



# The Built Environment

Designing for people,  
place and planet

## Decarbonising the built environment is crucial in achieving global climate goals and improving the sustainability, efficiency, and health of buildings and communities.

As designers and advisors, we continue to support our client's decarbonisation goals with our deep technical expertise and the creation and delivery of net zero roadmaps that define the changes required at portfolio, asset and operational levels.

By considering the entire lifecycle of buildings and using sustainable design principles that optimise building performance and reduce energy consumption, we shape buildings that are fit for the future – whilst bringing positive outcomes to the people and communities they serve.

We are delighted to share our latest collection of projects that demonstrate how, together with our clients, we strive to deliver greater outcomes to people, place and planet.



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# Designing for people and place

The built environment should balance the needs, aspirations, and experiences of its surrounding communities and people.

By placing people at the centre of the design process, we can create spaces that are functional, safe and enjoyable to use, as well as aligned to the fabric of their surroundings.



# Turning one of the world's greatest libraries into an engine for social value

British Library Extension, London, United Kingdom



The British Library extension creates a new front door for the institution, welcoming a new generation of public participation in line with their Living Knowledge vision. Arup has collaborated on unlocking the project opportunities from the start, making possible a sustainable co-existence of culture, commercial science, rail infrastructure and public realm for community benefit.

New northern entrances open up the British Library, improving accessibility and connection to the local communities and creating inclusive public spaces. Through people-centred design, this once-in-a-generation project will benefit the local community for decades to come.

To boost social value, Arup drew on insights from five years of community engagement and local socio-economic analysis to create a tailored and quantified social value framework.

This includes a social value compact that will encourage future occupiers to promote local jobs, develop skills and raise aspirations of local students through mentoring and workshops and create a subsidised incubator space for creative and socially responsible small businesses.

## Youth

Programme and subsidised adult learning once the extension opens

## Incubator

Spaces, subsidised, for creative and socially responsible businesses

## Workshops

And training to support local people with interview skills, CVs and job applications

This compact will evolve to meet changing local needs, steered by a committee involving local stakeholders and coordinated by a Compact Manager based in the community. The design incorporates incubator space and affordable workspace for creative and socially-responsible small businesses. High-quality space will be opened to the local community, including the foyer of the library, and a Learning Garden incorporated within improved public realm to be managed in partnership with local community organisations.

**“This project ensures we continue to grow as an open, creative and innovative institution at the heart of the Knowledge Quarter, in service to our growing public audiences in London, the rest of the UK and around the world. We look forward to working with local and national stakeholders alike, as our shared vision takes shape over the coming months and years.”**

Roly Keating, Chief Executive of the British Library



# Expanding nature and biodiversity in Central London

Exchange Square, London, United Kingdom



The new 1.5-acre park in Exchange Square quadruples the amount of green space at Broadgate in central London. Spanning over train tracks into one of the UK's busiest stations, British Land appointed Arup to de-risk the project. We identified where the existing suspended structure had enough strength to support mature trees, tens of thousands of plants, lawns, water features and a new retail unit.

This enabled British Land to maximise greenery in the new park, boosting wellbeing for workers and the wider community, without building a new supporting structure.

Strict movement controls were crucial to project success, as high-voltage cables hang from the suspended structure. Through advanced modelling and live monitoring, we kept structural movement within the 25mm limit.

We also coordinated an array of concealed services to run through the park, with power, data and drainage sandwiched between the existing structure and the new park. Today, Exchange Square provides a haven for wellbeing and biodiversity.

“Along with biodiversity and wellbeing, one of the major draws of Exchange Square is that it is a community space, open to all. This is a welcoming, beautiful place designed for accessibility. Whenever I visit, I’m blown away by the quality of design, workmanship and thought that’s gone into the space.”

Georgia Hogg, Asset Manager at British Land

**15 acre**

Park

**420m<sup>2</sup>**

Lawned areas

**£1.5 billion**

Wider investment in Broadgate



# Turning a substation into a giant public artwork

Brent Cross Town substation, London, United Kingdom



**21 meters**  
in height

**52 meters**  
in length

**6,700**  
New homes and 3m sq ft of offices  
will be powered by the new substation

**6 million**  
People will see the artwork  
every year

Brent Cross Town's substation equally prioritises environmental, social and economic factors – driving sustainable development. It will be critical to realising Brent Cross Town's ambition to be net zero carbon by 2030, providing clean power for 6,700 new homes, as well as offices, retail and leisure spaces. A colourful 'wrap' around the substation makes it a major piece of art and exciting new landmark. This is the first of many projects that Arup is supporting across Brent Cross Town, as a long-term partner to Related Argent.

We used circular economy principles to deliver a net zero substation, choosing materials based on their carbon impact, reusing materials and reducing waste. The lean structure is made of around 50% salvaged steel and low carbon concrete, including Earth Friendly Concrete (cement-free).

Located in the open air, it benefits from natural ventilation and is surrounded by native tree planting and wildflower meadows, enhancing biodiversity. Brent Cross Town plans to source all electricity it has control over from 100% renewable sources.

**Boosting social value, the substation is wrapped in a giant public artwork bearing the phrase 'Here we come, Here we rise and shine'.**

At its tallest, the artwork is taller than the Angel of the North, rising 21 metres high and stretching 52 metres long. In a prominent location, it creates a new gateway to London. As many as six million people will see the work every year as they pass it by rail and road. The substation was designed by architectural practice IF\_DO and local artist Lakwena, with Arup as lead designer.

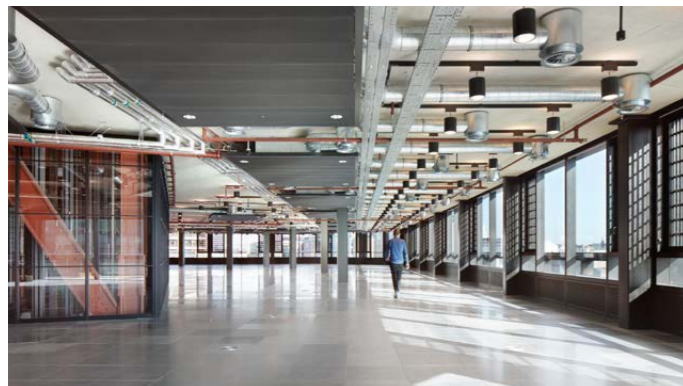
**“The primary substation is key to ensuring Brent Cross Town achieves its pledge to be carbon neutral by 2030, while collaborating with a local artist on the design will also add to the vibrancy of Barnet's new park town.”**

Councillor Daniel Thomas, Leader of Barnet Council



# Creating a vibrant mix of offices, retail and a new theatre above busy rail lines

Soho Place, London, United Kingdom



## 15 year

Collaboration

## 10%

More lettable space

## New theatre

First new West End theatre in over 50 years

Soho Place is a 285,000 sq ft mixed use development on London's Oxford Street. Located above a new Crossrail station and busy Underground lines into Tottenham Court Road station, it provides new public realm, the first new West End theatre in over 50 years, offices and retail space.

Working closely with Crossrail and London Underground over 15 years, we steered changes to station design, moving infrastructure below ground to add 28,000 sq ft of lettable space above ground.

1 Soho Place, which provides 192,400 sq ft of office and 33,000 sq ft premium retail space, achieved BREEAM Outstanding and LEED Gold. It features low carbon systems such as 115m<sup>2</sup> of photovoltaics, mixed-mode ventilation, with openable windows for natural ventilation, and enhanced sub-metering.

Extensive off-site construction reduced waste, cut carbon, saved time, and provided 'as-finished' materials. The Arup team tracked embodied carbon throughout the design stages, implementing innovative structural concepts into 1 Soho Place and delivering "Building A", Derwent London's lowest embodied carbon new building.

Every aspect was initially digitally engineered, resolving challenges in a simulated environment for a 'right first time' approach on site.

Shielding the theatre against noise and vibrations from busy rail lines below was a major design focus. We developed a 'box within a box' design, so the auditorium is structurally and acoustically independent. This works so well that – even though you need ear defenders in the adjacent Crossrail ventilation shaft – this noise is not audible in the auditorium. We also designed theatre balconies to fold away into the wall, allowing the auditorium to offer six seating configurations – unique in the West End – all with outstanding sightlines from every seat.

