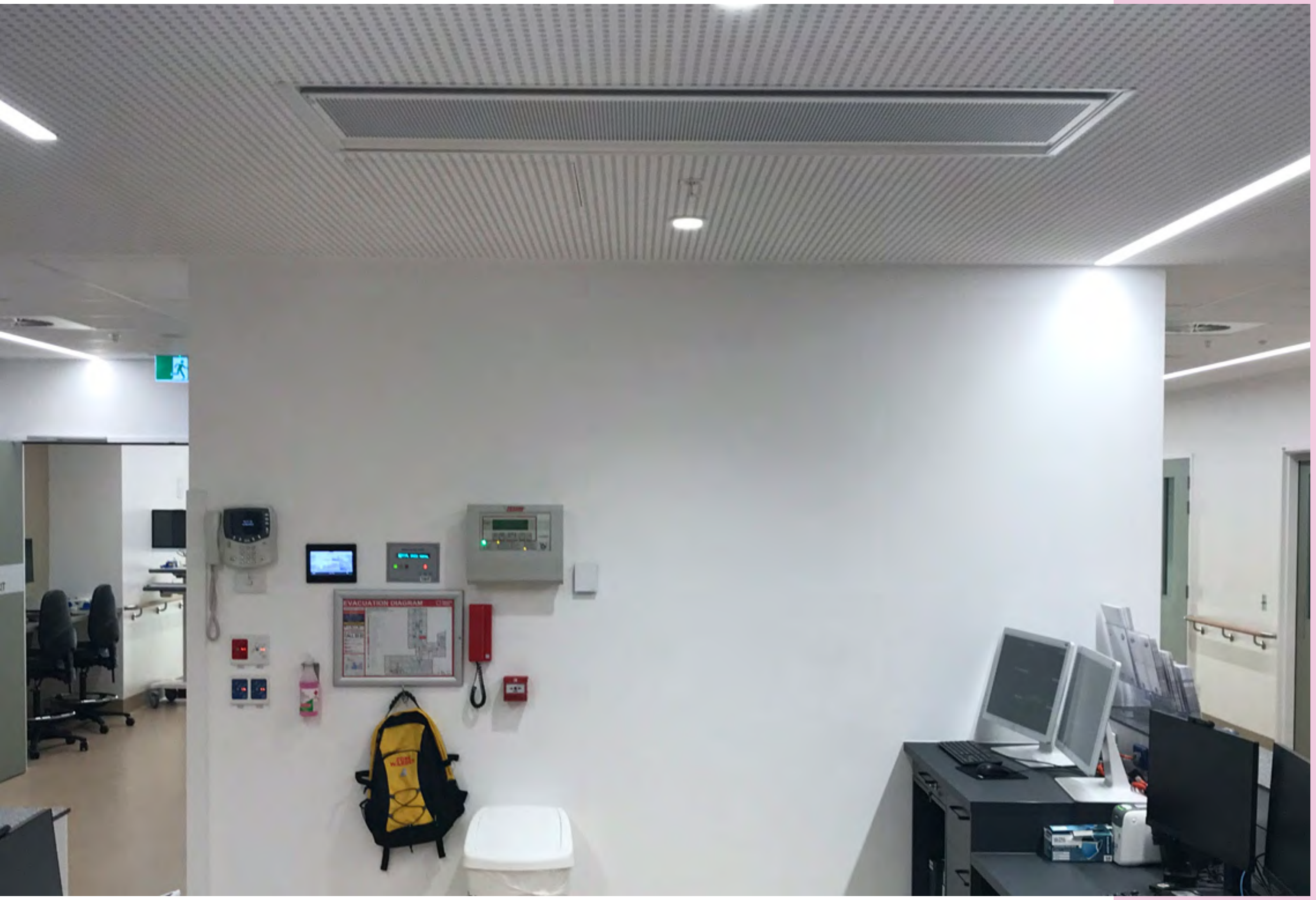


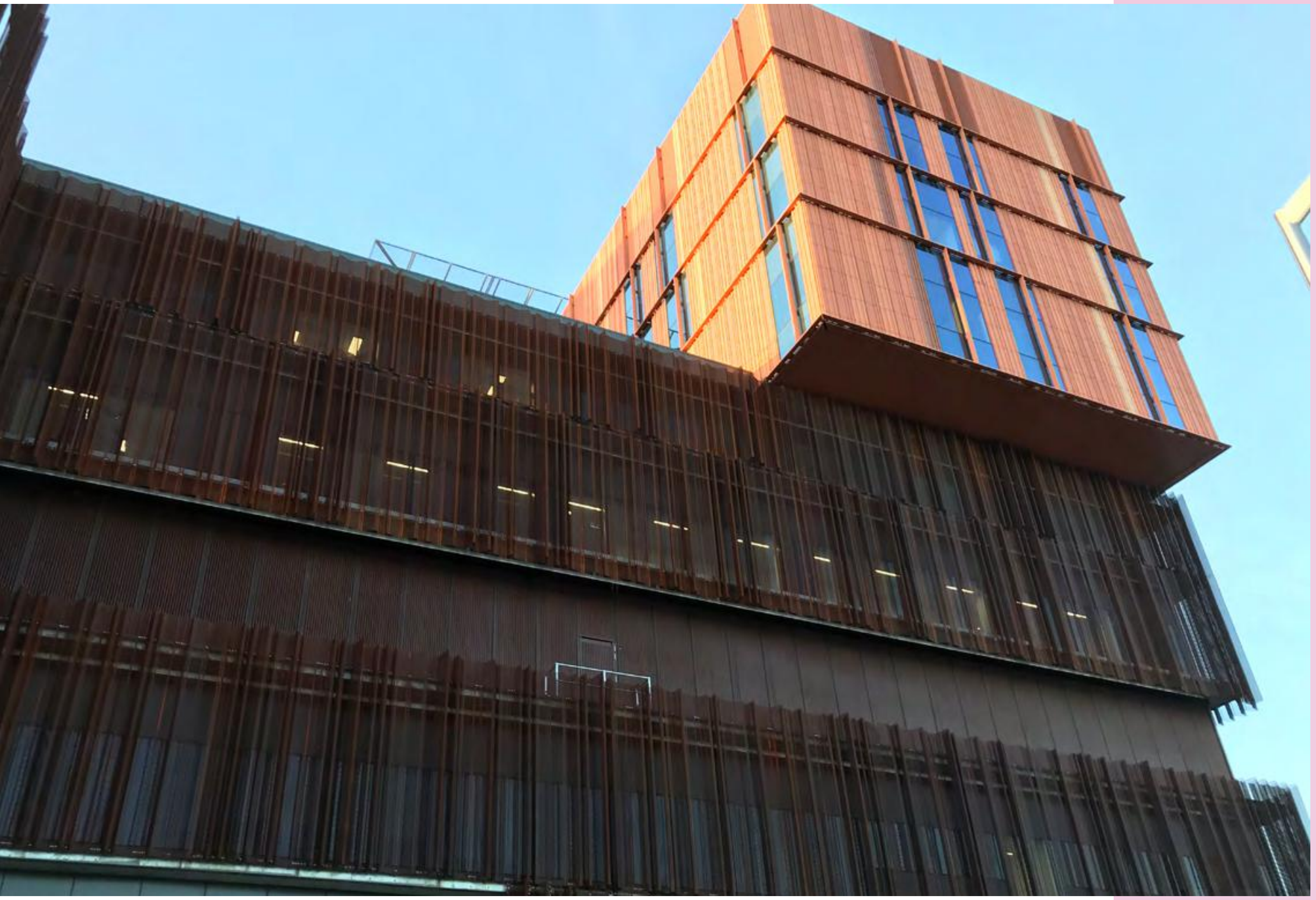

510 Church Street - Melbourne (AUS)



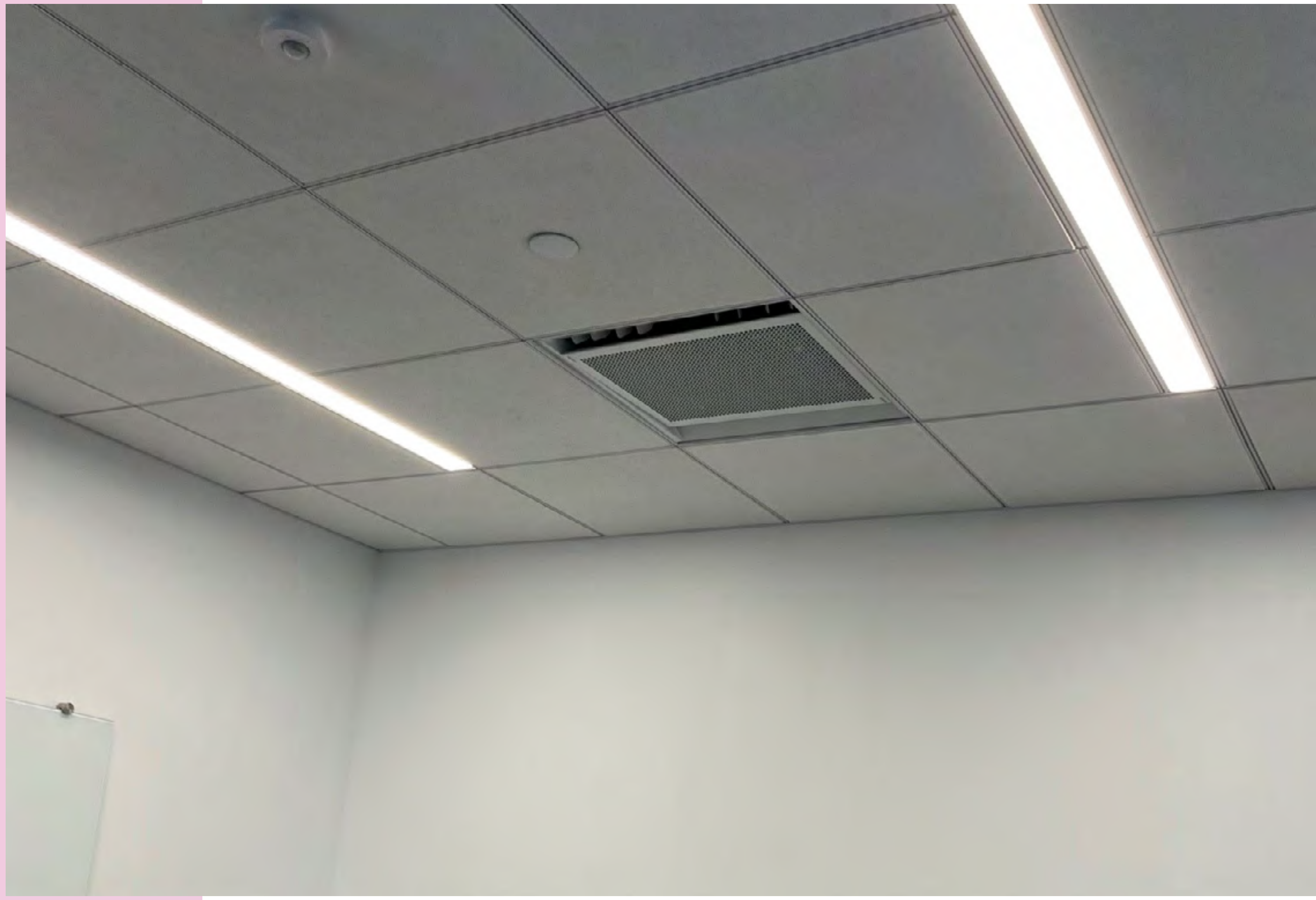


London School of Tropical Medicine - London (UK)

