SCOTT BROWNRIGG
DESIGN RESEARCH UNIT

INTELLIGENT ARCHITECTURE \ ISSUE FOURTEEN

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> **“We are the first generation to feel the effect of climate change and the last generation who can do something about it. ”**
> Barack Obama

INTRODUCTION: Architecture and Climate

Despite continued noise from the doubters, the weight of evidence is clear – Climate Change is here and unless we act positively and collectively, it will be existential writes Board Director, Neil MacOmish.

This edition of iA looks at what we can do as architects and designers to contribute to the necessary positive action.

Scott Brownrigg has a long history of making a significant contribution in this regard. From projects such as Red Kite House for the Environment Agency (when environmental and passive techniques were less that fashionable) to major input into forums, webinars, talks, discussions, institutions and general thought leadership, throughout our practice and at all levels of business. These are in addition to our projects.

We have operated at the highest levels – from United Nations sustainable development conference acting on scientific committees, to global talks, presentations and awards (receiving and judging). We are signatories to all of the major initiatives on climate and environmental sustainability. We are well placed with our international projects to affect change and promote best practice across the globe. We evaluate the use of the planet’s finite resources with the upmost seriousness when considering not only our projects, but equally in our day-to-day activities.

The consideration of sustainability requires equal robustness in challenging those three essential pillars – economic, social and environment. These are without doubt, more intrinsically linked now than they have ever been. Some would argue that without tackling the environment and climate, there will be no economics or social fields within which to operate. The ties and bonds between them are complex, subtle and sometimes elusive. It is by no mistake that the first of the UN’s 17 Sustainable Development Goals is ‘No Poverty’. Set against that, there are some on the outer edges of climate activism who would argue that the first point of sustainability is ‘build nothing’. The goals themselves sometimes are in tension – even opposition. But they can act as a touchstone for considering, testing and measuring appropriate development.

The content here looks at how and what we should be considering as designers within the climate emergency. The essays look at process, predict outcomes and suggest tools for all of us to potentially apply to the field of the built environment – the place where it could be argued, we can use our skills to best effect and maximum contribution. There is a perspective here that looks at simpler, historic (vernacular) methods of climate modification and projects them forward – others that look at technological advancement. There is an advocation for those simple (economic) design moves of orientation, fabric first, material choice, passive systems and a community-wide overview that links all our aspects of the everyday in a way in which we might minimise the use of resources whilst maximising a joyful and beneficial experience of our environment. What is clear is that there is no ‘one size fits all’ or a silver bullet that can tackle all of the complex interrelations and interactions between all the constituent parts. But what the projects and strategies shown here do demonstrate, is our collection skill and commitment to collaboration that will provide solutions and the application of best practice to the projects that we are fortunate enough to be involved in ●

RETROSPECTIVE:
What does it mean to be an architect in a climate emergency?

The built environment is responsible for 40% if global carbon emissions and therefore a significant contributor to climate change and its consequences. We now regularly hear warnings that “it is now or never”[1] if we are to prevent irreversible changes to our climate and biodiversity loss. Here, Head of Sustainability Mario Vieira explores what it means to be an architect in a climate emergency.

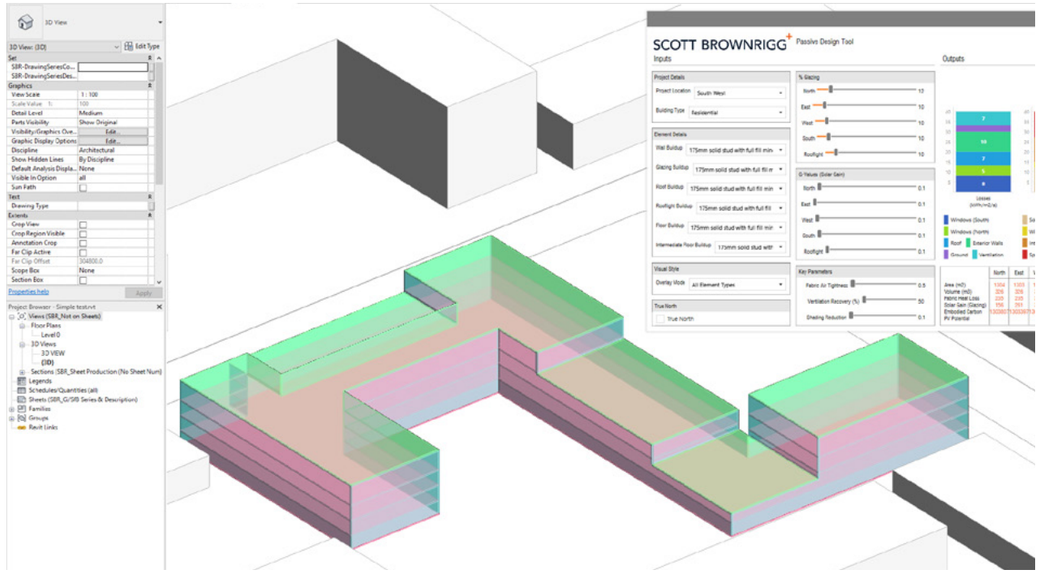
The RIBA Code of Conduct specifically requires its’ members to “consider the environmental impact of their professional activities, including the impact of each project on the natural environment.”[2] It calls on architects to ‘consider the environmental impact’ and ‘use reasonable endeavours’ to reduce it. This is not language of an emergency. Fortunately, we have seen building professionals come together and create movements such as, LETI Architect’s Declare and ACAN, which aim to change the industry at a greater pace. Change is still too slow, but these groups show us the direction of travel.

All this will have an impact on how we approach the design of a project, and how we define if it is successful.

TO BUILD OR NOT TO BUILD

Do we need a new building? There are many threats to the environment, but the greatest is carbon emissions. Buildings are responsible for two types of carbon emissions, embodied (also referred to as up-front carbon) and operational. The first is emitted at the beginning of a project during the procurement and construction of a project. These emissions happen now and at once. Operational emissions occur over the lifetime of a building.

The need to eliminate carbon emissions now has brought a greater focus on retrofit and adaptation. The lifespan of buildings are often determined by economic factors rather than the longevity of the materials. However once the embodied carbon of demolition and reconstruction is factored in, this equation changes. With this information, we are seeing changes to planning policies[3]. At the same time many investors and developers are committing to net-zero pathways and are looking for areas to reduce their carbon emissions. Combined these measures add risk to any project that cannot justify demolition and does not consider retrofit as an option. Campaigns such as the AJ’s RetroFit First[4] celebrate this approach, and are lobbying government to change laws that hamper retrofit.



ABOVE
Scott Brownrigg’s Early Stage Energy Analysis tool

BUILDING PERFORMANCE

In a data driven age, what was once a subjective design decision, is now becoming an objective one. We have measures of social value, embodied and operational carbon. As the tools for predicting and measuring building performance become commonplace, regulations and briefs will adapt to reflect this. We can see through the rise in rise in popularity of Passivhaus that some clients and designers are moving well ahead of minimum standards as they see the benefits such modelling brings to operations of their buildings.

Performance modelling discussed earlier is a useful tool, but not a replacement for real world observation. Our buildings contain data trackers checking air quality, noise levels and occupation. This data, together with post-occupancy evaluations, which allow designers to pick up things data trackers can’t, give us the opportunity to understand our designs better. There is however at time a reluctance in the industry to revisit our buildings in this much detail. This is due, not only to time and to cost, but also in terms of liabilities. Will we be held legally liable if our buildings do not perform as predicted? This barrier results in lessons going unlearnt, and the industry needs a new approach to this issue if it wants make the most of these tools.

Management guru Peter Drucker famously stated that what ‘what gets measured gets managed’. Whether we agree with it or not, it is inevitably this increase in data that will change how we determine the success of a building project. This does raise the question of what gets lost in a design process driven by data, and how do we ensure that those values are not forgotten. Design is always a value judgement. The weighing up of contradictory information and aims. The role of the architect is to use the better quality of data available to make these judgements.

TIMEFRAME AND SITE BOUNDARY

Designing in a climate emergency will require designers to extend the project’s time horizon and its’ site boundary. The idea of ‘building’ tends to have positive connotations. That is why it is often used in political slogans, as most recently demonstrated through “Build Back Better” and “Build, Build, Build”. However, building is also a destructive and violent act. It requires great force and energy to manipulate the site and materials into their final form, and relies on extractive and polluting processes to create the materials required. It operates, as most industries, in a linear economy of extract, use, discard.

In recent years, the idea of a circular economy has been gaining traction with the built environment. This approach requires us to extend the project timeframe by taking into account the life cycle of the building as a whole, and the individual components that make it.

The aim is to reduce the need to replace buildings as often as we do, and to reduce the need for virgin materials when we do build. Of course predicting what will be need in the future is an impossible task, but we can build resilience into our designs. If and when we do not to rebuild,we need to be able to source the materials of our new buildings from our old ones. This will require a structural change in the building industry – from how materials are manufactured, how buildings are put together and how they are valued. It will also require better record keeping and audit trails so the next generation know what they are dealing with.