**One of Derwent London's most technically challenging projects ever, they turned to Arup for the engineering design. Together, we prioritised environmental, social and economic outcomes – driving sustainable development.**



# A holistic response to designing low carbon buildings

One Wood Crescent, Television Centre, London, United Kingdom



## BREEAM

Excellent

## Client's

Lowest embodied carbon new build

## 1.7m sq ft

A new neighbourhood for London

One Wood Crescent is a new nine-storey commercial office building on the edge of Hammersmith Park at Television Centre in White City, where Stanhope is creating a 1.7 million sq ft neighbourhood for London. Previously home to the BBC, the 14-acre site provides offices, homes, television studios, restaurants, a cinema and hotel.

Stanhope appointed Arup right at the start, from initial feasibility through to multidisciplinary engineering and sustainability design on individual buildings and across the masterplan – integrating best-practice thinking and innovation to successfully create a vibrant new district for London.

One Wood Crescent is Stanhope's lowest embodied carbon new build, exceeding current Greater London Authority's aspirational targets.

Our multidisciplinary engineering team led this achievement by taking a holistic approach to integrated design, reducing basement volume and material use.

Thanks to this integration we delivered the optimal, leanest possible solution to each individual building element – fire engineering the structural columns saved 24t CO<sub>2</sub>e and eliminating requirements for supporting structure saved 84t CO<sub>2</sub>e. This allowed us to meet Stanhope's aspirations of a low carbon building whilst informing the building's architectural language by minimising perimeter structure, maximising daylight into the floorplate and allowing exposed structure to be expressed.

Plot D is aligned with UKGBC trajectory to Net Zero for both embodied and operational carbon. The BREEAM Excellent building has many environmental features – individual buildings plug into the site-wide infrastructure which maximises Television Centre's heating efficiency and reduces MEP plant embodied carbon.

Overlooking Hammersmith Park, offices are light filled, with outdoor terraces for wellbeing, a green roof encouraging biodiversity and first class cycle facilities to support active travel.



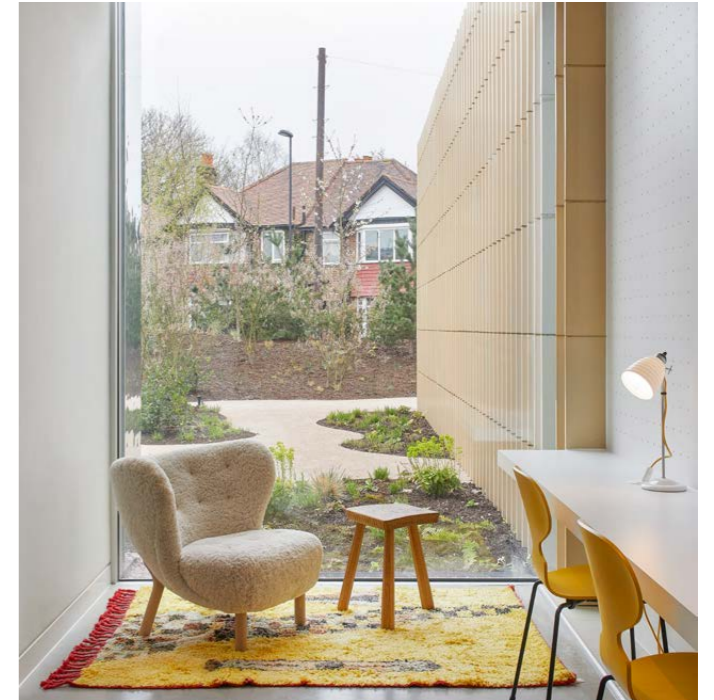
# Transforming a car park into a light-filled cancer support centre

Maggie's Centre, Southampton, United Kingdom



Maggie's Centres support people living with cancer. Located in a vast car park at University Hospital Southampton, the challenge was to turn this concrete landscape into a welcoming oasis. Architect AL\_A imagined a garden transported from the nearby New Forest, through which a glinting, enticing pavilion is glimpsed. We engineered ceramic walls in soft pastel glazing that promote a sense of calm. The ceramics fulfil multiple functions, structurally supporting the timber roof, insulating rooms for warmth and efficiency, acoustically separating spaces and providing lasting finishes to reduce embodied carbon.

Large windows and skylights create light-filled spaces, with views of the garden in all directions. Rooms are naturally ventilated, with passive design to limit solar gains and inclusive design throughout. Everything is organised around a central kitchen, including group spaces, therapy rooms, consultation areas and a library.



Engaging early to benefit end users, input from Maggie's Foundation, with its cancer patients and their networks, shaped the design.



“I have seen first-hand the significant impact Maggie's makes to individuals experiencing a cancer diagnosis. Their beautifully designed centres have an instantly calming effect and the staff are on hand to offer a full range of support.”

Shona Robison, Cabinet Secretary for Health and Sport

**360m<sup>2</sup>**

Warm, supporting spaces

**Inclusive**

Design principles

**Garden**

Views in all directions, with plenty of natural light throughout



# Delivering a new aquatics centre in just three years

Sandwell Aquatics Centre, Birmingham, United Kingdom



## Community

Olympic-sized swimming pool, encouraging an active lifestyle

# 1,000

Permanent spectator seats

Sandwell Aquatics Centre was the only brand-new venue for the Birmingham 2022 Commonwealth Games, hosting exciting swimming and diving events. Opening to the public as a community leisure facility in summer 2023, it will give Sandwell's residents access to one of the best aquatic centres in the UK.

**Arup completed the multi-disciplinary engineering design to create a venue not only for international swimming and diving competitions, but also for community, leisure, health and wellbeing.**

Permanent facilities include a 50m Olympic-sized swimming pool, 25m diving pool, 1,000 spectator seats, studio pool, 108-station gym, 25-station ladies-only gym, dry-dive centre, activity studios, sports halls and a café, plus a new park and play area.

The facility went from design to completion in just three years, ready for the Games. This is much faster than comparable schemes, which typically take five to six years. To leave a lasting sporting legacy, our engineers supported complex construction phasing, allowing the building to adapt for community use after the Games.

The pool uses significantly less energy than older Olympic-sized pools in the UK, thanks to fabric-first principles minimising heat loss. High efficiency systems and a PV array on the roof reduce the residual regulated energy by 10%, in line with the Black Country core strategy.

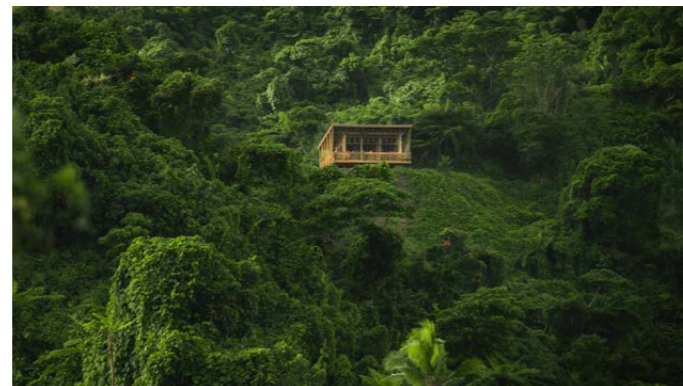
**“The Sandwell Aquatics Centre has the potential to inspire a whole region of people to try new sports, activities and connect with one another. The centre has the potential to create a long-lasting legacy which will motivate generations of citizens to keep active, enjoy exercise or even light the flame to move into elite sports, representing their region or country.”**

Alice Dearing, Tokyo 2020 Olympian and Co-founder of the Black Swimming Association



# Boosting tourism and generating lasting income for a local Fiji community

Urata Lookout Café, Savusavu, Vanua Levu, Fiji



Located at a popular view point, the Lookout Café is generating sustained income for the Urata Village Community. Designed and constructed with local people, it features a large veranda, plenty of seating, kitchen space, public toilets and a private caretaker's residence.

Arup engineered the structural frame using local materials and joined a team of international and local volunteers to build the café. Being on site meant we could quickly revise designs as issues arose – from adjusting the frame for uneven timber beams, to resizing foundations so they could be poured in a single day. This allowed construction to complete in only eight weeks.

As well as providing jobs and rental income for Urata, the café is one of only two cyclone-resistant buildings in the area. It is our third social project with young architectural practice CAUKIN Studio.