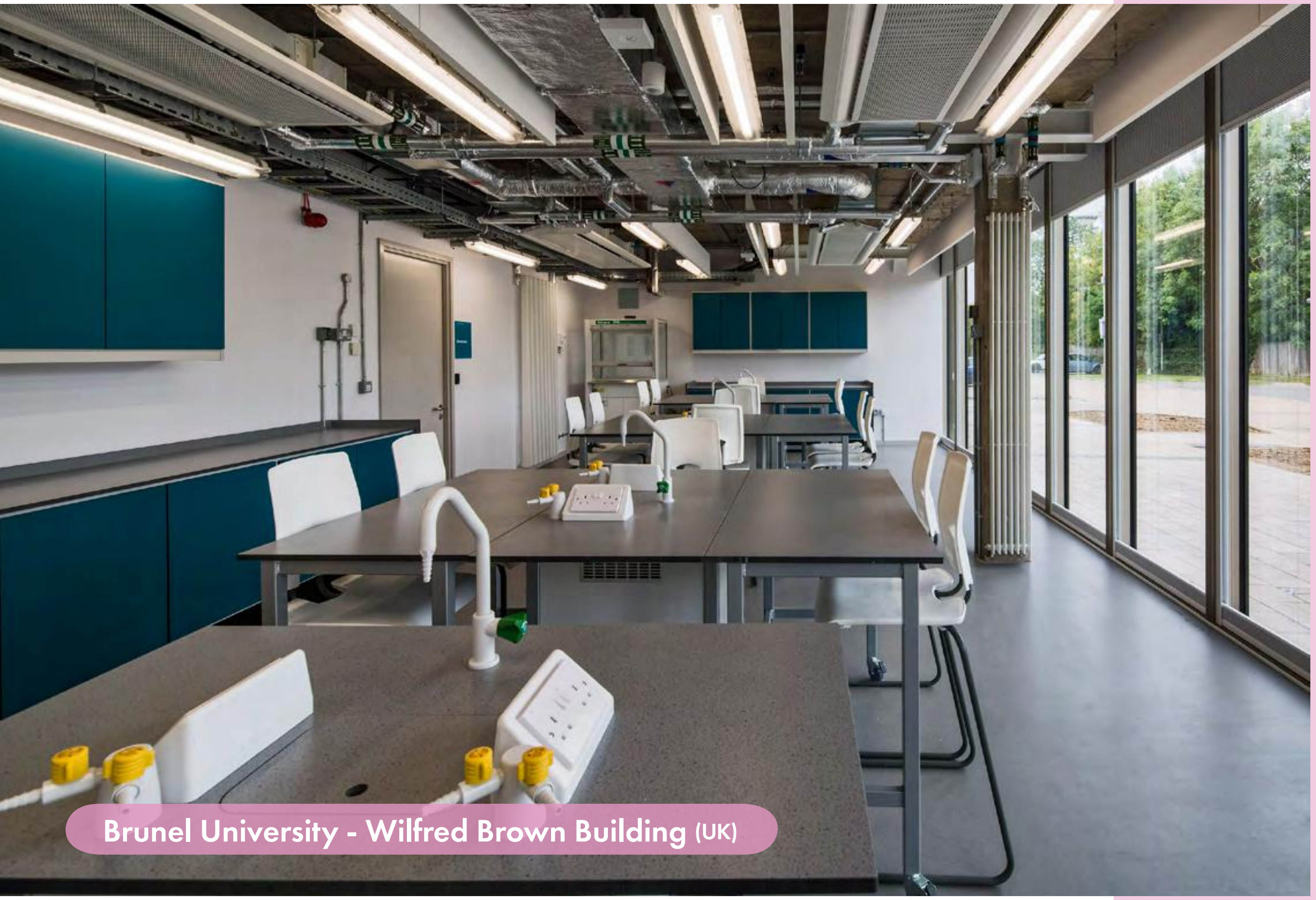




Victorian Heart Hospital - Melbourne (AUS)



Hub on Causeway - Boston (US)



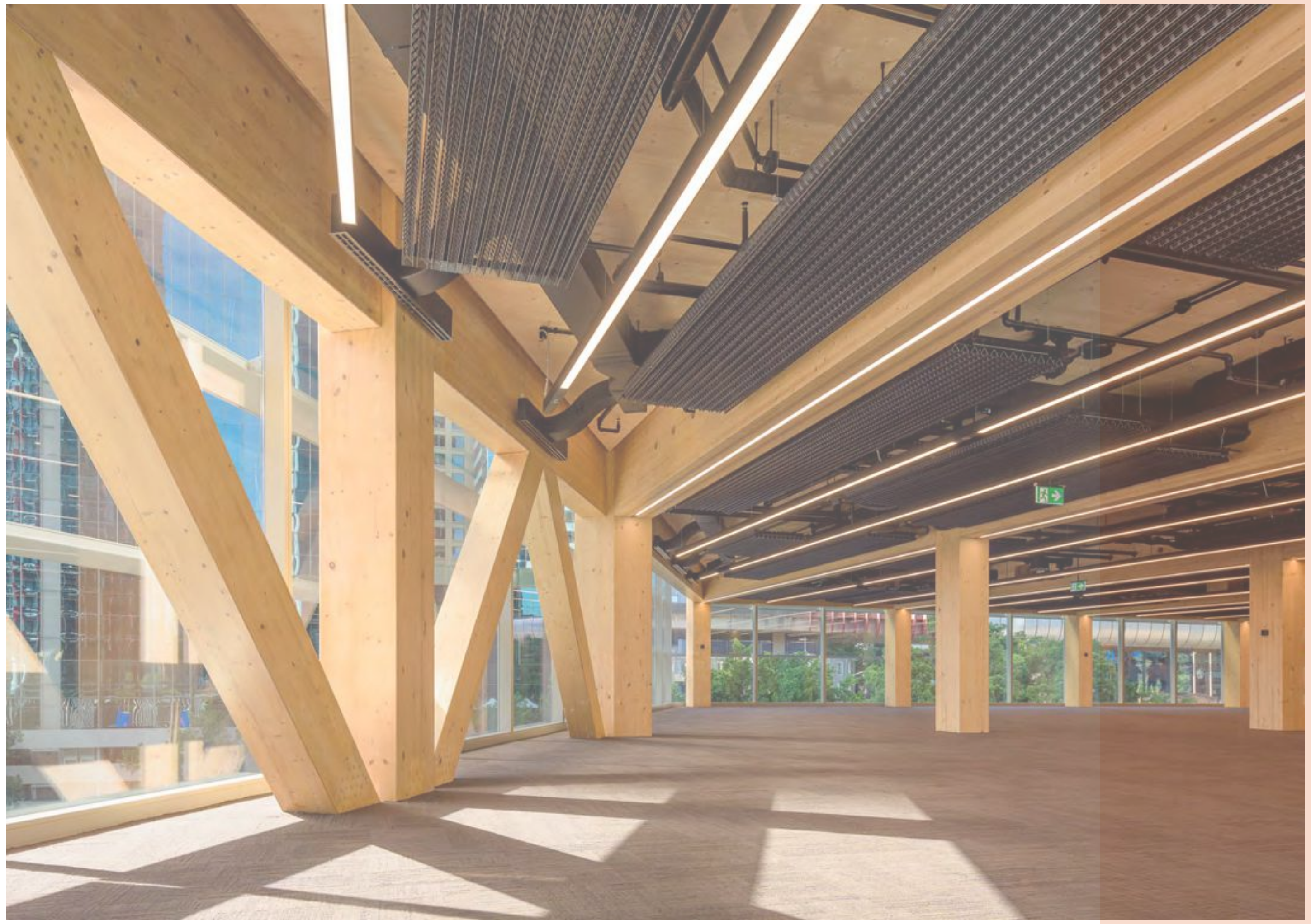
Brunel University - Wilfred Brown Building (UK)

