Llywodraeth Cymru
Welsh Government

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Practice Guidance

Planning for Sustainable Buildings

July 2014

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Wales Planning Policy Development Programme

This practice guidance was prepared for the Welsh Government by the Design Commission for Wales.

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Digital ISBN 978 1 4734 1399 3

WG 22631

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Introduction

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Introduction

The planning system plays an important part in improving the sustainability, including the energy performance, of new developments whilst helping to address the impact of climate change. As set out in Planning Policy Wales (PPW) the planning system must provide for new homes and buildings in a way which is consistent with sustainability principles.

Buildings have an inherent environmental impact and contribute to carbon emissions. They consume natural resources in their construction and use, and the way in which they are designed has a significant effect on how occupants use and maintain the building over its lifetime. The way in which buildings are planned for and designed can also reduce vulnerability to the effects of climate change and help secure development that is more sustainable.

Building Regulations set mandatory standards for the design and construction of buildings, which include aspects of health, safety and environmental protection. They are updated periodically to reflect changes in required standards and development in technology.

This Practice Guidance to Planning for Sustainable Buildings aims to assist Local Authorities, developers, clients, decision makers and delivery teams by promoting the routes to better sustainability outcomes for deliverable projects of various types.

The Best Practice Project Timeline (Section 4.3) provides an overview of the key considerations at various stages in the evolution of a project. It signals considerations for all the actors in a project team and for decision makers. The timeline is helpful in highlighting where and when opportunities for good design quality, building performance and sustainable outcomes can be maximised for added value.

2

Wales: Planning Context

2

Wales: Planning Context

PPW sets out the land use planning policies of the Welsh Government. It is supplemented by a series of Technical Advice Notes (TANs). Procedural advice is provided in circulars and policy clarification letters. PPW translates the Welsh Government's commitment to sustainable development into the planning system, so that it can play an appropriate role in moving towards sustainability.

PPW (4.4.3, 4.7, and 4.12) sets out the Welsh Government's land use planning policies in respect of planning for sustainable buildings in development plans and development management. It does not establish a higher national building standard than Building Regulations, but encourages local planning authorities (LPAs) to seek opportunities to do so on strategic sites. TAN 12: Design, is the primary guide to achieving good quality sustainable design.

Each LPA in Wales must prepare a Local Development Plan (LDP) for its area. LDPs contain local planning policy including the allocation of development sites. LDPs may also include site specific development principles, which could incorporate sustainable building standards higher than Building Regulations for particular locations (PPW 4.12.5). In order to do so, LPAs should demonstrate, through robust and credible evidence that the policy is realistic and does not impact on the deliverability of development (see LDP Manual: Soundness Tests, Section 8.3.1).

LPAs may also produce Supplementary Planning Guidance (SPG), which could outline how these development principles should be applied (LDP Wales, Chapter 5; LDP Manual 7.3.5; TAN 12.6.5). LPAs may achieve higher building standards by referring in LDPs or SPG to well recognised sustainability assessment techniques.

3

Wales: Building Regulations

3 Wales: Building Regulations

On 31 December 2011, the Welsh Government became responsible for new powers and functions related to the Building Regulations.

The Building Regulations set standards for design and construction which apply to most new buildings and many alterations to existing buildings. They ensure the health and safety of people in and near buildings, including responsible use of energy.

In Wales, adherence to and compliance with Building Regulations is checked by Building Control Bodies. There are two types of Building Control Bodies - Local Authority Building Control provided by each of the local authorities in Wales, and private sector Approved Inspectors. The option is available to choose one of the two to ensure that building work complies with the Building Regulations.

Practical guidance on how to comply with Building Regulations is provided in Approved Documents. These contain guidance on the performance expected of materials and building work to comply with Building Regulations, along with examples of ways to achieve compliance for some building situations. The Approved Documents cover different topics and are titled Part A – Part P. As guidance is reviewed and changes are made, separate Approved Documents are published.

Part L (Approved Document L) of the Building Regulations covers requirements with respect to the conservation of fuel and power, and is therefore the most relevant of the Approved Documents to planning for sustainable buildings.

It is essential that compliance with Part L is considered and assessed at a preliminary stage in the development of a project, as it will have an impact on many aspects of design. Best practice would be for the developer and design team to consult the Building Control Body prior to a planning application being made, and this is highlighted in the Best Practice Project Timeline (Section 4.3) in this Practice Guidance.

Further reading:

> Building Regulations Wales
http://wales.gov.uk/topics/planning/buildingregs/?lang=en

Further reading available via the Planning Portal; Association of Consultant Approved Inspectors website and Local Authority Building Control websites.

4

Purpose of this Practice Guidance

4 Purpose of this Practice Guidance

4.1 Planning for Sustainable Buildings

This Practice Guidance is one of a series of guides published by the Welsh Government as tools to support LPAs implementing national and local policy and considering planning applications. It is intended to assist the delivery of good quality, well designed, energy efficient homes and buildings which positively contribute to townscape and landscape, and which help capture public value and the wider benefits of sustainable development.

This Practice Guidance to Planning for Sustainable Buildings aims to assist LPAs, developers, clients, decision makers and delivery teams by promoting the routes to better sustainability outcomes for deliverable projects of various types. The guide is intended as a useful prompt and methodology for use in seeking the most sustainable building solutions.

Use of the guide will assist greater collaboration between LPAs and developers, in bringing forward sites during plan making and through proactive discussions at pre-application stages.

4.2 The Benefits of Sustainable Buildings

Building sustainably and designing, procuring and delivering good quality sustainable buildings and neighbourhoods is important for our economy, quality of life, environmental stewardship and climate change resilience.

Planning for sustainable buildings is a vital part of the process, and if done well, will capture significant benefits and help to ensure that the planning system effectively *'…manages the development and use of land in the public interest, contributing to the achievement of sustainable development (PPW 1.2 What the planning system is for, 1.2.1).*

The benefits of good sustainable design include:

- Efficient use and management of materials and natural resources
- Long life buildings which cost less to maintain and hold their value
- Good energy performance which reduces consumption, wasted energy, expensive bills and running costs for businesses and residents alike
- Good, comfortable places to live and work which support well-being and aid workforce productivity
- Healthcare environments where patient experience is better and recovery times are faster
- Education environments that enhance learning outcomes
- Good homes, neighbourhoods and green spaces that support quality of life, well-being and public health
- Improved biodiversity and landscape networks
- Greater access to green infrastructure which encourages healthy, active lifestyles
- Excellent development practice which is good for business and property values

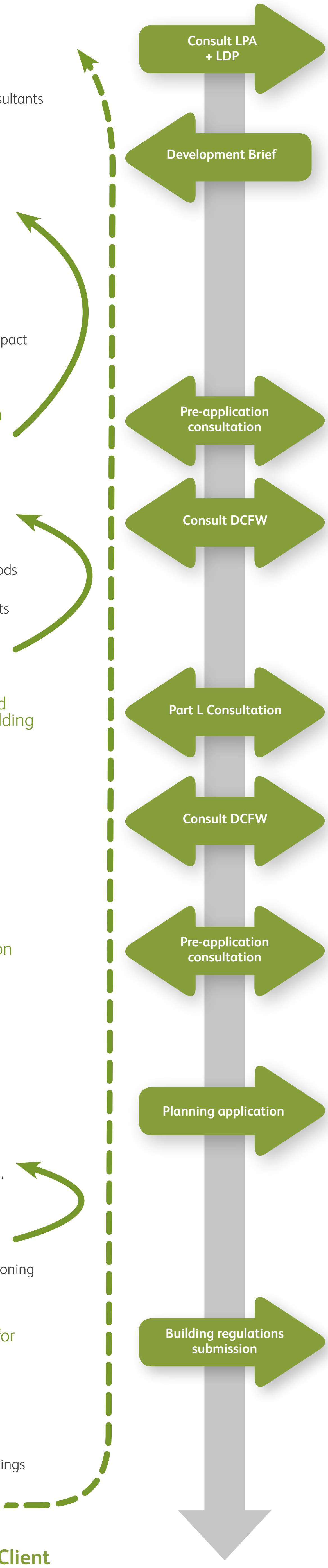
4.3 The Best Practice Project Timeline

Considering sustainability approaches from an early stage will help with setting appropriate sustainability targets for development. Continuous review of sustainability measures is conducive to an integrated design approach, and avoids the need to add potentially costly technologies at a late stage. It will also help to ensure that targets are met, and that the building delivered, performs as expected.

The Best Practice Project Timeline outlines the various elements of planning for sustainable buildings which should be considered by developers, designers, LPAs and Building Control Bodies, through the different stages of development. The timeline is not intended as a checklist, as the exact approach will differ between projects. It aims to demonstrate the importance of early and continued consideration of sustainability in planning for and delivering sustainable buildings, and the need for clear communication between developers and authorities, particularly at pre-application stage. The RIBA Plan of Work 2013 stages are mapped onto the timeline as a rough guide to assist with project programming. Users of the guide should remember that design is an iterative process, and that some steps shown in the timeline will need to be repeated and re-tested to improve design, quality and sustainable outcomes.

The timeline is not intended as a checklist, as the exact approach will differ between projects. It aims to demonstrate the importance of early and continued consideration of sustainability in planning for and delivering sustainable buildings, and the need for clear communication between developers and authorities, particularly at pre-application stage.

Sustainable Building – Best Practice Project Timeline



RIBA PLAN OF WORK

0+1

- Check LPA policy and LDP progress. Engage with LPA on LDP sites
- Site selection
- Appoint design team and other consultants

LDP sustainability appraisals for areas of growth and strategic sites

- Set brief, targets and outcomes

Consider sustainability approaches when preparing development briefs for allocated sites

- Consider lessons learned from previous schemes
- Discuss procurement and funding which will deliver outcomes
- Surveys: topographical, ecological, arboricultural etc
- Site appraisal and Environmental Impact Assessment (EIA) if appropriate

- Refer to Practice Guide: Realising the Potential of Pre-Application Discussions http://wales.gov.uk/topics/planning/policy/guidanceandleaflets/preappguide/?lang=en

Initial pre-application discussion of wider planning issues

Initial pre-application discussion of wider planning issues

2

- Optimise site layout and building form and orientation
- Consider passive design strategy, building services, construction methods and materials
- Preliminary performance assessments
- Results of assessments inform design process

- Establish stakeholders for public consultation

Initial discussions with Approved Inspector or Local Authority Building Control about Part L

Initial discussions with Approved Inspector or Local Authority Building Control about Part L

- Review procurement options and construction methods
- Develop biodiversity mitigation and enhancement strategy
- Consider sustainable drainage and water management

3+4

Further pre-application discussion of detailed planning issues

- Pre-planning Part L/interim performance assessment

Further pre-application discussion of detailed planning issues

Make planning application: to include justification of sustainability design process

Local Planning Authority assess planning application, checking for justification of sustainability design process

- Detail design for environmental performance: airtightness, insulation, cold-bridging, overheating
- Detailed building services strategy
- Detailed performance assessment
- Specify building handover, commissioning and post occupancy monitoring

5

Submission to Building Control for Building Regulations Approval

- Implement and review best practice site management
- Handover, commissioning and user training

6+7

- Post occupancy evaluation/soft landings
- Feedback lessons learned to future projects

Building Control assess for Part L compliance

- Building Control site inspections
- Local Planning Authority assess for sign-off of planning conditions
- Building Regulations sign-off

Developer/Project Team/Client

Local Authorities/Decision makers

4.4 Considerations for Local Development Plans (LDPs)

LDPs must follow national planning policy and LDP policy guidance in their content and preparation. As noted above, PPW sets the broad framework and context for LDP policy on sustainable buildings. TAN 12 outlines further tools and criteria for establishing good design policy in LDPs. TANs 5,8,15 and 18 also contain elements useful for determining what should be included in a local sustainable building policy.

Local circumstances may provide opportunities for LPAs to set local sustainable building requirements on strategic sites in LDPs. LPAs are able to explore the potential in LDPs to promote the underlying objectives of Welsh policy, moving towards more sustainable and zero carbon building in Wales.

Areas of Growth

An important feature of the LDP system is the emphasis on identifying and testing realistic strategy options which may include significant areas of change and growth. A Sustainability Appraisal (SA), including a Strategic Environmental Assessment (SEA) is required at this stage of the LDP (LDP Manual 6.4). Potential areas of growth should be assessed for their contribution to climate change resilience, including their potential for energy efficiency, minimising carbon and other greenhouse gas emissions associated with their location, design (including siting and orientation), and use. This should provide an indication of which growth areas make the better overall contribution to sustainable development.

The SA may signal opportunities for selection of growth areas that lend themselves to the delivery of sustainable building standards higher than the minimum in Building Regulations. This may, for example, include locating sites of specific uses together, making community heating schemes more viable, or identifying sustainable locations near existing or potential sources of renewable energy.

Further Reading:

- Practice Guidance: Planning for Renewable and Low Carbon Energy – A Toolkit for Planners
  http://wales.gov.uk/topics/planning/policy/guidanceandleaflets/toolkitforplanners/?lang=en
- Practice Guidance: Planning Implications of Renewable and Low Carbon Energy
  http://wales.gov.uk/topics/planning/policy/guidanceandleaflets/planningimplications/?lang=en

Strategic Sites

LPAs will identify some sites in their LDP that are critical to the implementation of their vision and strategy (LDP Manual Section 6.5.1). PPW sets out guidance on the selection of sites in order to deliver sustainability (PPW 4.7). TAN 12 (6.5) notes the opportunity for strategic sites to meet higher sustainable building standards than those required by Building Regulations. The SA of the LDP will also apply to strategic sites and could identify their potential to deliver higher sustainable building standards through site specific or locational characteristics. In order to accord with LDP soundness tests, these opportunities need to be considered alongside other site-specific requirements, including affordable housing, and an associated assessment of the overall deliverability of the allocated development.

The Annual Monitoring Report (AMR) of the LDP is a useful tool for monitoring the continuing viability of allocated and newly proposed sites as the plan progresses, including the impact of any local sustainable building requirements. Circumstances that indicate a significantly faster or slower implementation of sites may trigger an LDP Review (LDP Manual, Section 9). If the AMR/Plan Review indicates that site viability has improved. This may offer opportunities for increasing sustainable building requirements, supported by robust evidence.

TAN12 states that the ability of a major or strategic development site to meet higher sustainable building standards will be dependent on the opportunities and constraints present. For example, higher densities and mixed use developments may make community heating, cooling and power (and reducing energy from transport) supplied by low/zero carbon technologies both technically feasible and financially viable. These technical factors are explored in later sections of this guide.

During plan development and before the publication of the Proposed LDP Strategy, LPAs should initiate discussion with developers and landowners of possible growth areas and strategic sites to help assess their potential for delivery while meeting higher building standards. They should also encourage work with local communities to identify opportunities for achieving higher sustainable building standards on strategic sites.

Good practice would suggest that the LDP identifies such standards in development principles associated with each strategic site in the LPA area. This would need to be accompanied by appropriate evidence of viability. Any subsequent SPG, including development briefs, urban frameworks and/or master plans referring to such locations, should demonstrate how these principles or standards have been applied.

Local Requirements for Sustainable Buildings

When proposing any local requirements for higher sustainable building standards planning authorities must be able to provide sufficient justification through a robust evidence base.

TAN 12 states that local requirements should:

- Be set out in the LDP so as to ensure examination by an independent inspector. This is so that standards and requirements are properly consulted on and tested to ensure their ambition reflects local potential and are deliverable
- Be specified only in terms of a specific level against a recognised sustainable building standard such as BREEAM and not seek to identify individual categories or credits in any such scheme
- Ensure they are consistent with current and anticipated future changes to Building Regulations and/or other relevant national policy changes
- Be considered and consistent with the key objectives of good design
- Relate to a specific area or site and include justification

In preparing policies in an LDP which seeks higher sustainable building standards, TAN12 also states that LPAs will need to establish:

- The proposals are evidence-based and deliverable, having regard to the overall costs of bringing sites to market (including infrastructure and affordable housing where relevant) and the need to avoid any adverse impact on the development needs of communities
- The need for the proposed greater than minimum sustainable building standards
- The costs and benefits of delivering these standards
- The specific opportunities of the proposed development and/or site, which enables the achievement of higher sustainable building standards

When preparing such policies, LPAs would benefit from considering the impact of any sustainable building policies or principles in the LDPs on neighbouring authorities and likewise, the impact of their LDP proposals on neighbours. It may be that aligning strategic sites across boundaries could enhance the sustainable building benefits of each site.

LPAs following good practice should be able to provide appropriate advice to landowners, developers and communities on the implementation of these requirements and how they will be monitored and enforced through SPG.

4.5 The Role of LDP Development Principles and Design Related SPG for LDP Strategic Sites

Development plans should 'signpost' specific local design issues and requirements (TAN 12, 6.20). Good practice indicates that LDPs incorporate an outline of the particular infrastructure and community needs that are sought in areas of major growth and on strategic sites. These could include site specific local standards of sustainable building design, where there is robust evidence to support them, as noted above. Additionally, LDP design policies could highlight specific aspects of sustainable site design which should be considered early on in the development process (Section 5.2 of this guidance).

TAN 12 sets out the potential design solutions to reducing a development's environmental impact, and for example, minimising its demand for energy, water, materials and the creation of waste. These can be used as a guide to setting parameters of what is sought on a particular site to achieve the best possible sustainable building outcomes.

Where there is a requirement for a master plan or other relevant SPG, LDP development principles should set the framework for the developer to clearly demonstrate application of site specific local sustainable building policies with appropriate site analysis and visuals.

The principles of good design and the approaches suggested in this Practice Guidance, offer useful means of setting out such parameters and for testing them in detailed plans.

4.6 A Prompt for Developers and Designers

This Practice Guidance is intended as a prompt for developers and designers throughout the planning, design and delivery stages of a development. It will help developers to set goals for sustainable building outcomes at an early stage, maximising their value, and then to follow these through. This is not intended to be a detailed manual for designing sustainable buildings and building services, but outlines key issues for consideration and points to sources of more detailed information.

4.7 Early Pre-application Communication and Discussion

This Practice Guidance encourages regular communication with LPAs to promote the coordinated delivery of sustainable building within the context of the relevant LDP. The topics covered in this Practice Guidance can be used as a useful prompt during pre-application discussions between developers, designers, LPAs and the Design Commission for Wales. Developers should satisfy themselves that Building Regulations Part L and other sustainability targets will be reached. In the materials submitted in the planning application, the approach to sustainable buildings can be clearly demonstrated, well justified, based on proper analysis, and tested through modelling.

As noted above, and on the Timeline (Section 4.3), the most successful sustainable building outcomes come from early discussion on proposals and sites with the LPA and in particular during the formation of an LDP (LDP Manual Section 6). These discussions should assist in the early assessment of the sustainability and deliverability of a proposed LDP allocation and start the evidence-based approach required to justify its inclusion. It is the process by which the impact of potential site specific, local sustainable building policy, on a site's viability, can be considered. A similar process is recommended for any LDP Review.

5

Approaches to Sustainable Buildings

5 Approaches to Sustainable Buildings

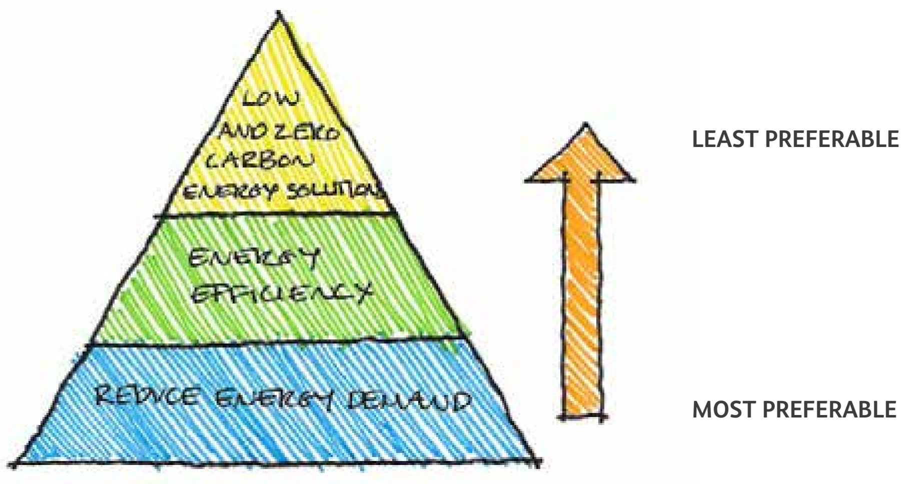
5.1 Introduction

This chapter of the Practice Guidance sets out best practice approaches to planning for sustainable buildings to be considered at various stages of planning and design, as reflected in the Best Practice Project Timeline (Section 4.3).

This Practice Guidance is not a comprehensive technical manual for building sustainably. Where applicable, references to further reading and guidance are signposted.

It is advisable to consider the wider site and context before attention is given to building form and fabric, and then to technologies. The sections in this chapter reflect this approach, and are intended to prompt discussions and design investigations. At the outset, the principles of the energy hierarchy form a useful starting point and guide throughout as does reference to PPW TAN 12: Design.

Fig. 1
Energy Hierarchy



It is advisable to consider the wider site and context before attention is given to building form and fabric, and then to technologies. The sections in this chapter reflect this approach, and are intended to prompt discussions and design investigations.

5.2 Site Analysis and Site Layout

Although the issues covered under these headings may appear repetitive, it is important to distinguish between the two stages: site analysis and site layout.

Without proper site analysis, design of the site layout will be ill-informed and will not capture the best opportunities to maximise sustainability and add value.

Site Analysis

Early and collaborative discussion, along with clarity of expectation set out in LDPs, SPG and other supporting policy, strategy and action plans, is crucial to capturing the benefits of good sustainable buildings in well planned places.

Locations and sites that demonstrate increased potential to capitalise on the opportunities and constraints of *both* the site and its surrounding context are important for good quality sustainable buildings.

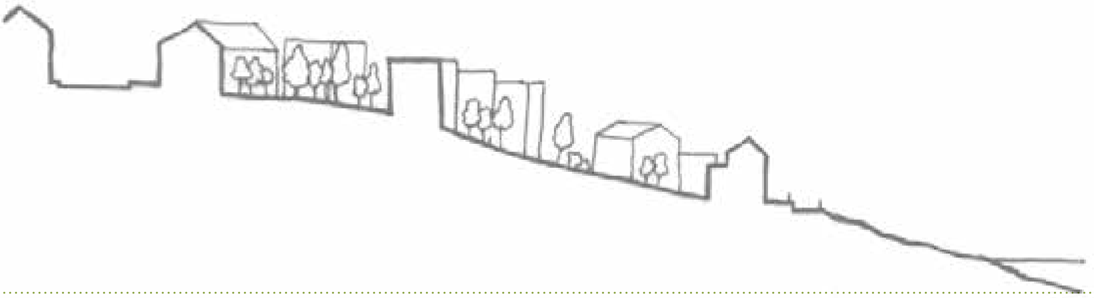
Capturing the value of sustainable building opportunities begins with good site analysis. Initially, basic site analysis can be used to inform the choice of site where there are options available. Once a site has been selected, thorough analysis will be essential in informing later design decisions. Good site analysis includes assessment of the following conditions:

- Topography and landscape
- Biodiversity
- Micro-climate (sun/wind)
- Access, routes and transport
- Existing buildings/structures
- Facilities/amenities and access to them
- Contamination
- Flood risk
- Noise
- Constraints and opportunities

Analysis can be clearly and informatively presented diagrammatically as shown in Figures 2 and 3. In some cases, specialist analysis and modelling may be necessary.

