Sustainability

How we can achieve sustainable architecture

eBook

GF+A
GRAHAM FORD +ARCHITECTS

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Glossary of Terms

EPC - The United Kingdom currently has a performance rating system for buildings called an EPC which grades the energy-efficiency of a property on a scale of A to G. A is the best and G is the worst. By 2025 all commercial buildings will need to have an EPC by law and by 2027 if your building does not get a C rating, it will be against the law to lease it. If you do not tackle this issue then you could be looking at a significant drop in value and diminishing yields from your building as tenants look elsewhere for better accommodation. If you do undertake a retrofit project and improve your building's ESG credentials you will find that there will be significant rental uplift which will pay for the cost of an upgrade. I will demonstrate how I have done this later in this ebook on an inner-city office estate.

SAPS - The SAP calculation is the methodology behind the EPC and is essentially a thorough list of calculations to judge the overall performance of a building. The EPC is the proof of those calculations. The methodology is set by the Government to show that a build complies with the energy and carbon requirements defined by current building regulations. It's a measure of the energy and environmental performance of a dwelling.

SBEM - This stands for Simplified Building Energy Model. It is essentially a methodology used to calculate the energy efficiency of commercial buildings. It also measures the amount of CO2 released from a structure, whereas SAPS measures the carbon emissions released from residential structures.

BREEAM - This is the world's leading sustainability assessment method for master planning projects, infrastructure, and buildings. It recognises and reflects the value in higher performing assets across the built environment lifecycle, from new construction to in-use and refurbishment.

Retrofit - Retrofit is the process of improving a structure after it has been done. Modernising a building may involve changing its purpose of use, structural elements or extensions. These structures can improve its functionality for building occupants and enhance building performance. It is also a really sustainable way of creating a different space without having to demolish it.

Figure 1
Heal's development, London

Introduction

As an industry, the property sector is responsible for one-third of global greenhouse emissions, and we consume 40% of all the world's energy. Given the compelling evidence of climate change, we have no choice but to provide better solutions and build exemplary projects that others can follow. If your asset is not sustainable and does not run with modern energy-efficient systems, its value will rapidly diminish and you will not meet the proposed statutory requirements for energy performance.

You will want to know how your building will gain a good energy performance rating and how in the near future it can become net-zero carbon without fossil fuel power. Our aim is to combine this with designing your building with materials that can be reused and replaced so there will be zero carbon emissions associated with the embodied carbon.

Now more than ever we understand how buildings, in particular poor ventilation systems, can potentially cause us a lot of harm. The value proposition for a new project must include ensuring that your staff and customers are safe, healthy and productive by designing a high-quality internal environment. This can be achieved by privileging sustainability in the design to ensure quality air and good levels of natural light. A sustainable approach will help reduce the energy you use and therefore reduce your carbon emissions. Increasingly, more of your customers will select which club or school they choose to join, and which building they choose to rent based on your building's sustainability credentials.

We are all facing complex challenges with the human population growing rapidly, putting huge pressures on ecosystems. In the United Kingdom, there is a large demand for housing. We need to accelerate how we can sustainably produce buildings to keep pace with the demand and at the same time develop clean electron production to reduce our dependence on fossil fuel energy and reduce carbon emissions into the atmosphere.

One of the most important aspects of sustainability is the orientation of the building. This will determine which rooms receive daylight and sunlight at which times of the day. The amount of sunlight entering a space will determine heat gain and our ability to store that heat in floors and walls. Orientation also impacts how we cool down the building through the use of prevailing wind patterns.

If parts of your project can be manufactured, you will benefit from products that have been improved over time in factory conditions. These could be timber panels, wall systems or platforms of structure for example, where embodied carbon has been reduced through iterations over time. You may find this process also improves efficiency on-site which reduces build time and energy consumption.

One of our missions is to design buildings to reduce operational costs. Your architect’s job is to also ensure building resilience against extreme weather conditions, such as heatwaves, floods and critical events such as earthquakes.

A strong value proposition that incorporates sustainability and a healthy building will also help convince the local planning authority that what you are proposing will make a positive impact on the area.

Sustainability is about the ability to adapt, change and relocate buildings. To illustrate this principle, I'm going to discuss a wide range of projects I've been working on.

A travelling scholarship

In 2000 I was granted a Todd Foundation Scholarship[1] and the fieldwork I completed in this trip to the United States and Europe was the basis for my master's research. The funding allowed me to travel the world and interview leading engineers and architects who had completed exemplary sustainability projects. Many of the architects I visited had pioneered a much closer relationship with their engineers and projects were developed from first principles of environmental design at the concept stage.

In 2002 I returned to the United Kingdom and was employed by Wilkinson Eyre to help with the developed design of the Jodrell Laboratory[2], a new research and office building in Kew Gardens. This project allowed me to put into practice many of the lessons I had learned during my master's research. We used timber louvres on the southern façade to shield the building from the midday sun, and combined with the thermal mass of concrete this controlled the internal temperature. We also designed the building so the offices would benefit from natural ventilation.

> **Addressing more sustainable forms of energy production will future-proof and optimise your building.**

[1] The funding for this scholarship comes from the Todd Corporation, one of New Zealand's largest and most successful companies. The Company has interests in hydrocarbon exploration and production, electricity generation, energy retailing, property development, minerals, healthcare and technology.
[1] This building won an Royal Institute of Architects award in 2008.

Climate Change and Loss of Biodiversity

Projects such as the Jodrell Laboratory point the way to how we can design a building more sustainably. Forty percent of the carbon pumped into the atmosphere comes from our buildings. In 1750 there was a concentration of carbon dioxide in the atmosphere of 250 parts per million, today there are 384 parts per million and by the mid-century, it is predicted that there will be 550 parts per million which equates to a 3-degree rise in temperature. There are profound economic, geopolitical and climate threats as a result of our addiction to oil. Much of the world's supply of oil and gas comes from highly unstable parts of the world. Reducing our reliance on fossil fuel energy reduces our dependence on energy supplies from countries governed by petro-dictators.

We now need an energy revolution where oil and gas companies will hopefully be transformed from fossil fuel exploiters to energy companies at the forefront of research and development in this sector. We need a supply of abundant, clean and reliable electrons provided from a variety of renewable sources. The clean energy sector is likely to be the next big technological revolution.

At the same time, we need to dramatically reduce the energy demand required to run our buildings. Imagine if you could reduce your energy bills through better design and at the same time produce energy that you could use and export to the grid. The payback times for renewable energy technology are reducing all the time.

The good news is that awareness of the impact of humans on the environment is growing. We now understand that the warming of the planet is triggering irregular seasonal change which disturbs natural systems. We are also now much more aware that changes in land use and sea use are a massive threat to biodiversity, loss of habitat and loss of species. A comprehensive masterplan can help you address biodiversity issues on your site.

Solar Master-Planning for your Estate

Anyone who manages a large estate of buildings will be thinking about development over the next 10 to 20 years and how best to allocate your precious resources to improve your assets. If you are a burser or headmaster you will have a vision for the teaching and learning pedagogy to which your school is committed, and you will have a strategic plan. With your design advisor or architect, you will want to link your physical master plan to the school's strategy and learning vision. These three documents work together and involve cycles of analysis, goal setting, fundraising and actions. Each will inform the other so that the planned facilities both support your specific approach to learning but are adaptable enough to be changed to support evolving approaches to pedagogy.

You do not want to construct a building that might solve a short term problem but create problems for you in the future, by blocking light or access to parts of your site. You need to be sure you don't locate a building somewhere that might be better designated for other uses. You will need to consider the infrastructure for future developments and when it makes sense to install drainage or electrical cables.

You should discuss who you need on your team to produce the master plan with your design advisor or project manager. Your team will then consult with school staff, students and the broader school community. The consultation and co-creation phase is vital so that the successful master plan can incorporate and reflect all insights and perspectives on education and design. All ideas will be evaluated against your school's vision for teaching, learning and your strategic plan.

This plan must be both visionary and at the same time have a strategy for which projects would be developed and in what order. You will also be discussing how they would be funded. Similar to the design of a building, in a master plan, you must think of key adjacencies between buildings and key routes through the site. The master plan will look at how your estate of buildings interfaces with surrounding buildings, landscape and infrastructure and it will consider local planning documents.

Like all projects, your value proposition for the master plan must consider social, economic and environmental values. You will consider community access and what value your new facilities could have for the wider community. You may also want to consider opportunities for housing for your staff and if this is viable or not. Having staff living on-site will make the premises more secure and less vulnerable to arson and vandalism. Your masterplan will have to consider:

Environmental Factors

Sun orientation, microclimate, prevailing winds, water, climate change, recycling, access and sustainable transport options.

Design Factors

Quality of links, circulation and transition spaces, waste and sustainable drainage, heritage and refurbishment of existing buildings, permeability, degree of enclosure, gathering spaces, acoustics and noise pollution, landscape and biodiversity.

Education

Improve teaching environments, contemporary pedagogy, learning and teaching approach, a mix of learning modes including small groups, solo, didactic etc.

Wellbeing

Health and safety, location of sports fields, opportunities for indoor sporting activity, opportunities for natural ventilation.