## 8 week

Construction programme

## Developing

Local skills for future projects

## 30 local

Community members, alongside 25 international participants, built the café



### Our experience in Urata

Sophie Jones, Andrew Whinney

We were lucky enough to be able to live with the villagers during our time on site, the most generous and patient families.

To put the project into context, there is a church in the village which is a two-storey concrete block structure which took 11 years to build due to funding, materials and natural disasters. We could not have estimated the sense of pride the locals felt due to knowing they were involved in the construction of the Lookout Café.

There was a real sense of belief and pride in the community that this project was going to be the start of a change in the village, allowing them to earn an income to put into future projects.



An aerial photograph of a city skyline at sunset. The sky is filled with dramatic, orange and purple clouds. In the foreground, there are several large, multi-story buildings, some with balconies. In the middle ground, a dense cluster of skyscrapers rises, including a prominent, tall, dark tower under construction. The background shows a range of mountains under a hazy sky. A large, semi-transparent red circle is overlaid on the left side of the image, containing white text.

# Decarbonising buildings

Decarbonising the built environment is a critical step in mitigating the impact of climate change.

Arup continues to use sustainable design principles and deep technical expertise to create energy-efficient buildings that have low carbon footprints. This includes appropriate and optimal material usage, renewable energy systems, and passive design strategies into projects.



# Engineering one of the UK's most sustainable office buildings

11 & 12 Wellington Place, Leeds, United Kingdom



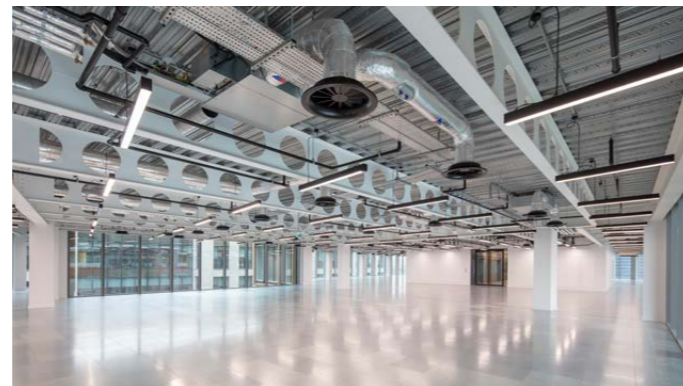
11 & 12 Wellington Place in Leeds offers 254,879 sq ft of BREEAM Outstanding space. As the first building outside London – and only the fourth in the UK – to achieve a NABERS UK Design for Performance 5\* rating, it sets a new benchmark for sustainable development.

Working closely with the architect TP Bennett and contractor Wates, we created the most energy-efficient office building in Leeds. At only 43kWh/m<sup>2</sup>, it is 41% ahead of average offices and 22% ahead of the UKGBC 2035 target. The fully electric building features high-performance façades, reversible air source heat pumps, a smart energy management system and 700m<sup>2</sup> of photovoltaics generating energy equivalent to powering 42 homes. 100% of energy will come from renewable sources, meeting the UKGBC standard for net zero carbon in operation.

“As the latest additions to the neighbourhood, 11 & 12 Wellington Place are setting the benchmark for future-proofed, sustainable development in the UK. We’re incredibly proud to have the first NABERS Design for Performance Design Reviewed Target Rating of Five Stars outside London. Securing this rating has required a collaborative approach and a real team effort.

Paul Pavia, Head of Development at MEPC

Arup led on both NABERS and building systems engineering – our eighth building at MEPC’s Wellington Place. It will also become Arup's Leeds home in late 2023.



**100%**  
Renewable energy

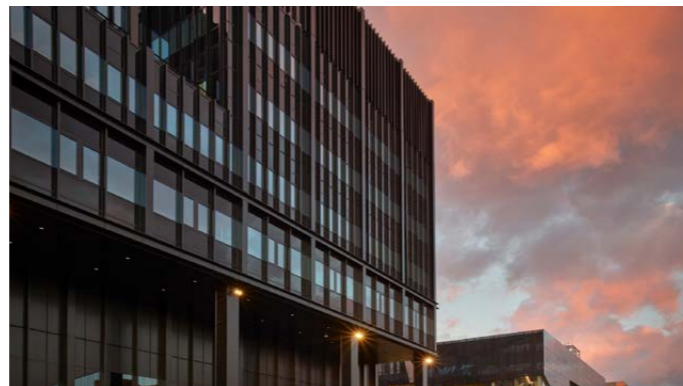
**5\* NABERS**  
UK rating

**700m<sup>2</sup>**  
Photovoltaics



# Creating an energy-efficient campus for global engineers and scientists

Manchester Engineering Campus Development, Manchester, United Kingdom



Both the largest home for engineering in any UK university and the largest construction project ever completed by a higher education institution within the country, the Manchester Engineering Campus Development (MECD) unites four engineering and material science departments into one coherent facility, helping the University of Manchester achieve its goal of becoming one of the top 25 research universities in the world. Arup has been advising on the campus since 2014 and have been retained throughout the entire project including post-occupancy support.

Bringing the University closer to its commitment to be net zero carbon by 2038, MECD has 50% lower predicted energy use than the existing buildings it replaces and 40% lower carbon emissions.

High-performance façades, natural ventilation and a mixed-mode solution at scale reduces energy demand in a fabric-first approach which will maximise energy and carbon savings in the long term. Testing many scenarios, we substantially optimised and reduced embodied carbon within the building structure and foundations, providing stringent performance requirements for vibration and the University's future adaptability and flexibility requirements. Some 97% of deconstruction materials were recovered for reuse. Smart use of space reduced the floor area needed for technical spaces by 40% versus existing facilities.



MECD is an exemplar of our 'total design' ethos. Collaboration with the contractor during detailed design allowed for the off-site manufacture of 1,500 MEP services modules, leading to a direct reduction in carbon during the construction stage.

**9,000**

Students, inventors, researchers, scientists and engineering experts

**19,000m<sup>2</sup>**

Lab space – including the UK's largest multipurpose high-voltage lab

**75,000m<sup>2</sup>**

Modern facilities



# Designing a slender tower that responds to seismic conditions and typhoon winds

Fubon A25 Xinyi Tower, Taipei, Taiwan



This slender 54-storey tower provides offices and a rooftop events area, alongside retail space, public gardens and a museum of contemporary and modern art. Arup worked closely with Renzo Piano Building Workshop and Kris Yao Artech to shape the competition-winning design, achieving the client's ambitions and setting new sustainability standards for Taiwan.

An active façade with automated blinds was designed to protect occupants from the heat of the Taipei sun, improving energy performance, opening up views and allowing natural light to flow in, which is a step change in the local market.

Other low carbon technologies in the fully electric building include thermal ice storage, which will reduce peak electricity use and improve cooling efficiency by 10%. The tower achieved Taiwanese Green Building Certification (EEWH) Gold and Leadership in Energy and Environmental Design (LEED) Gold.

Fubon A25 Xinyi Tower has exceptional seismic and typhoon resistance. Technical innovations include the world's largest buckling restrained braces configured to distribute foundation demands and tapering perimeter columns that respond to load variations at height. Using wind-seismic interaction analyses, we sculpted the tower corners to reduce mass. We made our research available to help others cut carbon and build efficiently in seismic and typhoon exposed areas.



Through a strategic and collaborative structural design approach, we reduced structural steel by a third versus the best local benchmarks, saving 23,500 tonnes of carbon and substantial costs.

**1/3 less**

Structural steel than the best local benchmarks

**2,000m<sup>2</sup>**

Contemporary and modern art galleries

**92,000m<sup>2</sup>**

Office space



# ESG, from vision and strategy through to delivered reality

CO—RE ESG Strategy, London, United Kingdom



Over the past 20 years, development management specialist CO—RE has advised on over 12.5 million sq ft with an investment value of over £10 billion. The business therefore identified a need for an ESG Strategy to sit across its business.

Arup supported them by developing an ESG strategy and objectives for their corporate and project activities, providing transparency on current/forecast performance and identifying key ESG risks and opportunities, we are helping CO—RE move projects closer to net zero carbon, improve the wellbeing of building users and add social value for communities.

CO—RE's new ESG strategy empowers design teams to deliver the right solutions for each project and encourages innovation through collaboration. It offers flexibility across diverse projects, supporting the aspirations of CO—RE as well as its clients. Regular reviews and updates are built-in, to drive continual improvement.