Fig 2
Contour map
A contour map shows the nature of the topography
© Mat Jones

Fig 3
Site section
Section drawings cutting through the site demonstrate the impact of any slope and landscape features
© Mat Jones



Topography and Landscape

The topography of a site and the nature of the surrounding landscape or townscape will influence the approach taken to developing a site. For example, a sloping site may have an impact on solar access, wind and potential site layout. A topographical survey will provide accurate measurements of site levels, whereas a wider study of landscape will identify further opportunities and constraints.

Further Reading:

> Landscape Institute and the Institute of Environmental Management and Assessment, Guidelines for Landscape and Visual Impact Assessment, GLVA, Routledge 2013, ISBN 978-0-415-68004-2

Biodiversity

It is essential to properly survey the flora and fauna of a site and how this relates to the immediate surroundings. The timing of ecological surveys is important, as some need to be carried out at particular times of the year (some bat surveys, for example).

The presence of protected species may place constraints on the location and type of development, and when construction can be undertaken. Identifying existing habitats will help in planning to mitigate loss and identify opportunities to enhance biodiversity. Green and blue infrastructure should be identified and mapped and an Arboricultural Survey will identify the most valuable trees on site, including those protected by Tree Preservation Orders. Certain ecological surveys may be required when a planning application is submitted. LPAs will be able to provide advice on this.

Further Reading:

- Natural Resources Wales, Surveys for European Protected Species http://naturalresourceswales.gov.uk/our-work/policy-advice-guidance/protected-species-wales/european-protected-species/surveys/?lang=en#.U6Gch5V8PIU
- TAN 5: Nature Conservation and Planning http://wales.gov.uk/docs/desh/policy/100730tan5en.pdf
- TAN 10: Tree Preservation Orders http://wales.gov.uk/docs/desh/policy/971001tan10en.pdf

Micro-Climate

Buildings, and clusters of buildings in particular, create their own micro-climate which influences air movement, ventilation opportunities, sunlight conditions and shadow effects.

It is important to think about the wind and solar conditions of a site at the pre-planning stage as these micro-climate effects can have positive or negative impacts on a building's comfort control strategy.

For tall buildings or dense developments, it may be appropriate to undertake wind analysis of the proposed building forms at the pre-planning stage in order to check that detrimental wind impacts will not affect pedestrian conditions at street level.

Further Reading:

- Environmental Site Layout Planning: Solar Access, Microclimate and Passive Cooling in Urban Areas, BRE (2000)

Overshadowing and Solar Access

It is critical to analyse the site in order to maximise the potential benefits of solar gain, as this can never be changed later. Analysis will consider solar paths, and the impact of any physical elements that could shade the site.

Overshadowing can block access to good sunlight for proposed and existing buildings. Overshadowing can be caused by natural obstructions (e.g. site slopes, surrounding mountains or trees), or man-made buildings and infrastructure. This will influence decisions about building spacing, form, height and elevation design.

Fig 4
Sun path and wind
Identifying the sun path and prevailing wind can help with site planning
© Mat Jones

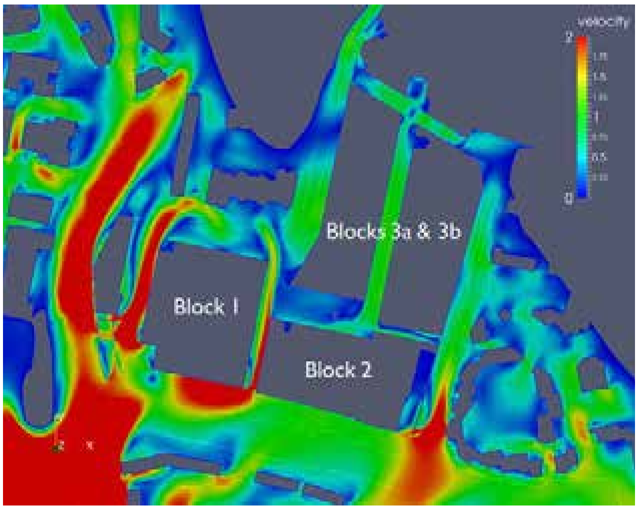


Fig 5:
Computer modelling of wind conditions in streets
Image courtesy of Hoare Lea & Ptnrs

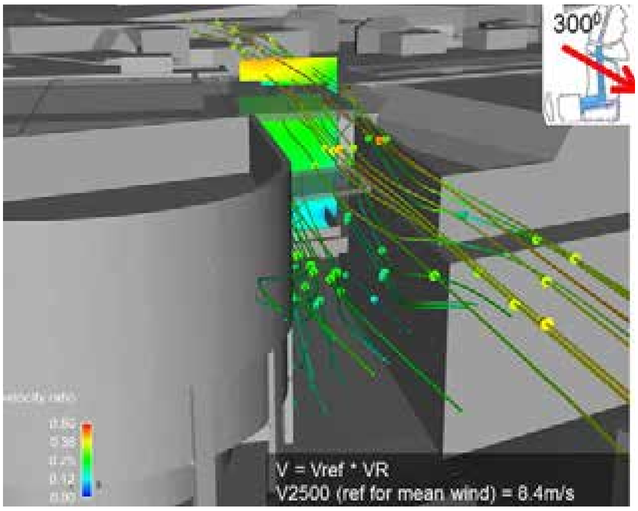


Fig 6:
Computer modelling of wind conditions at building corners
Image courtesy of Hoare Lea & Ptnrs

Access, Routes and Transport

Some sites are better connected to local facilities and public transport than others. There may already be important roads or cycle and foot paths through the site, or opportunities to connect to routes at the boundaries. Identifying these opportunities can help to provide better connectivity and encourage walking and cycling.

Further Reading:

> PPW, Chapter 8 Transport
http://wales.gov.uk/docs/desh/publications/140228chapter-8-en.pdf

Fig 7:
Map access, routes, transport
Mapping access, routes and transport can identify constraints and opportunities for development
© Mat Jones

Existing Buildings and Structures

Existing buildings and structures may be of value to a sustainable building strategy. Reuse, rather than demolition, has the potential to reduce waste and resources required. Alternatively, existing materials may be recycled on-site. Assessment of the value of existing structures will identify potential, and inform decisions about demolition and reuse.

It is important to assess the potential of brownfield site options, as development of these sites may have sustainable benefits, such as proximity to community facilities, transport and utilities, or significant opportunities to improve biodiversity. Depending on the previous uses on the site, there may be contamination to be addressed.

Further Reading:

> PPW 4.9
> http://wales.gov.uk/docs/desh/publications/140228chapter-4-en.pdf

Access to Facilities, Amenities and Utilities

Ideally, local facilities and amenity space should be easily reached from homes and work places. Analysis of existing facilities near a site will identify where improvements to transport and routes would improve sustainability, and might identify appropriate uses to be accommodated on the site. Analysis can include a study of walking distances to different facilities, which can be mapped in 5 minute, 10 minute and 20 minute zones.

Determining the locations of existing utilities will inform decisions about energy supply, water supply, drainage and telecommunications. The relevant local utility companies should be able to provide this information.

Fig 8:
Map access, routes, transport
Mapping access routes and identifying site connectivity in the wider context
© Mat Jones

Contamination

Contaminated sites may need to be treated before they can be developed. Early identification of the nature of any contamination will allow a sustainable decontamination strategy to be devised and implemented.

Further Reading:

- PPW 13.6, 13.7
  http://wales.gov.uk/docs/desh/publications/140228chapter-4-en.pdf
- Contaminated Land Statutory Guidance (2012)
  http://wales.gov.uk/docs/desh/publications/130712contaminated-land-statutory-guidance-2012-en.pdf

Flood Risk

A future-proofed approach maximises sustainability by anticipating and planning for change over the long term. With climate change, the risk of flooding is an increasingly important factor to consider when planning for development. Analysis of flood risk might rule that proposed developments are unfeasible on some parts of sites, and will identify where provision should be made for future adaption, such as setting buildings back from the edge of rivers. Where there is a higher flood risk, innovative or highly-engineered solutions might be required. These must be planned and budgeted for at the earliest possible stage.

Further Reading:

- TAN15: Development and Flood Risk
  http://wales.gov.uk/topics/planning/policy/tans/tan15/?lang=en
- Welsh Government Development Advice Map (DAM) which supports TAN 15 and PPW
  http://data.wales.gov.uk/apps/floodmapping/
- Natural Resources Wales mapping of flood risks in Wales.
  http://naturalresourceswales.gov.uk/alerts/whats-my-flood-risk/?lang=en

A future-proofed approach maximises sustainability by anticipating and planning for change over the long term. With climate change, the risk of flooding is an increasingly important factor to consider when planning for development.

Fig 9:
Noise Map
Map noise sources to inform building and site layouts
© Mat Jones

Noise

It is important to assess sources of noise in and around a site as there may be subsequent implications for site layout and ventilation strategies. Heavy traffic, railways, factories and heavy industry can each contribute noise. Mapping sources of noise can inform sensible planning of the site, such as clustering noisy uses together and locating sleeping or study places furthest away from noise. Buildings may be positioned so that noise does not have a negative impact on a natural ventilation strategy.

Further Reading:

- TAN 11: Noise
  http://wales.gov.uk/topics/planning/policy/tans/tan11/?lang=en
- A Noise Action Plan for Wales
  http://wales.gov.uk/docs/desh/publications/131217noise-action-plan-for-wales-en.pdf

Constraints and Opportunities

Following a thorough analysis of the site, a list of opportunities and constraints for sustainable development can be drawn up. A SWOT analysis (Strengths, Weaknesses, Opportunities and Threats) can be helpful in choosing between site options, may inform a detailed brief for the development, and can be used to guide design decisions, starting with site layout.

Site Layout

Good site layout provides a framework for sustainable buildings and adds value to the spaces between them. Considering the following aspects of site layout will help to maximise the sustainable benefits from the opportunities available:

- Network and hierarchy of routes
- Green infrastructure
- Enhancing biodiversity
- Site wide water management and drainage
- Connections to district heating networks
- Orientation and solar access
- Parking and transport
- Density

Further Reading:

> Building for Life 12
http://www.designcouncil.org.uk/sites/default/files/asset/document/Building%20for%20Life%2012_0.pdf

Network and Hierarchy of Routes

A well planned network of roads, cycle paths, foot paths and shared surfaces can improve sustainability by promoting walking and cycling and reducing car journeys. The safety and directness of foot and cycle paths should be considered when the routes are set out.

Further Reading:

> Manual for Streets
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/3891/pdfmanforstreets.pdf

Green Infrastructure

Different elements of green infrastructure are sustainable in many ways. The following benefits might be considered:

- Useable green space to encourage activity and healthy living
- Improving biodiversity and habitat connectivity
- Dealing with drainage and reducing surface water run-off
- Plants absorb carbon dioxide
- Green spaces can be used to enhance micro-climate, providing shading and evaporative cooling
- Space for growing food
- Amenity space for social interaction and play to promote well-being

Fig 10:
Map of green infrastructure
Mapping green infrastructure to identify opportunities for improvement, natural assets and amenity
© Mat Jones

Enhancing Biodiversity

Sustainable buildings will take advantage of opportunities to enhance biodiversity. This might involve provision, extension and connectivity of habitats, and increasing the variety and quantity of native species. A biodiversity strategy can build on information found in ecological surveys, and may benefit from specialist design expertise, such as those of a landscape architect.

An Environmental Impact Assessment (EIA) may be required by the LPA. Further guidance on EIAs can be found on the Welsh Government website.

Further Reading:

- Conservation and Biodiversity
  http://wales.gov.uk/topics/environmentcountryside/consmanagement/conservationbiodiversity/eiahome/?lang=en
- TAN 5
  http://wales.gov.uk/topics/planning/policy/tans/tan5/?lang=en
- Biodiversity
  http://www.biodiversitywales.org.uk/en-GB/Planning
- Environmental Impact Assessment
  http://wales.gov.uk/topics/planning/developcontrol/environmental-impact-assessment/?lang=en

Site Wide Water Management and Drainage

The inclusion of Sustainable Urban Drainage Systems (SUDS) is recommended for a reduced environmental impact approach to site wide water management.

The key objectives of a SUDS strategy are to manage the flow rate and volume of surface water run-off to reduce the risk of flooding and water pollution. SUDS also reduce pressure on the sewerage network and can improve biodiversity and local amenity.

SUDS generally aim to reduce the area of external hard surfaces surrounding a building and maximise the area of soft landscaping. The inclusion of measures such as permeable paving, filter strips and swales help in this regard.

It is important that there is clarity surrounding the responsibility for the ownership and long term maintenance of SUDS techniques. SUDS can form an integrated part of landscape strategy and approaches to green infrastructure.

For buildings, green roofs should be considered as an aid to water management and a contributor to biodiversity particularly where large roofs are visible and where groups of buildings lend themselves to this treatment.

Site wide, the capture, storage and use of rainwater for irrigation purposes, using low cost water butts, can be considered. However rainwater harvesting alone cannot be relied upon to reduce run-off during critical storm events and other extreme weather.

Further Reading:

- National Standards for Sustainable Drainage Systems: Designing, constructing, operating and maintaining drainage for surface runoff, DEFRA (2011)
- The ‘Susdrain’ website provides resources and case studies for sustainable drainage guidance
  http://www.susdrain.org/
- Flood and Water Management Act 2010
  http://www.legislation.gov.uk/ukpga/2010/29/contents

Connections to District Heating Networks

All new developments and major refurbishment can benefit from taking a strategic approach to energy supply which reviews on-site and off-site energy supply opportunities.

As part of the initial site analysis and development, it is good practice to investigate the possible connection to an existing or planned district heat network. This could provide a source of low carbon heating where the district heating is served by a Combined Heat and Power (CHP) plant or other low carbon energy source.

For large developments it may be appropriate to consider an on-site CHP energy source as a means of providing low carbon heat and power. However, calculations may find that distribution losses will not exceed the delivered heat where buildings are efficient. The suitability of a district energy network depends on there being sufficient thermal demand and a strategy for maintaining and operating the plant.

Energy Supply Companies (ESCOs) can provide early advice on procurement and the appropriateness of site-wide district heating.

Further Reading:

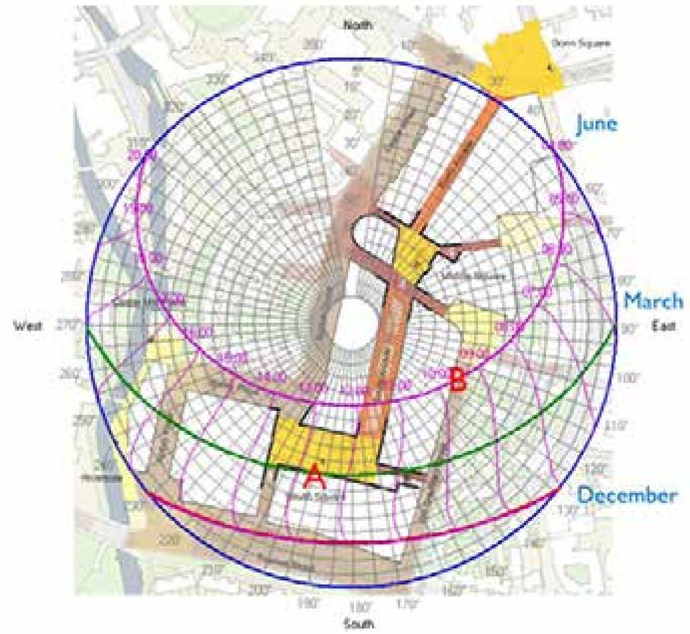
- Practice Guidance: Planning for Renewable and Low Carbon Energy – A Toolkit for Planners
  http://wales.gov.uk/topics/planning/policy/guidanceandleaflets/toolkitforplanners/?lang=en
- TCPA, CHPA (2008) Community energy: urban planning for a low carbon future
  http://www.tcpa.org.uk/data/files/ceg.pdf
- TCPA, CHPA & LDA Design (2010) Community energy: planning, development and delivery
  http://www.tcpa.org.uk/data/files/comm_energy_plandevdel.pdf

Orientation and Solar Access

Appropriate building spacing and scale play a major role in avoiding overshadowing. The impact on the opportunity of adjacent buildings to achieve sufficient daylight should be considered when new buildings are proposed. The overall shape and orientation of buildings should be modelled to match the function of internal uses to appropriate orientations.

Consideration should also be given to limiting unwanted solar heat gains which can arise when large areas of glazing are proposed for east, south or west facing elevations. External shading or an appropriate balance of glazed areas may help reduce risks of overheating that can arise from high solar gains.

Fig 11:
Sunpath analysis
Image courtesy of
Hoare Lea & Ptnrs



Sustainable Transport

Access to public transport which is frequent, convenient, safe and affordable has the potential to reduce car journeys, and therefore reduce energy and carbon emissions. There may be opportunities to improve public transport facilities alongside development.

Further Reading:

> Information on sustainable travel in Wales can be found on the SusTrans website
http://www.sustrans.org.uk/wales

Density

For buildings to be sustainable, the density of development needs to be considered and planned according to topography, location of community facilities and public transport routes. Development will need to be sufficiently dense to sustain shared facilities, public transport networks and district heating schemes. In general, it is best practice to plan for higher density close to transport hubs and interchanges to maximise accessibility. Considering density at an early stage in the design process allows appropriate supporting facilities to planned for.

Further Reading:

> PPW 4.7
http://wales.gov.uk/docs/desh/publications/140228chapter-4-en.pdf

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5.3 Building Form and Internal Layout

The building form and layout can be designed to maximise energy efficiency and take advantage of passive energy. The following aspects can contribute to a passive sustainability strategy:

- Building physics
- Space planning
- Form factor ratios
- Fenestration, daylight and solar control
- Off-site construction

At this stage of design, it can be useful to set specific energy targets for the building. Testing and analysis tools can be used to test and optimise building form in order to get closer to the targets that have been set.

Space Planning

The size of a well designed building will reflect the needs of the intended users, not only in the total area provided but also the configuration of rooms, layout of the rooms within the building and provision of storage space including space for laundry and utilities, cycles and the wider range of items families need and which may be used in multi-occupancy dwellings.

It is good practice for a planning application to demonstrate that all space requirements for the intended use of a building have been considered so that the building, once completed and occupied, serves the needs of the occupants, and ideally the needs of future occupants, which may change over time. A practical evaluation of space needs might include a review of areas required for toilet facilities, storage, waste management, building services equipment and vertical circulation.

Space is an important factor when people are choosing a home and many feel that newly-built homes are not big enough. A lack of space has been shown to impact on the basic lifestyle needs that many people take for granted, such as having enough space to store possessions or to entertain friends. In more extreme cases, lack of adequate space for households has been shown to have significant impacts on health, educational attainment and family relationships.

Further Reading:

> The Case for Space, RIBA, 2011
http://www.architecture.com/Files/RIBAHoldings/PolicyAndInternationalRelations/HomeWise/CaseforSpace.pdf

Building Physics: Understanding the Principles

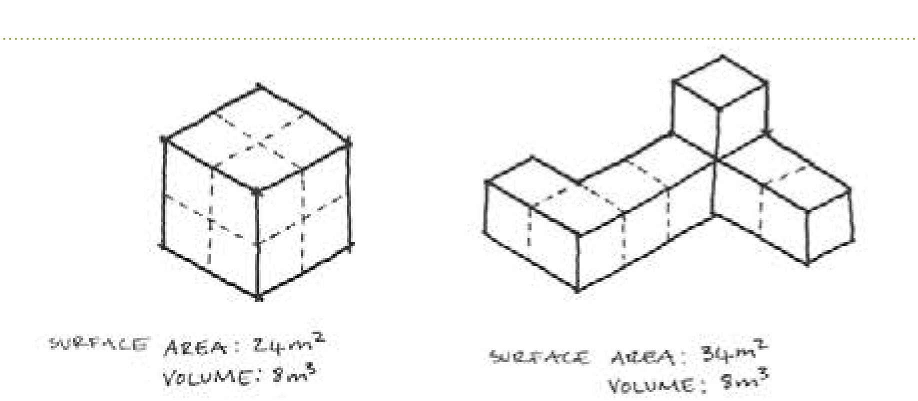
Building physics is the science of understanding how the physical form and fabric of the building, together with energy, affect the internal environment. An awareness of building physics will help to optimise building designs to achieve good environmental performance and comfort. The principle aspects of building physics are:

- Air movement: important in providing adequate ventilation for the occupants
- Thermal performance of the building envelope: heat loss through the building fabric can be limited through the provision of thermal insulation and passive solar design considerations (without creating an overheating risk)
- Control of moisture: excessive moisture can result in problems of condensation and mould growth, but can be controlled by adequate ventilation and methods to limit moisture generation
- Acoustics: controlling noise, both from the internal and the external environment and from building services equipment, is essential to create comfortable working and living conditions
- Light: lighting design includes consideration of source intensities, distribution, glare and colour rendering to create stimulating high quality interior environments. Giving priority to daylight will reduce energy demand.

Further Reading:

> Engineering a low carbon built environment: The discipline of Building Engineering Physics,
The Royal Academy of Engineering (2010). Available at www.raeng.org.uk

Fig 12:
Volume – surface area ratio
Both forms have the same volume, but the complicated shape has a larger surface area



Form Factor Ratios

The overall ‘Form Factor’ is the area of the entire external fabric including ground contact. As a ratio of the useful internal treated floor area, this Form Factor has a big impact on energy efficiency.

A building which has double the area of external fabric for the same given volume, will need twice the thickness of insulation to achieve the same performance. *That is twice the thickness and twice the area*. The better the Form Factor, the cheaper it will become to make your building more efficient. As a rule of thumb for sustainable buildings, the form factor ratio should be less than 3.

Buildings of more complicated shapes can encourage inefficient design, whereas improving the Form Factor has a direct, positive impact on energy efficiency.