Sudima Hotel - Auckland (NZ)

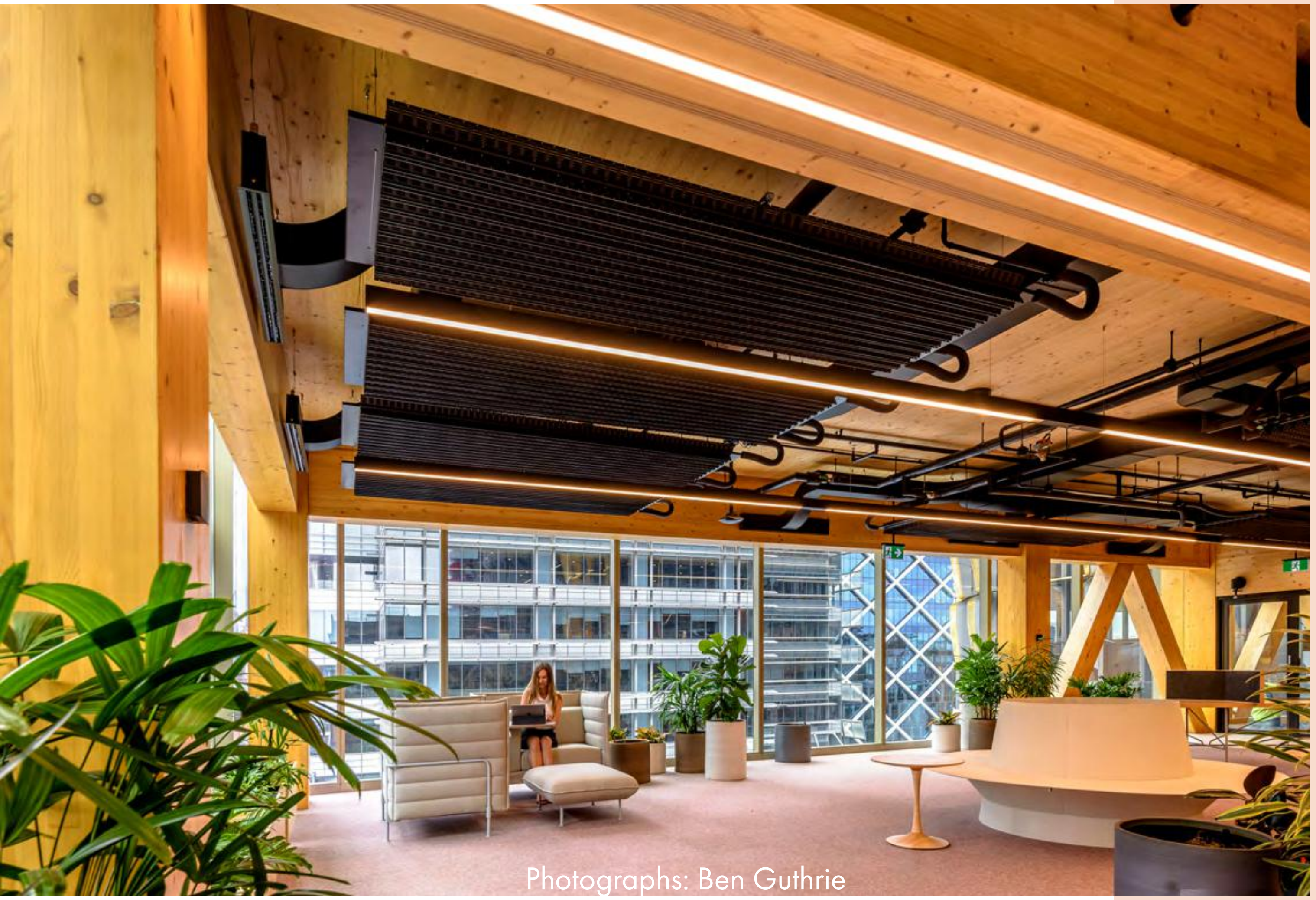
Lambeth Civic Centre - London (UK)

QMC Hospital - Nottingham (UK)