Energy

Energy generation on-site

Social Value

Opportunities for local employment, improved community connections, better social spaces in the school.

The master plan should be created in tandem with your teaching and learning pedagogy and your strategic plan. It will enable you to communicate your vision for the school to the wider community, discuss your funding priorities and be ready to respond when funds become available so you can design new facilities in keeping with the school's values and beliefs.

The pandemic and future-proofing your facility

The global pandemic of 2020/2021 brought our relationship with nature into sharp focus. Forests, freshwater systems, savannahs, oceans and the biodiversity within them, provide us with clean air and water, food and provide buffers that are a natural protection from viruses. With urban sprawl and deforestation, we are removing natural buffers and expanding the zones where wildlife comes into contact with humans and pandemics can emerge. We therefore we need to be much smarter and more sustainable about what we do.

We have the knowledge and the skills to design better buildings and landscapes, more efficiently than ever before. Our mission is to use design to drive innovation and real change to tackle the degradation of these ecosystems. To achieve this we must work more collaboratively with clients, consultants and contractors to find better construction solutions and improve building performance.

You will probably be reconsidering the future of your organisation and what impact the pandemic has had on your employees and clients. The pandemic is an existential health and safety crisis and one way through will be to upgrade the ventilation systems of your existing building and improve its performance through better data collection. Everyone will now want to join a club or school or rent a building that will not only keep them safe but also enhance their wellbeing and this, combined with the overall improved sustainability performance of your building will future proof your operation.

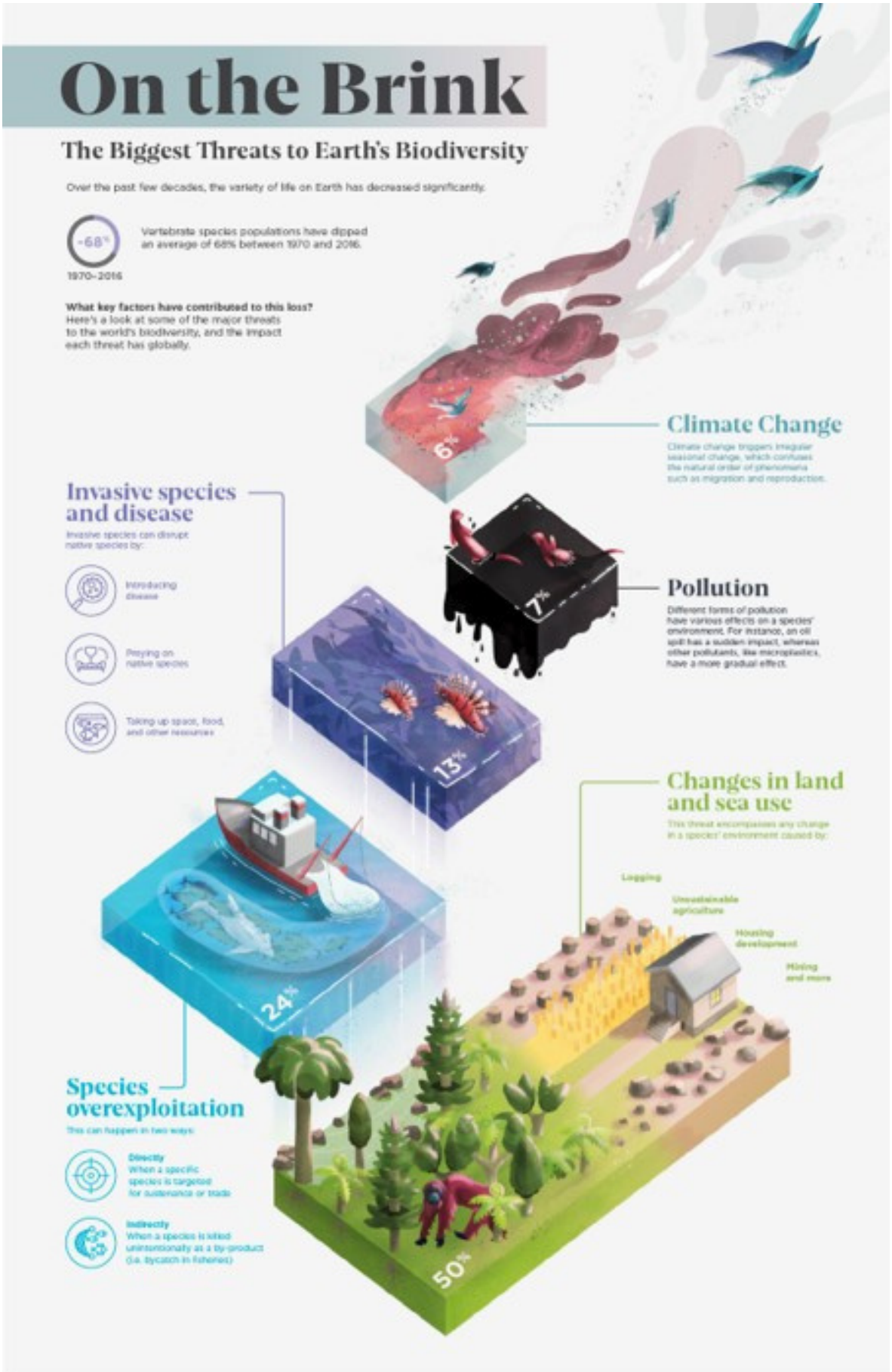
Your customers will now realise that your building has the potential to do them a lot of harm. In a competitive market, particularly after a pandemic, now is the right time to reassess your buildings and consider if they are enhancing the wellbeing and productivity of your staff and customers. Do they reflect your brand values and what you stand for? Customers have options and so to attract them you will need to become a great storyteller. Great brands represent great stories and if you are renewing or building new facilities the story you will tell needs to capture the wider benefits of what you are proposing.

Larry Fink the CEO of Blackrock with 6 trillion US dollars of assets under management, wrote in his recent annual letter to shareholders that there was a fundamental reshaping of finance occurring and climate change was driving a profound reassessment of risk which he anticipated would result in a significant reallocation of capital. He wrote that:

'Investors are increasingly reckoning with these questions and recognizing that climate risk is investment risk.'

When the man at the helm of a massive investment fund like Blackrock believes that sustainability and climate-integrated portfolios will provide better risk-adjusted returns to investors, then we know that a significant shift has occurred.

Thinking about the future, you will want to consider the impact of changes in energy supply, costs of energy and the risk of the impacts of climate change are for you and your staff, investors and clients. Those who truly embrace sustainability are going to build powerful brands, attract the best customers, and generate larger profits.


On the Brink
The Biggest Threats to Earth's Biodiversity
Over the past few decades, the variety of life on Earth has decreased significantly.
-68%
1970–2016
Vertebrate species populations have dipped an average of 68% between 1970 and 2016.
What key factors have contributed to this loss?
Here's a look at some of the major threats to the world's biodiversity, and the impact each threat has globally.
Climate Change
Climate change triggers irregular seasonal change, which confuses the natural order of phenomena such as migration and reproduction.
6%
Pollution
Different forms of pollution have various effects on a species' environment. For instance, an oil spill has a sudden impact, whereas other pollutants, like microplastics, have a more gradual effect.
7%
Invasive species and disease
Invasive species can disrupt native species by:
Introducing disease
Preying on native species
Taking up space, food, and other resources
13%
Changes in land and sea use
This threat encompasses any change in a species' environment caused by:
Logging
Unsustainable agriculture
Housing development
Mining and more
24%
Species overexploitation
This can happen in two ways:
Directly
When a specific species is targeted for sustenance or trade
Indirectly
When a species is killed unintentionally as a by-product (i.e. bycatch in fisheries)
50%

Air Tightness, heat loss, and MVHR

Your design team will advise you on airtightness and how this is critical to reducing your energy bills. The better sealed your building, the more thermally efficient it will be and the less energy you will use to heat it. Airtightness stops heat escaping from your building and stops cold draughts entering. However, ventilation is a critical part of the design of the building to prevent condensation and mould growth.

If you are developing a project in a built up urban area you should consider a mechanical ventilation and heat recovery (MVHR) system. MVHR will filter and heat the outside air, and reduce noise pollution as open windows and trickle vents are no longer required for ventilation. It extracts the air from the kitchen, bathroom, toilets and utility rooms and takes it through a central heat exchanger. The recovered heat is used in the filtered air supply to your apartment. This is all achieved through a network of ducts hidden above the ceilings. For this system to work your building needs to be designed to be airtight and well insulated.

If your project is in a rural area you may prefer not to use an MVHR system to control the ventilation into your building as there may be less noise and plenty of clean fresh air. If your building is designed with a well insulated, airtight envelope with opening windows, you may decide to use trickle vents with intermittent extract or continuous extract (without heat recovery) as your ventilation strategy. You will need to consult your design team to discuss your options to make sure you comply with building regulations.

One key consideration if you are renovating a building, is to ensure there is ventilation above the insulation on a pitched roof. On older buildings the membrane that sits under the roof slates or tiles may not vapour permeable, so it is essential that ventilation is introduced at the eaves and through tiles at the upper levels or at the ridge. The other solution is to remove all the tiles and replace the non permeable membrane, but this would be a more costly operation.