Fenestration, Daylight, Solar Control

In most cases, windows can be designed to provide sufficient daylighting and useful solar gain, without creating uncomfortable glare or overheating. Generally, south facing, high performance windows can provide a net energy gain. The high angle of midday summer sun means that for south facing windows overheating is more easily controlled by shading, whereas this is more difficult to achieve with east and west glazing, due to the lower angle of the sun. However, additional south glazing beyond what is useful for daylight and views is a very expensive way to heat a building. North glazing can be beneficial for good internal daylighting but will result in a net energy loss. Analysis of site noise may also influence the planning of fenestration.

It is better, and more sustainable, to prevent summer overheating in buildings by the careful design of fenestration and passive ventilation strategies, than to require a mechanical cooling system.

Further Reading:

> Zero Carbon Hub, Understanding Overheating
http://www.zerocarbonhub.org/sites/default/files/resources/reports/Understanding_Overheating-Where_to_Start_NF44.pdf

Fig 13:
Solar access
The high-angle of the sun from the south in summer makes it easier to control. In winter, heat gains from lower-angle sun can be useful. It is harder to control low-angle sun from east and west

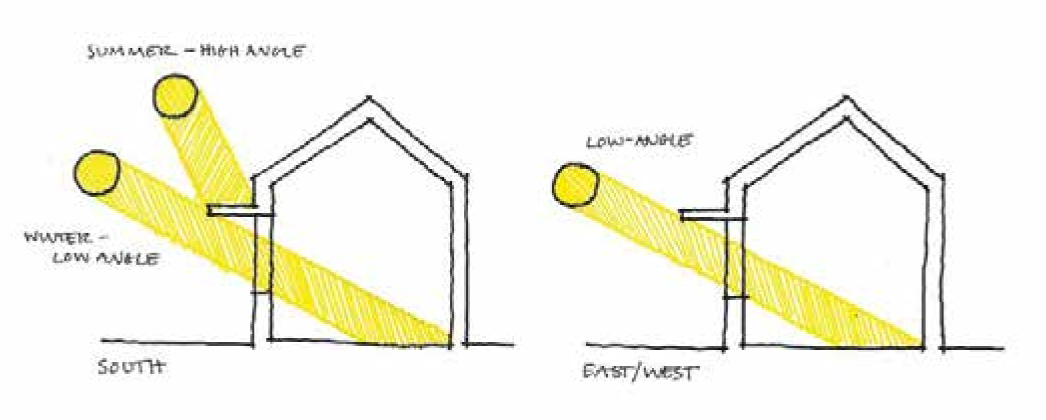


Fig 14:
Factory-made module being lifted into place
Images courtesy of DRU-W

Off-Site Construction

Sustainable buildings can be constructed using on-site and off-site methods of construction, or a combination of both. If done well, off-site construction offers improved quality control, a reduction in waste material, faster on-site assembly and cost efficiency. An early decision to use off-site construction will allow good communication with manufacturers and better integration of the system with the design of the building. Module or panel sizes may influence design of the building form and layout.

Energy Targets, Standards and Preliminary Part L Assessment

The Building Regulations (Part L) set minimum energy efficiency requirements and minimum carbon dioxide emission standards for new and applicable refurbished buildings.

The Building Regulations limit energy use arising from fixed building services such as boilers, pumps, ventilation fans and fixed lighting installations. It is recommended that the energy performance of the proposed building is assessed, at least at a preliminary level, at the pre-planning stage in order to ensure that the proposed building design is viable and will meet known future changes to Regulations if these will be applicable to the development. Without a preliminary Part L assessment there is a risk that the proposed design may not meet the Building Regulation standards when the design is submitted to the Building Control Body.

At the planning stage there are many crucial aspects of building design proposals that will affect Part L compliance, including the building form, building orientation, areas of glazing, and building services selection. A building with, for example, with a poorly performing facade might not pass Building Regulation standards, and certain building services require flues and vents which should be shown on drawings submitted for planning approval. If these things are not assessed prior to the planning application it could affect the viability of the project. Pre-planning discussion with the Building Control Body helps to highlight any areas for concern.

Energy use from loose equipment, such as computers, white goods and cooking appliances, and industry process loads, are not controlled by Building Regulations. These are also known as 'unregulated' energy uses. Whilst not directly affecting Part L compliance, they are a space planning consideration.

Various energy performance targets for buildings, over and above minimum Building Regulation requirements, have been put forward by industry and professional bodies.

For example, the Zero Carbon Hub has recommended the following minimum Fabric Energy Efficiency Standard (FEES) for residential developments, that is, a measure of how much energy a dwelling could require annually, as a proportion of floor area:

- 43kWh/m^2/yr for mid-terrace houses and apartments
- 52kWh/m^2/yr for end-terrace, detached and semi-detached houses

The Passivhaus Standard sets even more stringent energy targets. The Passivhaus targets are:

- a maximum space heating and cooling demand of less than 15 kWh/m^2/yr or a maximum heating and cooling load of 10W/m^2
- a maximum total primary energy demand of 120 kWh/m^2/year – this target includes all of the 'unregulated' energy not accounted for in Part L, and multiplies actual energy use to account for transmission and efficiency losses from generation to point of use

Tools for Analysis

Assessing the environmental performance of building designs can be complex and may require particular tools, including hand calculations, desktop analyses, computer modelling or physical modelling at the pre-planning stage.

The mandatory minimum analysis required for all new buildings is the assessment of Part L compliance. For domestic buildings this entails an assessment using the Standard Assessment Procedure (SAP). A Part L SAP analysis should be undertaken for new homes by an accredited assessor with knowledge of how the analysis tool works and of the relevant Part L compliance criteria.

For non-domestic buildings it is necessary to undertake a Simplified Building Energy Model (SBEM) or dynamic thermal model using approved software. Again, the analysis should be undertaken by an accredited assessor, qualified in the assessment of Part L compliance for non-domestic buildings.

The purpose of using tools for analysis is to demonstrate that a building will be sufficiently energy efficient (and comply with minimum Building Regulation requirements or, for example, Passivhaus requirements, if higher targets are being set), that comfortable conditions can be achieved with the proposed ventilation strategy and that adequate daylight will be provided.

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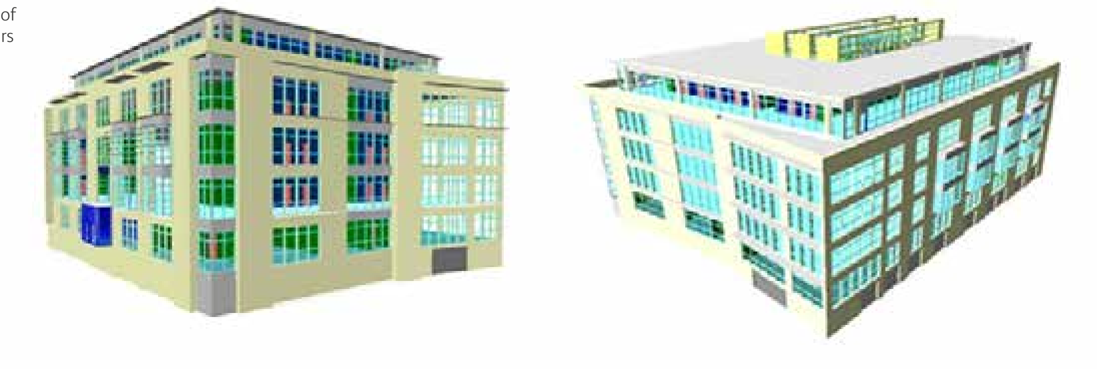
The following analysis tools may be appropriate for investigating and exploring efficient building forms and layout:

- Daylight modelling
- Sunlight availability and sun path analysis
- Building thermal simulation: this can also be used to assess the performance of a building in future climatic conditions. Global warming will result in elevated temperature conditions and this will have an impact on comfort and wellbeing. A building thermal simulation of conditions, in say 2030 or 2050, will inform the designers of potential measures to offset future discomfort that could occur and enhance resilience
- Comfort calculations
- Computational Fluid Dynamics (CFD) modelling to assess the impacts of air movement around buildings or to test the effectiveness of ventilation strategies in large spaces
- Wind tunnel testing: to assess the impact of building forms on wind movement
- Passive design assessment tools, including Passivhaus Planning Package (PHPP)
- Noise mapping and acoustics analysis

The PHPP provides a very accurate model of the actual energy consumption of a building, and can be used as a very powerful design tool to help optimise the form, orientation, fabric and glazing of a building. It also provides a useful indicator of any overheating. DesignPH is a new plug-in for SketchUp software which enables designers to get a PHPP energy prediction/indication, based on their SketchUp model.

Fig 15:
Thermal dynamic modelling to assess energy performance
Image courtesy of Hoare Lea & Ptnrs



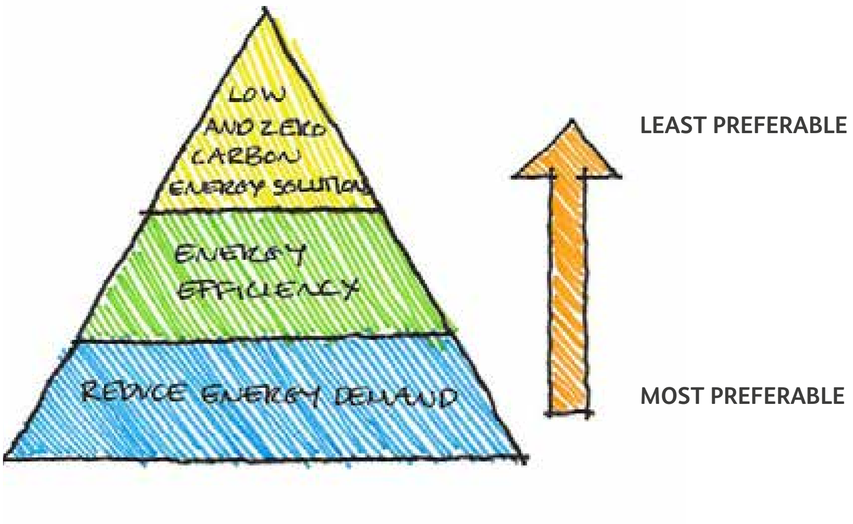
Global warming will result in elevated temperature conditions and this will have an impact on comfort and wellbeing. A building thermal simulation of conditions, in say 2030 or 2050, will inform the designers of potential measures to offset future discomfort that could occur and enhance resilience

5.4 Fabric First Energy Efficiency Principles

Energy Performance

It is best practice to maximise the energy performance of a building during the design process, with energy reduction and fabric efficiency measures prioritised over fuel sources and renewable energy. This approach reflects the Welsh Government's guidance in TAN 12, explained using the Energy Hierarchy.

Fig 16:
Energy Hierarchy



Fuel sources will undoubtedly change in their nature and cost in the future, and renewable energy technologies may not last the lifetime of the building or might be changed or added as viable and economic options become available. However, the building is only designed and built once.

Critical factors which affect the performance of the building are the:

- orientation of the building and extent of glazing (as discussed earlier)
- levels of insulation of fabric, glazing and doors
- level of airtightness
- thermal bridging: elements of structure and fabric that penetrate the thermal envelope

Insulation and U-Values

Typically, two thirds of the heat generated in a building is lost through the building fabric itself; that is, the ceiling, walls, windows, floors and doors of a building.

Increasing insulation levels (for both the building fabric and building services) and specifying materials with low U-values is perhaps the most cost effective means of improving the efficiency of building fabric.

U-value, expressed as W/m^{2}K, is a measurement of the rate of heat transfer through a building envelope, usually from inside to outside. The lower the U-value, the better the material is at preventing heat loss.

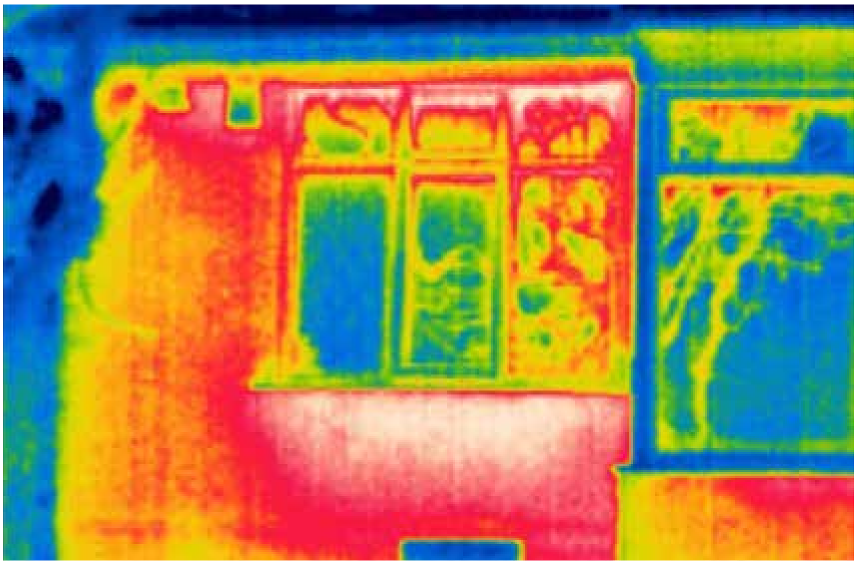


Fig 17:
U-values
U-value is the measurement of the rate of heat transfer through the building envelope

Airtightness

Airtightness is often confused with ventilation, despite most professionals being aware of the maxim, 'build tight, ventilate right'. Unplanned air leakage through building fabric makes it difficult to achieve reliable healthy ventilation. Aiming for the best possible level of airtightness will improve performance. Airtightness standards and testing requirements are set in Part F of the Building Regulations. The need to improve fabric performance to meet climate change objectives is likely to increase the focus on airtightness levels.

The Passivhaus target for airtightness is 0.6 air changes per hour. Achieving this requires careful attention during the design process to ensure that the line of airtightness can be clearly identified particularly at junctions, and particular attention is required during construction.

To achieve an air tight building, a high build quality and adequate inspection regime is required as air leakages are usually due to imperfections in the building construction such as cracks, gaps or porous joints.

Air tightness is measured by the degree of air leakage (uncontrolled ventilation) through the building fabric over a specified period of time and at a defined pressure. This is referred to as a building's air permeability rate or airtightness index.

The lower the air permeability rate, the more air tight the building becomes and consequently with increasing air leakage through the building envelope (walls, roofs and penetrations), the energy performance of buildings significantly diminishes.

It is recommended that two air tests are carried out – one before Second Fix, when any issues can be identified and corrected, and one at completion, for compliance.

Targets for airtightness can be set based on either Building Regulations and/or user requirements for comfort, energy efficiency, etc. The minimum air permeability rate is set by the Building Regulations, but better airtightness will help to make a building more energy efficient.

If airtightness is designed in, from the outset, it can be one of the most cost effective energy efficiency measures. Whilst airtightness has a significant impact on energy consumption, reducing air leakage is also important in reducing discomfort due to drafts and the potential for condensation leading to decay, within the building fabric.

Good levels of airtightness will require a designed and robust ventilation strategy to provide sufficient fresh air for occupants.

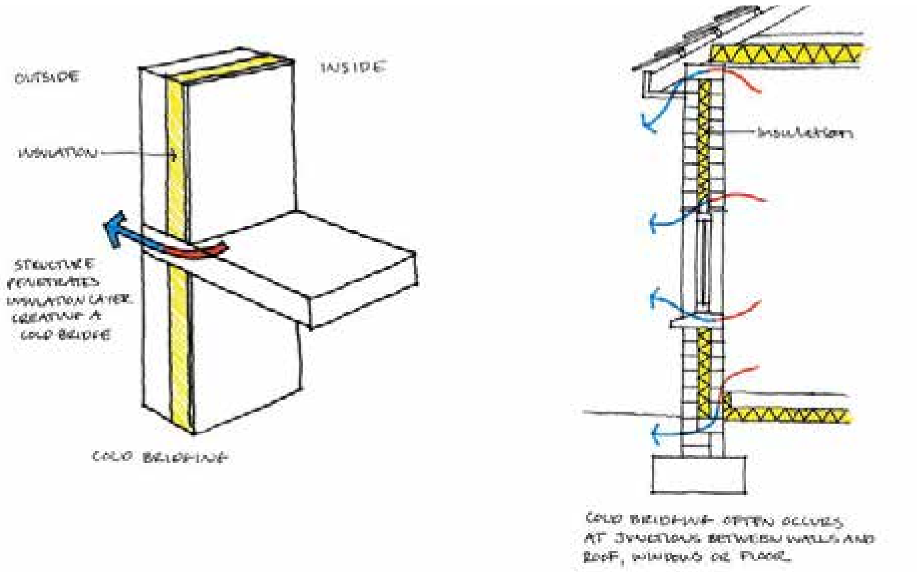
Thermal Bridging

Thermal bridges are localised areas of reduced thermal insulation or resistance in a building, which lead to a higher rate of heat transfer than the surrounding area. Thermal bridging often occurs at floor-to-wall, roof-to-wall, or ceiling-to-wall junctions.

Thermal bridges have an adverse impact on buildings. They cause unnecessary heat loss and create the potential for condensation, mould growth and fabric decay, as well as causing discomfort for occupants. Thermal bridges should be designed out, and if this is not practical their impact on heat loss should be calculated. Minimum thermal bridging standards are set by the Building Regulations.

An effective way to design out cold bridges is to keep the structural elements of the building wholly inside or outside of its thermal envelope, and avoid any elements of structure penetrating through this. Such penetrations can also increase the risk of water penetration.

Fig 18:
Thermal Bridging
Thermal bridging often occurs at junctions



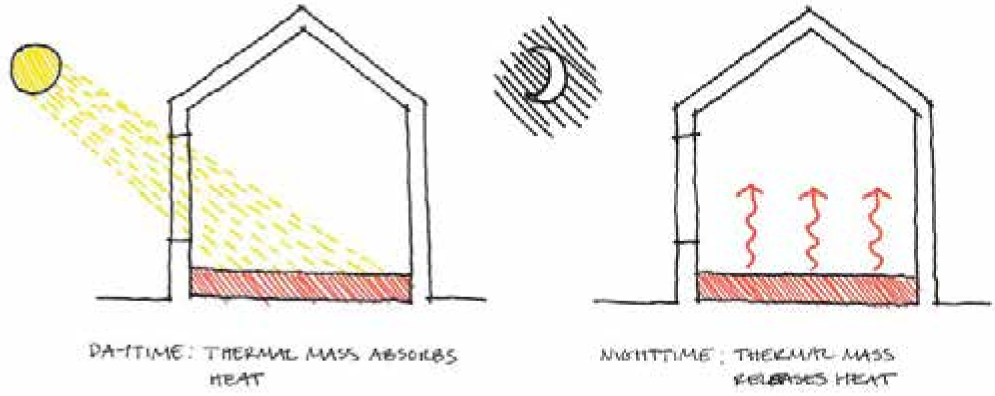
Thermal Mass

Thermal mass is the ability of a material to absorb and retain heat. Materials with a high thermal mass, which can include masonry constructions and dense timber constructions, will retain heat and release it slowly over time, balancing external temperature fluctuations.

This ability to store and release heat can be utilised to reduce summer overheating in a building by, for example, exposing concrete slabs and structure, provided this can be cooled overnight. Night time cooling of structures with thermal mass, facilitated by an appropriate ventilation strategy, can help avoid the need for mechanical cooling.

In all aspects of considerations of thermal mass, air-tightness and thermal bridging, detailed designed and specification is vital.

Fig 19:
Thermal Mass
Materials with high thermal mass can absorb heat during the day and release it at night



5.5 Materials

Embodied Energy

Embodied energy is the amount of energy consumed to extract, refine, process, transport, fabricate, maintain and dispose of materials. As we design buildings to use less and less energy in their operation, embodied energy becomes an ever more critical component of *overall* energy. Reducing embodied energy also reduces carbon emissions into the atmosphere in the immediate term, rather than in the future.

Use of materials and components with as low a level of embodied energy as possible, is best practice for sustainable buildings. These tend to be bio-based, including timber and/or timber products.

Information is becoming more readily available to help designers make decisions about materials, in the form of Environmental Product Declarations (EPDs) as well as databases such as the Inventory of Carbon and Energy (also known as the ICE Database).

Local Supply

As transportation is a fundamental component of embodied energy, using locally sourced materials rather than materials that have travelled a long distance can help to reduce carbon emissions.

Timber, which can be used for both structural and cladding applications, is an excellent example of a material that can be locally sourced within Wales, rather than being imported.

Using local materials in a building project can also support the local economy and help to root the building in its immediate or regional context.

Durability

It is important to specify robust and durable materials and components so that the building looks good and performs well throughout its lifetime.

Sometimes more durable materials are higher in terms of embodied energy than their less durable counterparts, but once replacement cycles have been taken into account, they may be less energy intensive over the building’s lifetime. It is important to consider the use and location of a building when specifying materials, as these factors will affect the level of wear and tear a building will need to withstand.

Recycled and Recyclable

Using reclaimed, recycled or partially recycled materials is a good way to reduce the embodied energy of a building, as well as preventing materials going to waste or landfill. EPDs generally contain levels of recycled content so can be used by designers to inform decision-making.

Using materials that can be recycled at the end of their use helps to contribute to future energy savings. Taken one step further, a designer might aim to specify only materials or components that can effectively be re-used or recycled, creating a ‘zero-waste’ building.

Further Reading:

> Waste and Resources Action Programme
http://www.wrap.org.uk/category/sector/construction

> Constructing Excellence Wales
http://www.cewales.org.uk/waste/

5.6 Building Services

Passive and active building services strategies require early consideration to fully integrate them with the rest of the design, and to ensure they operate efficiently and effectively. The following services can be considered:

Combined Heat and Power

Combined Heat and Power (CHP) is the simultaneous generation of usable heat and power in a single process. It requires an engine or gas turbine.

The electricity is generated on or close to the building site, allowing the capture and use of the resulting waste heat for site applications.

A CHP unit only generates economic and environmental savings when there is a high and constant demand for heat or cooling. As a rule, it should be running for at least 3,500 hours per year. It is particularly suitable for larger developments, where there is sufficient thermal load.