While technically this is possible now, we need a different relationship between client, design team, contractors and users. Construction is known for its often-adversarial nature and risk aversion. This is understandable as with longer timeframe risk increases while the rewards don’t. We are seeing a number of projects take this approach, which should set a precedent for the industry to follow. →

> “Design is always a value judgement. The weighing up of contradictory information and aims. The role of the architect is to use the better quality of data available to make these judgements. ”

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CABI Headquarters by Scott Brownrigg | Copyright Hundven-Clements Photography

The idea of context and the site boundary is another concept that needs to be redefined when addressing the climate emergency. As designers, we are very aware of the impact our designs have on the local context. Most design presentations and planning submissions begin with a contextual analysis. We know the effect of carbon emissions and pollution are felt well beyond the site boundary. However, the nature of our supply chains means that the impacts of the decision to build and how we build are felt around the globe. These can be positive in that they create markets and jobs, but also opens up the possibility that we may be supporting exploitive practices, both human and environmental. In a climate emergency, the site boundary is global and our design decisions must reflect that.

WHAT IS A GOOD BUILDING?

This article will not aim to answer this age-old debate, but it is worth considering how the climate emergency changes the debate. In recent years, we have noticed a change in judging criteria in design competitions. Many entries require the declaration of carbon and energy performance[5], and some only accept entries for buildings and spaces that have been completed and in operation for a minimum period of time. This is a move away from seeing a building as an object, to something that needs to perform both environmentally and for its users and context. Some may argue that meeting a minimum level of performance, be it in carbon, energy or other areas is a role, for building control and other regulation. However, we need to ask ourselves if, in a climate emergency, it would be correct to reward and celebrate projects that do not respond to the emergency in a positive way.

POLITICAL ACTION

It is evident that there is an increased awareness and action on climate change, but there is still a large gap between what is required and what is being achieved. To address this many are calling for greater regulation, where we might previously have seen the industry campaign against it. Most recently, the Environmental Audit Committee has called for government to stop "dragging its feet" on regulating carbon emission in the built environment. This is a call supported by industry lobby group the UKGBC[6].

Other grassroots groups have been encouraging architects to respond to building regulations consultations, and campaigning to introduce regulations on building related carbon emissions[7]. It is clear that as architects, we work within a system and only through changing that system will the change required occur. Becoming politically active is vital for designers.

WHAT DOES IT MEAN TO BE AN ARCHITECT IN A CLIMATE EMERGENCY?

The architect and designer's role remains to develop the concept in response to the clients brief, and coordinate the design team to make that concept real. It is a collaborative process that requires ever more input from specialist to inform the design. However, some of the biggest decisions with the greatest impacts are those made before a full team is appointed – whether or not to build, to refurbish or build new, the form and orientation. This makes it vital that architects develop a deep understanding of climate factors to sharpen their intuitive decision making in order to prioritise the environmental performance of the building, the site and the wellbeing of those impacted by it.

In From What Is to What If, the author Rob Hopkins describes "climate change as a failure of the imagination"[8]. As architects, we have the opportunity to imagine a different future, go out, and build it ●

1. United Nations: https://www.theguardian.com/environment/2022/apr/04/ipcc-report-now-or-never-if-world-stave-off-climate-disaster
2. https://www.architecture.com/knowledge-and-resources/resources-landing-page/code-of-professional-conduct - Section 13.
3. GLA Life-cycle carbon https://www.london.gov.uk/what-we-do/planning/implementing-london-plan/london-plan-guidance/whole-life-cycle-carbon-assessments-guidance
4. https://www.architectsjournal.co.uk/news/introducing-retrofirst-a-new-aj-campaign-championing-reuse-in-the-built-environment
5. https://www.architecture.com/awards-and-competitions-landing-page/awards/awards-entry-guidelines
6. https://www.ukgbc.org/news/ukgbc-welcomes-environmental-audit-committee-report/
7. https://part-z.uk/
8. https://www.robhopkins.net/the-book/

CURTAIN WALLING

VERTICAL FINS

BRICK / MASONRY

METAL CLADDING

ABOVE
Facarde material choices

PURE RESEARCH:
Journey to net zero: analysing the layers of the building fabric

How can architects design buildings with the flexibility to adapt and respond to our changing world and new ways of inhabiting our homes, whilst also responding to the global climate emergency? Director Nyasa Beale explores.

According to the World Green Building Council, buildings are responsible for 39% of global energy related carbon emissions[1] , a third of which are released from the materials we specify and the construction process of the buildings we design.

The materials that we specify are therefore our greatest opportunity to reduce the impact on the environment significantly and create a huge opportunity for change.

To meet our commitments to the RIBA's 2030 Climate Change Targets, we need to start with the materials.To allow us to do this, we need to analyse the layers of the buildings.When considering each layer of the building we start by investigating the expected life span of the element in relation to its function. Starting with the structure and external skin, which can be designed to last for up to 300 years, down to the furniture and general "stuff" within the space which can be designed to last as little as one month – a direct outcome of our 'throwaway' society.

It is important to change the focus and perception of the materials of each layer.We need to think of our buildings as material banks, designing for easy disassembly and recovery; this will allow us to work towards a true circular economy. Every element can contribute and have a future use.

However, when we analyse the layers in relation to residential buildings, there is often a romanticism associated with ownership of a property and the security of bricks and mortar. How do you focus the mind of the occupier to consider the romantic story to include the use of re-used materials, encourage them to invest in something that has been through a process of evolution and to continue to be a part of that?

Stewart Brand's book 'How Buildings Learn'[2] usefully breaks down the building design into six elements to be investigated. The diagram below demonstrates these layers.

The six layers will age differently whilst in use, however each layer will inform the design of the other five layers. The site will inform the structure and construction sequence, which in turn informs the materials and systems for the skin.The material for the skin will then inform the service requirements, which have a direct correlation to the layout and space plan and, ultimately, the stuff to go within the spaces.It is imperative that each of these elements are taken into consideration in order to create a holistic design for our buildings.

At Scott Brownrigg, our Environmental Sustainability Policy commits us to measure our projects against six key commitments at each stage of the project.These six points can also be used as checkpoints when looking at the individual materials at the beginning of the design process.

- Carbon Reduction – reduce the embodied carbon and impacts on the operational carbon of the material. Taking into consideration chemical content, packaging, transport, manufacturing waste and water consumption.
- Adaptability and resilience – ability to ensure re-use of the material. Taking into consideration design for disassembly and flexibility.
- Resource depletion – availability of the material now and in the future.Taking into consideration availability and transport.
- Equity and social justice – reviewing the life cycle of the material from extraction to delivery to the building site. Taking into consideration materials production, minimum wage for employees and working conditions.
- Healthy/green spaces – exploring the environment that the material will create once in situ. Taking into consideration inviting spaces and spaces that contribute to our wellbeing.
- Circular economy – ensuring there is a future life cycle for the material. Thinking about how can we re-use materials and change perceptions in order to consider our buildings as material banks which can contribute to future development.

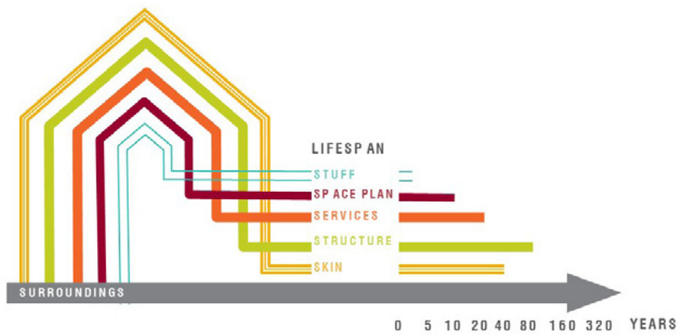
As we take a deeper dive into materials, we understand that the embodied carbon of a product appears to be the most important performance indicator. However, it is imperative that we begin to measure its performance against our six checkpoints, allowing us to investigate the manufacturing waste, water consumption, polluting process, transport, to name but a few, whilst also taking into account the wider equity and social responsibilities.

We have set up a task team to look at materials in relation to these key elements and we are now in the process of developing a material handbook.While the material handbook will be used to guide our specification, we now need to ensure that the suppliers of the materials are signing up to our goals and aspirations.We have to ask them to review their own manufacturing, production and supply principles to ensure they align with ours.

Looking specifically at residential buildings, our material handbook investigates the following materials, which are currently the most common materials used and associated with our residential vernacular; brick, concrete, timber, glass, glass reinforced concrete (GRC) and render. Our material handbook is informing our development of a prototype for what a carbon zero home will look like, adapting to different dwelling types and occupancies.