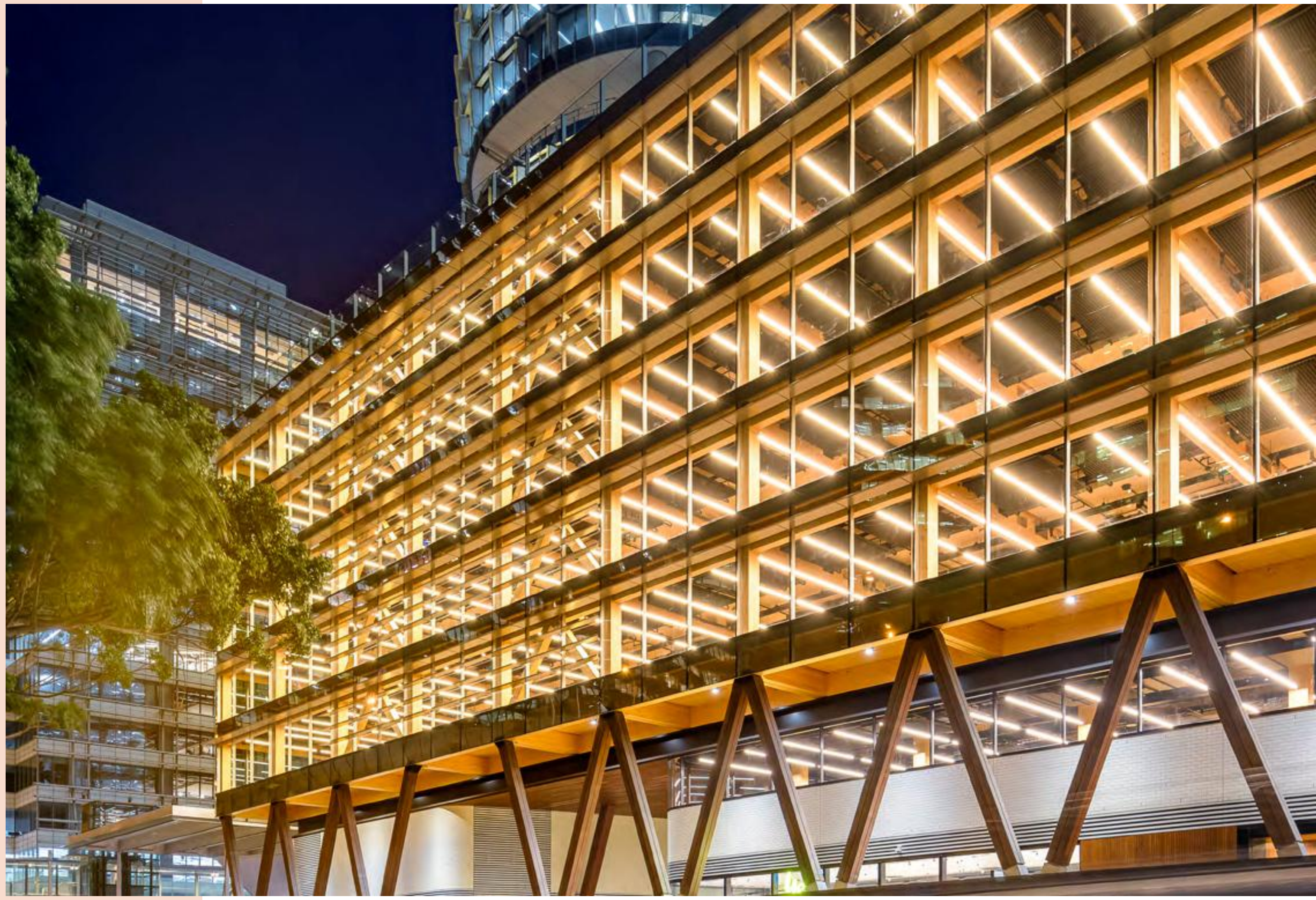
Passive



Chilled Beams

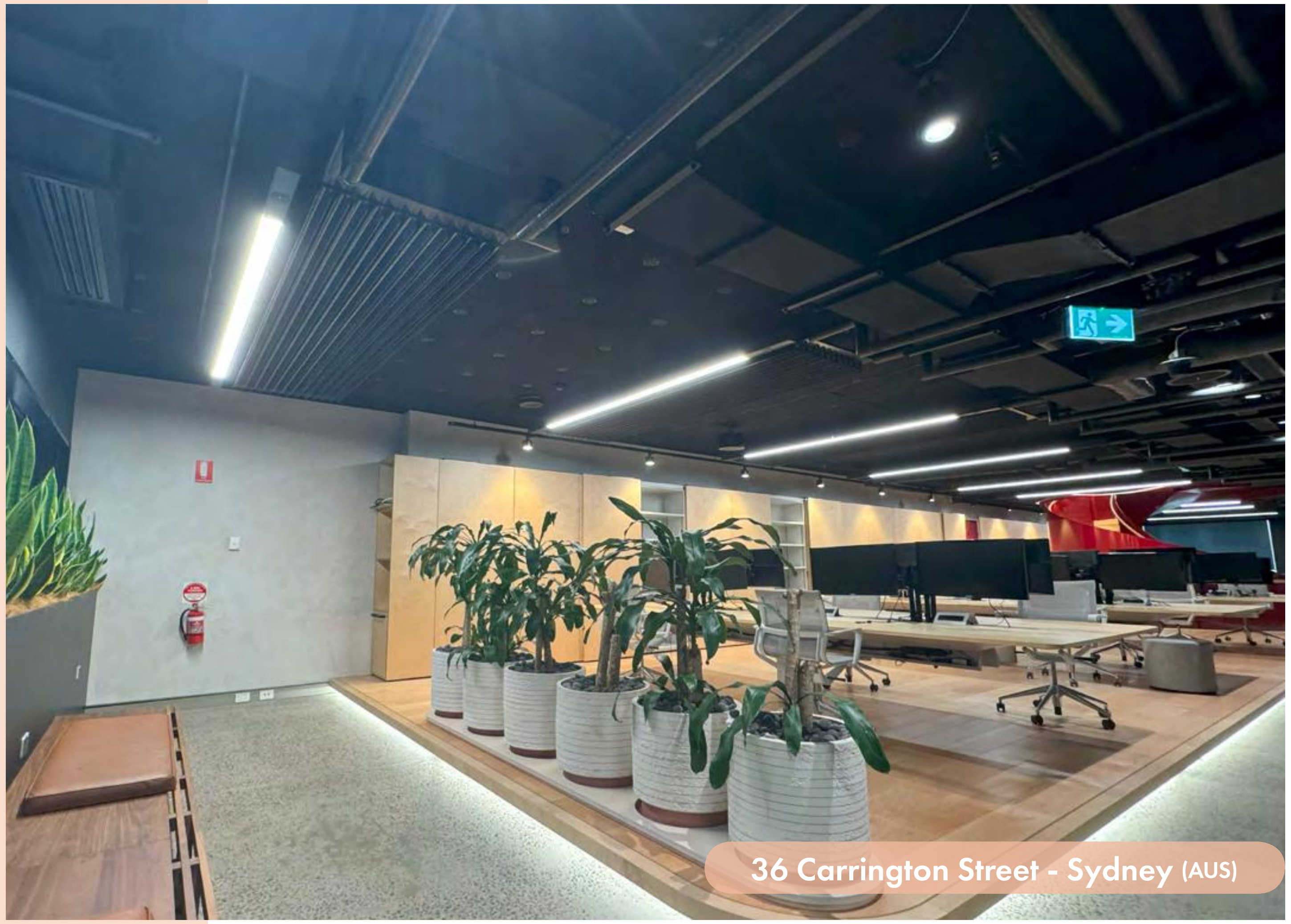


Photographs: Ben Guthrie

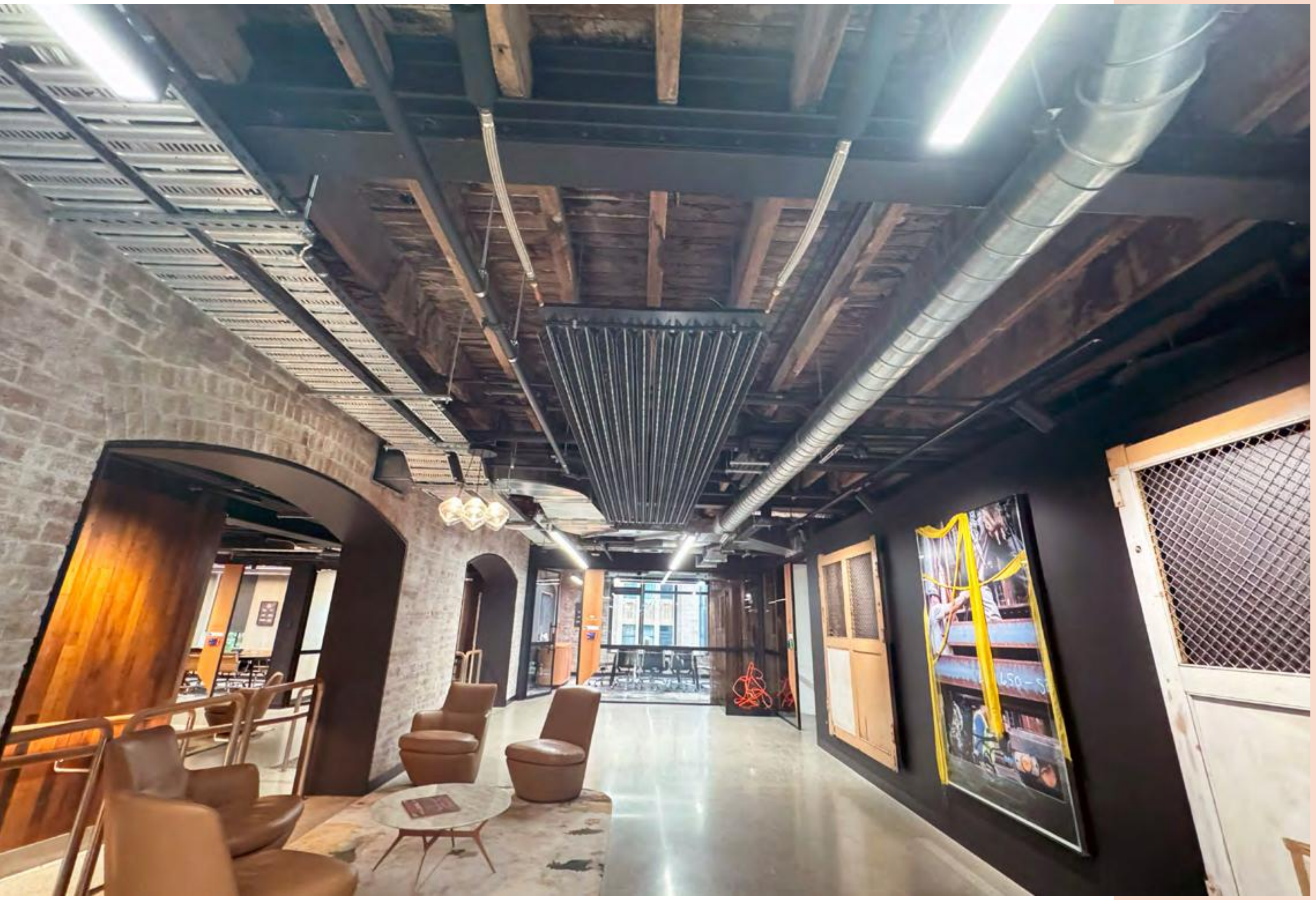


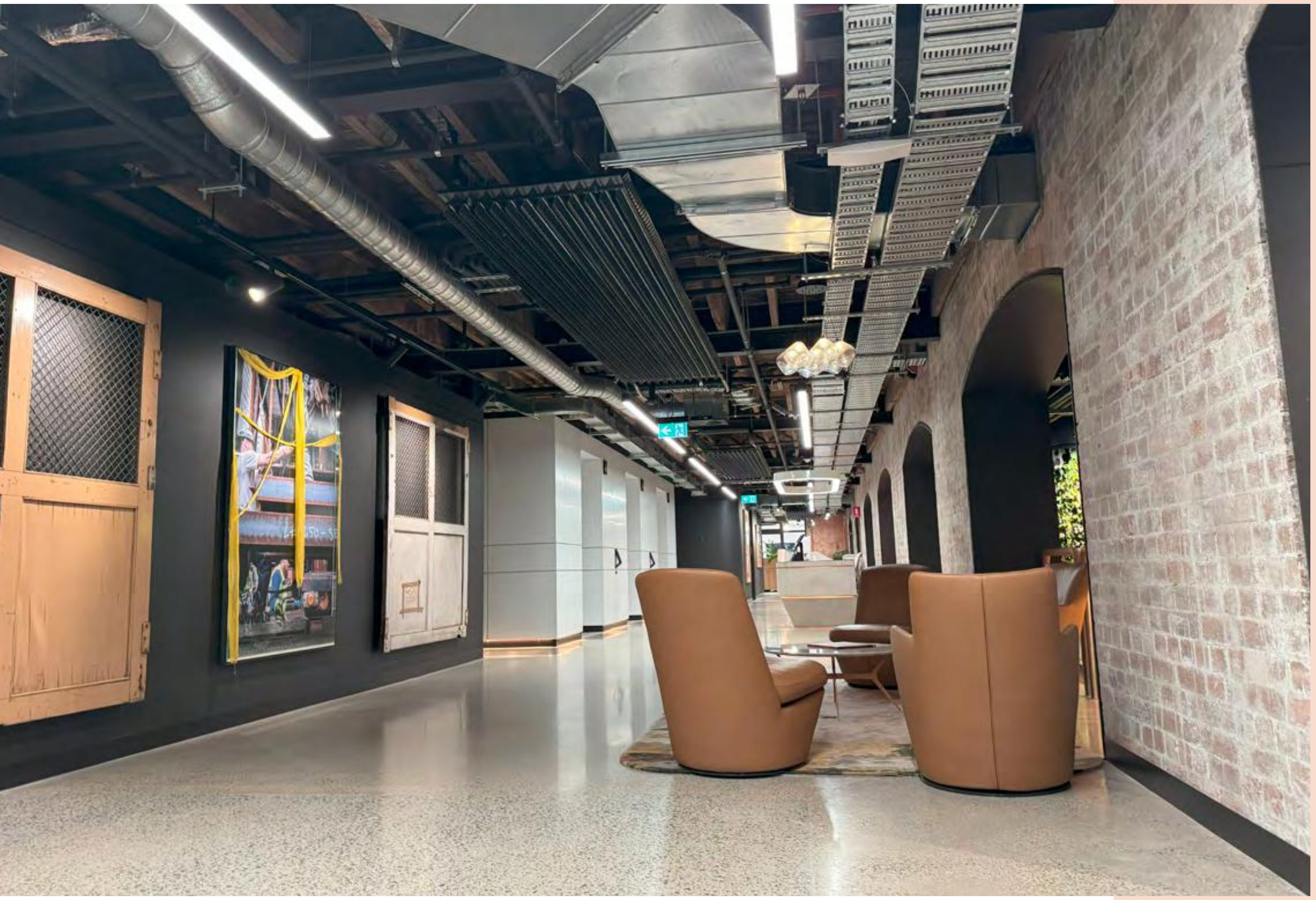
International House, Barangaroo - Sydney (AUS)