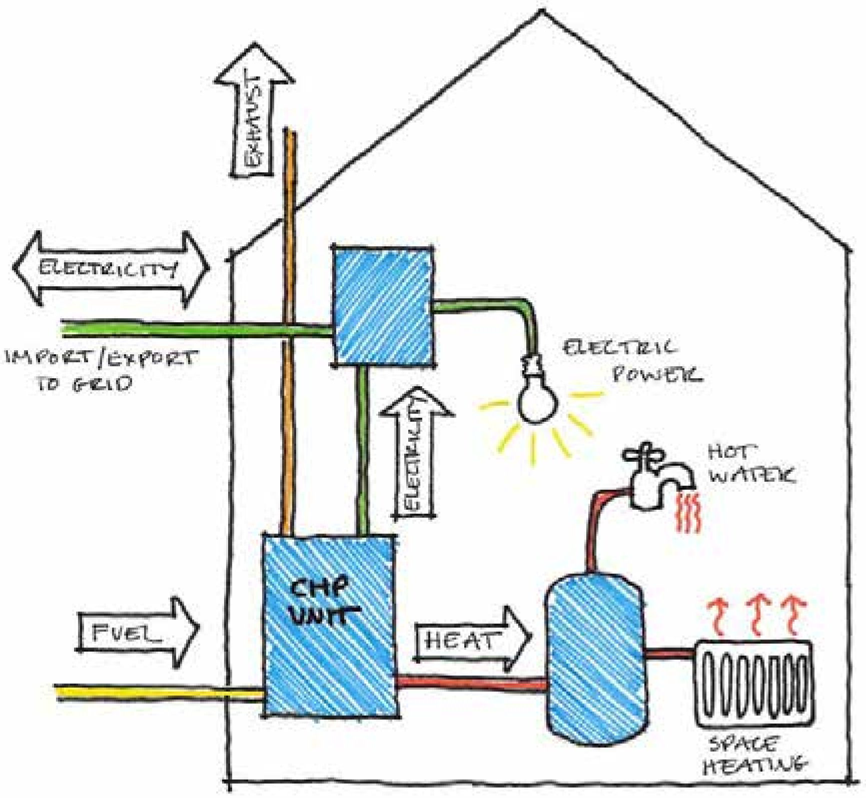
Where a CHP plant is used to supply cooling demands by utilising an absorption chiller connected to a CHP engine, it is called a Combined Cooling Heat and Power (CCHP) plant.

CHP requires significant capital investment in plant and resources. However, the capital outlay is balanced by lower costs, better environmental performance and additional security in energy supply, over the long term.

Further Reading:

> Practice Guidance: Planning Implications of Renewable and Low Carbon Energy Development
http://wales.gov.uk/topics/planning/policy/guidanceandleaflets/planningimplications/?lang=en

Fig 20:
A CHP unit generates electricity and useful heat in one process



Heating, Cooling and Ventilation

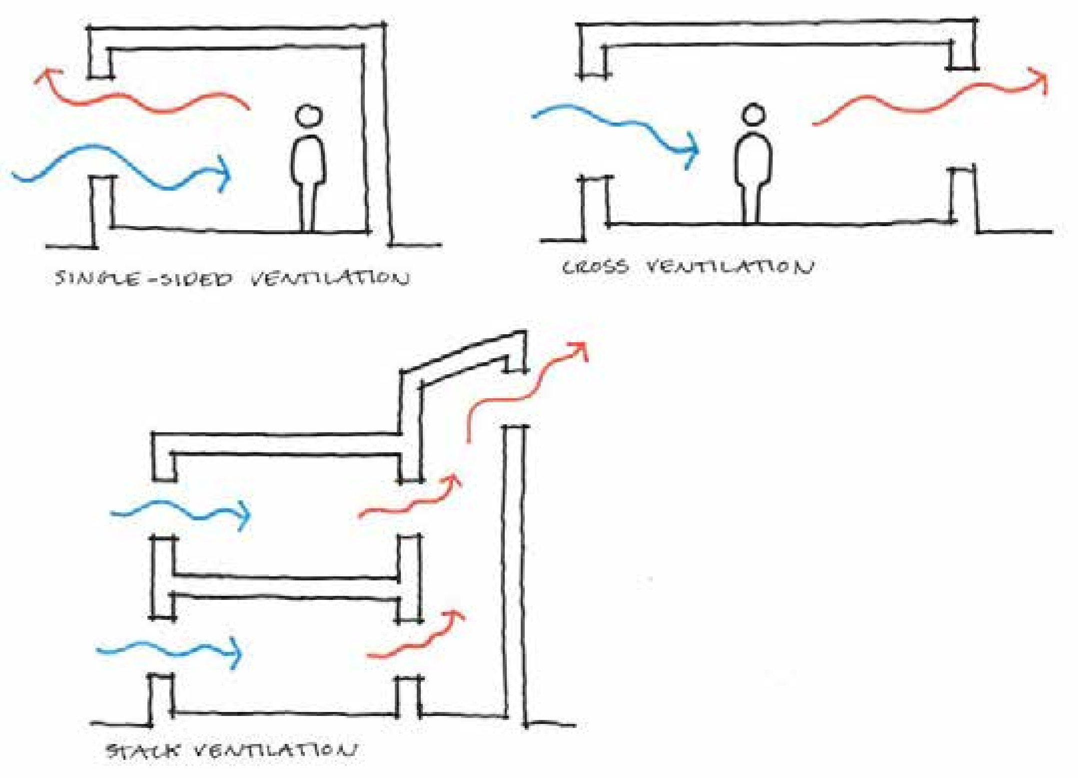
Ventilation is required in buildings to provide fresh air supply to occupants, maintain acceptable air quality levels and moderate the internal air temperature.

The need for heating and cooling inside a building depends on its purpose. Generally mechanical cooling is only necessary for non-domestic buildings which have occupancy levels or certain activities that generate much heat, such as a high density of computer or other electronic equipment.

The use of natural ventilation to provide passive dissipation of internal heat gains, and thus a passive cooling effect, should be considered in the first instance. Natural ventilation could be part of a mixed-mode ventilation strategy, meaning that mechanical ventilation systems are installed but can be modulated (turned down) or switched off when natural ventilation is sufficient. It is important to consider the ventilation strategy in combination with other passive design techniques such as the provision of external shading and overhangs above windows, to reduce solar heat gain.

Exceptions to this passive-first approach would be buildings or spaces which require strictly controlled indoor conditions. Active but highly energy efficient ventilation and cooling systems with heat recovery should be considered in these cases. Noise conditions may also make it more difficult to design appropriate passive ventilation strategies.

Fig 21:
Passive ventilation strategies
Single sided ventilation, cross ventilation, stack ventilation

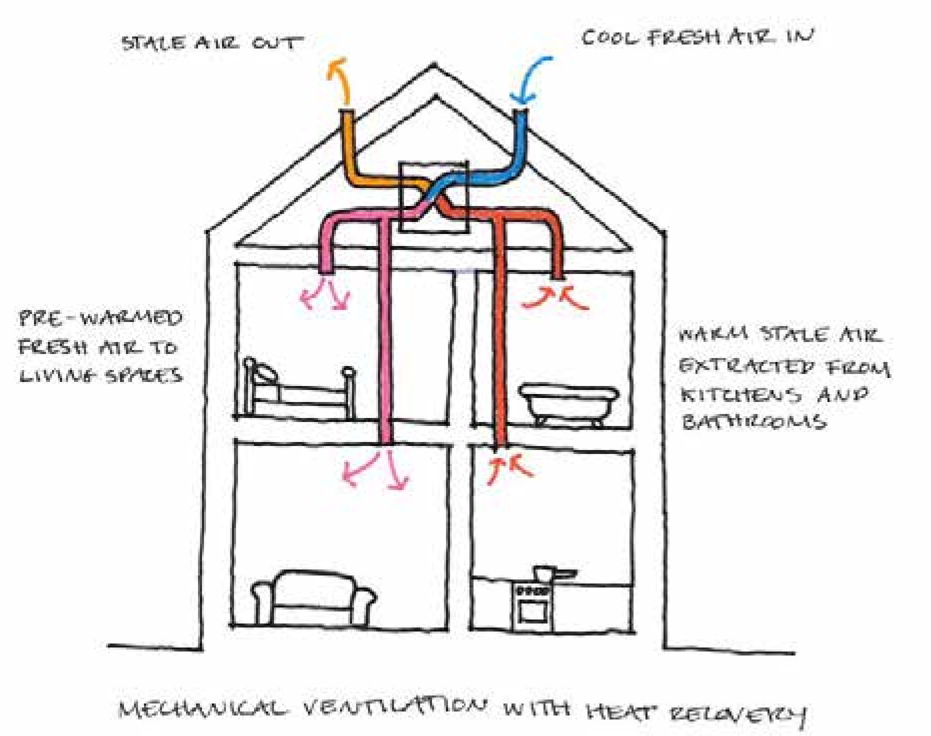


When the objective is to design very low energy consumption buildings the move towards mechanical ventilation with heat recovery, even for new homes, is an inevitable solution because the mechanical heat recovery system can reduce overall ventilation-related heat losses over the year. Energy efficient mechanical ventilation systems have low fan energy consumption, and adequate space to be provided for fan equipment, air handling plant and ductwork.

It is important to consider the noise impact of ventilation, heating and cooling equipment, so that it does not cause a nuisance to occupants or neighbours. If noise nuisance is considered a particular risk, a developer should undertake an acoustic assessment to evaluate the noise impact from building services equipment and proposals for noise mitigation.

The height of chimneys should be driven by air quality requirements and locations should be carefully considered. Reducing the height of chimneys on visual grounds can have a detrimental effect on performance, as they serve an important function in dispersing flue gases. The location and height of boiler chimneys should be identified at the planning stage as they can have an impact on air quality (if close to opening windows or nearby buildings), and air quality assessments may be required by legislation above certain sizes.

Fig 22:
Mechanical Ventilation Heat Recovery Diagram



Further Reading:

- Carbon Trust (2012) Technology Overview – Low temperature hot water boilers (CTV051) https://www.carbontrust.com/media/7411/ctv051_low_temperature_hot_water_boilers.pdf
- Carbon Trust, A Natural Choice: Natural Ventilation https://www.carbontrust.com/media/81365/ctg048-a-natural-choice-natural-ventilation.pdf
- Carbon Trust, Heat Recovery https://www.carbontrust.com/media/31715/ctg057_heat_recovery.pdf
- Carbon Trust, Heating, Ventilation and Air Conditioning https://www.carbontrust.com/media/7403/ctv046_heating_ventilation_and_air_conditioning.pdf

Hot Water

Hot water heating systems must comply with minimum Building Regulation Part L standards.

Reducing hot water demand by specifying water efficient taps, low flow showers and other efficient hot water appliances will help the building to use energy resources efficiently. Many modern appliances use water very effectively without any perceived reduction in user performance compared to older, less efficiently designed water appliances.

Gas-fired hot water heating is generally less expensive to operate and results in lower carbon dioxide emission than electric water heating. For small hot water systems with short pipe work routes it can be appropriate to have well-controlled electric water heating systems, as these can avoid the need for the investment in a gas supply system.

Particular attention should be given to maximising the efficiency of hot water systems to reduce energy consumption. This might include reducing storage and distribution losses, and eliminating or reducing circulation losses with insulated pipes or reduced pipe runs, with localised hot water heating units.

Assessing the different options will help to identify the most efficient solutions. Designers should be careful that hot water systems and distribution of hot water do not cause unwanted heat gains in summer. There is a danger that heat lost through poorly insulated pipe work could lead to overheating. With clever design, capital cost and energy savings can go hand in hand.

Solar water heating panels can act as a source of low carbon hot water heating and reduce operational costs for water heating. If considered for a building they should be shown on drawings and generally be south facing and not overshadowed to achieve beneficial output.

Electric Power and Appliances

When planning for large buildings or groups of buildings it is important to assess the electrical distribution strategy at the planning stage, as transformers and electrical switch rooms may be necessary within the development, and space for these will need to be planned.

Where integrated electrical appliances are specified, considering the energy performance of these can help to reduce overall energy requirements. Most appliances have an energy rating label which can be used to compare different products.

Lighting

It is important to assess opportunities for daylight, through appropriate allocation of windows and glazing configuration, at the pre-planning stage.

Electric lighting can be a significant source of energy use, particularly in office, retail and other non-domestic buildings.

Efficient light sources and automatic dimming or occupancy controls can reduce energy consumption, and can usefully be considered in the pre-planning Building Regulation Part L assessment. Ensuring that controls are intuitive to occupants and easy to use, will help in achieving predicted energy uses.

It is good practice for public realm schemes and large areas of landscaping to have an external lighting strategy, which can significantly enhance the public perception and experience of external spaces at night. The effect of 'light pollution' from external lighting can be minimised by directing lights downwards, where possible.

Further Reading:

- CIE Technical Report: Guide to the Limitation of the Effects of Obtrusive Light from Outdoor Lighting Installations, The International Commission on Illumination (2003)
- Carbon Trust, Lighting
  https://www.carbontrust.com/media/13067/ctv049_lighting.pdf

Demand Reduction and Renewable Energy Sources

Renewable energy sources can be a part of a sustainable approach to energy supply, as they can reduce dependence on fossil fuels and help in the reduction of building-related carbon dioxide emissions.

Renewable energy sources should be appropriate for the building application and site context, as the performance of renewable energy technology can be sensitive to location and building type.

Renewable energy sources include:

- Solar water heating panels
- Biomass heating systems
- Biomass CHP
- Solar photovoltaic (PV) modules
- Wind turbines
- Ground source heating pumps

Financial grants and funding may be available to assist building owners who are planning to use renewable energy sources. It is important to understand the criteria for qualifying for funding assistance prior to detailed design, and ideally prior to planning, as technical conditions may affect the renewable energy installation, and consequently the building appearance.

Feed-in-Tariff (FIT) support is available for a range of renewable electricity sources, such as solar PV systems and Renewable Heat Incentives (RHI) are available for some renewable heat sources, such as woodchip boiler systems and solar water heating systems.

The availability and eligibility criteria for these financial incentives are regularly updated by the UK Government, and it is advisable to check conditions prior to submitting a planning application.

It is also important that renewable energy sources are considered in the context of the approach to the energy strategy for the development. Whilst tariffs and grants can provide a financial return, it is not good practice to opt for solutions that are driven solely by current incentives.

Assessment of the effectiveness and appropriateness of renewable sources for each project is important. The most financially rewarding option may not be the most sustainable and may not be the most effective means of reducing energy demand.

Reducing energy demand should always be prioritised over renewable energy sources in addressing energy hungry buildings, as renewable technologies will often be an expensive and shorter term way of reducing carbon dioxide emissions. Below are some examples of demand reduction measures that could help achieve this:

- improved building envelope: specifying walls, roofs and windows with low U-values
- minimising thermal bridging through high quality building construction details
- specifying efficient building services

Once these measures have been applied, any residual reductions (carbon dioxide emissions or cost) required could be addressed using appropriate renewable technologies. This approach is actively promoted and is illustrated in the Energy Hierarchy diagram and in TAN 12.

Further Reading:

> Carbon Trust (2011) Power Play – Applying renewable energy technology to existing buildings (CTG050)

> Practice Guidance: Planning Implications of Renewable and Low Carbon Energy 2011
http://wales.gov.uk/docs/desh/publications/110228planimplicationsen.pdf

> Practice Guidance: Renewable and Low Carbon Energy in Buildings
http://wales.gov.uk/topics/planning/policy/guidanceandleaflets/energyinbuildings/?lang=en

> Generating Your Own Renewable Energy: A Planning Guide
http://wales.gov.uk/topics/planning/policy/guidanceandleaflets/generaterenewable/?lang=en

> Carbon Trust, Small Scale Wind Energy
http://www.carbontrust.com/media/77248/ctc738_small-scale_wind_energy.pdf

> Carbon Trust, A Place in the Sun
https://www.carbontrust.com/media/81357/ctg038-a-place-in-the-sun-photovoltaic-electricity-generation.pdf

> Carbon Trust, Renewable Energy Sources
https://www.carbontrust.com/media/7379/ctv010_-_renewable_energy_sources.pdf

Whole Life Costs

Building services installations are crucial to the functionality of buildings, but an awareness of operational costs is necessary. At the outset, the capital cost of these elements is often prioritised over their operational cost in the long term, reducing energy bills, maintenance and repair costs, replacements and disposal costs.

Assessment of Whole Life Costs (WLC) allows the systematic consideration of all relevant costs and revenues associated with the ownership of a system or building component. Whole life costing thus aims to capture the true cost of any building service option or building component and justify the long term cost effectiveness of an option. For example, a low capital cost system may end up costing more in the long run, say over 15-30 years, than a high capital cost system that is easier to maintain and repair.

It is best practice to take a WLC approach at the earliest stages of design, as decisions on the selection of systems and components could have long term implications for the building owner if maintenance and other operational costs render a system defunct if it cannot be affordably maintained.

Further Reading:

> Whole Life Costing, Constructing Excellence (2004)
http://www.constructingexcellence.org.uk/resources/themes/business/wholelifecosting.jsp

> Carbon Trust (2007) uilding Controls: Realising savings through the use of controls (CT032)
https://www.carbontrust.com/media/7375/ctv032_building_controls.pdf

> BS/ISO 15686 Service Life Planning
www.bsi-global.com

5.7 Water Management

Whilst Wales is not normally considered to be short of water, there are areas here as elsewhere, that suffer moderate and serious water stress. In addition, hot water use typically accounts for over half the heat energy requirement in a low energy dwelling.

Whilst water use is closely linked to user behaviour, water efficient fittings can save significant amounts of water and energy whilst improving function. Building Regulations set minimum standards for water efficiency in new housing.

Good quality regulated aerator fittings for taps prevent splashing and save water when rinsing under a running tap. Specially designed shower-heads can provide a very effective shower with around 6 to 8 litres per minute flow. By regulating the flow to individual fittings, the flow rates and temperatures throughout the system are more stable.

WC flush volumes have reduced to close to optimal levels but cisterns that use a valve-flush mechanism rather than the traditional UK siphon, are prone to leakage which may go unnoticed leading to very high water consumption.

As appliances are easily changed it is arguably more important to optimise the hot water system layout and design. It is not uncommon for hot water system losses to be greater than 50% (*The Importance of Hot Water System Design in The Passivhaus, Clarke and Grant, 2010*). Whilst some losses during the heating season contribute to space heating, over half may be unutilised. Compact plumbing layout and small bore hot water pipes dramatically reduce the wait for water to run hot. This saves energy, reduces summer overheating (especially in flats and commercial buildings) and saves water.

Long, oversized hot water pipes waste a lot of energy through distribution, as well as through water run to waste waiting for the hot water to come through. Even if the cool water is not wasted, the pipe is left full of hot water that will then cool down.

This issue is not covered by Building Regulations, but careful consideration of the plumbing layout at the design stage can save installation costs as well as energy and water, in use. Insulating hot water pipes helps delay the cooling off between uses but cannot stop it, so it is important to keep pipes as short as possible. Many plumbers tend to oversize pipes to ensure adequate flow rate but this exacerbates the problem. A growing number of domestic and commercial buildings are now using microbore pipe to very good effect. Building Regulations require that reasonable provision should be made to limit heat gains and losses from pipes used for new heating and hot water services.

Further Reading:

> Environment Agency (2007) Conserving Water in Buildings

> The AECB Water Standards
http://www.aecb.net/publications/publication-categories/aecb-water-standards/

> Guidance on the insulation of primary hot water and heating circulation pipework within dwellings, and hot water distribution pipes in common areas where blocks of flats are serviced via a communal heating system, can be found in the Domestic Building Services Compliance Guide (2013)
http://www.planningportal.gov.uk/buildingregulations/approveddocuments/partl/compliance

5.8 Waste Management

Construction Waste

Opportunities to reduce the amount of demolition and construction waste sent to landfill during the construction process should be sought. It is good practice to consider reclaiming and recycling materials where feasible and employing a specialist waste contractor to maximise the amount of construction waste that can be recycled off-site. Many suppliers of materials now offer their own recycling schemes so that, for example, thermal insulation and plasterboard does not have to be discarded to landfill. Utilising recycled materials in the new building itself can be considered, so that demand for raw materials is reduced.

Recycling Facilities and Space for Waste Storage

Adequate space should be provided in new and refurbished buildings to allow for separation of different types of waste generated in the function of the building. At a domestic level, this means that space should be provided internally to allow domestic waste to be separated and taken to external points for collection. At the commercial, industrial and public building scale an assessment needs to be made of the likely types of materials to be generated by the building users, and a strategy prepared for arranging removal of separated waste for off-site recycling.

Further Reading:

- TAN 21: Waste sets out the land use planning policies in relation to waste. It reflects the current and future priorities and considerations for managing waste in a sustainable way.
  http://wales.gov.uk/docs/desh/publications/140228technical-advice-note-21-en.pdf
- Waste and Resources Action Plan
  http://www.wrap.org.uk/content/about-wrap

5.9 Building Management and Post Occupancy Evaluation

Building Energy Management Systems

Poor control of heating, ventilation, cooling and lighting is responsible for excessive energy consumption in many buildings.

Simple, effectively designed and commissioned controls can help optimise energy use and limit wastage by turning down or turning off equipment when it is not required. Some controls, such as those for heating systems, are minimum requirements for Building Regulations, and compliance is mandatory. Additional controls, over and above those necessary to comply with Building Regulations, are recommended for best practice energy performance and will help building owners achieve comfort conditions effectively.

Building Management Systems (BMS) are relevant for complex buildings. They are computer-based management systems that provide the facility to closely control and monitor the performance of building services, including heating, cooling, ventilation and lighting. The BMS can be set up to display useful data on a computer screen for building managers.

If used correctly, a BMS can reduce total energy costs by 10%-20% whilst also increasing comfort. It should be acknowledged, however, that building control strategies should aim to be intuitive and easy to understand, as there is evidence that systems that are overly complex can be difficult to manage. Good practice testing, commissioning and training is essential for the value of building management systems to be fully appreciated. Poor performance and occupancy dissatisfaction can occur if adequate time is not allocated for the proper validation of building engineering services and control systems. To be of most benefit, this process will also entail a period of evaluation and fine-tuning after construction completion to ensure that set points and control strategies have been appropriately set up for the building users.

Soft Landings and Controls

It is an endemic problem that building users are given insufficient training and support to enable them to operate sustainable buildings effectively and efficiently.

Adopting a full programme of ‘Soft Landings’ can resolve this problem cost effectively and by adopting this approach at the outset of a project, it can involve users and building managers in discussion about building performance and operation, afford particular attention to the proper commissioning of systems, and then provide specific support to building users over the first 12-24 months of occupation.

‘Soft Landings’ might include simple user guides in addition to full Operation and Maintenance (O&M) manuals, and regular support and training workshops. The monitoring of building performance, to inform further seasonal commissioning, building system optimisation, and to enable further appropriate user guidance to be prepared, can also be included.

A ‘Soft Landings’ approach is more cost effective than the maintenance of poorly understood and poorly used systems.

Further Reading:

> Carbon Trust (2007) Technology Overview – Building Controls (CTV032)

> BSRIA Soft Landings Guidance
https://www.bsria.co.uk/services/design/soft-landings/free-guidance/

> Carbon Trust, Making Buildings Work: Commissioning Low Carbon Buildings
https://www.carbontrust.com/media/81377/ctg051-making-buildings-work-commissioning-low-carbon-buildings.pdf

Performance Monitoring

The ability to monitor building performance, through appropriate metering systems and post occupancy evaluation, can help demonstrate how well a building is performing in practice. Metering systems can be provided to measure the primary energy supplies to the building as well as particular end-uses which can be measured in detail.

A metering strategy will not normally have a planning implication, but for innovative projects, providing feedback on performance to planning authorities, say after 1 year of operation, would be beneficial for future learning.