As we develop this library of information, collectively addressing the issues contributing to our industry's impact on the climate emergency, it is important that we share our findings amongst our peers to ensure that we can deliver our clients' ESG aspirations and improve the built environment for future generations ●

1. https://www.worldgbc.org/embodied-carbon
2. Stewart Brand, How Buildings Learn: What Happens After They're Built, Penguin Books, 1995



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Building layering diagram

RETROSPECTIVE:
What does Inclusion have to do with Sustainability?

I hope our planetary climate and biodiversity emergency is now a given. We need every individual to be contributing to the solution. This inevitably means that inclusion matters to sustainability[1]. In this article, Director of Practice Helen Taylor explores what that means for architects, designers, and the built environment.

The United Nations Sustainable Development Goals (UNSDGs) recognise that inclusion is a driver for change in a range of areas from access to education to accommodating a diverse range of opinions or needs. Making assumptions or generalisations, or failing to consider or consult a whole section of users is going to impact the effectiveness, and therefore the sustainability of your design and project. And we can't afford to waste our efforts.

One example jumped out at me from the book "Invisible Women" by Caroline Criado Perez[3]- a publication I would recommend to everyone, one reason being her excellent evidence pointing to the importance of inclusive research and data on the effectiveness of design solutions. The book includes a particular example of attempts to improve domestic cooking equipment in the developing world since the 1950s. The existing typical "three stones and a pot" was inefficient, polluting, a health risk, and a drain on time. However the alternatives designed and provided didn't actually consider how the stoves were used, where the fuel came from, or the economic context, gendered roles and cultural norms that would determine who operated and maintained them. They ended up unused.

A huge waste of time and resources. Disappointingly, women were blamed for not adopting them rather than the providers trying to understand why they didn't work. Technical solutions alone are not the answer.

Of course, as its title states, Criado Perez's book particularly focusses on issues around gender, but this principal applies to consideration of all the "protected characteristics" defined in the UK Equality Act; disability, ethnicity, sexuality etc. It also needs to extend to addressing poverty or social mobility, or what is currently called the "levelling up" agenda in the UK. Our own commitment to social mobility, and creating opportunities for the next generation, has been supported by our investment in modern apprenticeships in architecture. Diversity and inclusion in our project teams, design briefs, design processes and design solutions has to be part of our drive to address climate change. We all need to be involved.

Kate Raworth's "Doughnut Economics"[4] provides a model, or a "compass" for an inclusive, sustainable future, with the aim of "meeting the needs of all people within the means of the living planet". This concept is based on a social foundation and an ecological ceiling. The space between the two is where we can thrive. We need to transition and adapt to a new social economic and environmental context and that transition needs to be fair. Equity and social justice must be at the heart of action on sustainability. Fairness of the transition to "green jobs" that is underway is being seriously scrutinised by the international energy agency, the International Labour Organisation, banks[5], energy providers[6], and trade unions[7]. The move to a low carbon economy is creating jobs but also causing people to lose well-paid secure work. It is vital to ensure that this individual impact doesn't undermine the need for change and fuel the voices against carbon reduction. We need everyone to feel listened to and part of a positive journey. As architects and designers, we need to communicate an inclusive vision, have empathy, and a plan to address the climate risks and embed resilience in every project we are part of.

> **"Diversity and inclusion in our project teams, design briefs, design processes and design solutions has to be part of our drive to address climate change. We all need to be involved."**

Alongside honesty, integrity and competence, concern for others and for the environment are the foundations of the RIBA's principles of professional conduct[8]. Architects must make informed, fair, and ethical choices. As an international practice and signatory to the RIBA 2030 Climate Challenge and Architects Declare, Scott Brownrigg acknowledges our responsibility, and the opportunity and agency we have, to enrich lives through the built environment. As a signatory to the UN Global Compact, we report annually on progress against our fundamental responsibilities in the areas of human rights, labour, environment, and anti-corruption[9]. We seek to act responsibly and ethically, and understand the broader impacts of our design decisions- whether that is through our design approach to a site and brief, careful selection of materials or products, minimising or managing waste and resources, accessibility standards, or through extensive community or stakeholder engagement or participation. Social value is as →

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Scott Brownrigg Architectural Apprentices

much about the processes of managing and implementing or enabling change, and creating opportunities through that process, as it is the end product. Involving a truly diverse group of stakeholders in the design process should result in projects with higher and more sustainable levels of social, economic and environmental benefit – adding social value. Architecture can improve people's lives, enhance social identity, enable and foster cohesion and wellbeing.

"Sustainable development is only possible with the active engagement of the world of work. Governments, employers and workers are not passive bystanders, but rather agents of change,"

Scott Brownrigg seek to focus on people and communities in our role as place-makers. Professional responsibility and standards, equality, diversity and inclusion, equity and social justice are all an inherent part of our corporate purpose[10]. This year, we are proud to have partnered with the Royal Institute for British Architects (RIBA) to launch the RIBA Scott Brownrigg Award for Sustainable Development. The Award will fund architecture research to address environmental and ethical issues and enhance the quality of life of communities across the globe. We want to invest in emerging talent and develop the new ideas required to address the complex global issues we face today. We welcome your collaboration.

Further reading: Guidelines for a just transition towards environmentally sustainable economies and societies for all, International Labour Organisation[11] ●

1. Why inclusion matters in sustainable projects (apm.org.uk)
2. https://www.iea.org/commentaries/the-importance-of-focusing-on-jobs-and-fairness-in-clean-energy-transitions
3. https://carolinecriadoperez.com/book/invisible-women/
4. https://doughnuteconomics.org/about-doughnut-economics
5. https://www.bankofengland.co.uk/climate-change
6. https://www.sse.com/sustainability/just-transition/
7. https://www.tuc.org.uk/research-analysis/reports/just-transition-greener-fairer-economy
8. https://www.architecture.com/campaign/practice-role-models/scott-brownrigg
9. https://unglobalcompact.org/what-is-gc/participants/139279-Scott-Brownrigg
10. https://www.scottbrownrigg.com/company/about/our-responsibility/1
11. https://www.ilo.org/wcmsp5/groups/public/---ed_emp/---emp_ent/documents/publication/wcms_432859.pdf

ABOVE LEFT
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RIGHT
Museum of Military Medicine

PURE RESEARCH:
‘Smart’ Vernacular

In this article, Part II Architectural Assistant James Smith discusses how we can learn from vernacular design, and explores the ways in which it can be adapted and modernised to provide a smart building solution to help address climate change.

As our environment continues to warm at the fastest recorded rate, our buildings need to respond. Yet our responsibility to ensure occupational comfort may be in conflict with societal responsibilities to reduce energy usage, thereby limiting progress towards more sustainable building stock. In seeking a more sustainable future, it is tempting to look back at pre-industrial buildings as examples of low environmental impact construction and occupation. These vernacular structures have long been admired for their contextual approach, and for the perceived thermal and environmental comfort they achieve. The term vernacular is broad, encompassing a wide range of methodologies and intents. Fundamentally, however, vernacular architecture - understood as an ‘undesigned’ approach - is not viable within modern regulatory guidance. Instead, we can learn from the underpinning principles, adapting them to create a ‘smart’ vernacular.

We need to continue to diverge from the homogenous and ‘alien’ processes that produced the architecture of the International Style. As such following the lineage of Frampton’s Critical Regionalism theory – smart vernacular is a response to the continued influence of the International Style and the abstraction this entailed. Whilst rejecting Ricoeur’s contention that universalization constitutes a destruction of cultural identity,

“ The term vernacular is broad, encompassing a wide range of methodologies and intents. Fundamentally, however, vernacular architecture - understood as an ‘undesigned’ approach - is not viable within modern regulatory guidance. Instead, we can learn from the underpinning principles, adapting them to create a ‘smart’ vernacular. ”

this article follows Rapoport’s widely accepted theory on the development of vernacular architecture; that buildings were structured around cultural usage. Hence, each space was iterated to be thermally, visually and spatially suitable for the specific social purpose.[1] This leads to a point raised by Mario Vieira in the first edition of iA, that sustainability is far broader than energy performance of a singular building.
To create better buildings, the usage of spaces, their required thermal performance, and understanding changing patterns of usage can contribute to the improvement of the wider built environment.Therefore, vernacular in this article is reconsidered as a process of design based on contextual knowledge and greater incorporation of occupancy experience. This needs to further connect the architect as ‘master builder’, with the wider social and tortious responsibilities of the profession.

However, this reinvention as ‘smart’ vernacular is based on applying the theoretical approach whilst underpinning with contemporary technology and data. The use of Digital Twins can help achieve this. In doing so, the architect can produce responsive designs that meet the needs of building users better, contributing to a reduction in environmental impact. An area of particular focus is the thermal performance of buildings, improving the efficiency of which can have significant impacts on lifespan environmental impact.