Thermal Performance, SAP, SBEM Calculations and EPC

We have to consider the thermal performance of the fabric as it plays a significant part in determining the building's overall efficiency. The most important value for your project is the U value which measures how effective a material is as an insulator. For example, if you are renovating an existing building then we aim to improve the external fabric above the standards of the building regulations.

The SAP (Standard Assessment Procedure) is used for residential buildings and the SBEM (Simplified Building Energy Modelling) calculation is used for all other buildings. These methods are a comprehensive list of measurements to evaluate a building’s overall performance. The United Kingdom currently has a performance rating system for buildings called an EPC which grades the energy-efficiency of a property on a scale of A to G. The EPC is generated by the SAP or SBEM calculations. The methodology is established by the government to demonstrate energy and climate performance.

This is calculated taking into account how the structure utilises and loses energy based on levels of insulation, windows, renewable energy technologies, types of boilers and leakage of air. Your engineer will use SAP methodology to analyse design changes and understand how to improve your EPC rating. Improved ratings can be achieved by providing an air-source heat pump, district heat network connection, mechanical ventilation with heat recovery, insulation, photovoltaic panels and solar thermal panels. When a structure is sold, rented, or developed, it is legally required to obtain a valid EPC.

The impact of statutory requirements on your asset

If you own a building you will want to know how the impact of future legislation on sustainability will impact your asset. According to Cushman and Wakefield only 4% of London offices have an Energy Performance Certificate or EPC meeting the energy use requirements that will be introduced in 2030. This means that without a major overhaul the majority of London office stock will soon be obsolete.

By 2025 all commercial buildings will need to have an EPC by law and by 2027 if your building does not get a C rating, it will be against the law to lease it. If you do not tackle this issue then you could be looking at a significant drop in value and diminishing yields from your building as tenants look elsewhere for better accommodation. If you undertake a retrofit project and improve your building's sustainability credentials you will find that there will be significant rental uplift.

According to UKGBC (UK's Green Building Council), most of the UK's existing buildings achieve the minimum EPC rating of an 'E'. LETI (The London Energy Transformation Initiative) has set target goals to increase building performance efficiency and to achieve a net-zero carbon future. The aim is for all buildings to achieve a C rating, with the ultimate goal of an 'A' rating in 2030. To achieve these objectives, we need to retrofit our buildings in order to make them more efficient. It is estimated that even if only 30% of buildings are retrofitted, it will make a big impact in moving towards the benefits of net-zero carbon.

Retrofit

Demolition is not just an ecological issue, it is undesirable for social and economic reasons. In terms of carbon footprint, retrofitting makes sense because of the significant energy savings that can be achieved by converting existing buildings compared to the high energy costs of demolishing and rebuilding.

There are many benefits to retrofit, both financial and social. Some of the financial benefits include lowering energy bills if buildings are substantially more energy-efficient, and achieving a higher asset value because buildings are more robust and durable. Additionally, occupants quality of life will improve greatly as they would be living in healthier buildings with decent air quality and thermal comfort.

An example of a retrofit project I have worked on is the Heals Development Project. This project resulted in a Grade A refurbished estate of buildings with a new efficient (Heating, Ventilation and Air Condition) HVAC system at roof level, thermal upgrading of the entire building fabric including existing roof coverings, and new energy efficient lighting. The project resulted in an upgrade to the clients' assets and the investors achieved significant improvement in rental yields.

Prototypes and Optimisation

On average, office buildings in the United Kingdom go through forty different internal changes throughout their life. These internal elements (partitions, doors, ceilings etc.) have embodied energy, so the sustainability story needs to articulate how, during the operational phase of the building, these elements can be reused or recycled.
One of our core ideas about sustainability is the design of buildings as products that can be adapted, extended, improved and even relocated over time. This applies to both the external envelope and structure and to the internal partitions and spaces. These ideas are not embedded enough in design thinking at the moment. We believe that this needs to change so your building can be optimised and improved to suit your needs and your customer’s needs over time.

To optimise you building during the operations phase of the project, the internal space must be able to be adapted without having to demolish walls or ceilings or compromise the acoustics and mechanical and electrical installations. This approach will ensure high levels of both satisfaction and utilisation of the space your tenants’ rent, or your pupils, members, staff or customers use regularly. Optimisation also involves your team designing a ‘tech-enabled smart asset’ that includes the

hardware (the building), the software (digital tenant/member experience platforms) and the services (hospitality, leisure facilities, meeting rooms, medical facilities etc).

VAT

One of the biggest obstacles to retrofitting existing buildings is a biased VAT system. You will currently pay 20% VAT for most renovation projects and typically 0% to 5% VAT for new buildings with high embodied carbon. We believe this VAT threshold should be changed to make retrofit projects more viable. We also believe that the planning system should be designed to support applications that include retrofit and require a much more robust justification for demolition than is currently required.
A reduced VAT rate of 5% applies where a house has been empty for two years prior to a contractor starting building works. The empty period has to be confirmed by the local authority.

Embodied Carbon

One of the big factors to take into consideration in design is the amount of embodied energy required to construct your building including extraction, processing, manufacture, transportation and assembly. Embodied carbon is the CO2 emitted in producing materials and the construction process and it includes the sourcing of materials and their conversion into products, systems and structures, along with transportation.

Disposing of the materials at the end of their life cycle also contributes to embodied emissions, therefore you should always consider which materials you use, to keep sustainability as a priority. During the refurbishment of the Roundhouse Theatre we retained the brick drum, the cast-iron structure and the existing timber structure saving over 60 per cent of embodied carbon emissions.

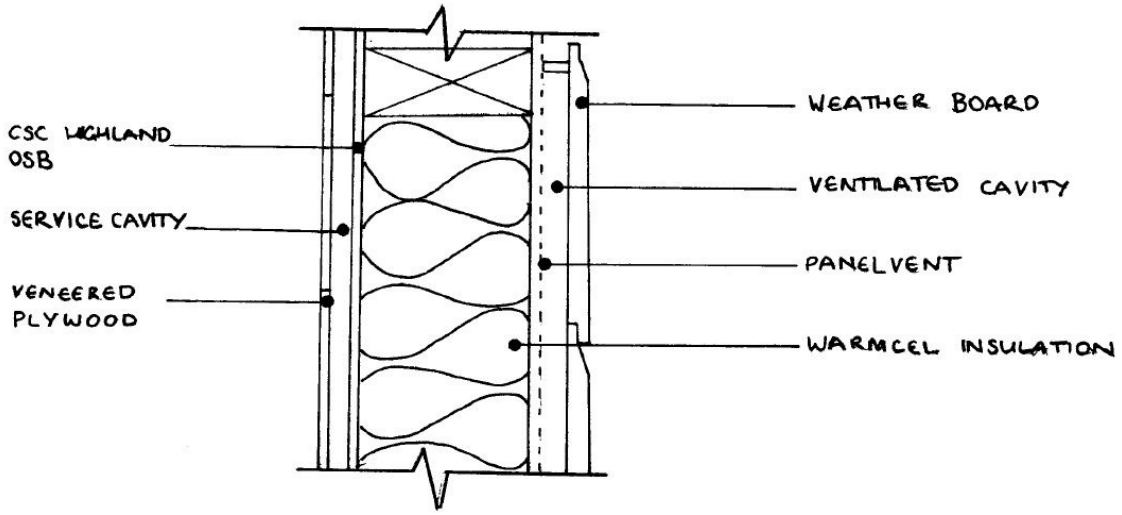
Through design innovation we are now able to reduce the amount of steel in a building’s infrastructure, resulting in a 20% reduction in embodied carbon. This is also partly due to the decarbonisation of the grid which means that steel produced on electric arc furnaces will have an exceptionally low embodied carbon content.

To ensure that embodied carbon is kept at a minimum, you will want to know what materials the team is proposing for your building and the amount of energy needed to create and install them. You'll also want to know how easy it is to replace and maintain a building, and if it's possible to recycle the building at the end of its useful life.

To deliver the performance that will be required by the UK government’s zero-carbon 2050 targets, and the interim targets that have been set, you will need to consider ensuring your building has bio-based materials with low embodied energy levels incorporated in its design. We try to achieve this by using as much timber frame construction as possible on our buildings incorporating Warmcell recycled cellulose insulation. We also advocate using natural and breathable lime-based plaster systems especially on renovation projects and other natural products such as cork insulation and wood fibre insulation.

It is important to emphasise that not all buildings can be constructed from materials that are grown and some manufactured products such as steel and aluminum may be required. Despite the large amounts of energy it takes to manufacture these products, they are relatively easy to recycle. The recycled content of materials can significantly reduce their embodied energy. The important thing is that componets are designed so they can be recycled or reused as we did on the Hyde Park Boathouse.

The combination of practical and efficient measures, when implemented in the form of a coordinated renovation plan, results in sustainable structures with a low carbon footprint. This significantly reduces carbon emissions and ensures we are supporting our national transition to net zero. This can be achieved by generating renewable energy as locally as possible, eliminating fossil fuel heat sources and replacing them with low-carbon alternatives.