Further Reading:

> Carbon Trust, 2010 nergy management strategy (CTV022)
http://www.carbontrust.com/media/13187/ctg054_energy_management.pdf

> Carbon Trust, Green Gauges: Metering and monitoring systems
https://www.carbontrust.com/media/81353/ctg037-green-gauges-metering-monitoring-systems.pdf

Maintenance and Security

In most cases, it will be beneficial to have a clearly defined maintenance strategy in place to ensure up-keep of the building fabric, landscape and building technology. Poor maintenance of buildings and landscapes can be detrimental to their environmental performance, and they may no longer be used as intended.

Poor maintenance may also be detrimental to the sense of pride, ownership and care that represents the critical success factor in good places and neighbourhoods.

Places where people feel safe and where social interaction in good communal and public spaces supports community cohesion and well-being, are frequently also those which hold their value and which remain attractive places where people want to live.

6 Case Studies

6 Case Studies

6.1 Introduction to Case Studies

The final chapter of this Practice Guidance on Planning for Sustainable Buildings comprises case studies of projects from Wales and elsewhere, which demonstrate some of the approaches in practice.

The case studies have been researched and identified for inclusion because they illustrate key benefits, good processes, excellent design quality and good sustainable outcomes.

The studies are not an exhaustive list and many more can be found across the UK and on several websites including the website of the Design Commission for Wales dcfw.org

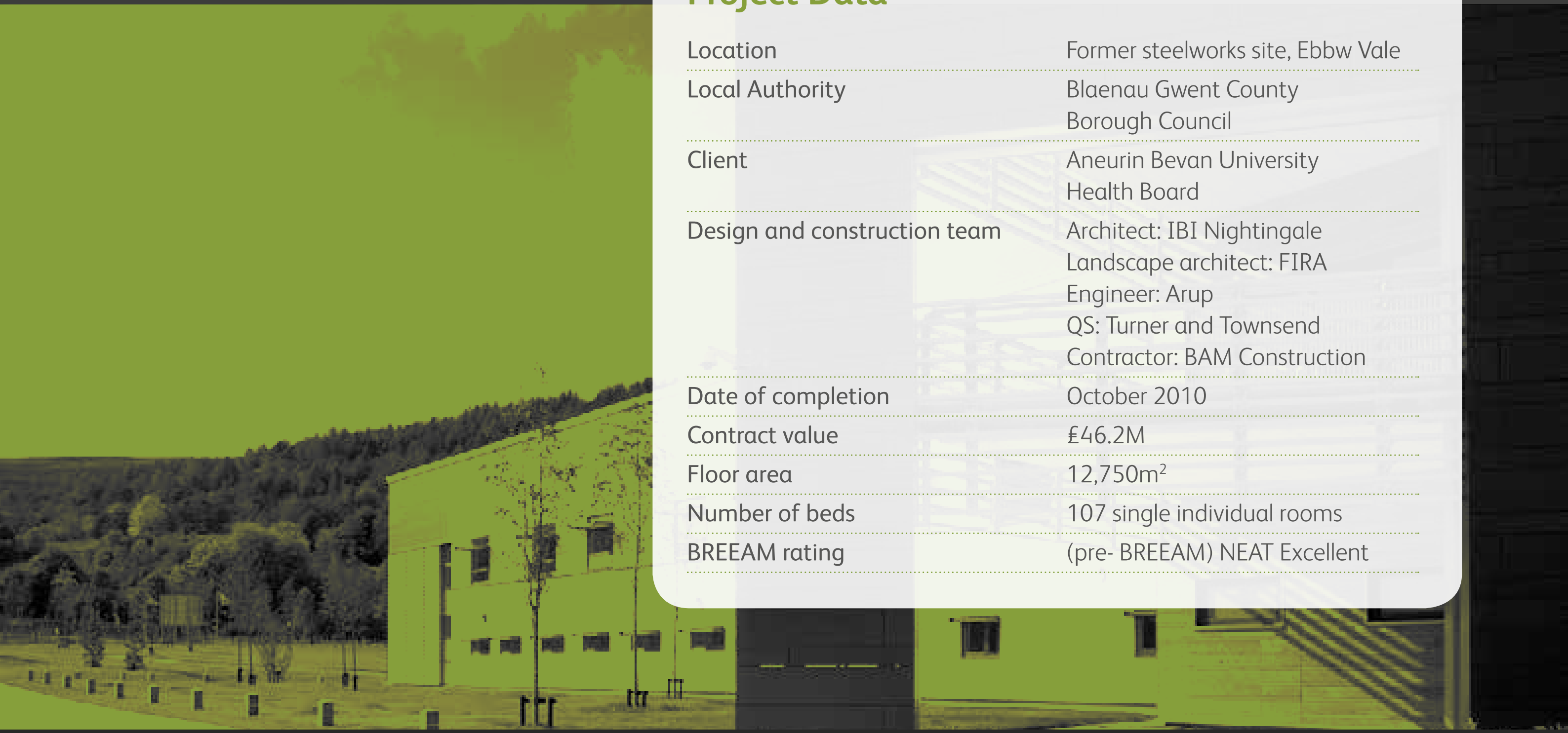
6.2 The Case Studies Matrix

The Case Study Matrix in this section highlights all the case studies by location, scheme or building type, process, design quality and sustainability outcomes.

This provides not only a list of the studies included in the guide, but a quick means of identifying case studies of interest for different users of this guide.

6.2 The Case Studies Matrix

	Project Type							Location			Context					Planning & Design Process												Sustainability Outcomes																	
	Residential	Education	Healthcare	Cultural/Leisure/Civic	Retail	Office	Mixed Use	Wales	UK	International	Urban	Suburban	Rural	Industrial/Post Industrial	Waterfront	Collaborative Working	Procurement Approach	Community Engagement	Whole-Life/Cost Planning	Masterplanning	Supply Chain	Modelling/Testing	Conservation Issues	Off-Site Construction	Building Re-Use	Design For Well-Being	Skills and Education	Sustainable Travel	Landscape & Biodiversity	Energy Centre	Water Management	Orientation, Form & Layout	Materials	Passive Design/Passivhaus	Insulation & Airtightness	Low Energy	Heating/Cooling/Ventilation	Lighting	Renewable Energy	Waste Management	BMS	Commissioning & POE	Affordable Energy	Flexibility	Skills and Education
Aneurin Bevan Hospital, Ebbw Vale			●					●			●			●	●		●			●						●			●		●	●		●			●	●		●	●				
Brent Civic Centre				●	●	●	●		●		●					●	●		●	●	●							●	●		●					●							●	●	
Bridgecroft Housing, Kingstone	●								●				●			●		●		●								●	●			●		●	●	●							●		
Brighton Library & Jubilee Street Masterplan				●			●		●		●						●			●		●										●		●		●	●	●							
Coach House, Cardiff	●							●			●						●		●				●											●		●								●	
Cwm Ifor Primary, Caerphilly		●						●				●				●		●								●	●		●			●	●	●											●
Denbigh Townscape Heritage Initiative	●			●	●	●	●	●			●					●	●	●	●		●		●		●								●		●										●
Farmhouse Passivhaus, Ayrshire	●								●				●								●						●					●	●	●	●	●	●								●
Hammarby Sjostad	●						●			●	●			●	●					●								●	●	●	●	●							●	●					●
Hampshire CC Offices, Winchester				●		●			●		●					●	●		●						●			●						●		●	●		●			●		●	
Hastoe Housing, Wimbish	●								●				●			●			●							●	●					●	●	●	●	●	●		●			●	●		●
Interserve, Leicester						●			●			●				●			●		●					●						●	●	●	●	●	●	●					●		
M&S Cheshire Oaks, Cheshire					●				●			●				●		●		●	●						●	●	●		●		●	●	●										●
Margam Discovery Centre	●	●		●				●					●										●	●					●	●				●		●	●		●						●
Nook, Oxwich	●							●					●						●				●										●	●										●	
Plas y Mor, Burry Port	●		●					●				●				●		●			●									●			●	●	●		●		●				●		
Princedale Road, London	●								●		●										●		●		●		●								●	●	●								●
St Luke's Primary, Wolverhampton		●							●		●					●		●								●	●			●	●	●	●	●	●	●	●	●			●	●			●
Sulgrave Gardens, London	●								●		●										●		●	●					●			●	●	●	●	●	●								
Triangle, Swindon	●								●			●				●		●								●		●	●				●	●	●	●			●				●		
Ty Pren, Brecon	●							●					●			●							●									●	●	●	●	●			●						
WISE, Machynlleth		●						●					●	●		●											●				●	●	●	●	●		●		●						●
WWF UK Headquarters, Surrey		●		●		●			●		●					●			●	●						●	●	●	●			●	●	●		●	●	●						●	●



Project Data

Location	Former steelworks site, Ebbw Vale
Local Authority	Blaenau Gwent County Borough Council
Client	Aneurin Bevan University Health Board
Design and construction team	Architect: IBI Nightingale Landscape architect: FIRA Engineer: Arup QS: Turner and Townsend Contractor: BAM Construction
Date of completion	October 2010
Contract value	£46.2M
Floor area	12,750m^2
Number of beds	107 single individual rooms
BREEAM rating	(pre- BREEAM) NEAT Excellent

Ysbyty Aneurin Bevan, Ebbw Vale

This new build hospital on the masterplanned former steelworks site in Ebbw Vale has 100% single bedroom accommodation as well as various outpatient facilities. The zigzag form of the building defines a number of landscaped courtyards. These bring lots of natural daylight and ventilation to the rooms, improving patient well-being as well as reducing energy demand.

Planning and Design Process

Procurement:

Ysbyty Aneurin Bevan was delivered under the *Designed for Life:Building For Wales 1* (DfL) Framework. The hospital was one of the first Pathfinder projects delivered through this framework which sought to change the face of healthcare facilities procurement across Wales. A collaborative working approach, encouraged by the New Engineering Contract or New Engineering and Construction Contract (NEC), helped move the construction industry in Wales forward in terms of delivery and supply chain. The construction stage was reached faster than if a traditional procurement route had been followed, and local labour and Small and Medium Sized Enterprises (SMEs) were used as much as possible.

Masterplan:

The building occupies part of a 90 hectare brownfield site formerly occupied by the Ebbw Vale Steelworks, now 'The Works' regeneration project. As the first 'anchor scheme' completed in accordance with The Works masterplan, the development was intended to act as both an exemplar for future development and a catalyst for further investment. As part of the planning conditions a Landscape & Biodiversity Management Plan, Travel Plan and a Sustainable Energy Statement were submitted. The latter stipulated a 45% reduction in carbon emissions beyond the current Part L Building Regulations, a minimum 20% contribution from renewable energy and a (pre-BREEAM) NEAT 'Excellent' rating; all were achieved or exceeded. Materials were in line with the Masterplan Design Code, drawing inspiration from the site's industrial heritage.

Designing for Wellbeing:

The intention was to create a patient-centred environment based on the patient's physical and emotional experiences. The zigzag form, containing three inter-connected 32-bed single-room wards, provides optimum orientation for each room and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engagement with the courtyards providing high levels of natural light. Each ward has a communal lounge with dedicated access to an outdoor terrace overlooking the courtyards. A variety of sheltered outside spaces allow users to benefit from fresh air, sunlight and outdoor therapy activities. Sustainable design and better patient experience have been achieved simultaneously.

As part of the collaborative procurement process a DfL Learning Set was set up in order to develop and analyse single bedroom layouts in order to produce an optimum layout. As a result, three full size mock-up bedrooms were built; staff and public consultation was undertaken over a three week period and feedback collated by the Aneurin Bevan Health Board. The preferred bedroom type was chosen based on measured and achievable levels of observation, daylight and ventilation, flexibility in use, infection control and cost effectiveness.

Sustainability Outcomes

Minimising Waste:

The reprofiling of the site sought to minimise the amount of waste material. Environmental impact was further mitigated by recycling Pulverised Fuel Ash (PFA) – a waste product of coal fired power stations – as the material to be pumped into the disused mining voids identified beneath the hospital’s footprint, thereby reducing the use of quarried material as well as diverting waste material which might otherwise go to landfill. Under DfL a target of minimum 15 % of construction materials (measured by value) to be sourced from recycled material was set. Using the Waste & Resources Action Programme (WRAP) Toolkit, and through careful choice of construction materials, the project was able to more than double the required target and achieved a figure of 31 %. Construction waste was separated on site for recycling under a certified waste management scheme.

Landscape Design:

The car park has been designed to provide clear pedestrian routes and good passive surveillance, providing wildlife corridors and screening via the use of native hedging and grouped tree planting. The wider landscape around the hospital has been developed using a parkland theme, it incorporates belts of native woodland and shrub edge planting with meadow grass areas, together with larger formal specimen trees.

Intelligent Building Management System (BMS):

A comprehensive BMS controls heating and ventilation. Data from the BMS is collected and reported to a PC, to facilitate careful monitoring and effective control of energy usage.

Ventilation:

The majority of the building uses a ‘mixed mode’ natural and mechanical ventilation system, providing a controlled amount of fresh air ventilation to rooms and some ‘free cooling’. The patient bedroom windows were carefully designed: the optimum dimensions and opening characteristics were studied and analysed to make the best use of natural daylighting and solar gains, and to provide ventilation at upper and lower levels to encourage air circulation.

Daylight, Views and Solar Control:

The building design carefully balances the desire for extensive areas of glazing with the need for thermal and solar control. Large windows in the patient areas provide good daylighting. The south facing glazing provides an opportunity for solar heat gain to reduce the heating load; shading devices avoid overheating and controllable window blinds reduce unwanted glare.

Water Management:

Low-volume WC cisterns, sensor taps and occupancy detection with supply cut-offs in toilet areas all contribute to reducing water usage. Water metering linked to the BMS enables monitoring of water consumption. Domestic hot water plate heat exchangers reduce the amount of hot water storage.

Transport:

The travel plan developed by the Health Board, in conjunction with the Design Team included new public transport service provision, controlled parking allocation, a bicycle shelter, and shower and changing facilities.

The hospital achieved an ‘Excellent’ rating under NEAT (NHS Environmental Assessment Tool), with a score of 76.6%, and an ‘A’ rated Energy Performance Certificate (EPC), with a score of 20. The completed building achieves a very low air permeability rate of 3.3 m3/(h.m2) at 50 Pa, and annual CO_2 emissions of 63.6 kg of CO_2/m.

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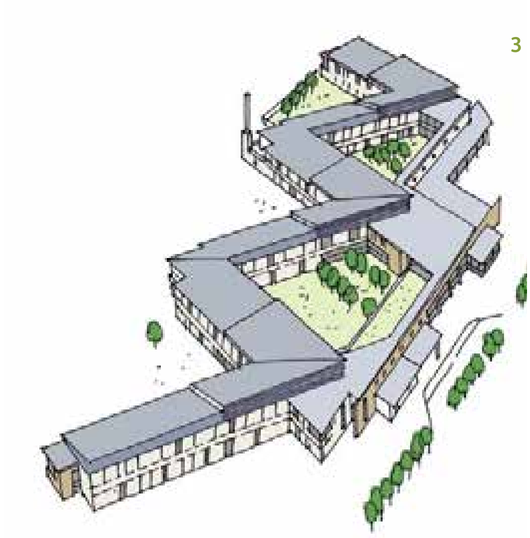

References:

- www.ibi-nightingale.com/ht-ysbyty-aneurin-bevan.html
- www.arup.com/Projects/Aneurin_Bevan_Hospital.aspx

Images

1 Sensitive Response to landscape. *Charlotte Wood Photography*
2 Bedroom Design. *Charlotte Wood Photography*
3 Zig Zag Form. *IBI Nightingale*
4 Site Plan. *IBI Nightingale*

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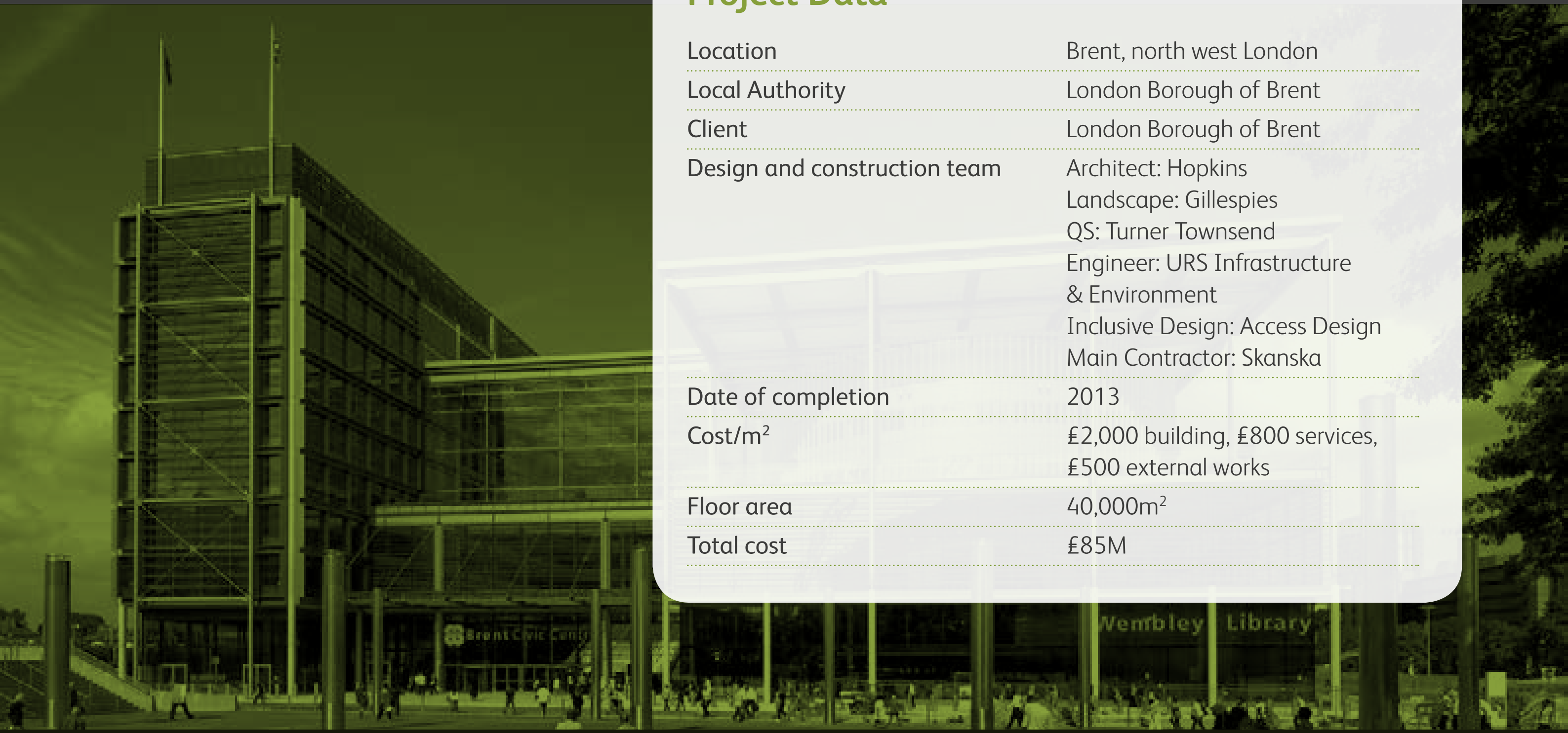

Project Data

Location	Brent, north west London
Local Authority	London Borough of Brent
Client	London Borough of Brent
Design and construction team	Architect: Hopkins Landscape: Gillespies QS: Turner Townsend Engineer: URS Infrastructure & Environment Inclusive Design: Access Design Main Contractor: Skanska
Date of completion	2013
Cost/m^2	£2,000 building, £800 services, £500 external works
Floor area	40,000m^2
Total cost	£85M

Brent Civic Centre

This large multi-use building on a prominent site next to Wembley Stadium and Wembley Arena has become a new heart for the local community, where they can come to meet, learn, shop and eat. Brent Civic Centre accommodates a library, registrar, community hall with winter garden, civic hall, an administration block, retail space and cafe bar all located around a large naturally-lit atrium which welcomes visitors, orientates them and provides an informal gathering space. The design incorporates passive strategies as well as a range of resource saving technologies; making it around 70 % more energy efficient than a comparable conventionally designed and constructed building. It has been awarded BREEAM Outstanding, the highest outstanding score for any local authority building.

Planning and Design Process

Local Authority Planning:

At a time when local authorities are struggling to deal with budget cuts, the London Borough of Brent found a way to procure this large building. By consolidating its services and minimising running costs through energy efficient design, the authority anticipates saving as much as £4M per year. Brent Council encouraged the design team to achieve very high sustainability credentials. The BREEAM Outstanding building is the result of close collaboration between the architect, client and design team. The project won a Business Award which celebrates excellence in Local Government.

Masterplan:

The building is part of a wider masterplan to transform the area. The building encloses one side of a new public square and adds life to the streets on days when there are no events in the stadium or arena.

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Local Supply Chain:

A Civic Centre Supply Chains Programme was established in order to maximise the involvement of the local economy. An event about the project and the procurement process was attended by over 100 local businesses. Over £2.2M was spent on products from local suppliers, and 24 % of the construction workforce was from Brent.

Travel Planning:

A Green Travel Plan, emphasising the use of public transport and walking or cycling to the Civic Centre, has been developed and a travel coordinator will facilitate its implementation.

Sustainability Outcomes

Energy Efficiency:

A number of energy saving technologies, as well as passive design methods, have been incorporated into the design, making it extremely energy efficient. A CHP plant uses waste bio fuel (waste fish oil residue) to provide cooling, heating and power for 90 % of the year. The plant is designed to eliminate the need for thermal storage. Ethylene tetrafluoroethylene ETFE material is used for the atrium roof, this is semi-opaque so that it allows daylight but prevents overheating.

Flexibility:

The fabric of the building is robust, but designed to allow flexibility of use both short term and long term. This means that the building will be able to adapt to changes within the local authority and the services it provides, increasing its likely life-span.

Landscape and Biodiversity:

Throughout the site, which was previously a car park with no plants, opportunities have been sought for improving biodiversity. Landscaped gardens, a green roof and the installation of bird, bat and insect boxes have contributed to this. Plants used include drought tolerant species to minimise the amount of water required for irrigation.