Having launched the new strategy, we are now collaborating with CO—RE's development managers and project supply chains to implement ESG monitoring against the new strategy on all projects.

**£10bn**

CO—RE's Investment value

**12.5m**

Sq ft of real estate advisory over 20 years

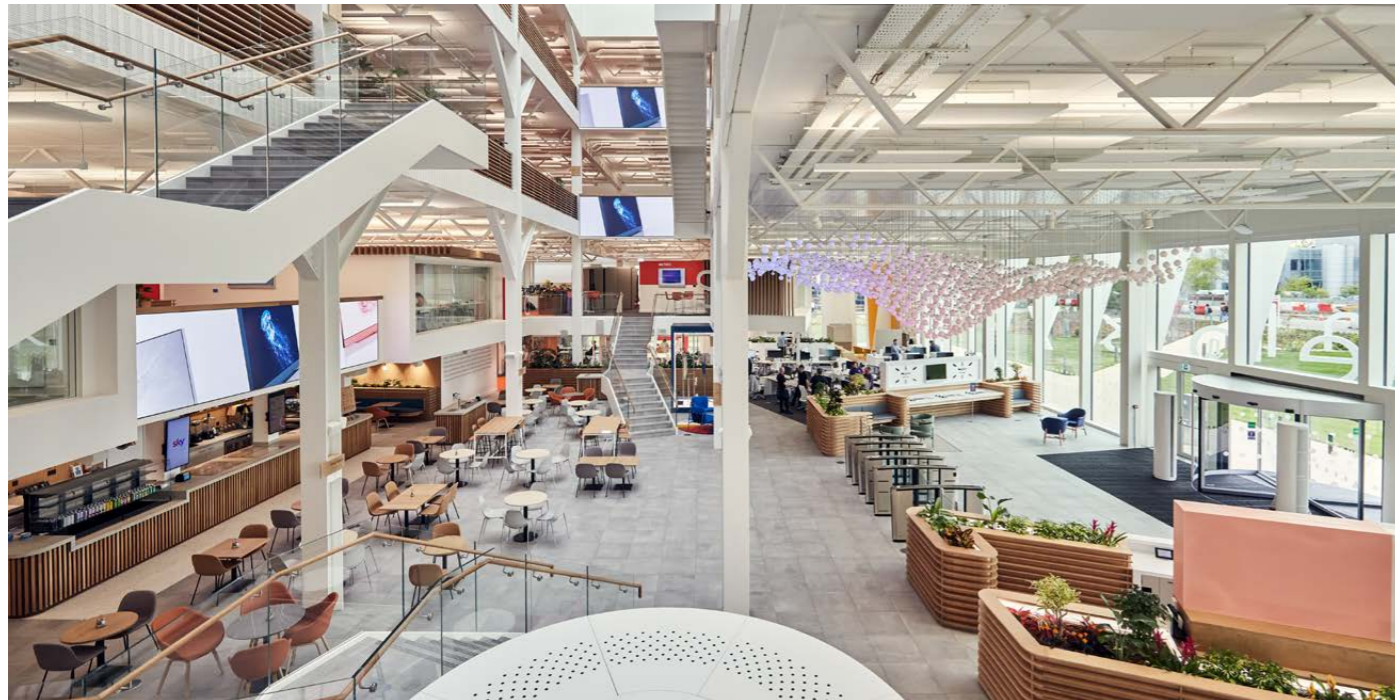
**ESG**

Performance transparency to identify opportunities and risks



# Creating a new Innovation Centre for Sky's inventive minds

Sky Innovation Centre and the Pavilion Restaurant, London, United Kingdom



Collaborating to achieve Sky's goals since 2005, Arup provided multidisciplinary services for both the new Innovation Centre and the new Pavilion Restaurant at Sky's Osterley campus.

The three-storey Innovation Centre is designed to create a new space where Sky's most inventive, forward-thinking minds can come together to match customer insight with rapidly changing technology requirements. By creating this shared space and working across the customer value chain, Sky will enhance its ability to meet its customer's needs. The Pavilion Restaurant serves the entire campus, home to over 8,000 staff.

We reduced structural embodied carbon by 22% in the Innovation Centre and 38% in the Pavilion, through lean design and sustainable materials. With over 470m<sup>2</sup> of photovoltaic panels, the highly efficient buildings are also ahead of UKGBC 2025 targets. These advances contributed to the Innovation Centre's BREEAM Outstanding rating.

Designed to inspire Sky colleagues and promote wellbeing, both buildings achieved WELL Platinum. Light-filled workspaces offer diverse areas for collaborative and solo working.

The beautiful timber restaurant features a central rooflight, openable glazed façades and a living wall. Extensive planting and landscaping provide spaces for socialising and relaxation.

Supporting Sky's commitment to transition to net zero by 2030, the operational energy will be 46% better than Part L baseline, Operational efficiency studies have also helped to identify ways to minimise energy in use, target energy intensities close to UKGBC 2030 targets.

**470m<sup>2</sup>**

Photovoltaic panels

**8,000**

Campus staff

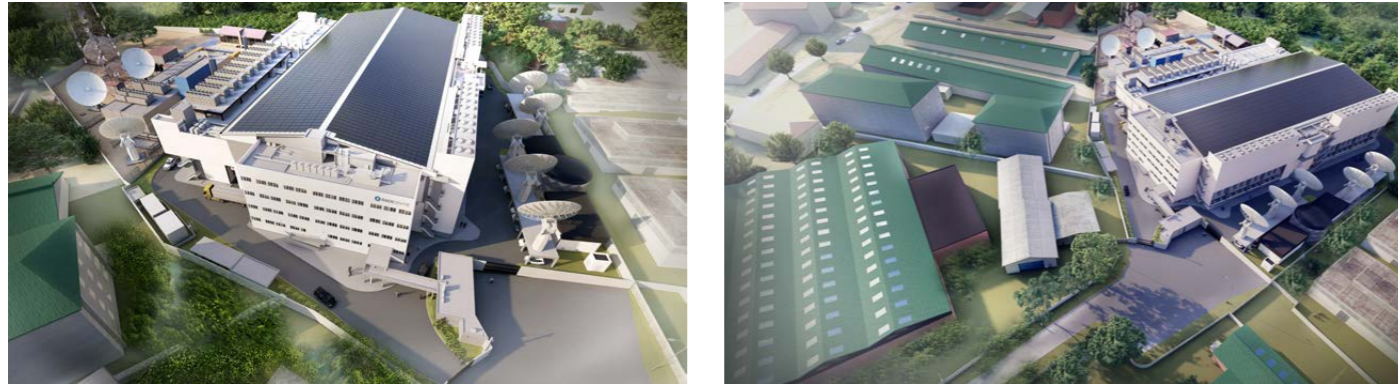
**WELL Platinum**

Promoting staff wellbeing



# Creating the largest and most energy efficient data centre in West Africa

Rack Centre Building Two, Lagos, Nigeria



As a trusted advisor to Rack Centre since 2018, we are designing its latest expansion. This will bring unprecedented carrier-neutral scale to West Africa, increasing IT power capacity from 1.5MW to 13.5MW.

It is the first data centre in Europe, Middle East and Africa to achieve the international EDGE certification for sustainable design. It is forecast to be 35% more energy efficient than the average for regional data centres and to use 41% less water, reducing operating costs and supporting the client's net zero carbon ambitions. Lean design has also reduced embodied carbon by 45%.

“At Rack Centre, we have had a track record of setting the standard for Power Usage Efficiency in the region. Sustainability is at the core of what we do and a quest that permeates through all of our actions. We are delighted to be the first to be certified in Europe, Middle East and Africa.”

Ezekiel Egboye, Rack Centre Chief Operations Officer on EDGE certification

“Meeting Africa's ever-growing demand for critical digital infrastructure must be achieved as sustainably as possible. We are proud to have secured IFC EDGE certification for a data centre in recognition of our work with the team at Rack Centre.”