In this way it can counter the repercussions of the International Style; challenging dogmas such as the indiscriminate application of air-conditioning. These hangovers from an age of environmental naivety are symptomatic of reckless, unthinking design which has contributed to the current environmental crisis and corollary political tensions.

Learning from the vernacular praxis, spaces should be arranged according to the environmental and thermal properties required; considering the differing relationships between adjacent spaces aligned with lifestyles. Effective application of this could enable symbiotic heating and cooling of differing spaces within buildings. The necessity for flexibility in space usage has been expedited by changing work patterns in the pandemic, hybrid models accommodate these. Thus, we have a chance to design buildings for a new way of life.

Scott Brownrigg’s Design Strategy Unit is a data driven service to improve the occupational efficiency of buildings. By focusing on the provision of space that is needed and the timetabling of functions Design Strategy Unit can reduce the area of building needed, thus the required materials and energy are reduced. However, the work done by Design Strategy Unit needs designers to translate data into physical manifestations that are comfortable for end users – to *design* it. This is a professionalisation of a process at the core of Rapoport’s defining of vernacular. Applied effectively within the design process this could help reduce the lifetime emissions of buildings.

Vernacular buildings provide thermal comfort through minimising extremes of the contextual climate, creating conditions of greater comfort, for example by raising dwellings off the ground to allow cooler air to be drawn through the building. Use of passive cooling methodologies like this are an effective contributor to thermal comfort - contemporary analysis demonstrates using passive cooling strategies appropriate to →

ABOVE
Vista

climatic context can reduce annual energy consumption by up to 23%.[2] Smart application of these developments, would enable modern building typologies to respond to increasing temperatures without increasing energy need.

This effect on internal comfort is similar to the impact produced by air source heat pumps, which are a key part of the strategy to improve the environmental performance of the UK's building stock. The use of heat pumps is the flagship policy on heating homes within the government's Net Zero Strategy policy paper. Unlike current heating and cooling methods heat pumps provide ambient temperature air to smooth the peaks and troughs of internal temp efficiently. Whilst this method would be considered by Ricoeur a problematic standardisation - it is a contextually applicable approach suitable for UK climates, and one which can be applied retroactively to traditional building typologies.
At a societal level, any design approach that limits the required energy needed to heat or cool buildings must be given consideration, especially given current cost of living increases.

In developing these principles within the work of the practice, Scott Brownrigg's design led approach has already started to consider innovative approaches. The design of Vista Chelsea Bridge illustrates how a 20th century typology – the apartment block – can be adapted, incorporating characteristics from traditional British housing. The environmental impact of deep balconies with large areas of planting is an increase in thermal mass on the roof of units below and additional shading of the façade resulting in a reduction in solar gain. These balconies also serve to increase the quantity and quality of outdoor space provision, often a challenge in the apartment block typology. Integration of these external spaces is likely to reduce the cooling required in occupation, contributing to reduced lifetime carbon emissions from the building. However further long-term analysis of the building's performance would be needed to fully understand the impacts.

While historically buildings were built by those that then inhabited them, in contemporary construction often the designer is ultimately abstracted from the end user. As such, the first-hand understanding of the performance of spaces is removed. Within vernacular architecture, this connectivity between construction and use enabled progression to be made within localities to maximise the comfort achieved. In order to replicate this cyclical learning, smart vernacular must utilise modern systems to reconnect design with occupation, learning to better future building performance. In this article's reconsideration of vernacular, the emphasis is less on understanding of construction but giving control and knowledge of the building performance to users. The Government Soft Landings methodology seeks to reduce running and capital costs by up to 20% by engaging facilities management at an earlier stage of the design process, however the impact of this approach must be supported by ongoing monitoring of building performance.

This should be developed further within the remit of architectural contracts. Greater emphasis of the benefits a RIBA Stage 7 service can provide both to clients and in learning to architects is supported by Chartered Institution of Building Services Engineers guidance document TM54. This seeks to standardise processes that provide data to feed back into the design process, iteratively improving the performance of designs through normalisation and quantification of best practice. Additional methodologies, both quantitative and qualitative, should become part of an enhanced Stage 7 to understand occupancy satisfaction and comfort with the design of the building.

Greater opportunity for monitoring comes from upcoming changes to CDM regulations which will introduce requirements for information on the as-built state of buildings. This information will have to be accessible and updated as modifications are made to ensure continued compliance with regulations. This is a key opportunity to further connect buildings and occupants, empowering informed occupation.

Whilst this article does not advocate a prescriptive or checkbox methodology, it creates an overarching thought process that can be applied flexibly to a wide range of contexts. It also illustrates how combining the approaches we are already using can bring about greater change. In looking to reduce our carbon footprint, the reapplication of 'smart' vernacular principals can help our future buildings fit to face the climate crisis ●

1. Weber, W., & Yannas, S. (Eds.). (2013). Lessons from Vernacular Architecture (1st ed.). Routledge. https://doi.org/10.4324/9780203756164
2. Hanan M. Taleb, Using passive cooling strategies to improve thermal performance and reduce energy consumption of residential buildings in U.A.E. buildings, Frontiers of Architectural Research, Volume 3, Issue 2, 2014, Pages 154-165, ISSN 2095-2635, https://doi.org/10.1016/j.foar.2014.01.002.

FURTHER READING

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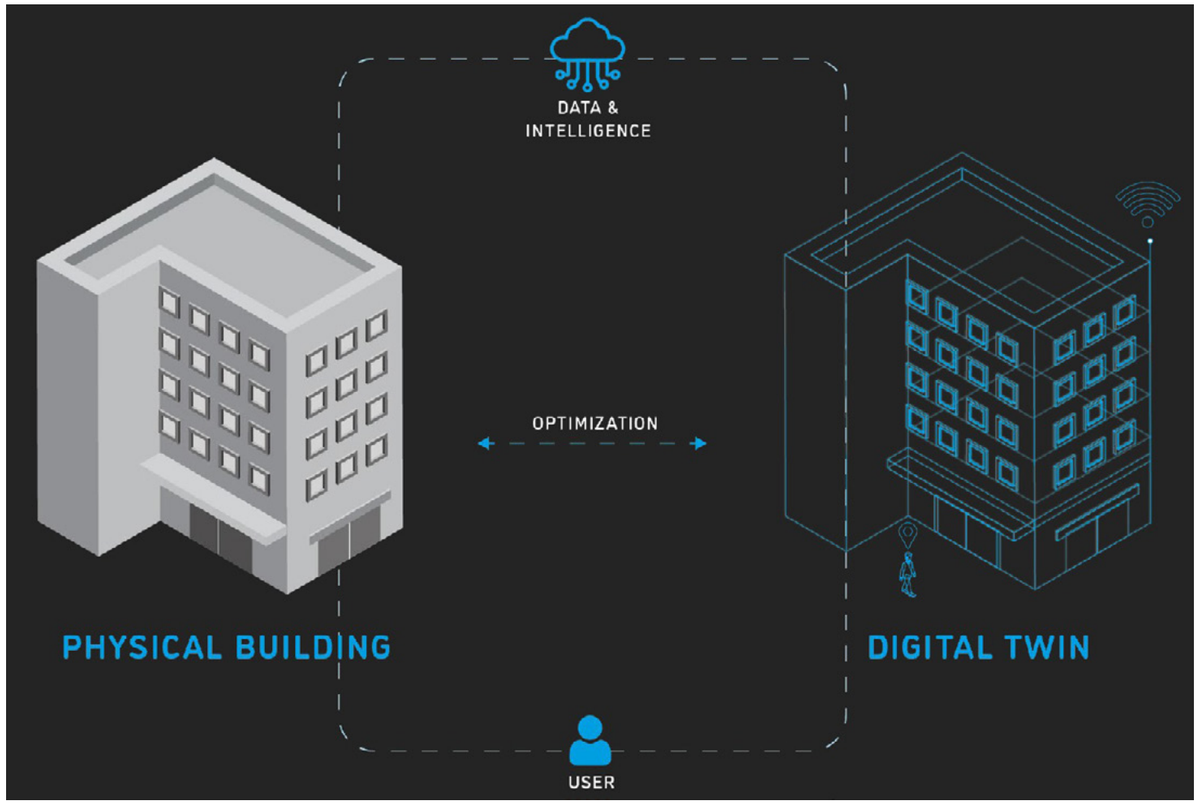
ABOVE
Natural air ventilation terminals, St George's College, Weybridge



ABOVE
Digital Twin concept

PURE RESEARCH 2:
Climatically astute modular construction

Modern and Modular methods of construction have acknowledged benefits associated with quality of product, programme efficiency and health and safety on construction sites. It is also hoped that the carbon footprint of modular buildings should be less than traditional methods. However, the deployment of modular construction in prefabricated house and apartment types could benefit from more intelligence in design in order to be climatically responsive. Rob Cullen and Annabel Chapman-Smith look at how a projects orientation and siting can inform modular architecture to be more responsive to climate in order to make cost effective and comfortable buildings.