References:

> *Project:* www.brent.gov.uk/your-council/brent-civic-centre
> *Architect:* www.hopkins.co.uk
> *Engineer:* www.urs.com

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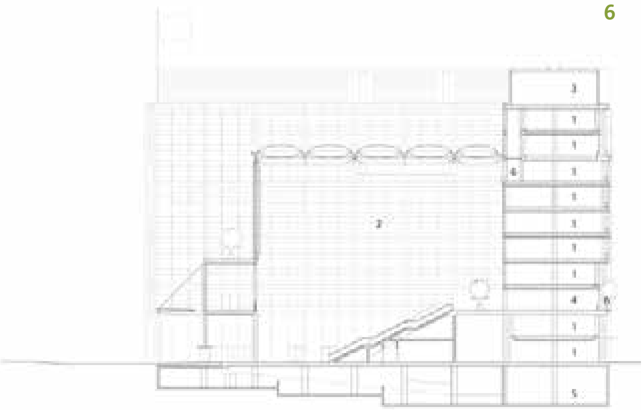

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Images

1 Daylit office. *Morley von Sternberg*
2 Central atrium. *Morley von Sternberg*
3 Civic/public space. *Morley von Sternberg*
4 Greening. *Morley von Sternberg*
5 Site Plan. *Hopkins Architects*
6 Building Section. *Hopkins Architects*
7 Public realm. *Morley von Sternberg*

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Project Data

Location	Kingstone, Herefordshire
Local Authority	Herefordshire Council
Client	ArchiHaus Ltd
Design and construction team	Architect: Architype
	Landscape Architect: Churchman Landscape QS: Ward Williams Associates Energy: Elemental Solutions Structural Engineer: Thomasons Civil Engineer: Price and Myers
Cost	£20m
Cost/m^2	£1250m^2 approx

Bridgecroft, Kingstone, Herefordshire

Bridgecroft, Kingstone is the first development by ArchiHaus Ltd and focuses on delivering better quality homes and energy performance.

It adopts a site layout appropriate to its rural context and setting, enhancing and expressing its distinctive landscape. Costs compare favourably with mainstream housing development and this was achieved through early integration of sustainable approaches and by establishing a local ‘house factory’ to fully and efficiently prefabricate the houses.

Planning and Design Process

Rethinking House, Site Layout and Construction:

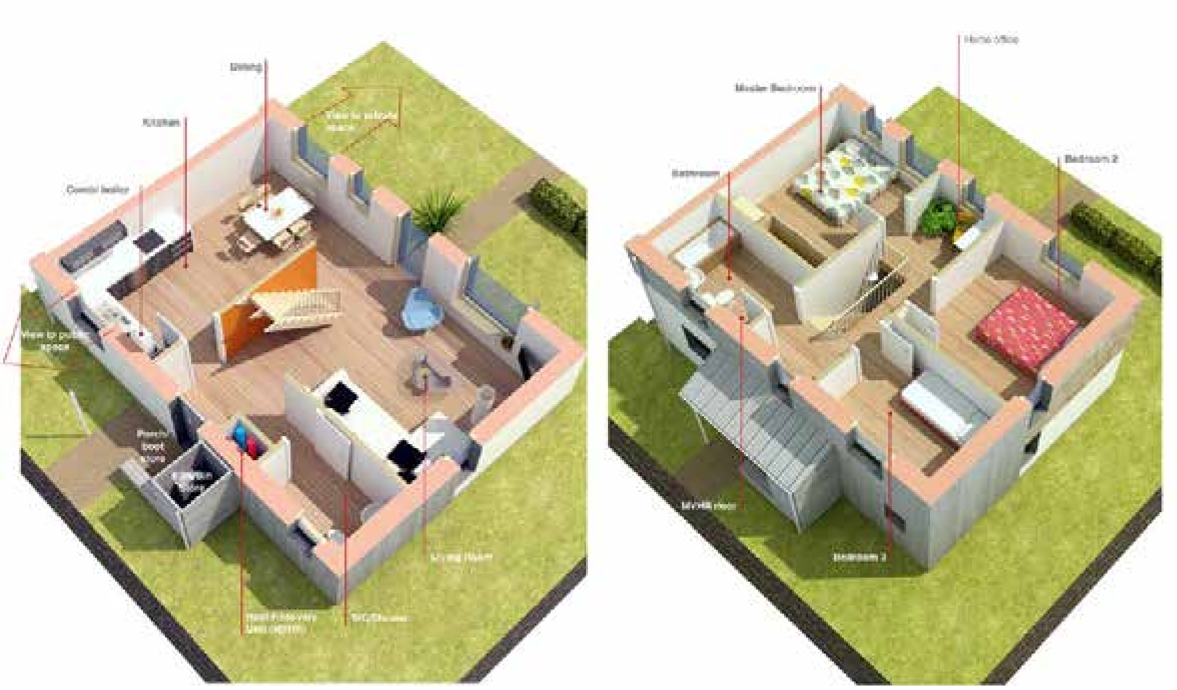
A study of the local vernacular and a rigorous PassivHaus energy analysis led to the development of a simple elegant house form, with a wider frontage and shallower depth, which also enabled the design of a more spacious and flexible house layout.

Collaborative Planning:

The project is an exemplar of a collaborative planning process, with monthly pre-application meetings with planning, highways, housing, landscape, ecology and drainage officers at Herefordshire Council, over a 12 month period as the scheme developed. This also enabled the development of a new and radical approach to rural housing layout, with houses orientated to maximise solar gain and control, shared ‘rural lane’ surfaces for access, SUDS for drainage, positive public realm, allotments and community orchards, with commitment from the local authority to adopt all public areas.

Community Consultation:

An innovative process of local consultation was adopted, through which the entire village was invited to attend a series of community workshops. Many ideas suggested were incorporated, and many concerns raised were allayed as the design developed. The scheme also benefitted from third party, independent Design Review. This collaborative approach ultimately led to a strong recommendation for approval by the planning officer to the planning committee, and subsequent approval by the committee.



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Sustainability Outcomes

Fully Integrated PassivHaus:

Rethinking the design process meant that PassivHaus was built in as a minimum standard rather than added as an extra cost. This brings benefits of energy efficiency, comfortable, healthy living and low fuel bills.

Site Design:

The considered approach to site design and layout means that the development is integrated into the grain of the local village. New cycle and pedestrian links promote healthy living and reduce reliance on the car.

Sustainable Landscape Design:

The site layout incorporates generous outdoor green community space, with community orchards and allotments.
The landscape scheme has been designed to support biodiversity with boundaries formed using local native hedgerows.
A SUDS deals with surface water drainage.

Integrated Housing Mix:

A cohousing group has been integrated into the wider development, and 35 % of houses are affordable, yet built to the same standards as the market housing, so that they are fully integrated and 'tenure blind' across the development.

References:

> www.archihaus.co.uk

Images

1 House layout. *Architype*
2 Annotated view. *Architype*
3 Site Plan. *Architype*


community allotments located adjacent site entrance road
pedestrian and cycle path linking B4348 to playing fields and south of village through public green space
cluster of houses arranged around central green space
apartment terraces arranged to overlook public space
community orchards sweep through centre of the site
natural play opportunities located all around the site
shared surface lanes designed to naturally slow vehicular traffic
hedges form boundary to all public edges of gardens
swale provides natural separation between public and private
footpaths provide pedestrian link between shared surfaces
water attenuation integrated fully within design of the site

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Project Data

Location	Brighton
Local Authority	Brighton & Hove Council
Client	Brighton & Hove Council/Mill Group
Design and construction team	Architect: Bennetts Associates with LCE Architects Structural Engineer: SKM Anthony Hunt Services Engineer: Fulcrum Consulting Landscape Architect: Land Use Consultants
Date of completion	2004
Cost/m^2	£1250/m^2 excluding site infrastructure, basement and cafe.
Value	£8.2 M
Area	6,450 m^2

Brighton Central Library & Jubilee Street Masterplan

The new library building forms part of a masterplanned regeneration of a derelict site which forms an extension to the city's cultural quarter. As well as the library, the masterplan included office, retail, residential and community accommodation and a hotel set around a new public square. From the outset, the library building was designed for low energy consumption, making good use of natural ventilation and daylight.

Planning and Design Process

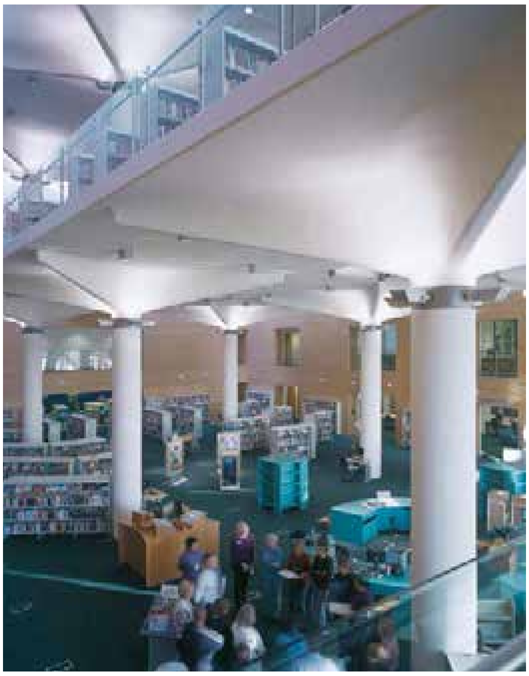
Design Quality and Private Finance Initiative (PFI):

Brighton and Hove's new library is the centrepiece of the Jubilee Street development and the catalyst for regeneration of Brighton's cultural quarter. It is a highly innovative design with sustainability at its heart, delivered on time and to budget, and has the architectural stature and ambition of a major public building, whilst being delivered via a PFI route.

Two previous attempts to build a new library had foundered during the planning process so, when the Council was obliged by the Government to follow the PFI for the third attempt, it made design quality a central feature of the tendering procedure. Developers were invited to bid for the whole of the Jubilee Street site, with the prospect of cross-subsidising the library with revenue from other developments. The scheme was chosen after an extensive public consultation exercise and has since been praised as a rare example of high design quality within the PFI system.

Mixed-Use Masterplan:

The masterplan effectively extends the cultural quarter of Brighton from the Dome northwards to embrace the network of streets previously cut off by a derelict car park. To do this, the design reinstates Jubilee Street to its original alignment, with most of the new buildings playing a background role in order that the external spaces predominate. Street level is filled with shops, cafes and restaurants, with either offices or residential above. In the centre of the site, a small square provides the setting for the library and a venue for public art, performance and the Brighton Festival. With a hotel on its south side and a cafe on its east, the square also resolves the unfortunate approach to a 1970s municipal swimming pool.



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In economic terms, the addition of many new properties is substantial, but it is the mix of building-types and the permeability of the plan that makes this especially significant. The library itself builds on these themes, with a mixture of uses that includes a café (still to be fitted out), bookshop, music library, children's area, life-long learning centre, conference rooms for hire and so on. Access is total, both in respect to physical disabilities and in relation to legibility and openness.

Sustainability Outcomes

Ventilation, Heating, Cooling and Daylight:

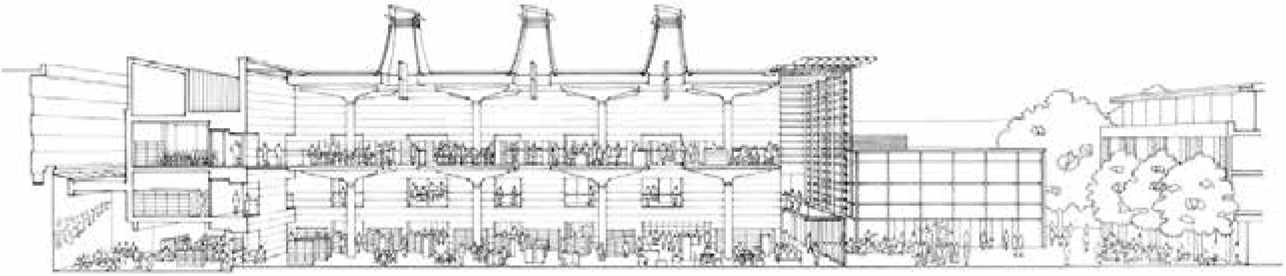
The engineering of the building supports the architectural intention. The thick walls surrounding the central space contain air ducts from the roof-level plant rooms, feeding air through voids in the concrete 'Termodeck' floor slabs before entering the perimeter rooms and the main space. In winter, warm air is recirculated back to the plant room at high level; in summer, the extract system is driven by three centrally-located wind towers, adding interest to the skyline of a city known for its Regency domes and minarets. Dominating the library, eight freestanding concrete columns with fan-shaped heads support the middle floor and the roof, defining the character of the space and greatly adding to the building's thermal mass. Lightweight bridges cross the air-gap between the central structure and the deep reveals of its enclosure, allowing daylight to penetrate deep within the plan.

BREEAM in a Public Building:

Unusually for a public library, the building was designed to achieve an BREEAM Excellent rating. This includes exceptionally low energy consumption, low embodied energy and recycled rainwater.

Reference:

> www.bennettsassociates.com/portfolio/9904/



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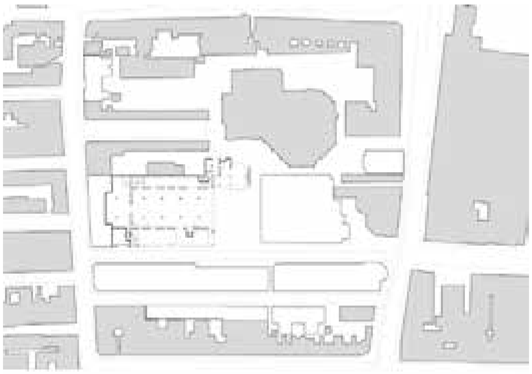

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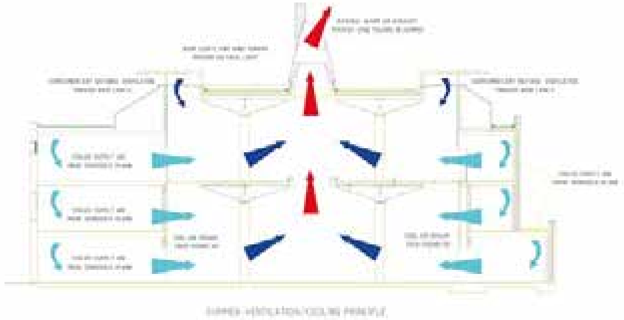

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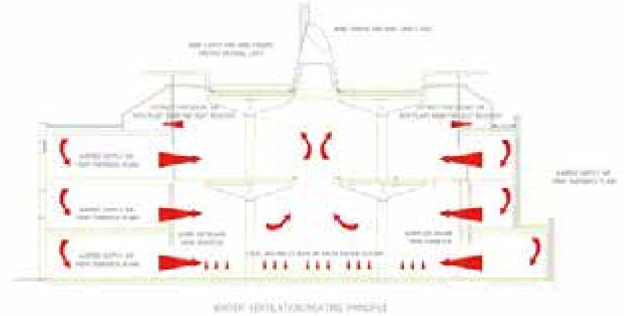

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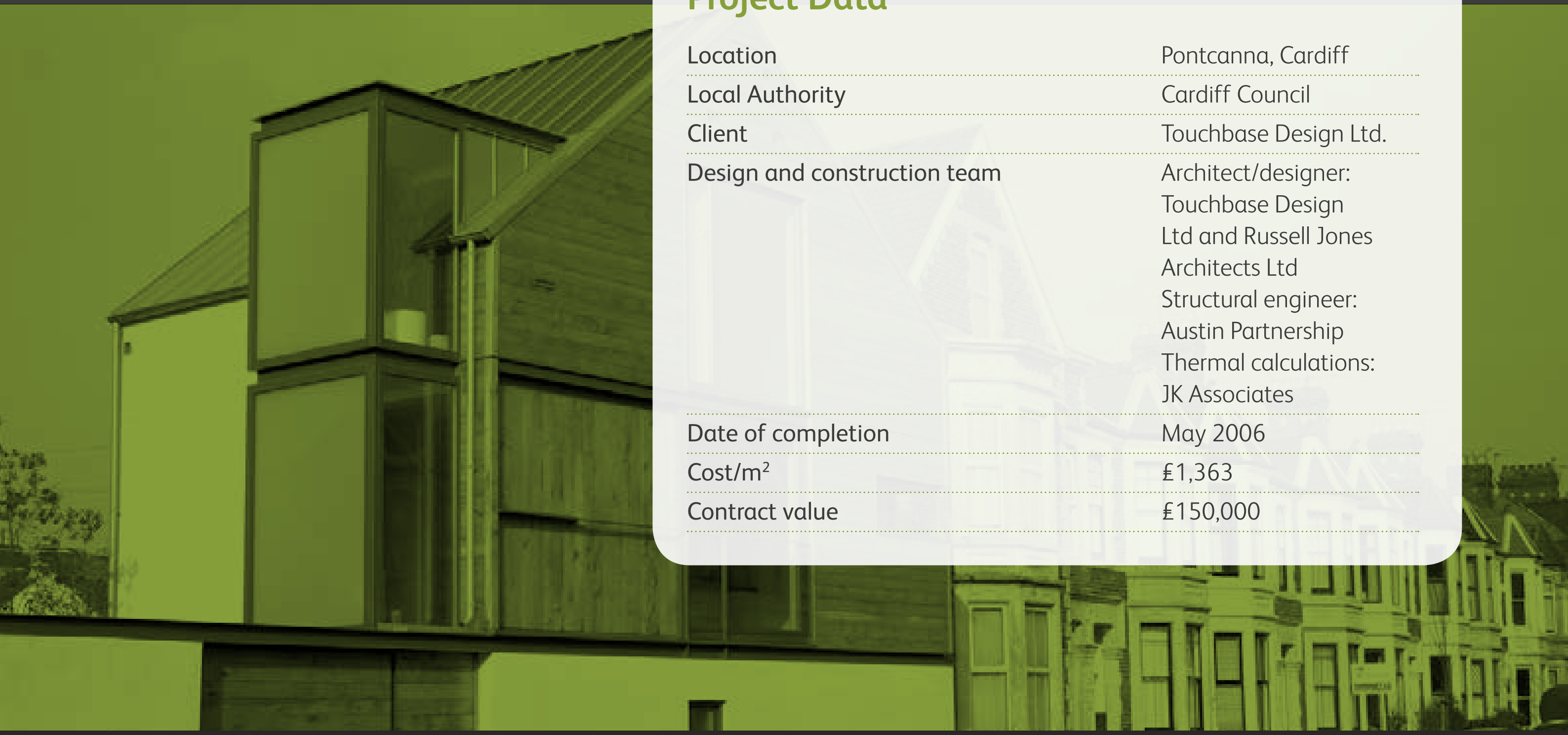
Images

1&2	Good daylighting and contribution to public realm. *Peter Cook/LCE Architects*
3	Building Section. *John Bradbury*
4&5	Site Plans. *Bennetts Associates*
6&7	Ventilation and heating strategy. *Bennetts Associates*
8	Public realm. *James Brittain*



Project Data

Location	Pontcanna, Cardiff
Local Authority	Cardiff Council
Client	Touchbase Design Ltd.
Design and construction team	Architect/designer: Touchbase Design Ltd and Russell Jones Architects Ltd Structural engineer: Austin Partnership Thermal calculations: JK Associates
Date of completion	May 2006
Cost/m^2	£1,363
Contract value	£150,000

The Coach House, Cardiff

The Coach House is a two-bedroom live/work unit designed to be highly sustainable and to allow the residents to work from home. It is located on a south facing brown-field site in a quiet residential street of Victorian houses adjoining a Conservation Area. The site originally housed a stone coach house which had become a derelict eyesore.

Planning and Design Process

The Brief:

The brief from the client was to produce a two bedroom live/work unit of innovative contemporary design, with as low environmental impact as possible. The building was to be a good example of inclusive design to accommodate those with disabilities and provide facilities for working from home. The client sought a healthy interior environment through use of natural daylight and ventilation, and good connection to outside spaces.

Site and Planning Constraints:

There were a number of site and planning constraints which had to be considered in the delivery of this project. The small size of the site required efficient space planning which also made use of passive solar gains and daylight. Building height, overlooking of neighbours and proximity to the conservation area all had to be addressed for the planning application, and to create a well-designed, contemporary, sustainable place in this context.

Sustainability Outcomes

Energy Efficiency:

The building uses underfloor heating with an efficient gas combi-boiler. Zoned thermostatic controls and good insulation minimise wasted heat. Photovoltaic solar panels are integrated with the roof design and generate around two-thirds of the building's electricity, making the running costs more affordable. Large south and west facing windows allow winter solar gains and plenty of natural daylight. Wherever possible, local materials and suppliers were used.