Kabir Chal, Director in Actis' Africa Real Estate team

## EDGE certified

The first data centre in EMEA

### 35%

More energy efficient than average regional data centres

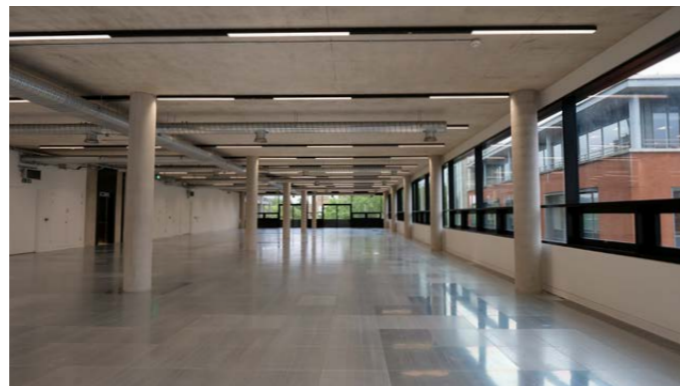
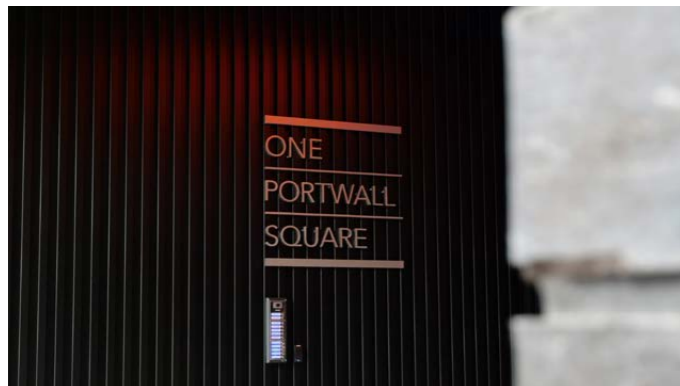
### 45%

Reduction in embodied carbon



# Regenerating a constrained city centre site to deliver vibrant offices

One Portwall Square, Bristol, United Kingdom

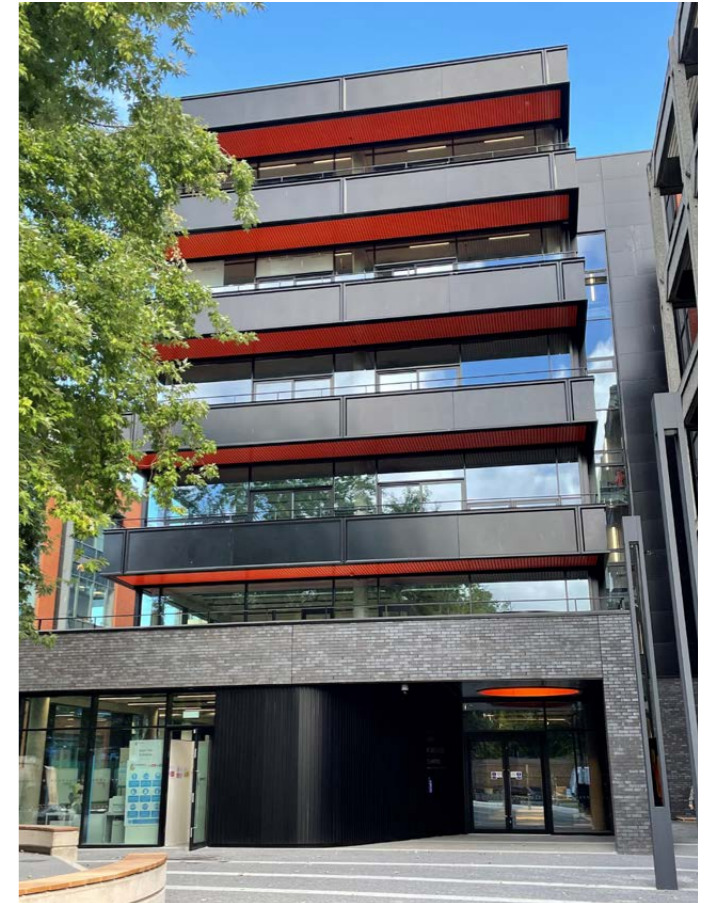


One Portwall Square, located in the heart of Bristol's commercial district, was previously owned by Bristol City Council and included a disused squash court and car parking.

The site, overlooked on the east by Council offices and on the west by another commercial office, was considered undevelopable by others due to its close proximity to the two adjacent buildings and site boundaries. However, rather than shying away from this challenge, close collaboration between the architects and engineers forged a solution that, with meticulous planning, raised the bar in terms of design, occupant comfort, placemaking and sustainability.

We worked closely with Nord and Allford Hall Monaghan Morris to overcome the challenges and create 33,750sq ft of offices with a landscaped square. In a first for Bristol offices, we introduced in-slab cooling, along with rooftop photovoltaics and a combination of natural and on-floor mechanical ventilation. This also increased the lettable space available. Through our technical expertise, the building design includes mixed-mode ventilation which allows 'free running' for nearly six months each year.

Connected to Bristol's district heating network, One Portwall Square will help reduce carbon emissions by 60% compared to Building Regulations 2013, and 25% improvement over 2021 regulations. It is rated BREEAM Excellent and EPC A.



**60m<sup>2</sup>**

Green roof for biodiversity

**40% better**

Energy efficiency than the typical good practice office benchmark

**60% lower**

Operational emissions than Building Regulations



# New approach to building management slashes energy use, maintenance costs and whole life carbon

Southern House, London, United Kingdom



Southern House is a 200,000 sq ft office building in Croydon, home to multiple Government departments. As a trusted advisor to Avison Young, Arup ran a six-month analysis of building systems, finding faults on the system configuration and understanding asset condition from available data.

This also revealed the value of switching to condition-based building management – reducing operational emissions by 18%, saving £100,000 on annual energy and maintenance costs, saving £1.4m on plant replacement over five years, cutting whole life carbon and optimising building performance for occupiers.

Collaborating to achieve our shared decarbonisation goals, we resized building systems. This included introducing 60% smaller electric calorifiers to heat water, allowing gas-fired systems to shut down for four months a year. We proposed streamlined heating systems 33% to 1.8MW, reducing the number of boilers from three to two, and shrank cooling systems by a third to 1.4MW, going from three chillers to two.

When Avison Young implemented our updated maintenance specifications, it reduced maintenance costs by 45%.

**Over 20 configuration faults were discovered within the BMS set up, which led to significant energy savings.**



**900t**

Annual carbon savings

**45%**

Reduction in maintenance costs

**50%**

Lifecycle cost savings over five years





# Reimagining existing buildings

Retrofitting existing buildings is an essential element in the fabric of cities and achieving net zero carbon ambitions, often delivering greater social and commercial value to their nearby communities.

By improving energy efficiency, reducing emissions, and improving the health and comfort of occupants, retrofitting can help create a more sustainable built environment for the future.



# Transforming a former office and exhibition centre into a new headquarters and events centre

City Hall, London, United Kingdom



**50%**

Reduction in carbon emissions

**20%**

Improvement in energy efficiency

**100%**

Green energy tariff

When the Greater London Authority wanted to move into a building they owned, they turned to the engineers Arup to help transform the former office and exhibition centre. Designed for inclusion and accessibility, bright, modern spaces for high-profile events include a 140-seat chamber, 200-capacity event space with views over historic Royal Docks and committee rooms.

Supporting the Mayor of London's net zero carbon goals, the new City Hall is fully electric, with ground source heat pumps, solar renewables, natural ventilation, high-performance façades, low energy lighting and a smart management system. This will reduce running costs, freeing up funds for frontline public services.

Originally engineered by Arup over a decade ago, the former office and exhibition centre was the first building in the world to achieve BREEAM Outstanding and LEED Platinum.

We upgraded and recommissioned systems, analysed/estimated to improve efficiency by 20% and reduce carbon by 50% – ahead of London Plan targets – closing the performance gap to achieve the building's design potential.

It is now re-established as an exemplar of sustainability, through a BREEAM Outstanding refurbishment.

“I am delighted that we have officially moved into the new City Hall as we usher in a new era for the GLA in this fantastic part of East London, while saving Londoners tens of millions of pounds. This relocation will act as a springboard for the regeneration of this historic area, just as the opening of the previous City Hall did for its London Bridge surroundings. I'm grateful to everyone who has worked so hard to deliver the new City Hall.”

Sadiq Khan, Mayor of London  
[sourced from london.gov.uk](https://www.london.gov.uk/news/sadiq-khan-welcomes-new-city-hall)



# Transforming and modernising a 1930s town hall

Camden Town Hall, London, United Kingdom



Grade II listed Camden Town Hall has been transformed to become one of the most sustainable historic buildings in Camden.