Construction	U-Value
Weather Boards	0.152 m2K/W
Ventilated Cavity	0.180 m2K/W
Panevent	0.115 m2K/W
Warmcel Insulation	3.889 m2K/W
CSC Highland OSB	0.064 m2K/W
Service Cavity	0.100 m2K/W
Veneered Plywood	0.072 m2K/W
Inside Surface Resistance	0.130 m2K/W

Figure 2
Section through cladding
Hyde Park Boathouse

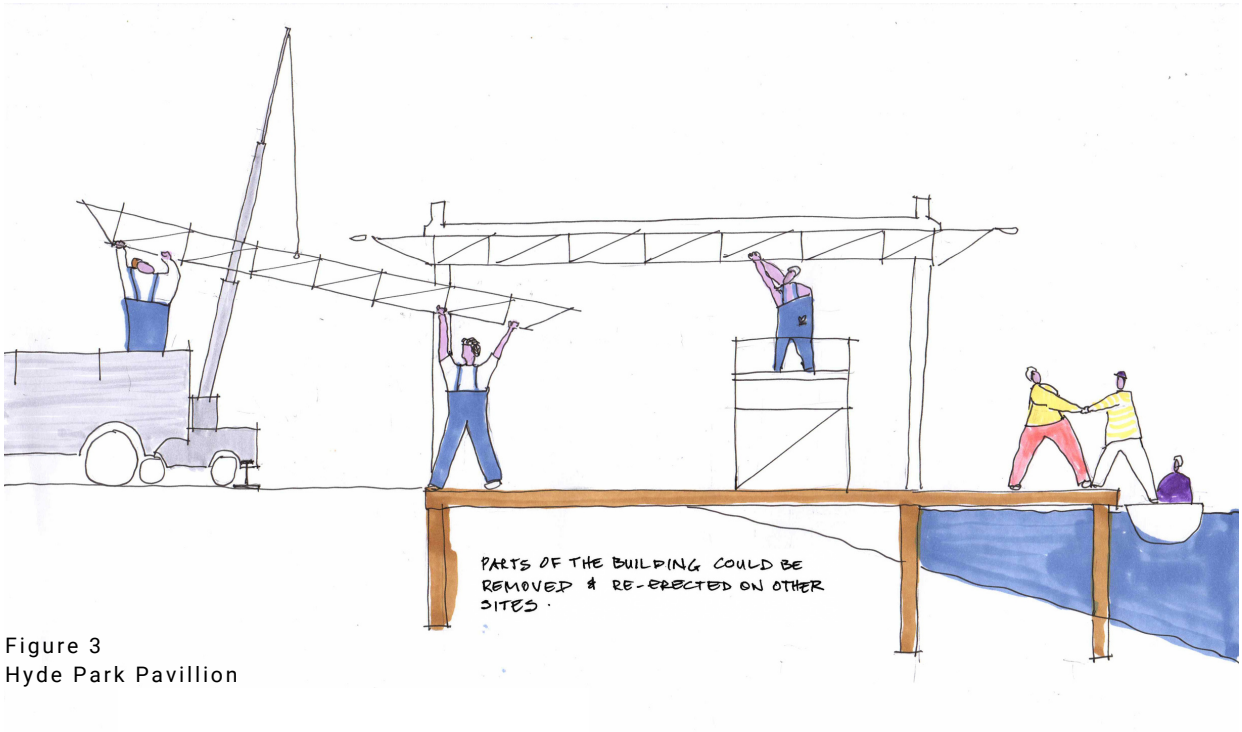


Figure 3
Hyde Park Pavillion

Figure 4
Blue Bird Boathouse, London

Case Study:
Retrofit Heals Tottenham Court Road

I was contracted to assist a large commercial architectural practice in developing the technical design for the redevelopment of several buildings behind the Heal's department store on Tottenham Court Road. The development consisted of a group of art deco, early Victorian, and 1950s and 1960s office buildings around a central courtyard. The site is surrounded by the district of Bloomsbury within the London Borough of Camden and the boundary of the Bloomsbury Conservation Area. The estate is historically significant and was listed as Grade II* in 1974.

The project was commissioned by Threadneedle Pensions and the Bedford Estates who were upgrading the buildings to provide 39,000 ft2 of modern office accommodation. The design connected the buildings with glass lifts, a glazed atrium, new lobby and entry sequence, and a full renovation and upgrade of office space including new mechanical and electrical systems.

I was employed as a consultant by the scheme architect, John McAslan and Partners, a large practice that has designed significant commercial, cultural and infrastructure buildings in the United Kingdom. The architect had been novated to the contractor to complete the technical drawings. Key members of the architect’s team had left the office and due to the studio’s workload, they needed an experienced architect to assist the team leader to manage the development of the technical design. I was asked by the project director to help as I knew the architect’s systems and design philosophy having worked in the office for three years during the development of The Roundhouse Theatre. I also have specialist skills in the renovation of historic buildings. I was introduced to the project between the first and second stage tenders.

I initially interpreted the design drawings with the project architect to find gaps and inconsistencies. We needed to understand the project through a forensic analysis of the information that had been produced by the architect’s previous team together with the other consultants’ drawings and reports. We then developed a strategy to organise the team the project architect had available. I helped her make decisions on what to draw, what scale it should be drawn at and the details that needed to be drawn.

We had to collaborate closely with external engineering consultants who had a long history of involvement in the project. I worked as a design advocate to help the team develop consistent coordinated information that interpreted and delivered the design intent. I reviewed all aspects of the build including the glazing around the internal glass walls, display boxes, glazed meeting rooms and atria. I used the contractor's knowledge to help me select materials that could be installed safely in a very compressed site at height. I also conducted research with subject matter experts that ranged from structural glass to roofing details to ensure the drawings and specifications matched the design intent.

One of my aims in this period was to make sure the contractor's scope of work was well defined, and they had a robust coordinated set of information that responded to the demanding heritage context. The project needed to be costed correctly before they were contracted to deliver the second phase to ensure the quality the client required was allowed for.

During the second stage tender period, I helped the team develop packages of work that would be tendered to the supply chain. I was then involved with the contractor in the selection of key subcontractors to ensure the best team was engaged. The selection process involved a tender interview, a discussion of the design, a discussion about risks, costs, program, and an assessment of their capability to complete the work based on their experience. In this project, the glazing subcontractor was vital to ensure the complexity of the glass boxes, windows, curtain walling and atrium were developed and built to match the design intent.

Once the project commenced on site, I was engaged as the employer's agent. In this role, I continued my role as a design advocate to ensure that what was being proposed in the shop drawings and what was being built matched the design documents.

Conclusions

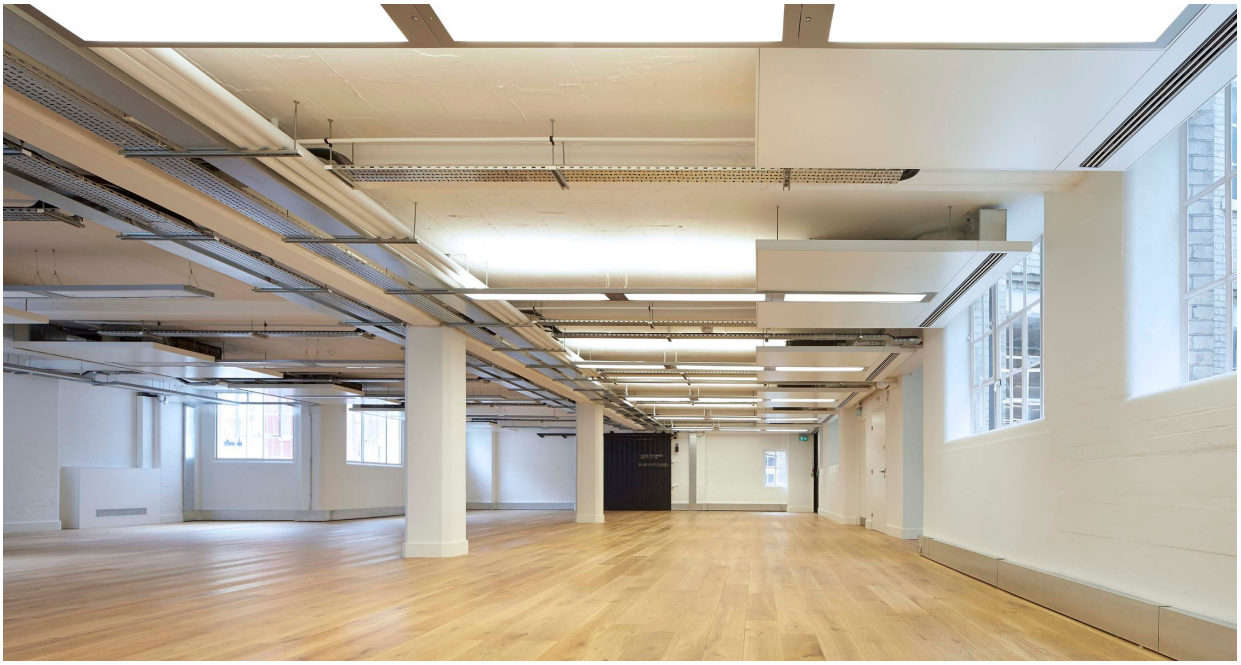
During the project duration, my role was not to manage the architect's team, it was to give the project architect confidence to lead the team and advise on strategy for getting the project completed. I needed to understand what the architect was wanting to achieve and then advise how this could be done. As a mentor, I had empathy, teaching skills and knowledge of many disciplines.