“So how can modular housing typologies contribute towards solving the climate and housing crisis?Part of the answer may lie in breaking the perception regarding the longevity of buildings constructed modularly and also by presenting innovative ways to ensure that the manufacture of the building components take place near to, or indeed on the development site.”

MODULAR CONSTRUCTION IN THE UK

In the UK, the climate crisis does not just involve challenges brought about by global warming. We are also facing a social and economic climate crisis evidenced by the fact that there is currently a shortfall of supply of homes across the UK, with, according to Shelter England: “17.5 million people being denied a safe and stable home.”[1]

As a society, we are in dire need of a solution to the housing crisis, a solution that needs to deliver homes, create jobs and enhance the wellbeing of communities whilst being intelligent in its response to the wider challenges faced with global warming.

Sadly, housing shortages in the UK are not a new thing. In the years that followed the Second World War, there was an immense need for new homes to be built. Under the Housing (Temporary Accommodation) Act 1944, Sir Winston Churchill’s government allocated £150 Million pounds to produce 300,000 pre-fabricated, or modular, homes which was achieved by the utilisation of factories previously allocated for the production of weaponry.[2] Whilst pre-fabricated houses provided much-needed homes, they were not intended to be permanent and designed to last only 10 years.

RECENT DEVELOPMENTS IN UK MODULAR CONSTRUCTION

Recent developments undertaken in the housing sector of the construction industry include the creation of modular dwelling typologies. Scott Brownrigg have worked with hatch. to develop a CLiCs System, which provides modular building solutions for both houses and mid-rise apartment buildings. CLiCs is essentially a steel framed building system, which is fabricated under factory conditions and then delivered to site.

It allows modular buildings to be developed to provide a variety of configurations to suit the site constraints and conditions.

So how can modular housing typologies contribute towards solving the climate and housing crisis?Part of the answer may lie in breaking the perception regarding the longevity of buildings constructed modularly and also by presenting innovative ways to ensure that the manufacture of the building components take place near to, or indeed on the development site.

One of the main criticisms of late twentieth century modular construction in the UK was a lack of contextual response in the design process. For example the concrete pre-fabricated buildings of the 1960’s have fairly similar appearance to one and other, and were not fine-tuned to local climatic conditions.

For example - window aperture sizes in some of these buildings were standardised for UK buildings - wherever the buildings were to be constructed be that in the south of the country or in the far north. ‘Invisible standardisation with a high degree of customisation underpins our core CLiCs principles.’[3]

Modular building components such as the CLiCs are system are evolving so that they can provide contextually responsive architecture which can be clad in contextual, locally sourced materials which can be considered to be a betterment in terms of carbon used to transport materials to the locations where building components are being constructed. →

ABOVE FROM TOP
Figures 2 & 3 hatch. two and three bed apartments
Figures 4 CLiCs unit as it arrives on site and then clad

MODULAR CONSTRUCTION AND CARBON REDUCTIONS

The benefits of factory conditions and modular design, which were utilised post war, also support a reduction in carbon. As factory conditions allow for safer working conditions and greater control of workmanship, it is easier to ensure the quality of interface details, improve efficiency of the design and air tightness of buildings. All of which will increase the thermal performance of the building and therefore reduce the operational carbon. 'The hatch. goal is to help create quality and low carbon homes using considerate construction methods.' hatch. are achieving this through:

- Reduction in the number of lorries to site
- Reduction in the number of days on site
- Reduction in the amount of waste to landfill"[4]

Offsite construction can also reduce the embodied carbon in several ways. As well as an overall reduction in waste, it is also easier to reuse and recycle any waste products. There is a marked reduction in construction transportation - it is estimated that there are 70% fewer transport movements overall for a modular home built off-site.[5]

Most modular buildings are constructed with steel frame technology, which can provide a reduction in carbon footprint in comparison to a reinforced concrete building especially if the steel has a high recycled content.With a modular construction, it is also easier to refine, optimise and standardise the structural design through prototypes and testing and therefore reduce amount of steel used.

Additional opportunities could be delivered through exploring the use of timber in lieu of the steel in order to reduce the carbon footprint of the modules and taking advantage of the high level of workmanship to design to PassivHaus standards and further enhancing the thermal performance.

FINE TUNING THE RESPONSE OF CONSTRUCTION TO CLIMATE

Finer tuning of the design of modular building components (or rooms) can be informed by the analysis of parametric data which can be tailored to suit the geographical location of a project along with the buildings orientation. By optimising the design of components in this manner there is the potential to promote health and wellbeing within the building by providing appropriate lighting and heating levels within the building whilst optimising operational energy usage.

LETI guidelines prove to be very helpful in informing the sizing of windows and apportioning the materials on the facades of a modular constructed building before it goes into manufacture. This is because they provide guidance on areas of glazing provision for various building typologies and the orientation of facades.

To further improve building façade efficiency, careful consideration should be made in relation to the sizing of windows in order to ensure that the building can achieve an appropriate portion of natural ventilation. BIM software can be utilised to size windows and ensure that rooms are orientated appropriately and the optimum level of thermal insulation provided in order to create a comfortable, energy efficient building envelope.

Parametric modelling provides an almost unlimited potential for buildings to respond to their context, and constructed by economically viable and sustainable methods.The precision of assembly in factory conditions and the use of BIM software can combine to further minimise material wastage. Hatch. have developed an Urban Developer software application h.UD 'that utilises real-time plot data to model how schemes can be placed and developed on any given site. Using hatch modules to build the scheme out (akin to Minecraft) enables live construction costs and viability testing for multiple design iterations'.[6]

"As factory conditions allow for safer working conditions and greater control of workmanship, it is easier to ensure the quality of interface details, improve efficiency of the design and air tightness of buildings. All of which will increase the thermal performance of the building and therefore reduce the operational carbon."

MODULAR CONSTRUCTION AND SOCIAL CLIMATE

Whilst physical climatic conditions are important, construction projects and buildings also need to be responsive to the social contexts where they are located in order to be a success. The social climate where buildings and places are created is also of paramount importance in creating sustainable places. Modular construction can create the potential to create highly skilled jobs locally to the locations where buildings are constructed. Modular building factories can be created in close proximity to the construction sites for large scale regeneration projects. This strategic decision promotes local job creation for the duration of the construction phases of a project.

The climate in the UK is diverse and differs depending upon where you are in the country, as does the availability of local materials and skilled labour. Consequently Local vernacular architecture styles constructed by local crafts and trades people have evolved so that architecture creates regional identities and contributes to distinctive places within the UK.

If materials are locally sourced, buildings can be contextually responsive, and benefit from reductions in embodied carbon; there is of course the potential to provide employment for local crafts people to work on some of the construction, for example the external envelope of buildings, so that the resultant buildings are locally constructed and befitting to their contextual surroundings ●

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7. https://www.hatchmodular.co.uk/manufacturing/#factory

ABOVE TOP TO BOTTOM
Steel frame being constructed in the factory
Modular unit as delivered on site

RIGHT
Completed modular dwelling

DESIGN PROCESS:
Visions and values.
The intelligence behind the drawing.

Here Director Bruce Calton, and Senior Urban Designer Lucy Fineberg explore the importance of holistic thinking in creating masterplans that are truly reflective of people, place and culture, and how this informs our approach at Scott Brownrigg.

Taking a holistic approach in considering all facets of design is imperative when approaching site and development. Every aspect, when considering a design, interacts with every other part –leaving out key design objectives leaves an incomplete approach. Juggling all of these positive aspects of strategic urban planning design is necessary to ensure the collective outcome is place specific, responsive, brings social value, and has a clearly understood narrative.

We witness many 'meeting the minimum' objectives, guidance and targets, but we aim to deliver greater than these baseline objectives. We look to find and curate the rich textures and tapestries of a place, unearthing the influences of the first move in any design, and seeing these expressed in the emerging settlement. How a place emerges and develops into the future, how residents can take ownership, and how interventions add value to the lives of communities is imperative. We should be leaving a positive legacy to any intervention we make.There are many aspects of masterplanning, the following seven key themes underpin our approach towards holistic design:

1 – First Move Principles

STRATEGIC DECISION MAKING FORMING A DEVELOPMENT

Our research stems from understanding why settlements are located where they are from a, geography, climatic, socio-economic, ceremonial, and technological perspective. This understanding can help shape emerging strategies for the completely new settlement and expansion.

We read place through history, and try to understand what is unique about the proposed site and its surroundings. This includes settlement strategy, heritage and history informed by literature such as Historic England's Understanding Place: Historic Area Assessments guidance[1], legibility, existing buildings and features, and permeability. All of which contribute to the process and decision making of visioning places that are rooted to the ground on which they emerge.