Reference:

> www.russelljones.org/projects/residential/hamilton-road/

Images

1 Building Section. *Russell Jones Architects*

2 Site Plan. *Russell Jones Architects*

3 Street view. *DCFW*

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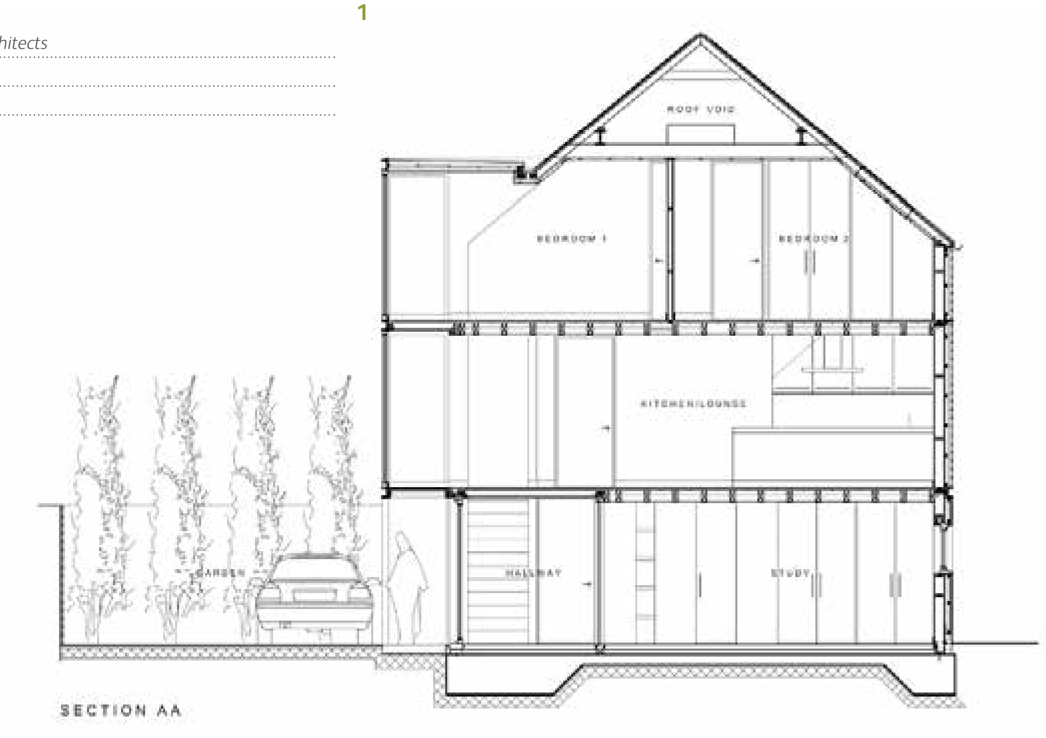

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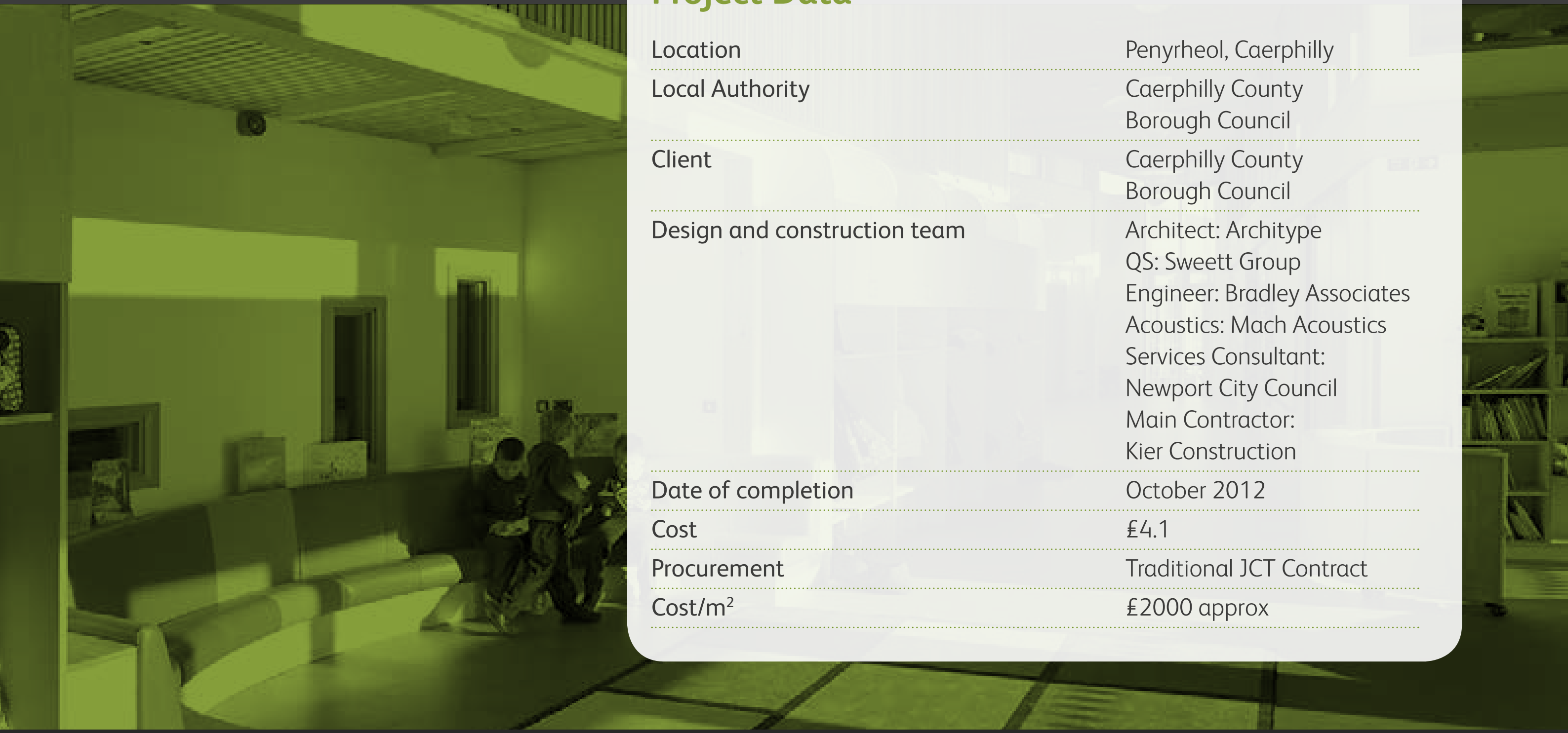


Project Data

Location	Penyrheol, Caerphilly
Local Authority	Caerphilly County Borough Council
Client	Caerphilly County Borough Council
Design and construction team	Architect: Architype QS: Sweett Group Engineer: Bradley Associates Acoustics: Mach Acoustics Services Consultant: Newport City Council Main Contractor: Kier Construction
Date of completion	October 2012
Cost	£4.1
Procurement	Traditional JCT Contract
Cost/m^2	£2000 approx

Cwm Ifor Primary School, Caerphilly

Cwm Ifor Primary School was part of the 21st Century Schools Programme. The project designed a new build 1.5 form entry primary school to RIBA Stage 3, including in depth client and user consultation, Caerphilly County Borough Council (CCBC) Building Consultancy then led from Stage 4.

The brief placed emphasis on the need for the design to embrace the school's culture and ethos of community, and support delivery of the Welsh Primary Curriculum. Through extensive consultation, a radical layout was created which is unique compared to traditional classrooms off corridors for 'stand and deliver' education. The scheme adopts a smaller class size with shared hub spaces, breakout spaces, outdoors classrooms, inhabitable walls and nooks for various learner-directed activities with small groups and one-to-one sessions.

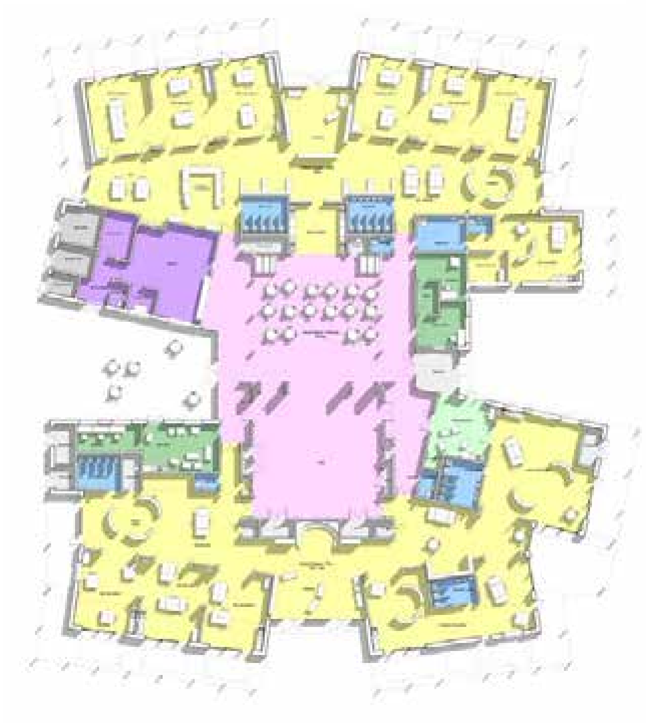
Planning and Design Process

Community Engagement:

The school is in an area of social deprivation, and the new building is relocated on the site to invite and encourage people from all around the area to take pride in the facilities and widen attendance. The scheme adopted a partnership approach with extensive consultations with the school and other stakeholders.

Education Strategy and Passive Design:

An innovative educational strategy in conjunction with the Welsh 21st Century Schools agenda drove the design of the building and the landscape. There are no traditional sized classrooms for 'stand and deliver' education, but smaller class bases, shared hub spaces and inhabitable walls and nooks for various learner directed activities for small groups and individuals. Sliding doors and folding partitions between spaces allow multiple arrangements of different sized spaces, including opening



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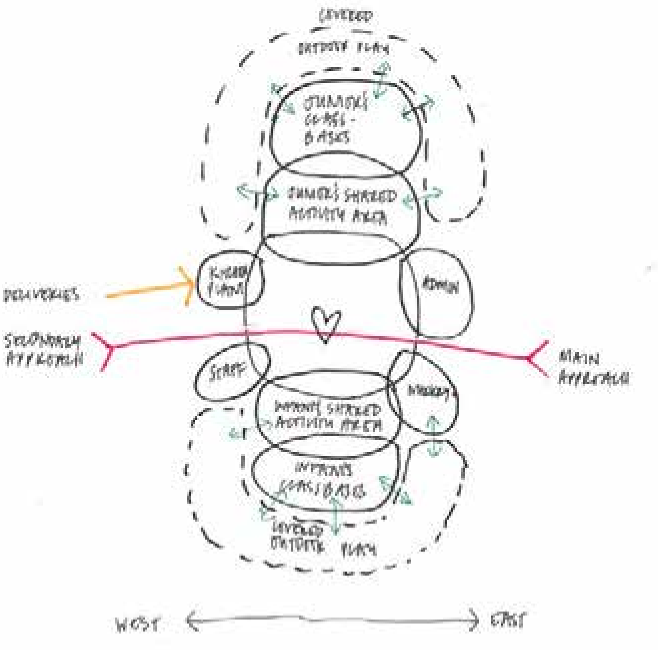

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to the outside. The passive design approach creates environmental conditions inside the building which are conducive to this way of education. The landscape is developed as an integral part of the educational provision, with a series of outdoor teaching spaces and stimulating play areas.

Sustainability Outcomes

Building Orientation and Form:

The building orientation and section have been carefully designed to maximise natural daylight in every space, and to control solar gains. The form and plan arrangement allows natural ventilation.

Structure and Materials:

The timber structure used off-site timber panel construction, and is highly insulated with recycled newspaper insulation. Renewable and healthy natural materials and finishes, such as timber, linoleum, natural paints and natural oils are used throughout. The UK-sourced timber cladding is left untreated, whilst the meadow grass green roof improves insulation and biodiversity.

Educational Landscape:

An integrated approach was taken to building and landscape design to extend the educational strategy beyond the walls of the building. The educational landscape design includes an open water course, pond and bridge for the children to interact with and learn from.

References:

> http://learn.caerphilly.org.uk/cwmiforprimary/

> www.architype.co.uk

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Images

1	Floor plan. *Architype*
2	Concept diagram. *Architype*
3	Shared space. *Leigh Simpson*
4	Site plan. *Architype*
5	Daylit classroom. *Leigh Simpson*
6	Landscape design. *Leigh Simpson*
7	Architect's sketch. *Architype*

Project Data

Location	Denbigh, Denbighshire
Local Authority	Denbighshire County Council
Client	Various building owners in conservation area and The Denbigh Partnership
Design and construction team	Architects: Lloyd Evans Pritchard (Manchester), Purcell Miller Tritton (Liverpool), Chris Sanders (Denbigh), Adrian Jones (Ruthin), ISP Architects (Wrexham) Contractors: Chester Masonry Ltd, Pen y Bryn Joinery, Carroll Builders, B & W Builders
Date of completion	December 2006
Contract value	£5,000,000
Number of properties	17

Denbigh Townscape Heritage Initiative

Denbigh is a small historic town in North Wales, which had seen its social and economic profile slowly decline. In parallel, the condition of much of its built heritage also suffered. A determined team and funding from the Townscape Heritage Initiative (THI) led to a successful six-year programme to upgrade the built fabric of the town. The renovation of buildings and public space has made a significant impact on the town centre economy, and has improved the environmental performance of many of the historic buildings.

Planning and Design Process

Collaborative Project Team:

The THI was funded by the Heritage Lottery Fund, a scheme designed to address problems of disrepair, erosion of quality and the under-use of historic buildings. The initiative was managed through three teams:

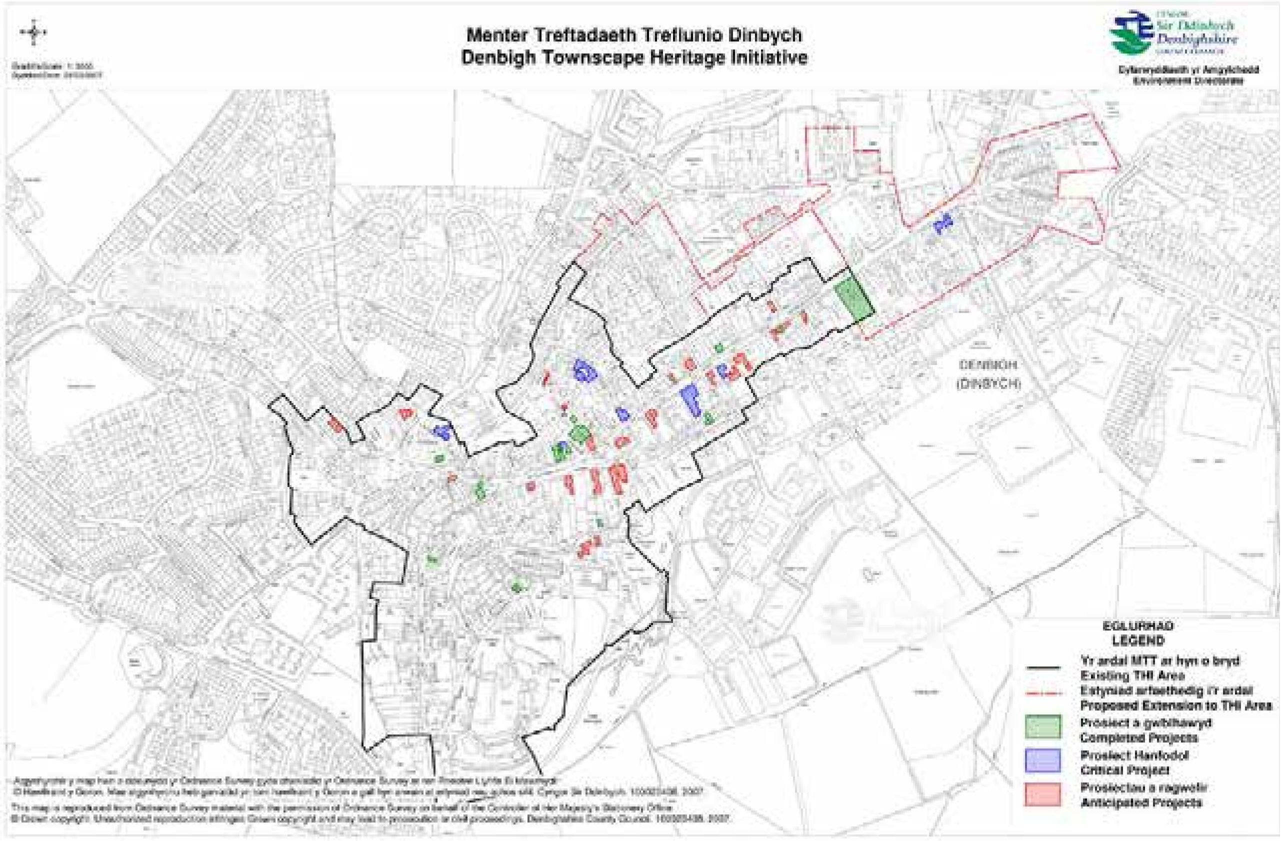
- The Denbigh Partnership, which comprised the Denbigh Civic Society, Denbigh Town Business Group, Popeth Cymraeg and the Denbighshire Enterprise Agency
- The Project Board, which consisted of the funding bodies, including representatives from the Welsh Government, Cadw, Wales Tourist Board (Visit Wales as of 2006), Denbigh Town Council and Denbighshire County Council
- The Project Team, which was the internal support group of Denbighshire County Council.

It was crucial that all partners worked together through the initiative to maximise benefit to the town. The local community was involved in decision making processes through participation and representation on the board.

Getting Best Value from Funding:

The teams worked together to increase awareness among local property owners of the qualities of the heritage in the town centre and the opportunities presented by the initiative, encouraging them to take up grants.

Fabric improvement works were carried out on numerous properties and a public space, returning neglected buildings in



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the conservation area to their former glory, and in re-establishing old uses or establishing new ones. Employment, housing, educational and community facilities were all upgraded through the scheme.

Sustainability Outcomes

Building Re-Use:

The re-use of the historic buildings is compatible with the principles of sustainability. By repairing rather than replacing them, the consumption of resources was minimised. Encouraging use of previously empty units in the town centre for commercial enterprise and residential use is helping to sustain the local economy and reduce outward migration. Locating living accommodation close to other facilities and work places reduces transport related energy and promotes healthy living.

Traditional Skills and Materials:

Many of the repairs were carried out using traditional building methods and materials, such as lime pointing and rendering. The use of natural, local materials reduced embodied energy and transport related energy. Because craftsmanship and traditional skills were employed, the use of energy intensive processes was minimal. Using 'breathable' traditional materials is helping to prevent problems such as condensation and mould growth.

Improving Fabric Performance:

Where possible, the thermal insulation of the building fabric, especially roofs and windows, was upgraded to reduce wasted heat energy. The character of the historic buildings was preserved.

Reference:

> http://dcfw.org/denbigh-townscape-heritage-initiative-denbighshire

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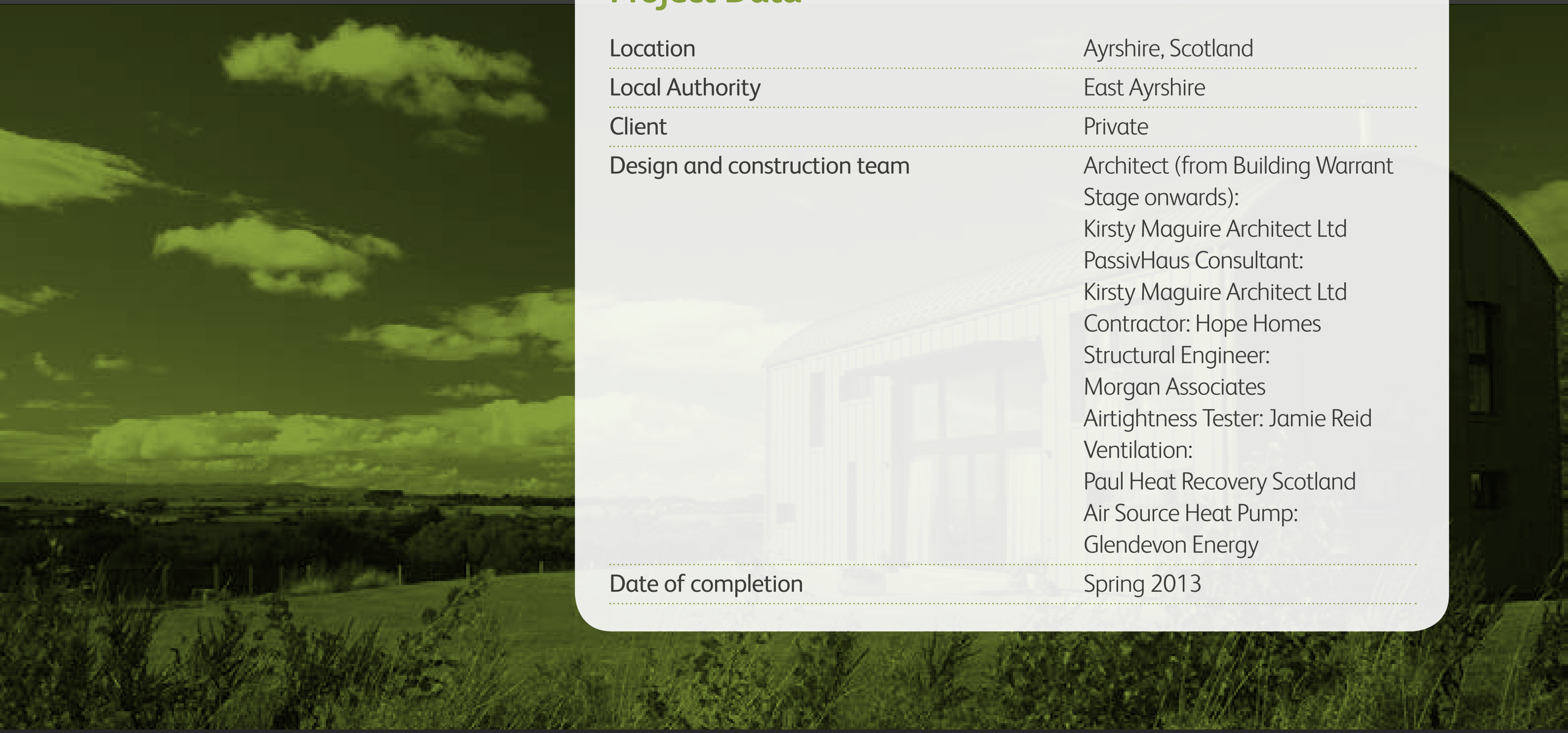
Images

1 Site plan. *Denbighshire County Council*

2-5 Individual Building Improvements. *DCFW + Denbighshire County Council*



Project Data

Location	Ayrshire, Scotland
Local Authority	East Ayrshire
Client	Private
Design and construction team	Architect (from Building Warrant Stage onwards): Kirsty Maguire Architect Ltd PassivHaus Consultant: Kirsty Maguire Architect Ltd Contractor: Hope Homes Structural Engineer: Morgan Associates Airtightness Tester: Jamie Reid Ventilation: Paul Heat Recovery Scotland Air Source Heat Pump: Glendevon Energy
Date of completion	Spring 2013

Farmhouse PassivHaus, Ayrshire

The aim of this project was to develop a comfortable, low maintenance, light filled and warm home that takes advantage of the stunning views from the site whilst minimising fuel bills. The design is a modern home that refers to the local farm vernacular of the west coast traditional hayshed, rather than re-creating a 'traditional' farmhouse. Using passive solar design and natural ventilation, combined with heat recovery and a high performance building shell, gives great comfort to the occupants and very low running costs for energy. The house is designed and modeled to meet the stringent PassivHaus Standard.

Planning and Design Process

Rural PassivHaus:

As well as meeting the PassivHaus Standard, this new farmhouse sought both inspiration and advantage from its beautiful rural landscape setting. The building is inspired by the vernacular haysheds which are part of the local farm building clusters. It responds to local climatic conditions, balancing views, sunlight, shelter and low maintenance.

Local Skills and Training:

Local skills were used where possible, from designers, installers and tradesmen. Upskilling the workforce was a conscious part of the process.

Training was provided for the people involved in the project as many of them were unfamiliar with the PassivHaus principles. Training included a seminar for Building Control and tool box talks for the contractor which helped raise awareness of PassivHaus principles and benefits.

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Sustainability Outcomes

Low Energy:

The house is certified as meeting the PassivHaus Standard, the best practice European energy standard. The house is typical of a rural property, in that it is not on the gas grid. Very little heating is required, as the building is super insulated and designed to heat and cool passively with small top up heating in mid winter to keep the house at 20°C. This is provided by towel rails and a small wood burning stove as is traditional in a rural farmhouse. Energy use is extremely low, modelled to use only 13kWh/m^2.yr of energy for space heating.

Hot water is provided by an air source heat pump. There is a heat recovery ventilation system and efficiency is further enhanced by using any remaining heat, from the waste air from the heat recovery system, in the heat pump.