The result was a Grade A refurbishment of an estate of buildings with a new entrance, new glass atria and new circulation core to provide access to upper levels of the building. We also installed a new riser with replacement of plant at roof level and thermally upgraded the entire

building fabric including existing roof coverings. New comfort cooling and heating and low energy lighting were also installed. The project was completed in 2013 with the investors achieving a significant uplift in rental income from the renovated building.

Case Study:
Retrofit Heals Tottenham Court Road

Figure 5, 6, 7
Heals Tottenham Court Road



Orientation of the building

If you are serious about reducing your energy bills and playing a role in minimising our impact on the planet, then the principles of sustainability need to be introduced into your project from an early stage. The first and most important is the orientation of the building. Any façade facing west or south-west will be subject to significant amounts of heat. The sun is lower in the sky as it tracks around to the west so the screens and roof design need to protect, screen and shade the windows to minimise heat gain.

It is important to realise that the main issue with large commercial buildings is cooling them down. Most of the year they are full of people, computers, printers, kitchens etc that generate heat. One way to combat this is to have exposed concrete walls, stone or concrete walls and precast ceilings. This allows heat from internal spaces to be absorbed into the materials during the work day and being released at night. If the building is located in an area where there is minimal traffic and pollution, and the floor plates are not too deep then natural ventilation may be a possibility.

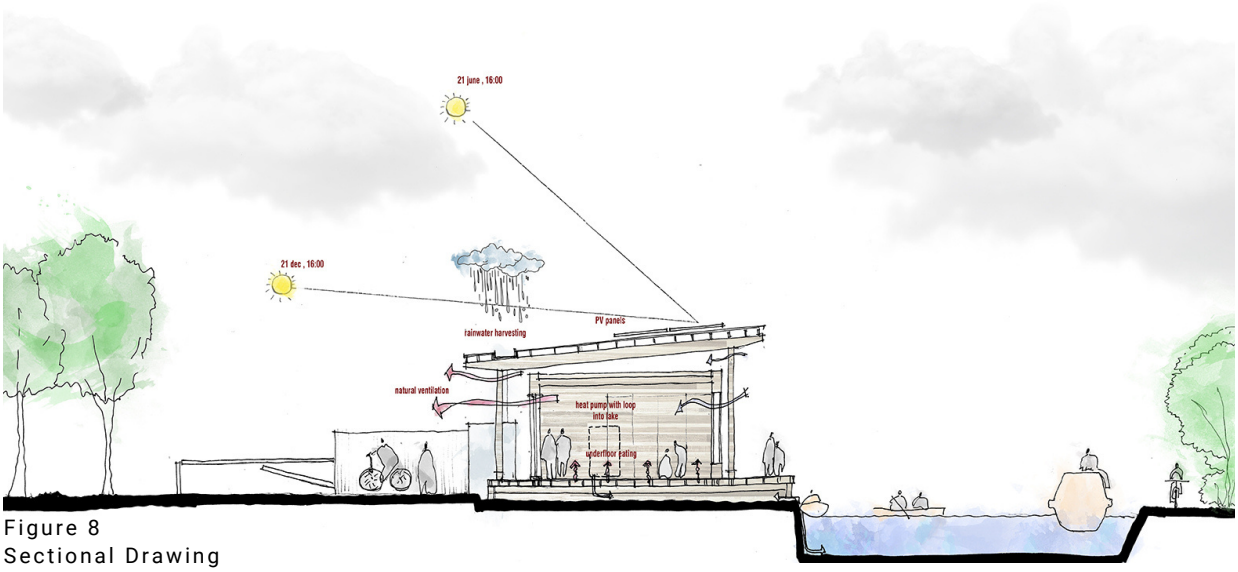


Figure 8
Sectional Drawing
Canoe Centre, Lea Valley, Haringey

How the principles of precision and efficiency support sustainability

The current generation of architects have used their training to pioneer the introduction of ‘platform’ design or design for manufacture and assembly. One aim of this approach is to improve efficiency delivering custom-made products at low costs possible with mass production.

Architects are proposing a radical new way of procuring buildings with the client working more directly with manufacturers and purchasing at a component level to speed up the process and reduce transactional costs. A manufacturing procurement manager manages the project as opposed to using a main contractor. This is the way that the Hyde Park Pavilion was built.

A more precise, design-to-manufacturing approach helps to reduce the amount of material used in each component. It is also more efficient to reduce the time spent on-site and reduce the amount of waste generated. You and your team should consider these sustainability benefits at the strategic design stage.

One of the considerations you should have when designing a building is what will happen to it once it is has served its practical life. During the preparation for the London 2012 Olympic Games, I worked on the spectator enclosures for the shooting venue as a quality assurance advisor to the Olympic Delivery Authority. My job was to make sure the venue was being constructed according to the employer’s requirements.

This venue consisted of three pavilions which formed a collection of colourful tents scattered around Woolwich Common forming a shooting and archery campus. The structural frame is built up from standardised steel trusses that are widely available for hire wrapped with a fabric skin. The range (field of play) was enclosed in a plywood perimeter fixed to a steel frame. Most parts of the pavilions could be easily removed and reused. The piles for the venue were all made from recycled gas pipes driven into the ground, easy to recycle once the Games were over. The structure for the three pavilions used rental components. We call this ‘pre-cycling’ where you plan the second and third uses of the equipment during the initial design phase. I believe this innovative thinking can be more widely applied for different uses such as disaster relief

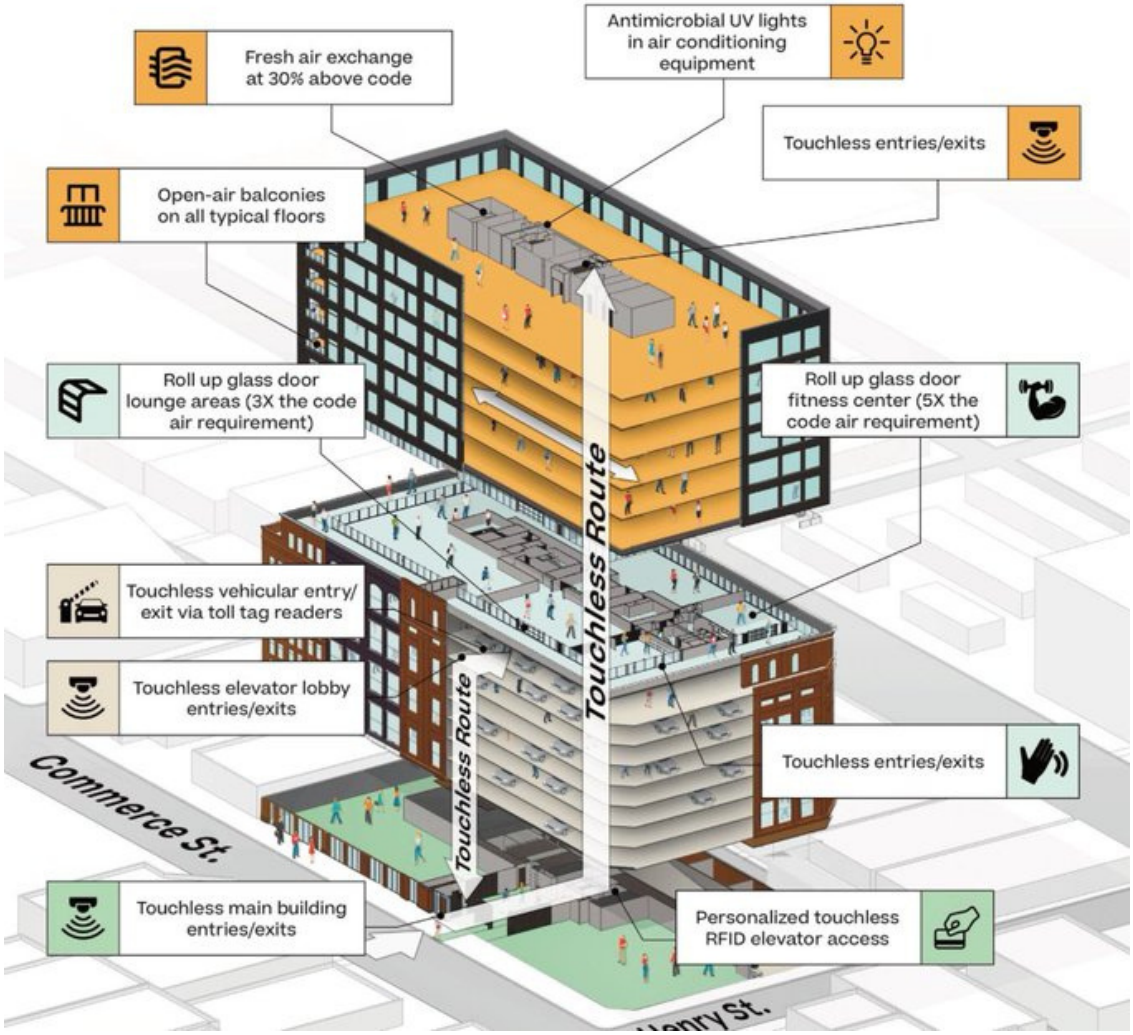
(post-earthquake structures), classrooms or small stadia for schools, arts and sports events.