It is also important that we identify existing stakeholders, understand their interest in the development, and build upon this meaningful influence proactively. Often, development is undertaken at such a pace, that the traditional process of establishing communities is put on a fast track and under strain. Our aim is to smooth this process through clear settlement strategies, understanding of the existing demographic, and how these elements mesh to create a new place. Establishing 'Meanwhile Spaces during the programme is one such way of engaging with a place as it emerges.

According to the Meanwhile Foundation, "When it works, it creates pride, a sense of achievement, a can-do approach, and a more vibrant, interesting place for the people that live and work there, now and long into the future. That's the real power of Meanwhile use."[2]

On the contrary, some developments can take decades to complete, and this period is crucial to the success of the scheme. We aid in developing community resilience by creating 'Meanwhile Spaces as part of the overall vision and incorporating these as part of the first move strategy. Meanwhile Spaces are temporary interventions that provide the platform for communities to mature and grow while development is in progress. We aim to move, integrate, and foster communities as they evolve through development phases that can take decades to be realised.

This alongside local colloquial referencing 'Landmarks' by Robert Macfarlane'[3], and understanding the rich tapestries of places demonstrates a need to engage with place in a more profound way, unearthing existing and emerging identity, and how they interact and blend.

ABOVE
Town centre analysis

2 – Density

SEEK APPROPRIATE DENSITY FOR LOCATION, WHICH SUPPORTS PROSPEROUS POPULATIONS AND EFFECTIVE SOCIAL INFRASTRUCTURE

Density is key to the commercial viability of shops and services, and is a place-specific delicate subject. We aim to understand the key themes of the location, while encouraging future place preservation with sustainable higher density.

As a sensitive topic, density is often considered through two threads - existing and emerging. Where emerging density is contrary to existing it brings about conversation of what the intentions for a place should be, and whether the future and the past can sit together in harmony. Building communities requires critical density to allow for lively centres and social hubs, which thrive and support job creation, upskilling, and community engagement. In addition, density is often considered without reference to potential further development beyond the immediate red line boundary, with an industry approach taking overly-sensitive edge treatment as a key factor in decision-making. Emerging density needs to be understood holistically to avoid a series of developments which work as independent unconnected and disjointed islands.

The red line is an invisible boundary of current intervention, and should not be treated in isolation. Understanding context and strategic intent will lead to appropriate, place specific densities. These have a fundamental impact on the sustainability of the development, and the ability to provide improved lifestyles where people can work, learn, and play locally to where they live.

Finally, increasing density promotes and supports sustainable forms of infrastructure and transportation; opening up alternative options away from traditional modes of transportation, and shortened distances to travel and supply water and utilities. →

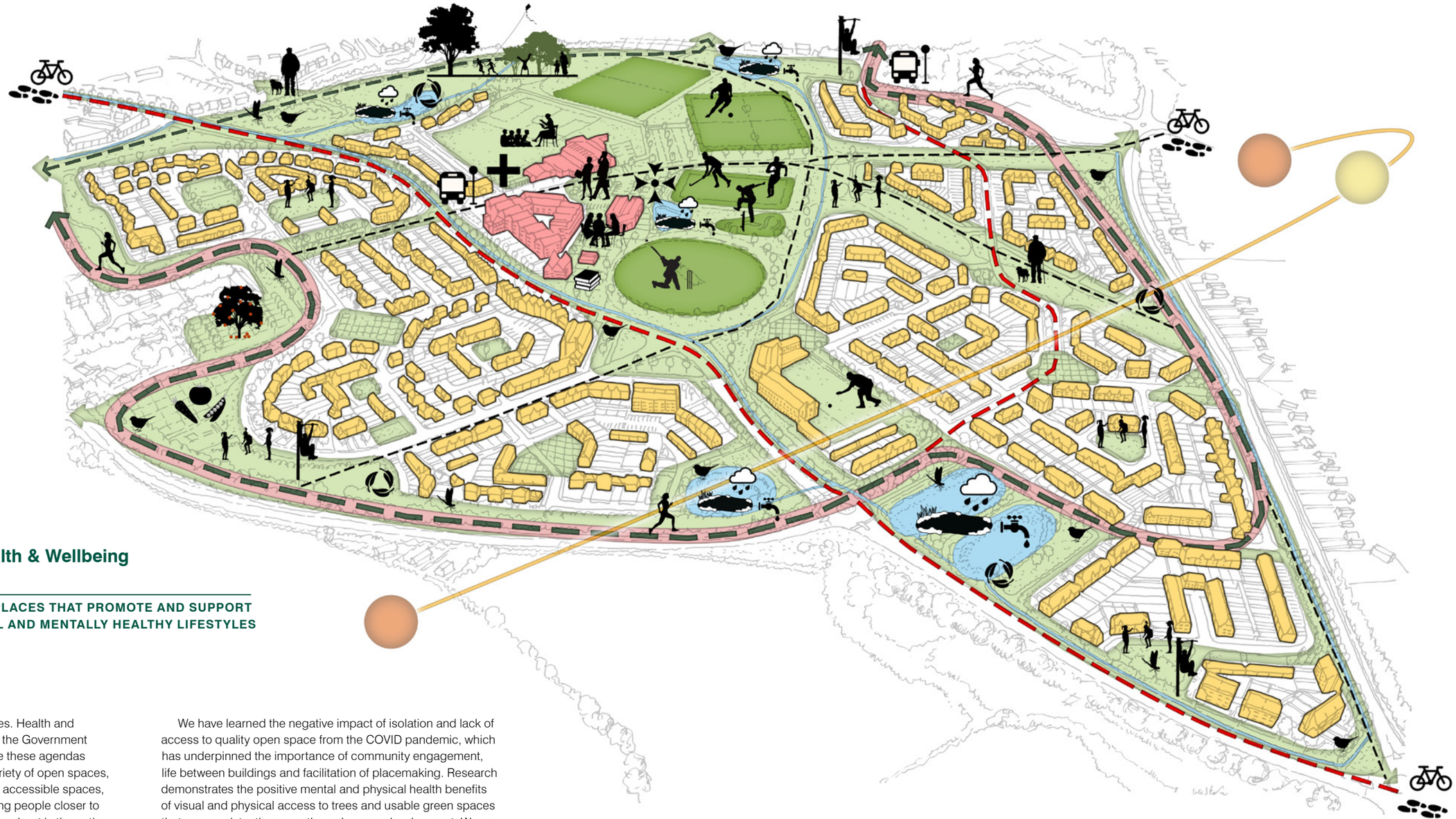
3 – Health & Wellbeing

DESIGN PLACES THAT PROMOTE AND SUPPORT PHYSICAL AND MENTALLY HEALTHY LIFESTYLES

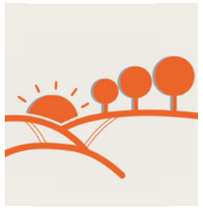
People are at the centre of creating places. Health and Wellbeing has become a key agenda for the Government across all design, and we aim to promote these agendas through inclusivity, access to a broad variety of open spaces, community food production, shared and accessible spaces, active design, and environments that bring people closer to nature, regardless of location. Laced throughout is the notion of creating safe streets and communities, achieved through passive surveillance and overlooking, and the avoidance of alleyways and dead ends as described in Death and Life of Great American Cities by Jane Jacobs[4]. Our project, Land West of Bersted, demonstrates this thinking, where we have implemented a 5km wellness trail with fitness and activity stops, with a strong cycle network which links to the countryside, direct access to activity routes, and a diverse sport led landscape with a community sports hub. These facilities contribute as a benefit to the existing wider community as well as the emerging settlement.

We have learned the negative impact of isolation and lack of access to quality open space from the COVID pandemic, which has underpinned the importance of community engagement, life between buildings and facilitation of placemaking. Research demonstrates the positive mental and physical health benefits of visual and physical access to trees and usable green spaces that are consistently woven through a new development. We are therefore keen to deliver key notions, such as the 3, 30, 300 rule as proposed by Cecil Konijnendijk van den Bosch[5], where every resident should be able to see 3 trees from their home; 30% canopy coverage after 20 years should be provided in every neighborhood, and every home should be within 300m from a park or green space. Providing dedicated routes for walking and cycling, health trails and reduction of car usage for a more densely populated area, promotes improved air quality health benefits accessible from each and every home.

Our design agenda aims to plant a design seed and nurture it through community engagement, learning of place, co-design, and listening to what communities' desire from emerging settlements. →



ABOVE
Land at West Bersted wellness provision diagram



4 – Landscape

DESIGN WITH LANDSCAPE AND NATURE LEADING THE VISION

Landscape provides the green lungs for cities and settlements, and offers benefits ranging from reduction in the heat island effects and flood resilience, to supporting health and wellbeing through access by communities to high quality, useable green open spaces. Life takes place in the spaces between the buildings, from informal interaction, to organised community led events as highlighted by Jahn Gehl in Life Between Buildings: Using Public Space[6]. Landscape provides great opportunities to create meanwhile spaces while settlements mature and develop (*https://www.meanwhile.org.uk/resources/17-meanwhile-space-10-years-in-practice*), and is the melting pot which balances each of these aspects and blends the uses so there is a layering of reason and meaning to the design. Our project, Deal Ground and May Gurney, undertook a water-led landscape, and promoted connections to varying types of landscape through different and seasonal conditions. A boardwalk was designed over the flood plain, to provide access and engagement with the space through wet and dry conditions, while making a light touch intervention on a sensitive water landscape.