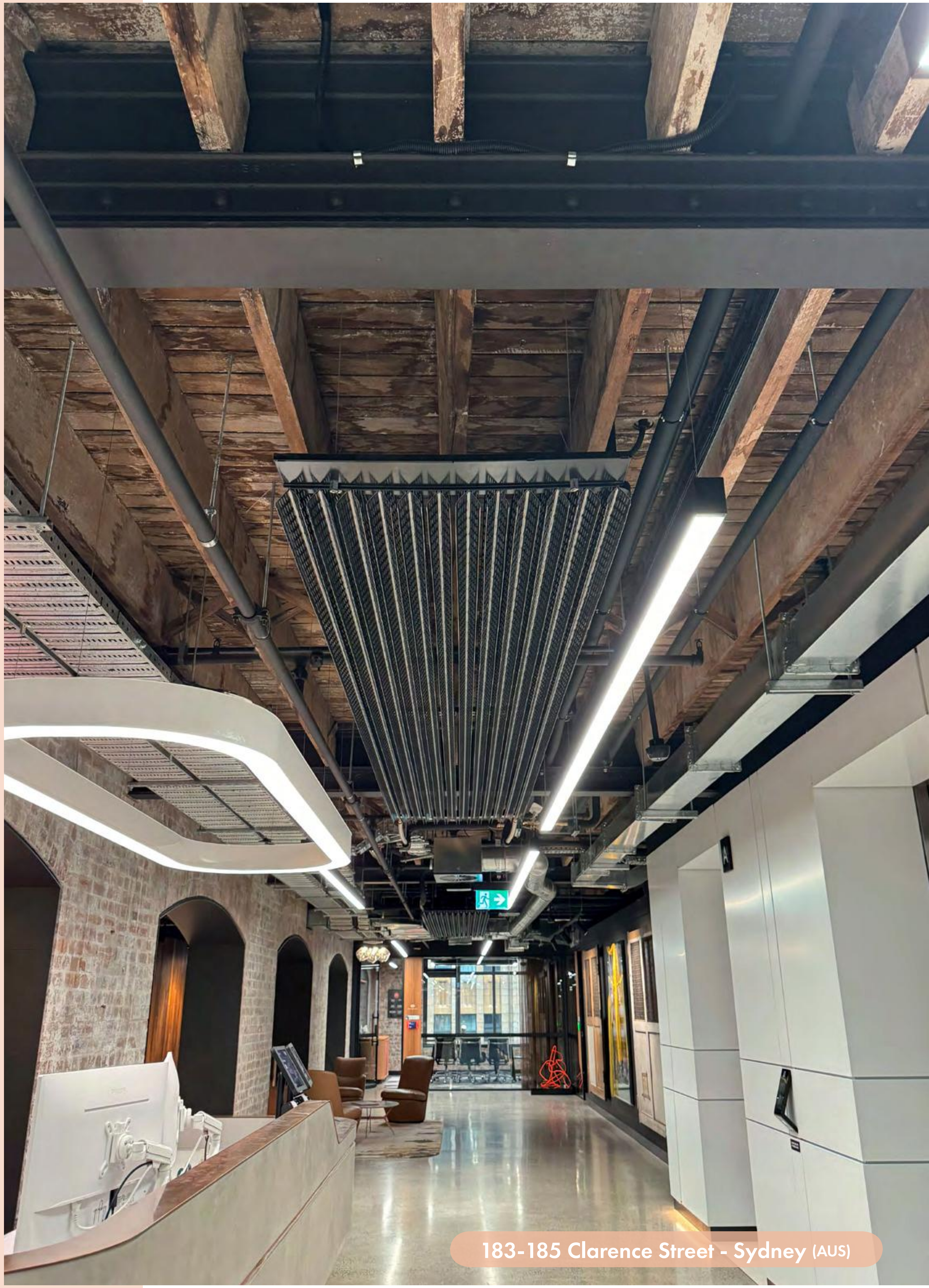
Riverside House - Salford (UK)



36 Carrington Street - Sydney (AUS)







183-185 Clarence Street - Sydney (AUS)

John Medley Building - Melbourne (AUS)

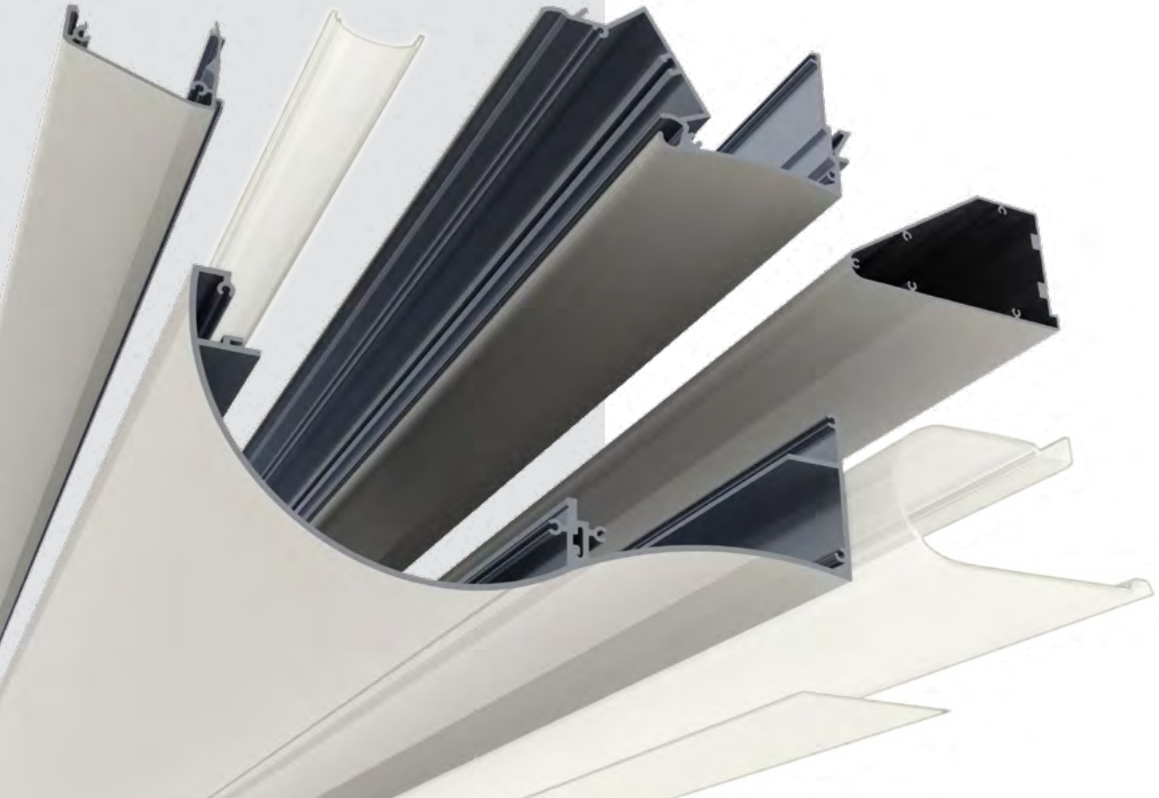
UIUC Siebel Centre - Illinois (US)