The democratic, community and civic facilities have been modernised, with repairs and upgrades to the glazing. Historic features have been restored, and the new systems sympathetically integrated within the neoclassical town hall.

Heating and cooling of the building is powered 100% by renewable resources. This combined with improved insulation has reduced its energy use by 60%.

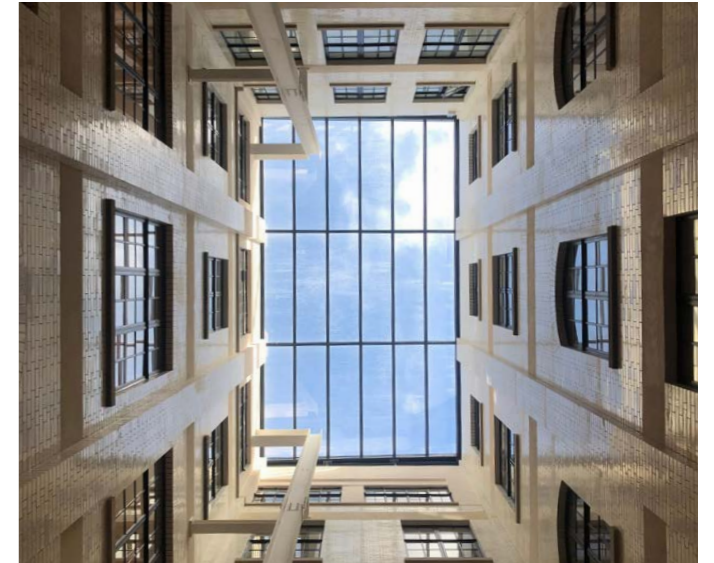
Set to receive an 'Excellent' BREEAM rating, the building incorporates sustainable features such as greywater recycling, cycle storage and improved biodiversity through green roof terraces and integrated bird and bat boxes. In addition, the use of single-use plastic is banned.

**60%**

Reduction in regulated carbon emissions, amounting to 335 tonnes of CO<sub>2</sub> per year

**100%**

Energy comes from renewable sources



Working together with local disability groups, Camden Council made improvements to the building to make it accessible for everyone. This includes the modernisation of existing lifts and the installation of new ones within a converted lightwell, wheelchair spaces, baby-changing facilities and accessible toilets on all floors.

The refurbishment is now fully electric, with heating and cooling provided by air source heat pumps, removing reliance on fossil fuels.



# Refurbishing existing offices to improve operational efficiency

Bow Bells House, London, United Kingdom



Designs are subject to planning consent, and are at RIBA Stage 2.

Originally developed in 2007, the 215,000 sq ft office building links the Bank of England and St Paul's Cathedral, within the Bow Lane Conservation Area.

Arup was engaged on the project to define a sustainability, operational and capital investment strategic pathway for this prime-rent, central London asset.

Critical success factors included working with the existing building to retain as much of the existing structure as possible, while anticipating future occupier demand for lower carbon buildings.

Our work involved assessing opportunities to enhance the building's user experience through several architectural interventions, investigating building and operational performance in support of a path to net zero and decarbonisation, and to define the building's sustainability targets and associated next steps.

**5-15%**

Energy use reduction through quick-win interventions

**10-20%**

Energy use reduction through longer-term interventions



Short term interventions requiring little-to-no mechanical changes would see a significant reduction in energy use. Savings of up to 15% energy use are anticipated.

Longer term interventions requiring significant mechanical changes would see a further significant reduction in energy use. Savings of up to 20% of energy use is anticipated.

Arup has advised on a range of projects at Bow Bells House in recent years – from performance analysis to a net zero carbon pathway and building upgrades.



# Securing a historic listed façade during deep excavations

Scottish National Gallery temporary works, Edinburgh, United Kingdom

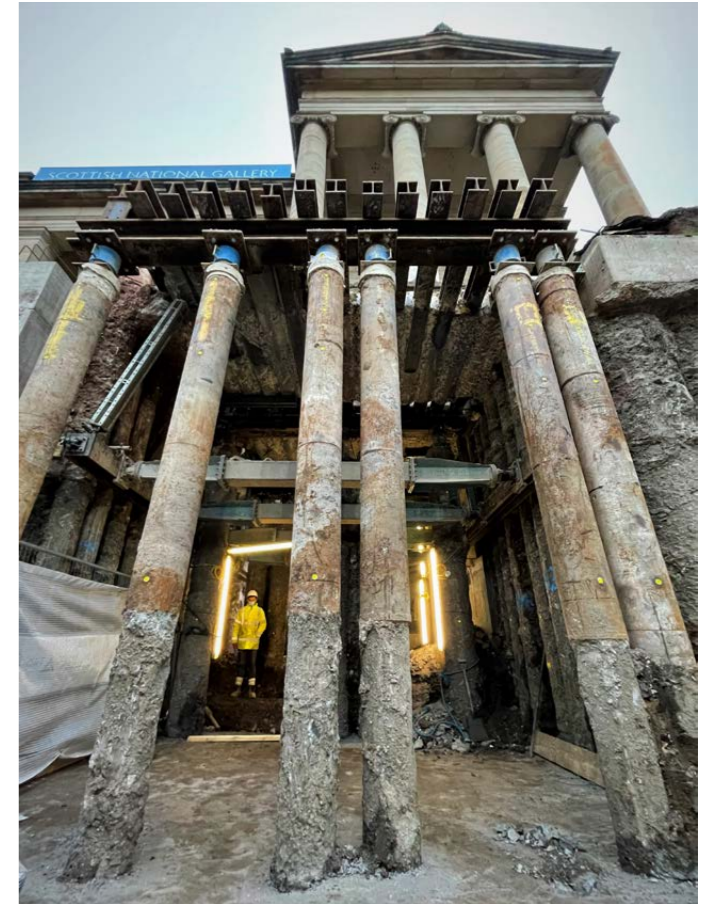


The Scottish National Gallery is a landmark neoclassical building, constructed in the 1850s on the Mound in the heart of Edinburgh, and located within a UNESCO World Heritage site.

When the National Galleries of Scotland was looking to create new subterranean exhibition suites for the world's greatest collection of Scottish art, they turned to Arup for the most technically complex phase – the temporary works.

The challenge was to protect the Grade A listed façade, whilst creating a 6m deep excavation beneath, staying within tight movement and vibration limits, on highly unpredictable ground conditions, above busy rail tunnels and in a constrained site – all whilst keeping existing the galleries open to visitors.

Bringing together multidisciplinary experts, we used a combination of digital tools and adaptable solutions to de-risk the temporary works. This included 49 mini piles to support the historic building, 26 hydraulic jacks to control movement, and daily reporting to predict movements and strains in order for the team to adjust hydraulic jacks before any potential damage occurred, successfully securing the Palladian façade until it was transferred onto permanent works.



**1850s**

Neoclassical building

**Scottish art**

Home to the world's greatest collection

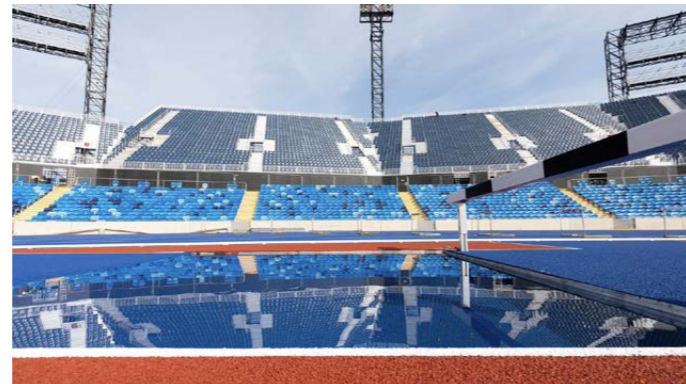
**3x**

Increase in space for the Scottish art collection



# Upgrading a 1970s stadium for international athletics and community wellbeing

Alexander Stadium, Birmingham, United Kingdom



For Birmingham to host the 2022 Commonwealth Games, the city needed to redevelop Alexander Stadium into a world-class stadium able to host athletics and stage the opening and closing ceremonies.