The project demonstrates how these ‘pre-cycled’ rental systems can be the future for large scale sporting events. This pavilion was demounted, and parts of the structure were reused at the Glasgow Commonwealth Games. In the future, to reduce the massive cost to host countries of staging the Olympic Games and World Cups, it makes more sense if some of the venues are transported to the next country ready to be reassembled. Buildings that are recycled in this way can help to reduce the embodied carbon needed to construct them.

Figure 9
Woolwich Shooting

Sustainability and technology

The number of devices connected to the internet is continuing to rise. Connected operational devices such as thermostats, lights, etc will help to make buildings self-optimising by changing temperature, lighting levels and colour, to create the perfect living and working conditions throughout the day. In time, more connectivity will give the devices controlling your building more data, which they can harness to create the conditions we need. This will reduce the amount of energy our buildings use. I believe that when you are planning your building you should ensure that your brief includes as much technology as you can afford, so it can be integrated into the building design to make sure that your building is working to save you money in the longterm.



Environmental Assessment Tools

Sustainable structures can achieve a higher value, especially if they have acquired an accredited certification. Developed in the U.K., BREEAM (Building Research Establishment's Environmental Assessment Method) is a global sustainability assessment method for master planning projects, infrastructure, and buildings.

BREEAM sets standards for building environmental performance at each stage of planning, specification, construction and operation and can be applied to new development and refurbishment projects. Your building will be assessed on its sustainability across various categories such as Health and wellbeing, Pollution, Water and Energy. The results indicate how your building performs compared to others in the UK, whether it is in the top 25% of UK buildings with a rating of 'Very Good' or the top 75% with a rating of 'Pass'. Using the BREEAM assessment tool will allow you to know the value of your asset over its entire life cycle. It is highly recommended to complete and may be specified by your local authority during the planning process.

Future Energy Requirements for your Building

Future energy requirements need to be thought about during the initial design phase including how new and potential legislation may impact what energy systems you can use and the allowable emissions. What you don't want is to design a facility that runs on a source of energy that is being phased out and has unacceptable levels of C02 emissions. You should consider heat pump technology and if economically feasible and possible you should utilise renewable energy generated from your site or building. It is worth remembering that it is much harder to integrate energy systems as a retrofit once the building has been constructed.

Buildings that consume a lot of energy cost a lot of money to run and in turn produce carbon that contributes to global warming. Where possible ask your design team how they can reduce the overall running costs of your project.

A key consideration in achieving this will be deciding what heating and cooling system you will use in your building. In the Hyde Park Pavilion project we used the Serpentine Lake as a heat exchange source for the building. Because water temperature is more stable than air, the heat pump system uses the lake as a heat sink or a heat source depending on the season. The thermal energy is collected via pipes that sit in the lake and the heat transferred into the building is 4 times larger than the electrical energy consumed. The heat in the boathouse was distributed using an underfloor heating system. If you don't have a lake you can use, then you should consider an air source or ground source heat pump.

Case Study:
The Masonic Lodge

The Masonic Lodge project is an extension to an existing Mock Tudor pavilion located in a conservation area in the London borough of Bent. The brief included a large banqueting hall for 350 people, flexible meeting rooms, with independent access, a new bar, and a commercial kitchen. I was asked to design the building to match the classical additions in brick from the 1960s. This involved designing a new entrance from the car park on the Western side of the existing building, landscaping and a new access route into the site.

The storytelling stage commenced with the development of a value proposition based on the project's contribution to the community through employment, using local materials and working with local businesses. The design focussed on the future health and wellbeing of visitors and the quality of spaces we could provide. We achieved this by opening up the building to natural light and views over the landscape while providing high-quality internal air through natural ventilation. The value proposition also extended to our client's environmental values and their desire to reduce the amount of energy required to heat and cool the building, in turn reducing the centre's carbon emissions. I collaborated with our mechanical consultant who was capable of helping us to deliver a sustainable design solution.

The mechanical engineer was critical to achieving our heritage aims by keeping the height of the link as low as possible through a natural ventilation strategy using windcatchers. This reduced the visual impact on the existing mock Tudor pavilion compared to the standard solution of mechanical air supply distributed through large diameter ductwork requiring more void space and therefore pushing the link roof higher. This solution ensured that the critical relationship between the two pavilions with a flat roof as required by the conservation officer from the council could be achieved.

The use of windcatchers also allows the building to have a sustainable ventilation system as air enters the space through external static louvres. This was implemented in the central dining area and allows stale air to rise through natural buoyancy becoming separated in the windcatcher with internal dividers. The use of windcatchers eliminates the need for large ductwork enabling us to maintain a low level for the link between the two pavilions.

This natural ventilation system uses no fossil fuels and no maintenance is required, making windcatchers a suitable and sustainable ventilation solution for your building.

As can be seen in Figure 16, the orientation of the project in relation to the suns path was another important aspect to consider. The building faces west and so in the hours of 1600 – 1700, the sun is at an angle of around 30˚, directly hitting the glass windows. To manage this, external retractable blinds are placed vertically, protecting the face from overheating and uncomfortable internal conditions. The blinds also allowed us to maintain the orientation as determined by the heritage of the building and site.

Figure 10 shows how the use of windcatchers as well as external retractable blinds can create comfortable internal conditions for a building of this scale and capacity.

One of the key learnings from this project was to build a strong value proposition encompassing social values or how the project would positively contribute to the neighbourhood, provide economic value through employment and generate income locally, and the environmental value through a low energy solution. The value proposition extends to the future users of the building promising a great experience by designing and delivering a single product service that includes hospitality, IoT, data analysis, and quality space to work, live and meet in.