Strategic landscape design is pivotal to the health and wellbeing of populations, enhancement of flora and fauna, and the planet as a unified existence (**The Biodiversity Metric 2.0 (JP029)**, Natural England). The large tree provides sensory input, and shelter from climate, balances the water table, provides food and habitats for a variety of fauna, and supports the balance of the ecosystem as well as an object for play and recreation, exploration and education. Landscape is the ultimate example of multi-use space design, and provides a key platform for environmental resilience and potential for decarbonisation.

5 – Adaptation and Resilience

NARRATE A PROJECT THAT IS ABLE TO ADAPT TO SOCIAL, ECONOMIC, ENVIRONMENTAL, AND TECHNOLOGICAL CHANGES IN THE FUTURE

Appropriate development and change are inevitable (and welcomed) as time progresses. While it is key to design for the needs of the present day, it is crucial to consider the potential changes that are predicted or unforeseeable and to adapt thinking to deliver alongside COP26 objectives to reduce emissions by 78% by 2035 and achieve Net Zero by 2050.

Direct allowance for predetermined changes is not possible for the future unknown, but the design can provide enough flexibility and adaptability to support the future and create a positive legacy. Unforeseen changes in the human condition, such as medical and technological advancement, find us living longer and living in a more accessible world.

These changes have proved to be a strain on the environment (as seen during the global pandemic), so it is important to progress into the future in a way that allow for changes in the human condition and for the built environment to support the planet.

Job insecurity and skills gaps is an issue that can be tackled through job creation, training and apprenticeships provided within developments and interventions. Social hubs within developments can provide a strategy for community workspace engagement, where people can work and share ideas in a positive collaborative environment, this reflects our new work habit and evolving culture. Whilst we have also experienced the slow and delayed effects of our impact through progress, so are conscious of proposals that encourage working with context and environment for the present and potential future conditions.

Our efforts to engage with improvements to landscape and biodiversity (**The Right Tree in the Right Place for a Resilient Future – Urban Tree Manual**, Forestry Commission and Forest Research) underpin an overall target to create greater resilience to climate change and flooding (**Flood risk assessments: climate change allowances,** Environment Agency, 2020), while providing nature and landscape lead health and social benefits to existing and emerging communities.

6 – Sustainability

UNDERTAKE THE SUSTAINABILITY PRINCIPLES SET OUT BY SCOTT BROWNRIGG, AND EXCEED TARGETS SET NATIONALLY AND INTERNATIONALLY

Promotion of healthy lifestyles across all aspects of the community is key, responding to the climate crisis and aiming to deliver a decarbonised economy is critical. Choosing to develop greener sustainable movement networks (**Inclusive Mobility, Making transport accessible for passengers and pedestrians**, Department for Transport, 2005) that connect integrated neighbourhoods within a 15 minute walkable neighbourhood support self-sustaining economises and a diverse range and scale of economic activities. Alongside strategic considerations which affect the potential sustainable credentials, a fabric first approach is adopted to ensure long-term efficient buildings (**Future Homes Standards changes to Part L and Part F of the Building Regulations for new dwellings**, Ministry of Housing, Communities and Local Government), with an avoidance of bolt on solutions.

We feel passionately about understanding sustainable advancement that avoids quick fix solutions, which often have a short lifespan, and become waste products (and more embodied energy).

While aiming to achieve net zero carbon status in our buildings and built environments, our focus is on promoting effective use of land for settlements and communities (**BREAAM Communities**), which are fundamentally sustainable and that promote decarbonisation. This includes understanding how people live their lives, and how where they live influences the decisions they make. We carefully consider existing buildings for their embodied carbon value, and whether they can be retained for their social or cultural value, repurposing where possible, and whether embodied carbon in redevelopment can be reduced. In addition, reducing parking allowance is unlikely to reduce car usage, but providing a day-to-day means of undertaking actions and tasks that is not dependant on needing a car, such as higher density and walkable neighbourhoods, possibly can.

7 – Governance

THERE ARE NUMEROUS STATUTORY GUIDES SET TO PROVIDE CLEAR CRITERIA AND DEFINITION OF BASELINE STANDARDS AND OBJECTIVES TO BRING FORWARD A MASTERPLAN

There is guidance setting the minimum requirements for masterplanning, however we look to exceed these minimum standards by considering what happens to a place once the intervention completes through Governance. Governance is crucial in supporting the potential success of a settlement as it is part of the management of how a place and community will settle and interact after the project has completed. It is the gateway to community engagement and support to social value achievement. We aim to understand what the aim of legacy is, and how quality, care and activity can be ensured in the future. What is this new place and how can a community settle in and take ownership in the same way that historical settlements have achieved cohesion. Our interests lie in the blending of past and future, to form a harmonious outcome, whilst recognising that the building process is only the first step in the journey of history yet to be made ●

ABOVE
Masterplanning and Urbanism Principles

1 Historic England, Understanding Place: Historic Area Assessments, Historic England 2017
2 Dr. Garyfalia Palaiologou, Meanwhile Space: Ten Years in Practice, Meanwhile Space 2019, pg 8
3 Robert Macfarlane, Landmarks, Hamish Hamilton 2015
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DESIGN PROCESS: Considerations for the future of sustainable cities – Cardiff as a case study

Using a proposal that reimagines Cardiff as a sustainable city, Part II Architectural Assistant Lara Miller explores the issues and opportunities that can arise when adapting cities for the future.

All around the world population is increasing, in particular within cities. Current urbanisation rates are causing great damage not only to the planet's health but also to the well-being of its inhabitants, since cities produce large amounts of pollution. Adapting cities to become economically, socially, and environmentally sustainable is a necessary step in transitioning to a sustainable future. Without sustainable cities and cities of the future, there will be no sustainable world. This article will discuss ways in which we can adapt cities to aid in the fight against climate change.

Many cities, including Cardiff, have set targets to become carbon neutral by 2030. This will take radical action. Cardiff currently is a three planet city, meaning if everyone lived liked its residents, we would require three planets to be sustainable. The Welsh Well Being Act and the Environment Act have stated that Cardiff is to reduce carbon emissions by 57% by 2030, however startlingly few strategies for achieving this aim, were set out and these may not be enough alone. As part of my M.Arch studies at The University of Bath, five students and I developed a proposal that reimagines Cardiff as a sustainable city of the future. As a result of this project, examples will be provided to demonstrate how issues and opportunities will arise when adapting cities for the future.

ENERGY

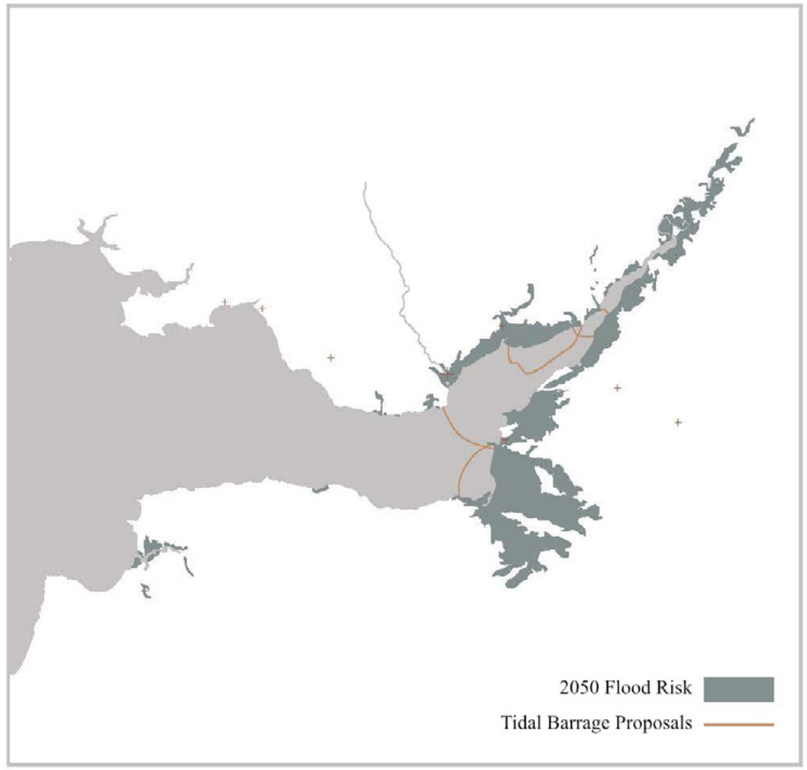
In the light of Climate Emergency, there is a need for bold moves to meet the high demand for renewable energy. More than 70% of carbon emissions from final energy use can be attributed to urban areas. The choices made to organise our energy infrastructures will have long term effects and will lock us into specific ways of living.There are multiple options for implementing sustainable energy systems, and the combinations are almost endless. Regardless of what technology is used the vision must equally benefit the population within this shift. The technology is only part of this solution; changing the behaviour of users is of key importance. A truly smart move is to make a solution not just an option, but the default option.