Brunel University - Wilfred Brown Building (UK)

Dogger Bank Wind Farm O&M Base - Port of Tyne (UK)

Options

Linear LED Solution with Seamless Polycarbonate 'Bullnose' Diffuser



Multiservice Chilled Beams (MSCB's) offer an alternative to the monolithic ceilings that have become commonplace in office developments, providing attractive yet extremely functional building services installations. The appearance of each beam can be customised in terms of services incorporated, shape, dimensions, colour and perforation pattern to meet the client's particular preferences.

Functions:

- Water Driven Cooling
- Fresh Air Delivery
- L.T.H.W Heating
- Lighting LG7
- Lighting Control PIR/Photocells
- Sprinkler Pipes
- Smoke Detectors
- PA/VA Speakers
- Control Valves
- Acoustic Insulation

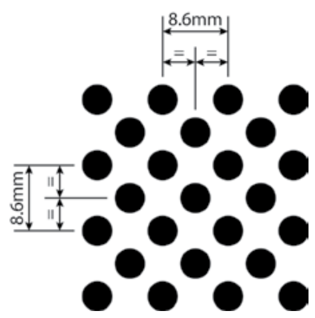
We have a wide range of extruded aluminium side profiles to facilitate various different types of luminaire. We also have a wide range of extruded polycarbonate (fire rated) side profiles which become the lighting optic. More variants of the various aspects of MSCB's are available upon request and any new design requirements can be accommodated.

Symmetric Linear LED Solution with Micro-Linear-Multi-Layered Extruded Aluminium Diffuser

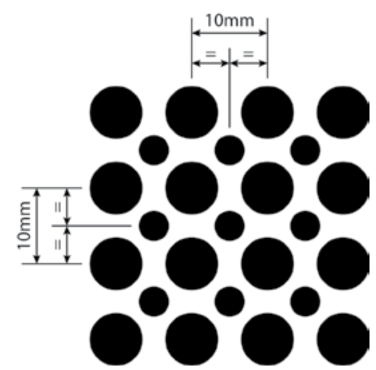
Linear Asymmetric LED Solution with Micro-Linear-Multi-Layered Extruded Aluminium Diffuser

Linear Asymmetric LED Solution with Micro-Linear-Multi-Layered Extruded Aluminium Diffuser

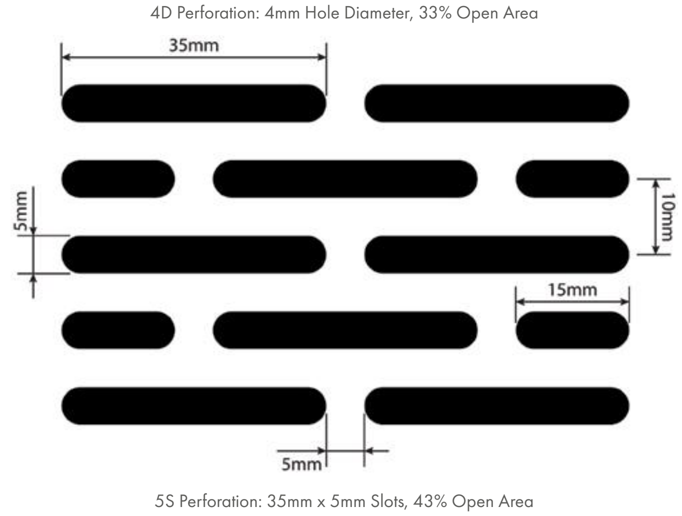
Linear LED Solution with Seamless Polycarbonate 'Square Edged' Diffuser



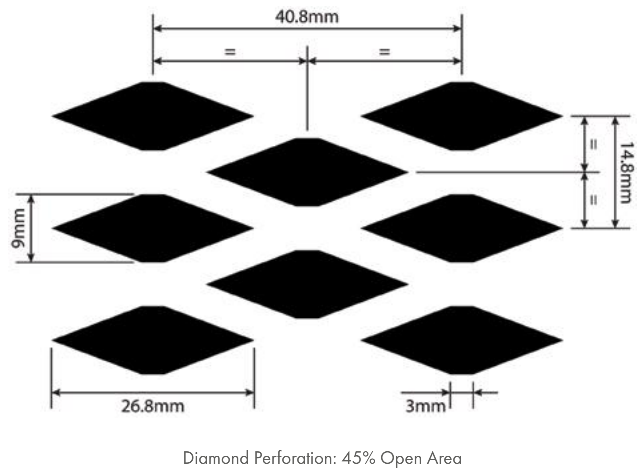
4D Perforation: 4mm Hole Diameter, 33% Open Area



7D Perforation: 7mm & 4mm Hole Diameter, 51% Open Area



5S Perforation: 35mm x 5mm Slots, 43% Open Area



Diamond Perforation: 45% Open Area

Options

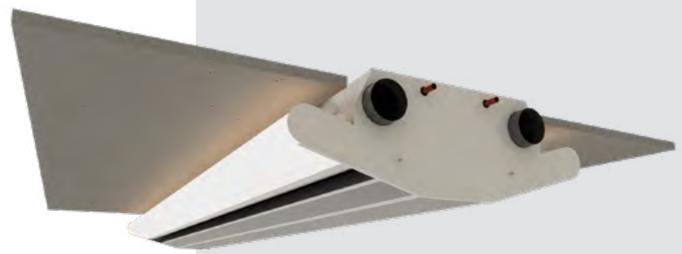
Bullnose Polycarbonate LED Lighting Side Profile with Faceted Underplate

Circular Polycarbonate LED Lighting Side Profile with Curved Underplate

Side LED Lighting Pod with Multi-Layered Prismatic Diffuser

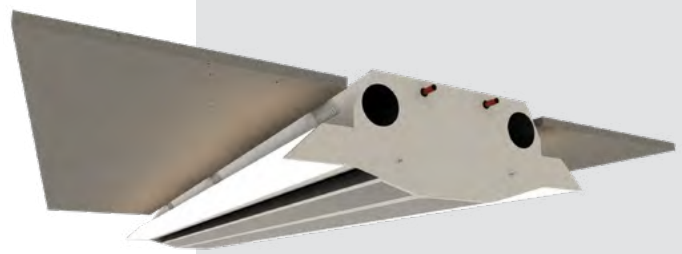
Design Example A.

Design Example B.



Design Example C.

Design Example D.



Design Example E.

Company

Profile

Company

Fenger's Technical Facility and Head Office is predominantly based on the prestigious Pride Park, Derby in the United Kingdom. Frenger has a wealth of experience in the design, development and manufacture of heating and cooling systems dating back some 80 years.

Frenger employs professional project managers, designers, mechanical and electrical engineers; the company has a reputation for delivering complex projects on time, within budget and to specification. To meet architectural expectations Frenger employs in-house 3D computer generated modelling using various different software packages which include Solidworks, Revit and can even produce building fly throughs.