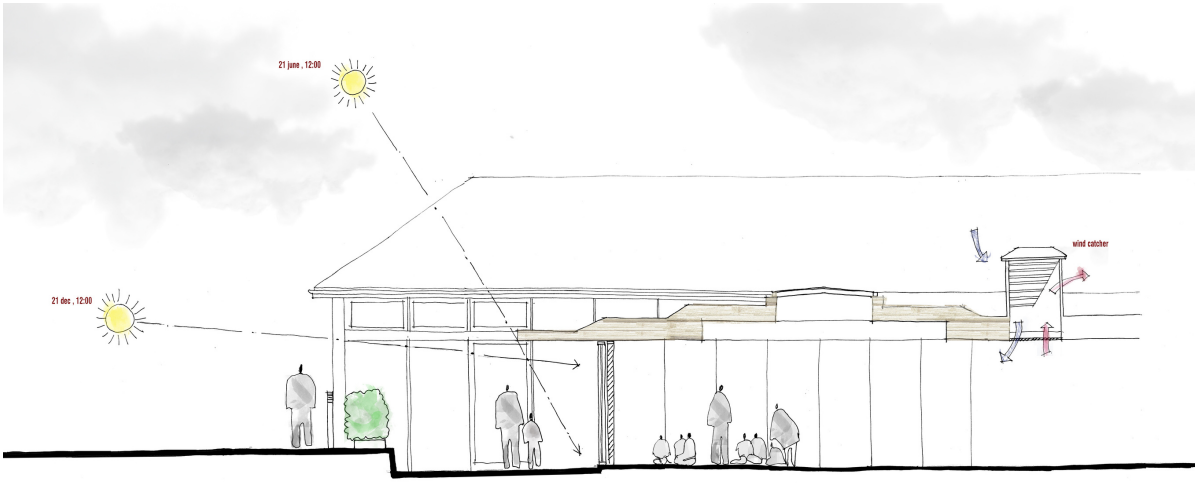


Figure 10

Figure 11
The Masonic Lodge

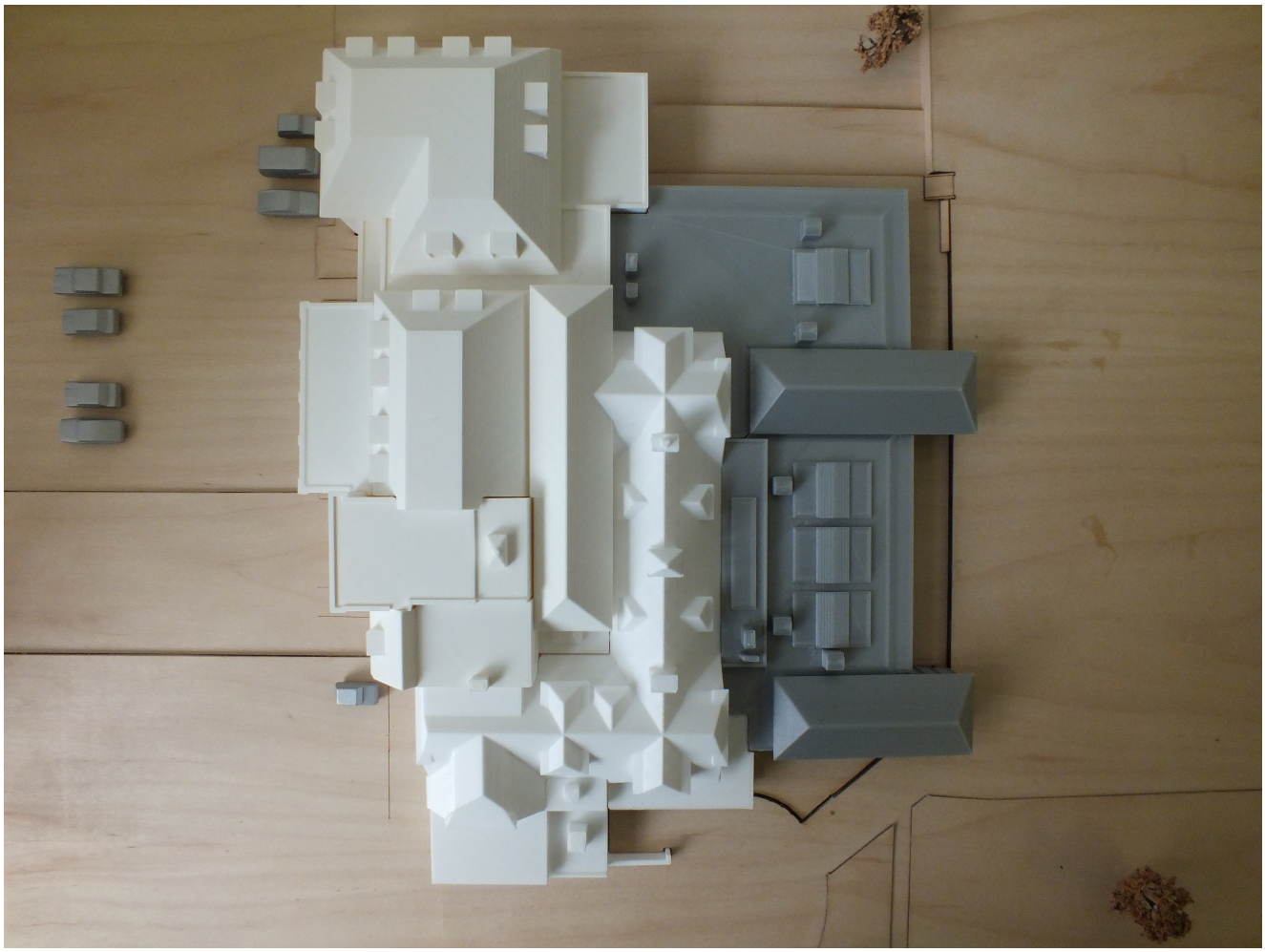


Figure 12
Plan view of Masonic Lodge model

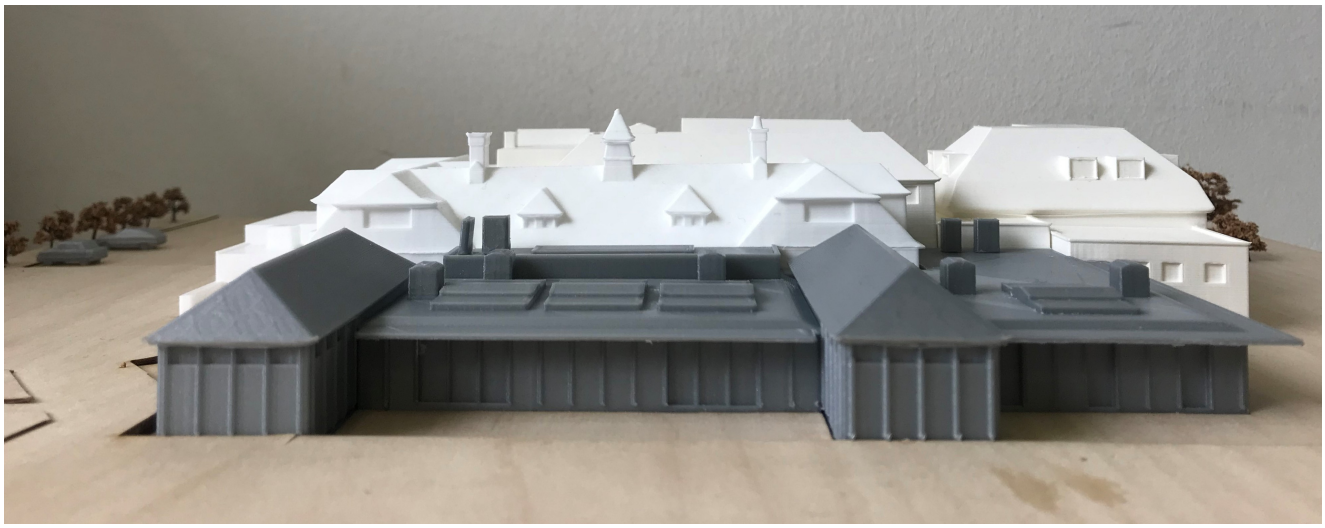


Figure 13
Elevation view of Masonic Lodge model

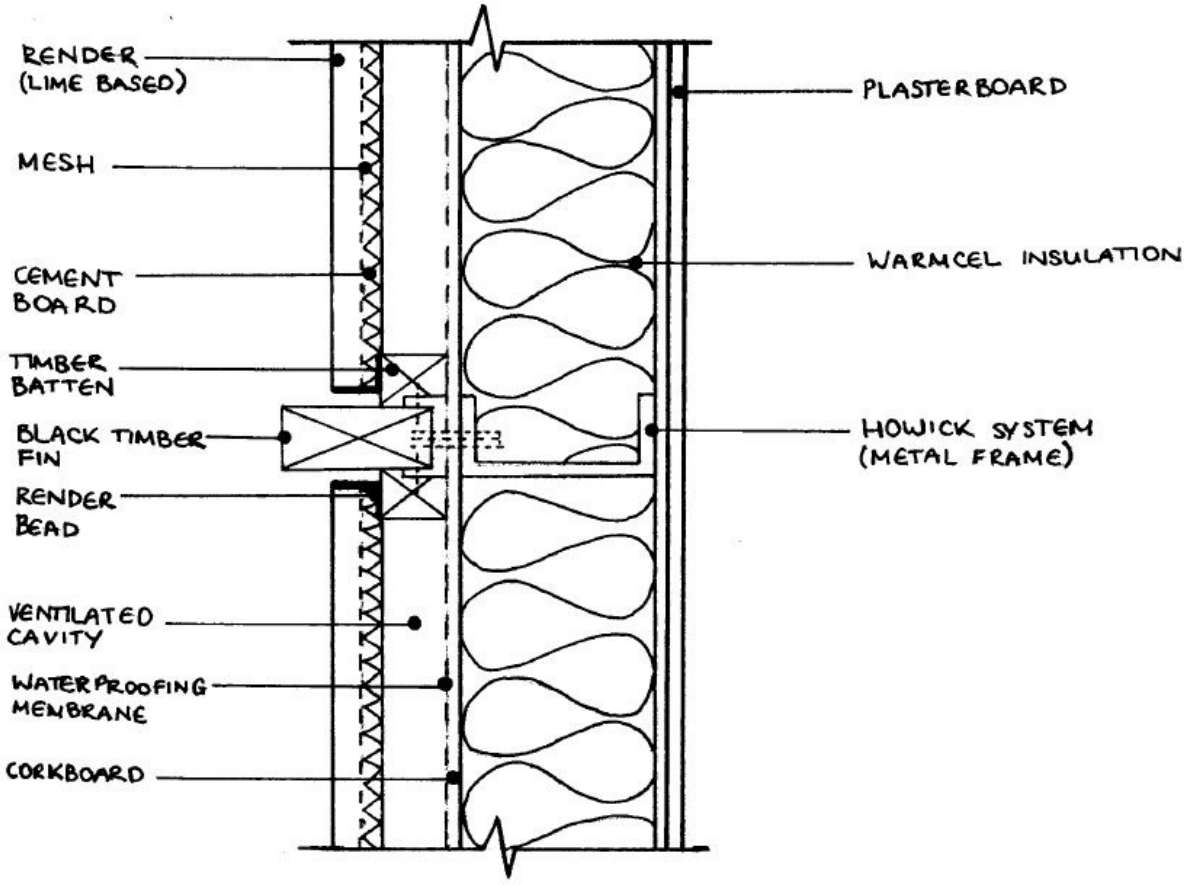


Figure 14
Plan Detail
The Masonic Lodge

Figure 15
Elevation
The Masonic Lodge

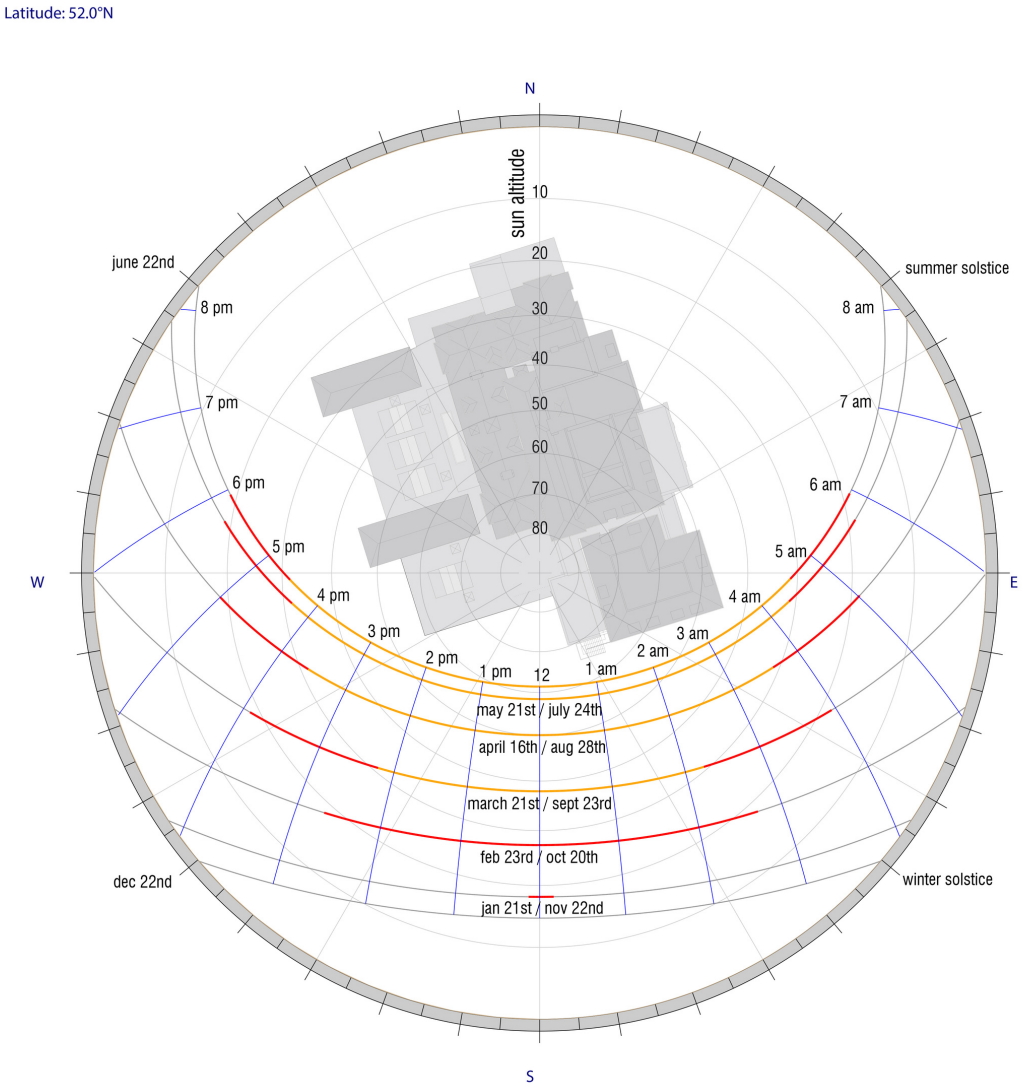


Figure 16
Solar Analysis
The Masonic Lodge

Summary

There is no doubt that we are facing issues of a warming climate, loss of habitats and biodiversity. You can play an important role in helping to make a dent in some of these issues by commissioning consultants who share your values and want to make a difference. A sustainable design will reduce your energy bills, improve the well-being and health of your employees and clients and enhance your brand.

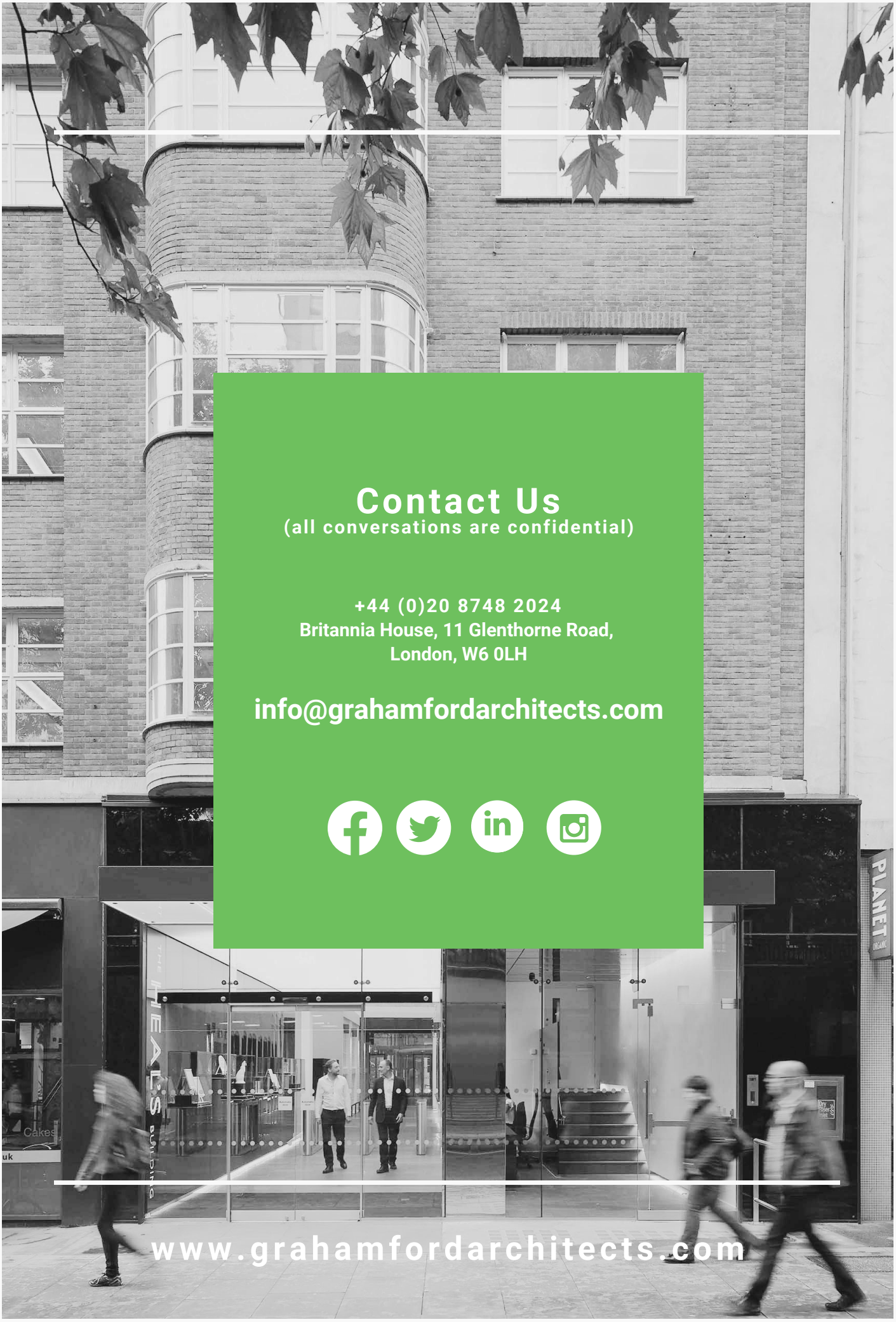
In the United Kingdom, we are fortunate as there is a long tradition of high-quality research in environmental design. To achieve a remarkable building or masterplan, your design team needs to be well-integrated and work together from the earliest stages. As I have shown in my case study for the Masonic Lodge in Harrow, it is when environmental engineering is combined with architecture that remarkable solutions emerge.

The retrofit of your existing buildings to meet sustainability targets and new emissions standards is going to be a major part of upgrading and futureproofing your projects in the very near future. This work requires attention to detail, invasive investigations and a dedicated team to overcome the inevitable tension between energy saving and heritage.

I believe that all buildings should be designed thinking about environmental and structural systems together from the beginning. These ideas should drive how the building form develops in conjunction with the brief from the client. If modern methods of construction can be incorporated into the building design then the project will be more precise and more efficient which will reduce the building's embodied carbon.

Sustainability is mostly about getting the design and orientation of the building correct and we have never had more computational tools at our disposal to help make sure we get this right. There has never been a more urgent time for leaders to get to work and show the way to a brighter, more sustainable future.

*I worked on the London 2012 Handball Arena. The ODA's goal for these large projects was to reduce the concrete carbon footprint by 25%. This was achieved by replacing the amount of mined coarse and fine aggregates, Portland cement, and mix water with recycled materials. Polycarboxylate superplasticizer admixtures were also used to reduce carbon emissions. Crushed recycled concrete was also used as an aggregate source. Other methods used in concrete production to reduce the carbon footprint included using glass sands and recycled concrete fine aggregates, especially for precast concrete.



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