By engaging with Arup early, we were able to provide co-ordinated design, planning and engineering services for the project, enabling Birmingham City to achieve better outcomes. These included a hybrid planning application that smoothed the approvals process, a smart use of digital tools that optimised seating layout, and a new West Stand and tiered seating area which increased capacity during the games to 30,000 spectators and 18,000 after the event.

The venue also welcomed a new 400 metre warm-up track, upgraded competition track and a new teaching base for Birmingham City University – all delivered within tight timeframes.

The redevelopment of Alexander Stadium has created a centre of sporting excellence for major events and elite sports, where local communities and sports groups are set to benefit from the upgraded facilities, improved public spaces and increased job creation.



“The Arup team’s design and technical expertise has been exceptional, including navigating the project through a number of complex planning submissions. From concept design right through to supporting the client following the completion of RIBA Stage 4, a fully integrated and skilled team has provided a sustainable vision that has become a striking reality.”

Dave Wagg, Head of Sport & Physical Activity at Birmingham City Council

**40%**

Increase in permanent capacity to 18,000 spectators

**Catalyst**

for local regeneration



# Uniting separate buildings to create a collective space for students and staff

Learning & Teaching Building, University of Strathclyde, Glasgow, United Kingdom



The University of Strathclyde wanted to bring diverse facilities together under one roof to enhance the student experience. Working closely with the architect BDP, we joined two buildings (one Grade B listed), refurbishing as much of the existing structures as possible and adding a new hub in-between.

Rebuilt with sustainability in mind, it has achieved a 67% carbon reduction on a new build project, the equivalent of carbon generated by 3,350 Scottish homes in one year.

The AJ Architecture Awards' judges remarked: "It would have been ripe for demolition and rebuilding in many other contexts." Instead, adaptive reuse created a sustainable new home for the student union, student support services as well as Strathclyde Doctoral School, along with a 400-seat lecture theatre and breakout spaces.

Arup was the structural engineer for both the new facility and the original 1960s building. We strengthened the existing structure to minimise new foundations, converted chambers that previously housed water tanks into social spaces, and engineered a cantilevered steel frame projecting off the existing frame to increase valuable floor area.



**1960s**

Building

**67%**

Lower embodied carbon

**20,000m<sup>2</sup>**

Learning and teaching space



# Digital transformation

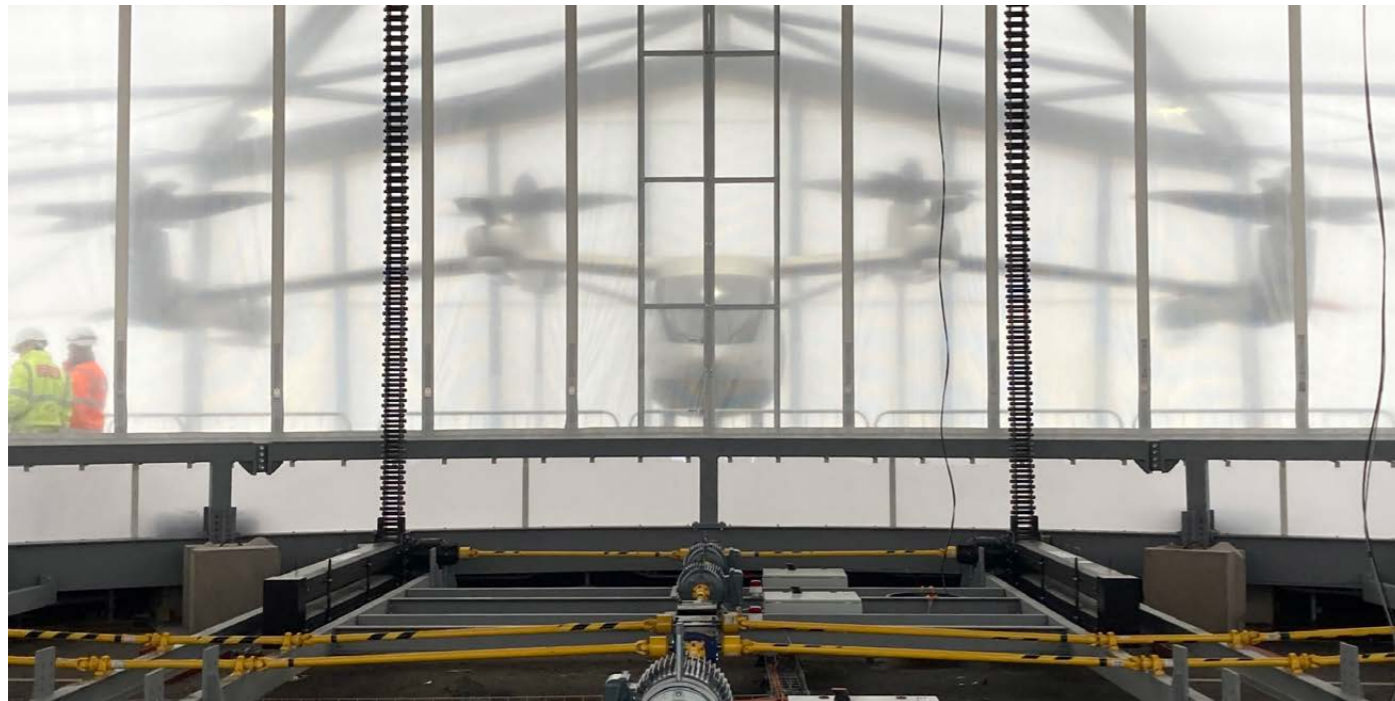
Digital technology and data are transforming the way we design and engineer buildings, enabling a deeper level of insight and allowing us to reduce operating costs and optimise the life of buildings.

Embedding real time data also provides our clients with valuable metrics to optimise the in-use performance of their assets.



# Smart digital design brings the world's first hub for flying taxis to life

Air-One, Coventry, United Kingdom



Supported by Arup, Urban-Air Port won the Government's Future Flight Challenge – funded by the UK Government with funding matched by Hyundai – creating the world's first vertical take-off hub for flying taxis and delivery drones.

Air-One launched in Coventry in April 2022, showcasing how advanced air mobility can cut congestion, improve air quality and decarbonise transport, integrated with electric vehicles. This prototype provides a blueprint for 200 planned hubs worldwide over the next five years.

Using digital tools, we engineered an ultra-compact, rapidly deployable hub that is 60% smaller than traditional helipads. We introduced adjustable supports to allow the structure to sit firmly on uneven ground without foundations and created an innovative lifting platform to avoid the need for a lift pit.

**100+**

Successful drone flights in three weeks

**60%**

Smaller than traditional helipads

**15 months**

To design and build



Smart 3D modelling was central to the speed of design and construction, opening up possibilities for rapid response air mobility in emergency situations. 100% of components are reusable and the hub can be operated completely off-grid, powered by zero-emission fuel cells.

**“The opening of Air-One is a pivotal moment – the starting gun for a new age of transport, an age of zero-emission, congestion-free travel between and within cities that will make people healthier, happier and more connected than ever before.”**

Ricky Sandhu, Founder and Executive Chairman of Urban-Air Port

**“The opening of Air-One, backed by Government funding, will revolutionise the way people and goods travel across the nation.”**

Robert Courts, Minister for Aviation



# Maximising a constrained site to create a vibrant new student centre for Cardiff University

Centre for Student Life, Cardiff, United Kingdom



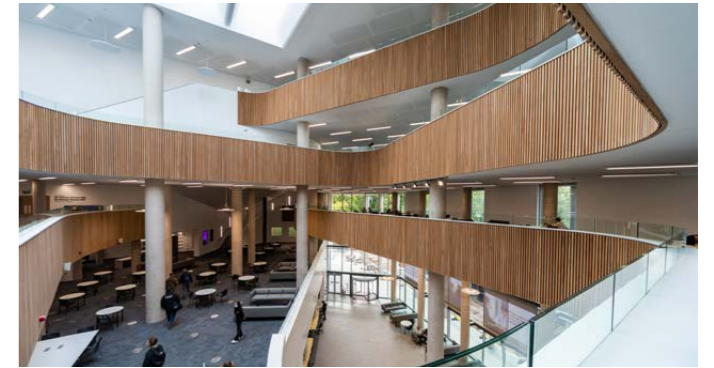
Part of the biggest Cardiff University campus upgrade in a generation, the Centre for Student Life unites a range of facilities under one roof. It houses student support services, a 550-seat lecture hall and flexible open spaces for studying and socialising.