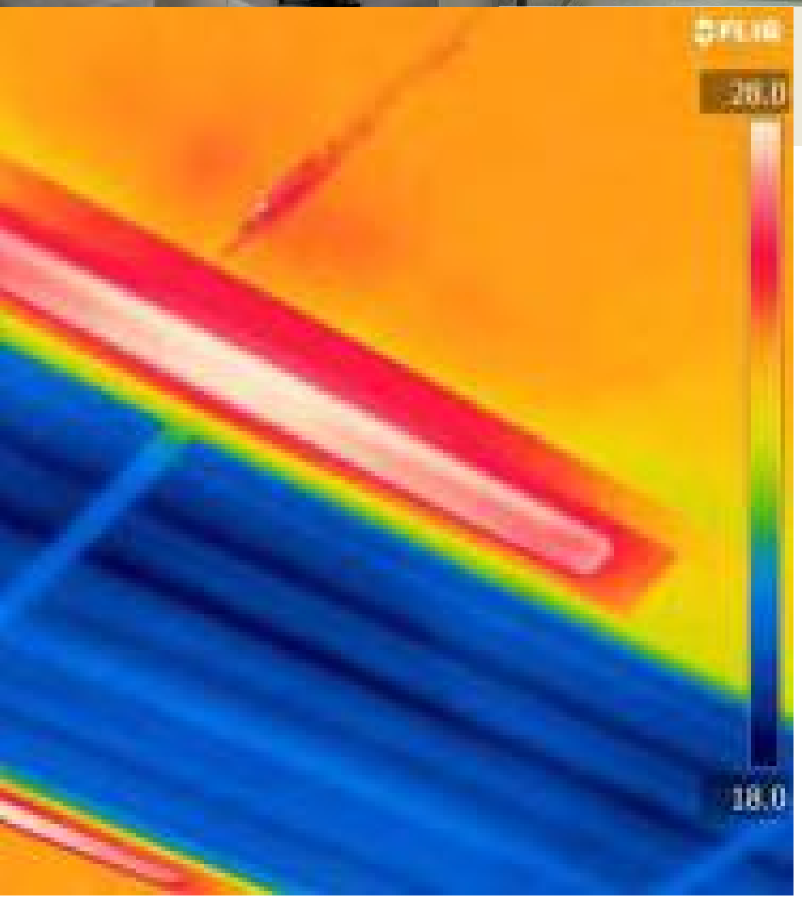
Frenger also model the heating, cooling and lighting performance using various specialist software, but also actual project specific testing in the climatic test laboratories, photometric lighting laboratories and even measure the sound from the product in their acoustic testing laboratory.

Frenger has earned an enviable reputation as a dependable supply partner capable of developing effective space conditioning solutions for the most complex of projects. BIM models of most of our products are available.


3No. Climatic Test Laboratories


2No. Photometric Laboratories


1No. Acoustic Laboratory



In-House Technical Capabilities

Frenger Systems have **three state-of-the-art Climatic Testing Laboratories** at the technical facility situated at the prestigious Pride Park, Derby. Each Laboratory has internal dimensions of 6.3 x 5.7 x 3.2m high and includes a thermal wall so that both core and perimeter zones can be modelled. The test facilities are fixed in overall size and construction therefore simulation of a buildings specific thermal mass cannot be completed, it should, however be noted that a specific project can be simulated more accurately by recessing the floor and reducing the height as necessary.

Frenger also employ the use of cutting edge thermography technology with FLIR® thermal imaging cameras to help determine the best way to improve project specific installations, as well as to further the development of Frenger's spatial conditioning technology.

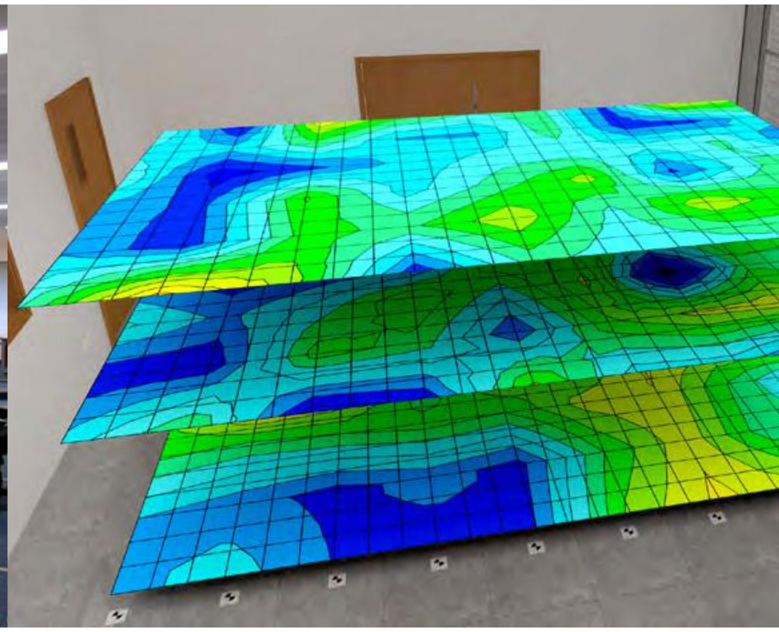
The Frenger Systems technical facility also has **two Photometric Test Laboratories** which are used to evaluate the performance of luminaires. To measure the performance, it is necessary to obtain values of light intensity distribution from the luminaire. These light intensity distributions are used to mathematically model the lighting distribution envelope of a particular luminaire. This distribution along with the luminaires efficacy allows for the generation of a digital distribution that is the basis of the usual industry standard electronic file format.

The **Acoustic Test Room at the Frenger Systems Technical Facility** is a hemi-anechoic chamber which utilises sound absorbing acoustic foam material in the shape of wedges to provide an echo free zone for acoustic measurement; the height of the acoustic foam wedges has a direct relationship with the maximum absorption frequency, hence Frenger had the wedges specifically designed to optimise the sound absorption at the peak frequency normally found with our active chilled beam products.

Project Specific Testing

The 3 number state-of-the-art Climatic Testing Laboratories at Frenger's technical facility in Derby (UK) have internal dimensions of 6.3m (L) x 5.7m (W) x 3.3m (H) high and includes a thermal wall so that both internal and perimeter zones can be simulated. Project specific testing validates product / solution performance (outputs) and resultant Room Comfort Conditions for compliance category grading in accordance with BS EN ISO 7730. All of Frenger's chilled beams have also been independently tested and certified by Eurovent in terms of product performance (output), as Eurovent can not test for thermal comfort; hence the need for Frenger's own laboratories.

Project specific mock-up testing is a valuable tool which allows the Client to fully assess the proposed system and determine the resulting room occupancy Thermal Comfort conditions. The physical modelling is achieved by installing a full scale representation of a building zone complete with internal & external heat gains (Lighting, Small Power, Occupancy & Solar Gains).



The installed mock-up enables the client to verify the following:

- Product performance under project specific conditions.
- Spatial air temperature distribution.
- Spatial air velocities.
- Experience thermal comfort.
- Project specific aesthetics.
- Experience lighting levels (where relevant).
- Investigate the specific design and allow the system to be optimised.

The project-specific installation and test is normally conducted to verify:

Product capacity under design conditions.

Comfort levels

- air temperature distribution.
- thermal stratification.
- draft risk.
- radiant temperature analysis.

- Smoke test video illustrating air movement.
- Live Thermal Imaging

Photometric Testing Facility

The in-house Photometric test laboratories at Frenger are used to evaluate the performance of luminaires. To measure the performance, it is necessary to obtain values of light intensity distribution from the luminaire. These light intensity distributions are used to mathematically model the lighting distribution envelope of a particular luminaire. This distribution along with the luminaires efficacy allows for the generation of a digital distribution that is the basis of the usual industry standard electronic file format. In order to assess the efficacy of the luminaire it is a requirement to compare the performance of the luminaire against either a calibrated light source for absolute output or against the "bare" light source for a relative performance ratio.

The industry uses both methods. Generally absolute lumen outputs are used for solid state lighting sources and relative lighting output ratios (LOR) are used for the more traditional sources. Where the LOR method is chosen then published Lamp manufacturer's data is used to calculate actual lighting levels in a scheme and for LED light source the integration chamber is used to measure LED luminance efficacy.

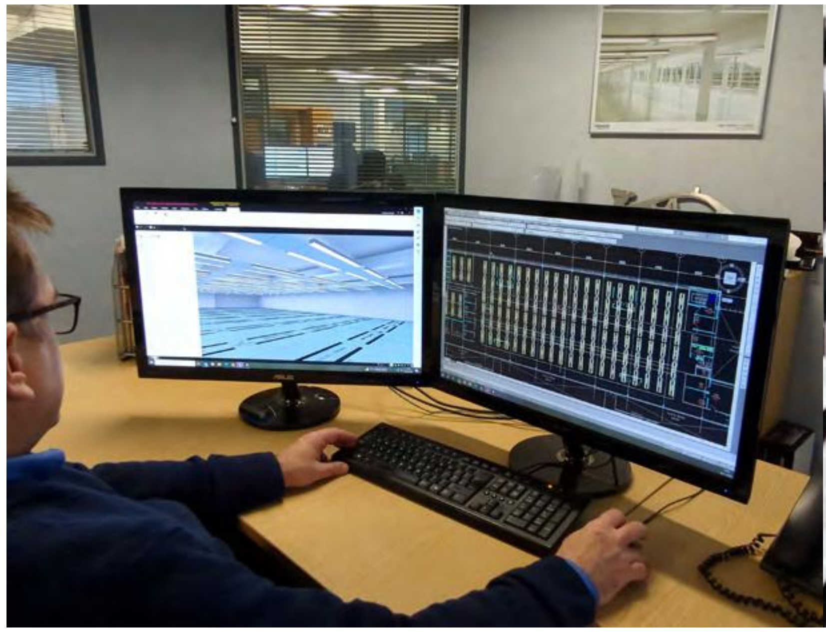
The intensity distribution is obtained by the use of a Goniophotometer to measure the intensity of light emitted from the surface of the fitting at pre-determined angles. The light intensity is measured using either a photometer with a corrective spectral response filter to match the CIE standard observer curves or our spectrometer for LED sources.