Cardiff uses approximately 7TWh/year of energy, making it by far the highest energy consumer in Wales. Most of which is derived from non-sustainable sources. The team and I decided that, because of this, the Severn Estuary Barrage, which has been debated by governments for decades, hypothetically would be implemented. During the development of the project the team did not take this decision lightly. It was heavily debated considering both the arguments for and against its implementation. Furthermore we considered ways in which we could mitigate its impact. Ultimately, the positive arguments outweighed the negative. Sustainability is often about balance, there is no perfect solution.

Cardiff once provided energy for the whole world. As we read more about Cardiff's history, we came to realise how important coal is to its story. Given this, we thought it appropriate that Cardiff take primary responsibility for the Severn Barrage - could the region's excess energy be exported to the world, allowing energy to drive the city's economic growth, just as it once did with coal? What does the future look like for energy-centred cities?

There is a shift away from fossil fuels toward renewable electricity. While that is undoubtedly good news, electricity is difficult to transport and store, rendering it unsuitable for air travel, heavy industry, and shipping.To solve this, hydrogen could be produced from excess electricity. While this is less efficient than using electricity directly, hydrogen's relative ease of storage and transportation means that even industries for which direct electricity use is inappropriate can be powered from renewable sources.

By far one of the most space-efficient techniques of generating electricity is the barrage.The same level of energy creation by wind farms would require over 30,000 times the space. Much of Cardiff's city-centre land has been neglected and underutilised, leading to investors' aversion to investing in flood-prone areas. By building the Severn barrage, the city would be saving approximately 430 hectares of brownfield site from flood risk, freeing it up for investment. Furthermore, looking at the existing development proposals for Porth Teigr, which has a known area and GDV, we could extrapolate that the GDV of the land we're saving would be worth approximately £16 billion. Not only this but we calculated that even though has a very high upfront cost relative to other methods of producing energy. When considering how long it lasts and how little maintenance it requires, it becomes evident that the barrage is one of the most cost-effective ways to generate electricity.



ABOVE
Severn Estuary 2050 Flood Risk Map

FLOOD

Due to rising sea levels, it has recently been estimated that much of the UK will be underwater by 2050 if no action is taken. According to a research, by 2050, 30% of Cardiff will be submerged at least once a year. The city will also continue to be affected by extreme fluvial flood events. This has left doubts over the future of the city. While the UK's coastal waters pose an existential threat, they are also an important component of the cities' identity. Coastal cities' ability to find a balance between engaging with and defending against water will determine their future.

In Cardiffs' case, while the Severn Barrage greatly reduces flood risk, it does not eliminate it. To mitigate fluvial flood risk, the team researched 'sponge cities', which make use of sacrificial green spaces to attenuate water-level fluctuations. One example that we used as precedent is a proposal for San Francisco Bay, home to very low-lying and vulnerable communities, which are simultaneously growing rapidly and lacking adequate housing and transit connectivity. Sponge cities have great potential. They can help soften the impact of floods, improve water supply and quality and help aid in fixing other environmental problems. Sponge city techniques can be integral components of a comprehensive restorative design strategy to treat polluted river water and restore the damaged waterfront in an aesthetically pleasing manner. When dealing with flood risks, both fluvial and tidal flooding should be considered.

The issues Cardiff face are bigger than one part of one city. As part of the project a framework was developed that could be applied to all the major cities along the Severn Estuary, ensuring that all in the area take advantage of its positive aspects and mitigate against its negative aspects. This combination of tidal power and hydrogen fuel creation allowed us to design a scheme that dealt with flood risk from tidal flooding. →

EXPERIENCING A CITY

During the process of a masterplan design it is important to acknowledge that there will be existential issues, highlighted through research. Often these can surround subjects that been previously discussed. However, there are also experienced issues within a city that often can't be understood properly without visiting the city and learning how the people within it live and what they need the city to be for it to have the capability to perform sustainably.

Cardiff is a city of contrasts. It is both busy and quiet, ambitious and relaxed, beautifully landscaped and overly developed. We chose to use this theme to create a short film about our experience in the city. Upon experiencing the city through different perspectives, it became clear that the city was orientated towards trav-elling by car, trains and buses far more than it was orientated towards travelling on foot or by bike, similar to many other UK cities.

The prioritisation of coal transportation and the establishment of rail and canal connections in the early 1900s' led to the fact that today the city is divided. This goes beyond physical separation; the railroad repre-sents not only a physical, but also a social division. At the micro level, the communities were separated by rail lines and roads with emphasis on the vertical axis, which prevented east–west permeability.

When considering the health of an entire city, air pollution must be factored in. The World Health Organisa-tion recommends not reaching pollution levels above 10 μg/m3. Cardiff regularly exceeds this level, creating unhealthy living conditions for its residents. This is mostly due to car use. Throughout Cardiff there is a high presence of on-road parking is, much to the detriment of the city's urban design. The vast majority of people in Cardiff are increasingly traveling by car. It is no surprise, therefore, that satisfaction with transport in the city is decreasing. The main complaint? Public transport facilities, followed closely by cycling facilities.

Cardiff Central is the busiest station in Wales. However, this piece of large infrastructure has little permea-bility. It is a barrier to the north-south movement and is physically exaggerated by the social divide between the city centre and the waterfront area. In the course of the project, the team developed additional transport networks that would facilitate connections between the city centre and the bay region, as well as reunite many communities. In cities, we must address transport infrastructure, and the current focus on road transport will only exacerbate the climate emergency. Cities should have community-based infrastructure, along with enough space for vehicles such as cycle tracks, electric buses and park and ride schemes. These are only some options to consider.

URBAN SPRAWL

Despite having better access to green space, the north of the Cardiff is not immune from biodiversity loss. A growing population means that the city is expanding, and greenfield sites currently bordering the north of the city are being cleared for development. Expansion is not necessary for population growth, however; the density of Cardiff (2,500 people per km2) is less than half that of London (5,701 people per km2). The current local development plan hopes to create an additional 29,201 homes by 2026, by predominantly building on greenfield sites.

Only 6.5% of the proposed development areas are brownfield sites, some which are at signifi-cant risk of flooding. The residents in Cardiff expressed their dislike of the surge in high rise construction which has taken place over the last decade. Density and housing types within the new masterplan were considered carefully. This raises questions over the density of the city; too much low-density development has created the urban sprawl we see today, and too much high-density is seen negatively by the local population.

We estimated, given population projections, that Cardiff would need to build 50,000 housing units by the end of the century. Given available brownfield space available due to the mitigated flood risk and desired densi-ties, we establish that the locale designed within should hold 11,500 dwellings. Work done in the research phase of the process indicates that there is plenty of space for this. If cities take the necessary action to prevent flood risk, this will majorly reduce urban sprawl. Often a city will not need to expand in this way to fit in the growth of a population, as proven in the Cardiff masterplan.

It is vital that when designing spaces for people to live in we must consider the amenities that also go along with this appropriately. For example, 100 local residents are required to support one small coffee shop. When designing the masterplan we came up with a method of mapping, aiding us in discussing where there is space designated for the population increase we also made sure the amenities were either already available or if not, provided. It is important to calculate that there will be enough doctors, schools, leisure space, etc to ensure that the scheme can be successful.

CONCLUSION

As shown, there are many factors that need to be considered to create a sustainable city, this is only a small proportion of opportunities that could be considered. The masterplan for Cardiff delved into further detail, looking at habitats, incentives for locales to live sustainably, design of public space and much more. No one solution is perfect and every city must be treated in its own right. Thorough research must be done to under-stand how each individual city can engage in becoming carbon neutral and reaching those ambitious 2030 targets. Cities cannot work without the infrastructure needed by the communities in them, creating a sus-tainable city is routed in the people and aiding the way we live to reduce the impacts on the planet ●

“ Sponge cities have great potential. They can help soften the impact of floods, improve water supply and quality and help aid in fixing other environmental problems. Sponge city techniques can be integral components of a comprehensive restorative design strategy to treat polluted river water and restore the damaged waterfront in an aesthetically pleasing manner. When dealing with flood risks, both fluvial and tidal flooding should be considered. ”

ABOVE RIGHT
Cardiff Masterplan Imagery - Highlighting multipurpose public space, reconnecting the cities inhabitants

RIGHT
Cardiff Masterplan Imagery - Highlighting Transport Connections

A Scott Brownrigg Design Research Unit publication
September 2022

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