Throughout this complex, site constrained project, we used our digital capability to maximise available space and in turn, deliver increased site value to the client.

Every single floorplate is unique, to make the most of the narrow plot. We automated column reinforcement to refine structural efficiency, saving carbon and costs. Advanced modelling and phased construction made it possible to keep the adjacent Students' Union open throughout, retaining an existing access route until a new entrance and terrace were added in the second phase.

Arup SoundLab enabled the University stakeholders to virtually experience acoustic performance in the lecture theatre, consultation rooms and other spaces. It also allowed us to design out structural isolators for vibration from the nearby railway, saving the client significant costs and cutting carbon.

**Our proposal to build over an existing sewer and use its easement as a service tunnel was part of the competition-winning design, as it allowed the full site to be developed while avoiding a costly diversion.**



## SoundLab

Acoustic and vibration standards achieved with Arup's simulator

## Advanced

Modelling enabled Students' Union to remain open throughout construction

## Automated

Column reinforcement to refine structural efficiency



# Creating a new cultural and social landmark for Vietnam

Hanoi Opera House, Hanoi, Vietnam



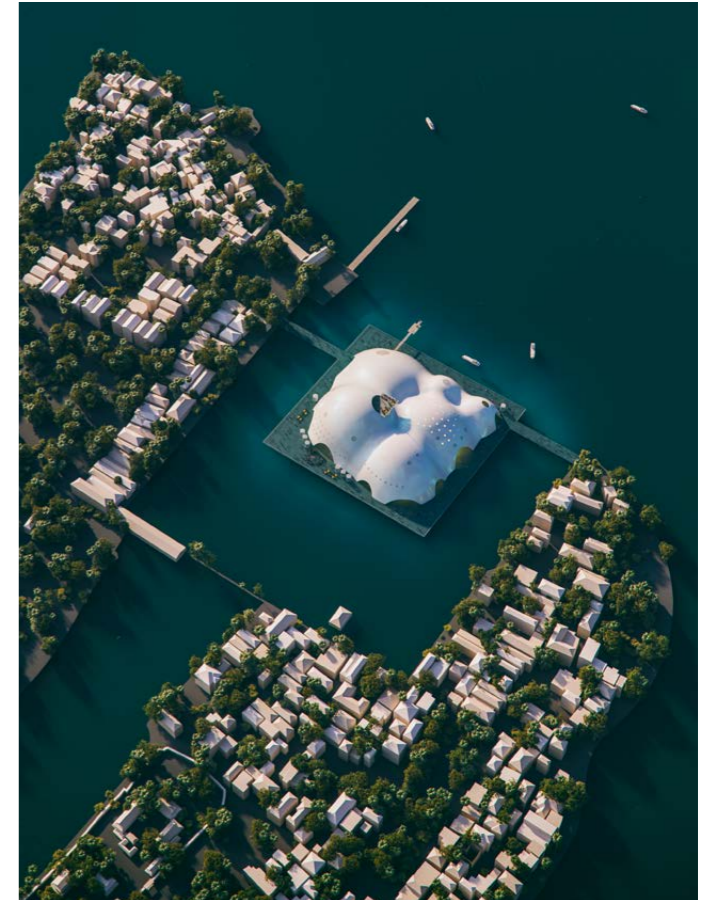
Hanoi Opera House will be one of Vietnam's most significant performance venues in 100 years. Flexible spaces include an 1,800-seat concert theatre and a 500-seat multipurpose theatre.

It will also be home to Vietnam's first private symphony orchestra. Located on the shores of West Lake, Hanoi, the venue features one of the largest concrete shell roof structures in the world, inspired by the oyster shells once harvested in the lake.

Using digital design tools, we developed an advanced algorithm with Renzo Piano Building Workshop to shape the roof, making it ultra-thin, low carbon, and highly resilient to earthquakes and storm winds.

Pearllescent tile cladding has been selected as it reflects solar radiation, enabling better building temperature regulation and reducing energy use.

If the entire building was scaled down to the size of an egg, its roof would be even thinner than a real eggshell – minimising materials, reducing carbon and saving operating costs.



**One of**

The world's largest concrete shell roof structures

**1,800 seat**

Concert theatre

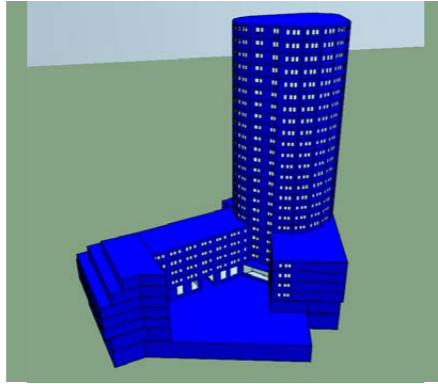
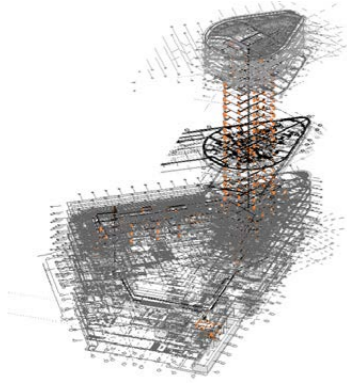
**500 seat**

Multipurpose theatre



# Replacing a faulty heating system while keeping residents in their homes

City Road, London, United Kingdom



With the hot water system at this 27-storey, 240-apartment residential development suffering multiple leaks and problems despite being less than 10 years old, the owner and managing agent turned to Arup as a trusted advisor.

During the pandemic, access to the site to carry out surveys was limited, and accurate records of the building were not available. Arup created a 3D digital model of the building that was then used for discussions with the client to check space requirements, access arrangements and produce a final design for the replacement system.

Testing multiple scenarios, we engineered a solution that completely replaced the faulty system, without residents having to relocate. This avoided huge disruption and halved project costs, saving over £3m on relocation costs.

This new, efficient system cuts energy use and emissions, reducing operating costs. It also empowers tenants to better understand and manage their own energy use through the option of a smarter billing system that monitors the consumption of each home's heat interface unit.

Creating a 3D digital model of the building, we identified free void space that could be used to install the new system in parallel with the existing one, and correctly sized the system for performance and so pipework fits in the available space.



## 3D model

Matterport point-cloud scan to create a 3D digital model of the building

## £3m+

Saved by avoiding relocation, halving project costs

## Granular

Metering to enhance energy monitoring



# Engineering the biggest development Birmingham has seen for a generation

Paradise Phase Two, Birmingham, United Kingdom



## Site model

LidAR surveys and BIM to create a virtual 3D model of the whole site

### 3

New public squares across 1.8 million square feet of space

Paradise will deliver 1.8 million sq ft of space when complete in 2028. Arup is providing all engineering and specialist design for the phased development, which will deliver ten new buildings. These will bring new offices, commercial areas and a hotel, along with 370 residential units and three new public squares. Creating a quality place to live, work, and play, we developed a comprehensive digital model of the seven-hectare site. One and Two Chamberlain Square formed part of phase one, providing highly sustainable office space, ground-floor retail and a newly refurbished, iconic square.

As part of phase two, we engineered the most complex of all the buildings at Paradise, One Centenary Way. This will be home to Arup in the Midlands from summer 2023. Positioned directly over a dual carriageway, the 12-storey building cannot be supported by a normal core and foundations. So, we designed the façade to provide stability, via an exposed steel frame.

The building is smart-enabled, allowing the landlord and tenants to create a digital community where data can be shared in a secure and controlled way.

This creates a striking gateway to Paradise, opening up city views that have been blocked for 50 years. Fire engineering for the structural frame saved over £400,000 on intumescent paints.

This new level of interaction between the landlord and tenant's digital systems will adapt to the tenants needs, while at the same time surfacing data to allow the building managers to operate the building efficiently. When we agreed our tenancy, we redesigned the heating system to be all-electric, saving 150 tonnes of operational carbon per year.

Phase three includes additional commercial buildings, including Octagon – the world's first pure residential octagonal tower – and a 152-room boutique hotel.

“Arup have been excellent and are up there with the best engineering firms I have worked with in terms of the relationship and getting things done.”

Rob Groves, Regional Director, Argent



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