Luminaire outputs are measured using our integrating sphere for smaller luminaires or our large integrator room for large fittings and Multi Service Chilled Beams. For both methods we can use traceable calibrated radiant flux standards for absolute comparisons.

All tests use appropriate equipment to measure and control the characteristics of the luminaire and include air temperature measurements, luminaire supply voltage, luminaire current and power. Thermal characteristics of luminaire components can be recorded during the testing process as required.

A full test report is compiled and supplied in "locked" PDF format. Data is collected and correlated using applicable software and is presented electronically to suit, usually in Eulumdat, CIBSE TM14 or IESN standard file format.

Frenger conduct photometric tests in accordance with CIE 127:2007 and BS EN 13032-1 and sound engineering practice as applicable. During the course of these tests suitable temperature measurements of parts of LED's can be recorded. These recorded and plotted temperature distributions can be used to provide feedback and help optimise the light output of solid state light source based luminaires which are often found to be sensitive to junction temperatures.



Acoustic Testing Facility

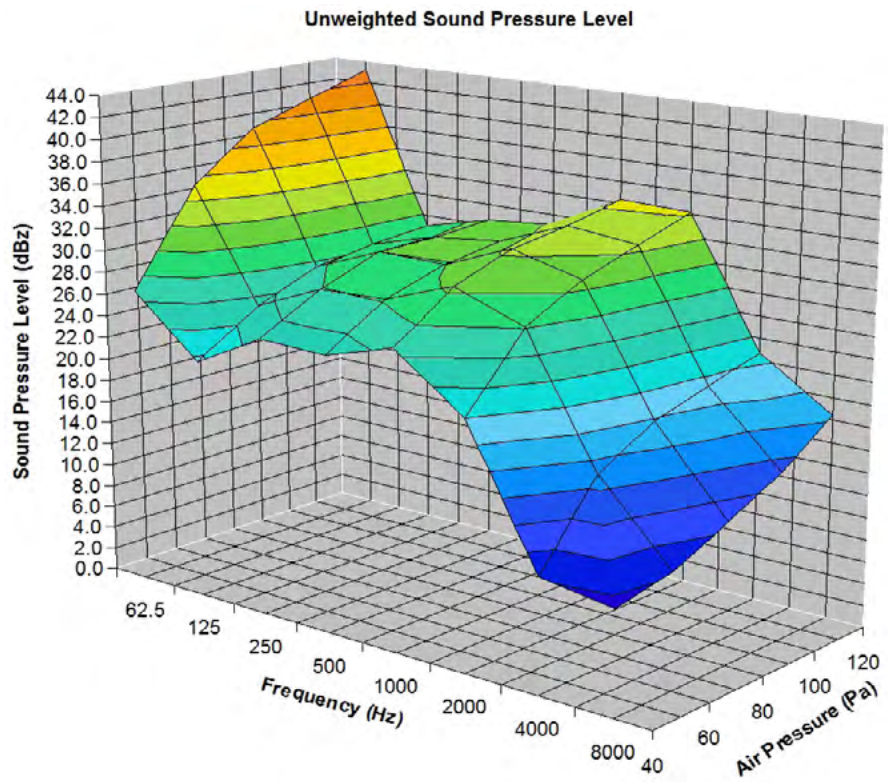
The Acoustic Test Room at Frenger is a hemi-anechoic chamber which utilises sound absorbing acoustic foam material in the shape of wedges to provide an echo free zone for acoustic measurements; the height of the acoustic foam wedge has a direct relationship with the maximum absorption frequency, hence Frenger had the acoustic wedges specifically designed to optimise the sound absorption at the peak frequency normally found with our active chilled beam products.

The use of acoustic absorbing material within the test room provides the simulation of a quiet open space without "reflections" which helps to ensure sound measurements from the sound source are accurate, in addition the acoustic material also helps reduce external noise entering the test room meaning that relatively low levels of sound can be accurately measured.

The acoustic facilities allow Frenger to provide express in-house sound evaluation so that all products, even project specific designs can be quickly and easily assessed and optimised.

To ensure accuracy, Frenger only use Class 1 measurement equipment which allows sound level measurements to be taken at 11 different ⅓ octave bands between 16 Hz to 16 kHz, with A, C and Z (un-weighted) simultaneous weightings.

In addition to the above, Frenger also send their new products to specialist third party Acoustic Testing. The results of which are very close and within measurement tolerances to that of Frenger's in-house measurement of sound.



Design

Capabilities

Design Capabilities

To allow Frenger to stay at the forefront of spatial conditioning technology, it employs the use of a wide variety of design software in-house. These range from 2D and 3D Computer Aided Design (CAD) packages to help with bespoke project design to computational fluid dynamics (CFD) and lighting calculation design programs to allow all aspects of the use of chilled beams to be developed and refined to the highest levels.

The level of expertise Frenger has acquired allows the chilled beams to be designed with the flexibility to suit any project. Using CAD software does not only allow for chilled beams to be sized and configured on a project to project basis, but also allows photo realistic 3D images to be rendered to simulate how the products will look when installed. Collaboration with the climatic testing department lets data obtained in the test labs be realised in a visual medium, making deciphering the data more intuitive.

Software such as Solidworks is used to simulate real-world scenarios, such as stress/strain and bending motions applied to parts of the chilled beams, this enables bespoke designs to be refined prior to testing and reduces the amount of iterations required to create the optimum product. The design software is also used to aid manufacturing and installation, with 2D and 3D representations used to improve accuracy and reduce human error.

CGI Room Renders Inhouse Produced by Frenger

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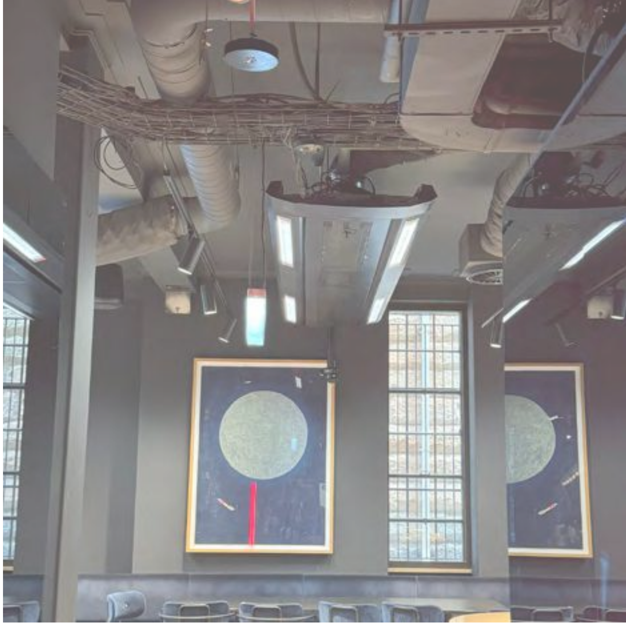
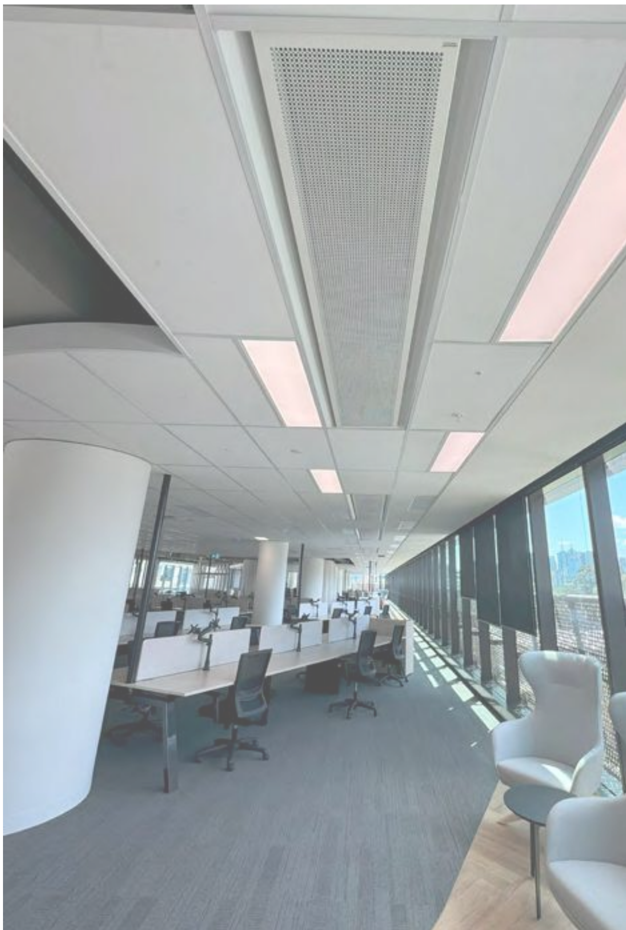
FRENGER systems





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