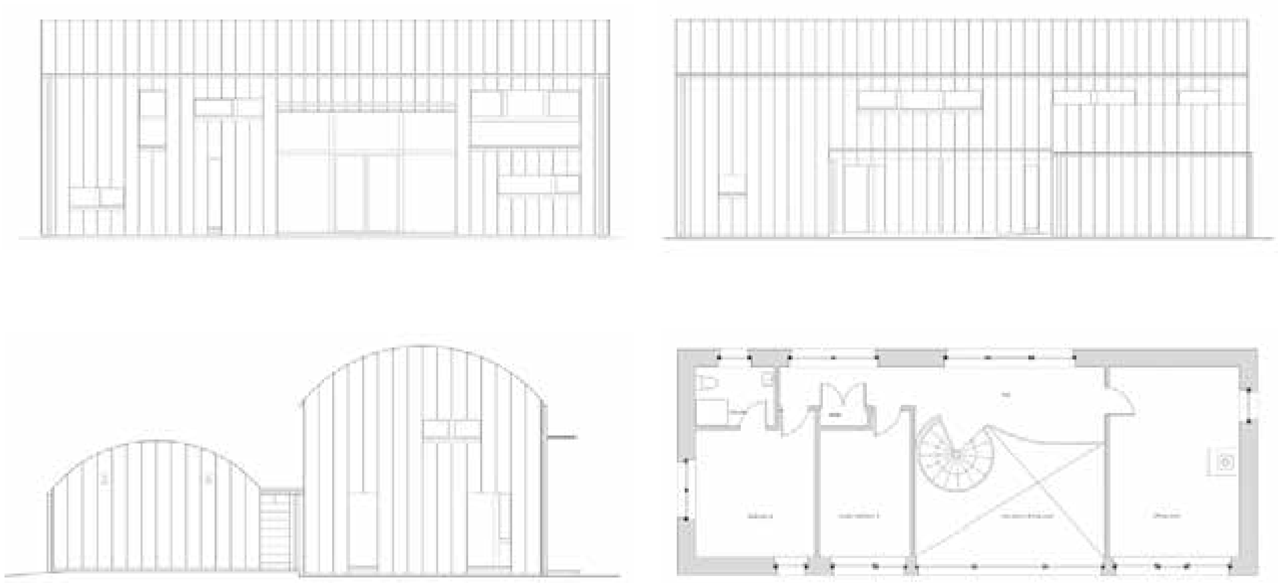
The property is very airtight, achieving a test result of 0.22 air changes per hour @50pa. This means that little heat is lost through draughts.

Materials:

Where appropriate and within the confines of the specification, locally sourced materials were specified. I Joists came from the UK (JJI), and the Superglass insulation was manufactured in Scotland using 100% post consumer waste, mainly locally sourced recycled glass bottles.

Reference:

> www.kirstymaguire.com/projects/PassivHaus-farmhouse/



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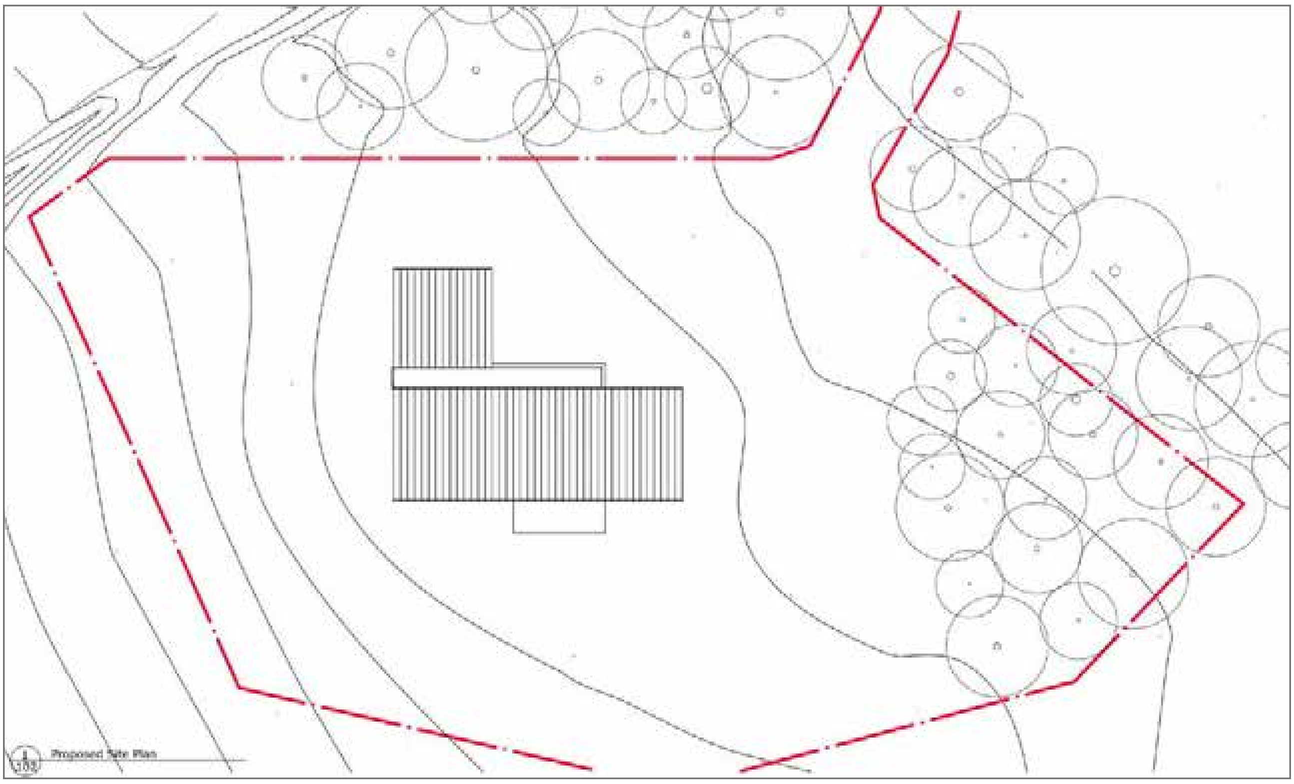

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Images

1 Exterior view. *KMA Architects*

2 Response to landscape. *KMA Architects*

3 Building plan and elevation. *KMA Architects*

4 Site plan. *KMA Architects*

Project Data

Location	Hammarby Sjöstad, Stockholm, Sweden
Client	City of Stockholm, Stockholm Water Company, Fortum and the Stockholm Waste Management Administration
Design and construction team	Masterplan and project management by Stockholm City Planning Bureau, with Jan Inghe-Hagström as lead architect. Various design teams and contractors.
Date of completion	Anticipated 2017
Contract value	Estimated approximately £1.5 billion
Site area	200 hectares, brownfield land (incl. 50 ha water)
Residential units	10,000-11,000 apartments
Commercial floor space	200,000m^2
Density	45 du/ha

Hammarby Sjöstad, Sweden

Hammarby Sjöstad is an urban extension with a balanced mix of uses including sustainable residential development. A former derelict industrial site to the south of the city centre, the area is now identified as part of the city centre core. The city's commitment to high environmental performance standards and robust planning of district-wide solutions has resulted in 50% reduction in emissions compared with the 1990s Swedish standard. By the time the development is completed it is estimated that residents will produce 50% of all the energy they need via district wide systems which recover energy from waste.

Planning and Design Process

City-led Masterplanning:

Masterplanned in the 1990s as part of the bid for the 2004 Olympic Games, the site was originally intended as a modern city district, with a core area housing the Olympic Village. Despite the failure of the bid, the original masterplan was largely adopted to govern the development.

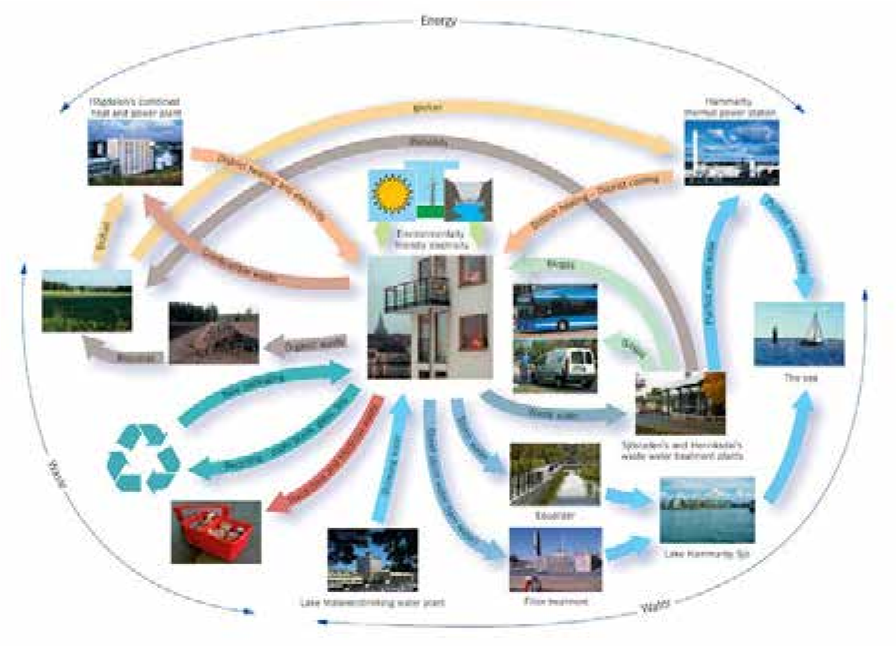
The City Planning Bureau divided the development phases into twelve sub-districts, and used an approach known as 'parallel sketches' to achieve a final masterplan for each of the twelve sub-districts. The City attracted three to four young innovative design teams to 'test' the strategic masterplan and to draw up more detailed proposals for the sub-district. The city then evaluated the sketches and assimilated the best features from each to arrive at an agreed detailed masterplan.

Planning Process and Design Code:

Subsequently a design code was prepared by the municipality and the team in order to deliver the detailed plan for each sub-district. The design code implementation was secured in an appendix to the development agreement between the city and the selected development partner.

Infrastructure and Energy Targets:

Sustainability was integrated from the outset. This ensured that the necessary infrastructure was installed. The municipality imposed strong environmental targets for buildings, infrastructure and transportation alongside an ambitious goal of 'twice as good' (i.e. a 50% reduction in overall emissions compared with new housing built in the early 1990s).



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Sustainability Outcomes

Decontamination:
Land decontamination and clearance, using biological rather than chemical treatment.

Community Combined Heat and Power (CHP):
The CHP district system, fuelled by biomass and pre-sorted combustible waste, provides most of the heat demand as well as generating electricity. The remaining heat demand is met by extracting waste heat from the waste water treatment plant. The cooled and treated waste water is used in the district cooling network.

Waste Management:
A vacuum-driven waste disposal system conveys pre-sorted solid waste to be recycled, or used to produce heating and electricity.

Water Management:
Domestic water consumption is reduced to 100 litres per person per day. Storm water is treated locally in settling tanks. It is then drained into canals which run through the site and is eventually released into the adjacent sea.

Routes and Transport:
'Ecoducts' (i.e. planted viaducts and green corridors) link the development with the vast forested area of the Nacka nature reserve to the south of the site. Substantial investment has been made in public transport provision, in the form of a new tram link, good bus routes, and free pedestrian ferry. A car pool with around 30 biofuelled cars is used by 10% of households. There are numerous pedestrian and cycle paths. The aim was for 80% of all journeys to be by public transport, foot or cycle.
A methane digester is used to produce biogas for vehicle fuel and around 1,000 gas stoves in Hammarby. The remaining sludge is used as a fertiliser in the forestry industry.

Education:
The GlasshusEtt information centre acts as a community education centre to promote sustainable lifestyles.

Reference:

> www.hammarbysjostad.se

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Images

1 Sustainability diagram. *DCFW and Hammarby Sjöstad*

2 Waterside footpaths. *DCFW and Hammarby Sjöstad*

3 Landscape and parking. *DCFW and Hammarby Sjöstad*

4 Active waterfront. *DCFW and Hammarby Sjöstad*

5 Integrated public transport. *DCFW and Hammarby Sjöstad*

6 Provision for cycling. *DCFW and Hammarby Sjöstad*

Project Data

Location	Winchester
Local Authority	Hampshire County Council
Client	Hampshire County Council
Design and construction team	Architect: Bennetts Associates Project Manager: Mace Structural Engineer: Gifford Services Engineer: Ernest Griffiths QS: Davis Langdon Contractor: BAM
Date of completion	2009
Value	£29M
Area	13,600m^2

Hampshire County Council Offices

This innovative transformation of a run-down and inefficient 1960s building has provided Hampshire County Council (HCC) with a highly sustainable facility which better addresses the historic context of Winchester. Natural ventilation and heat recovery from the data centre have led to a 60% reduction in carbon emission compared with the building before it was refurbished.

Planning and Design Process

Planning for Building Re-use:

The project represents a groundbreaking transformation of a dilapidated 1960s office block into a modern, efficient and highly sustainable workplace for HCC. Following a feasibility study to compare the costs of replacement, repair or refurbishment, it was decided that this option represented the best asset management decision for HCC.

New Ways of Working:

The council took an active role in the project and a well-managed culture change programme ensured that the move to flexible working has been a great success. Economically this also allowed the occupancy of the building to be increased significantly, which in turn has enabled the consolidation of several leased office buildings and a 30% reduction in overall office space requirement for HCC.

Sustainability Outcomes

Lifecycle Environmental Impact:

The project is an exemplar for both urban natural ventilation and the re-use of a building type that exists across the UK. The whole lifecycle environmental impact of the building has been reduced to less than half that of an equivalent new-build

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mechanically ventilated office building, while also transforming its appearance and working environment.

Retention of the concrete frame saved 50% of the embodied energy normally required to construct a building and use of local brick and timber based window systems helped to significantly reduce CO_2 emissions. Demolition materials were recycled through the contractor's supply chain.

Bespoke Ventilation:

Ventilation is via a carefully engineered, wind-driven system that doesn't require windows opening on the heavily trafficked roads. The design was extensively tested using computer modelling, which was then verified with wind-tunnel testing at Cardiff University.

Passive Heating and Daylight:

During winter, heat is recovered from HCC's datacentre which is accommodated within the building. This heat is then used to pre-heat ventilation air into the office spaces. Highly efficient light fittings are controlled by combined daylight-level and presence detectors. Solar shading, exposure of the concrete soffits for thermal mass and a new efficient building envelope contribute to achieving very significant energy savings.

Renewable Energy Assessment:

Renewable energy was studied extensively but, it was calculated that the equivalent cost spent on implementing natural ventilation and improving the building fabric would result in at least a fivefold better reduction in carbon emissions than on-site generation. The use of wind to drive ventilation is renewable energy in its most raw state.

Post Occupancy Monitoring:

The project was BREEAM Excellent (offices 2006) and has been extensively monitored by the Carbon Trust post-occupancy, with the monitored regulated carbon emissions being $28kgCO_2/m^2/y$.

References:

- > www.bennettsassociates.com/portfolio/0603/
- > www.ernestgriffiths.com/projects.php?iCaseStudyId=20

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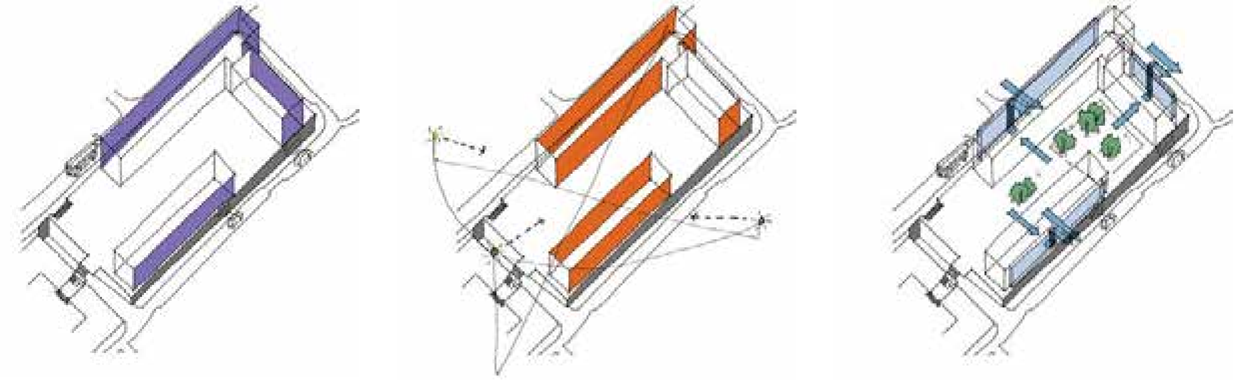

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Images

1 Street view before. *Tim Crocker*

2 Street view after. *Bennetts Associates*

3 Site plan. *Bennetts Associates*

4 Interior office. *Tim Crocker*

5 Façade ventilation diagrams. *Bennetts Associates*

6 Ground floor plan. *Bennetts Associates*

Project Data

Location	Tye Green, Wimbish, Essex
Local Authority	Uttlesford District Council
Client	Hastoe Housing Association
Design and construction team	Architects: Parsons + Whittley Employers Agent: Aecom Main Contractor: Keepmoat Sustainability Consultant: Inbuilt
Date of completion	June 2011
Cost/m^2	£1555 Gross Internal Floor Area (GIFA)

Hastoe Housing, Wimbish PassivHaus

The scheme comprises 14 rural affordable, local needs houses consisting of 3 x 3 bed houses, 5 x 2 bed houses and 6 x 1 bed flats.

As well as being delivered to the PassivHaus standard these houses also achieved level 4 of the Code for Sustainable Homes. The well-insulated airtight building fabric means that fuel bills are affordable for tenants, whilst the environmental conditions inside the houses are healthy and comfortable.

Planning and Design Process

Planning for Affordable PassivHaus:

In 2009, both the Parish Council and local planning authority understood how PassivHaus could address the lack of sustainable, affordable housing in the area. The land to be developed was on a greenfield site and the scheme falls into an exception site policy aiming to address local housing need. It provides affordable housing for local people in perpetuity as people need strong local connections to be housed and no-one is able to buy more than 80% of their home. Funding was provided via the Homes and Communities Agency (HCA) with investment from Hastoe.

Education, Skills and Risk:

The sustainability consultant helped address the steep learning curve of PassivHaus and highlighted that, for the scheme to be successful, careful attention to detail would be required. The site easily accommodated a solar oriented layout and adapting conventional construction techniques limited risk. Thin joint masonry with external insulation delivered the fabric performance, and cleverly designed brise soleil and external blinds ensure overheating risks are controlled. Individual gas boilers and solar thermal provide heating and domestic hot water, and residents report annual fuel bills in the region of £150.

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Sustainability Outcomes

Tackling Rural Fuel Poverty:

One of the principle drivers for the client, in delivering affordable dwellings to the PassivHaus standard, was to tackle the ever growing problem of fuel poverty. It was recognised that fuel poverty can be significant in isolated rural communities, and that delivering fabric first solutions ensures that fuel savings will continue throughout the life of the building.

This scheme has seen annual fuel bills for three bedroom houses at around £150, covering all the space heating and domestic hot water requirements for a family of four. Averaging around 3000 kWh, the houses compare favourably with published typical consumption figures of around 13,500 kWh. And for the housing association, happier tenants who can afford their energy bills provide a consequent reduction in both rent arrears and void periods, with high tenant satisfaction.

The energy balance in a PassivHaus is calculated from a comprehensive model which takes into account the solar orientation, heat losses and gains from fenestration and from occupancy. Heating, where required, is provided from gas boilers and solar thermal panels, serving a wet thermal store from which a coil in the supply air is served when space heating is required. Because of the small usage, Liquefied Petroleum Gas (LPG) can be considered where town gas is unavailable.

Health and Comfort:

Another benefit of delivering the PassivHaus Standard has been the tenants' appreciation of a healthier and more comfortable living environment. Through the extensive monitoring programme, it can be seen that temperatures in the houses are constantly maintained at a reasonable level, but in addition air quality (measured through CO_2 levels), and relative humidity remain very good. Understanding comfort levels is very important, as low fuel bills alone can be misleading if they are being achieved through the sacrifice of decent comfort standards.

All of the tenants report very comfortable environments, and in particular, allergy sufferers comment on the air quality in the homes. Unlike many 'normal' homes, this ventilation quality is being achieved at the same time as recovering around 90 % of the heated air, whilst avoiding drafts and security issues.

Because PassivHaus requires additional insulation, high quality doors and windows and good air tightness, tenants notice how quiet and 'solid' their properties feel. This is also evidenced in their ability to use all of the space, as there are no cold or hot spots in the rooms.

BREEAM and PassivHaus:

PassivHaus has been used to resolve the energy and comfort requirements of these homes. The scheme also achieves Code for Sustainable Homes level 4 with significant attention given to the sourcing of appropriate materials and ensuring reduced water usage were part of the overall design strategy. Surface water is retained on site and attenuated to the green field run-off rate before being discharged into the adjacent ditch, ensuring that the scheme would not contribute to downstream flooding. Ecological considerations ensured that the biodiversity of the site was increased over and above the original site, and timing of the works was necessary to avoid risks to the globally scarce, but locally prevalent Great Crested Newts.

References:

- > www.parsonswhittley.co.uk
- > www.hastoe.com
- > www.aecom.com

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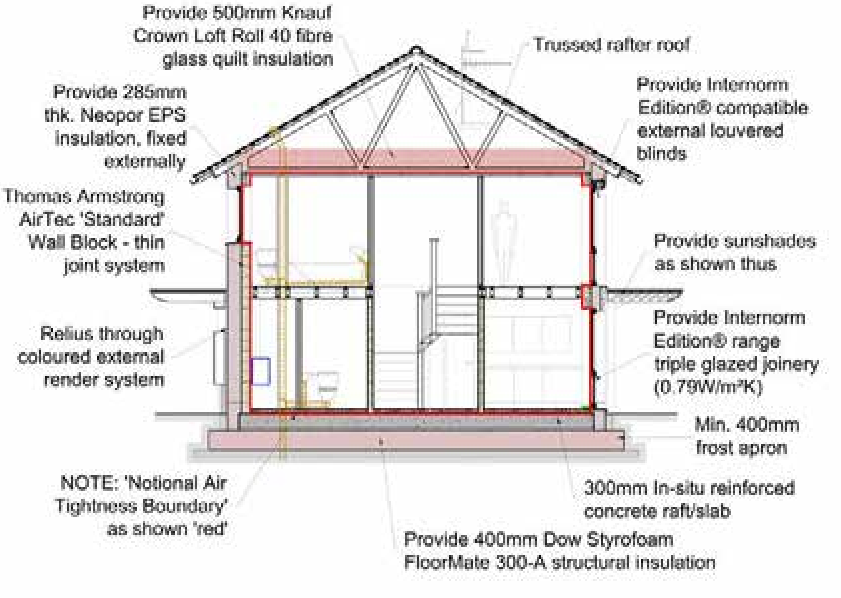
Images

1 Completed project. *Mark Baigent*
2 3D view. *Parsons + Whittley*
3 Floor plan. *Parsons + Whittley*
4 Section diagram. *DOW Chemicals*



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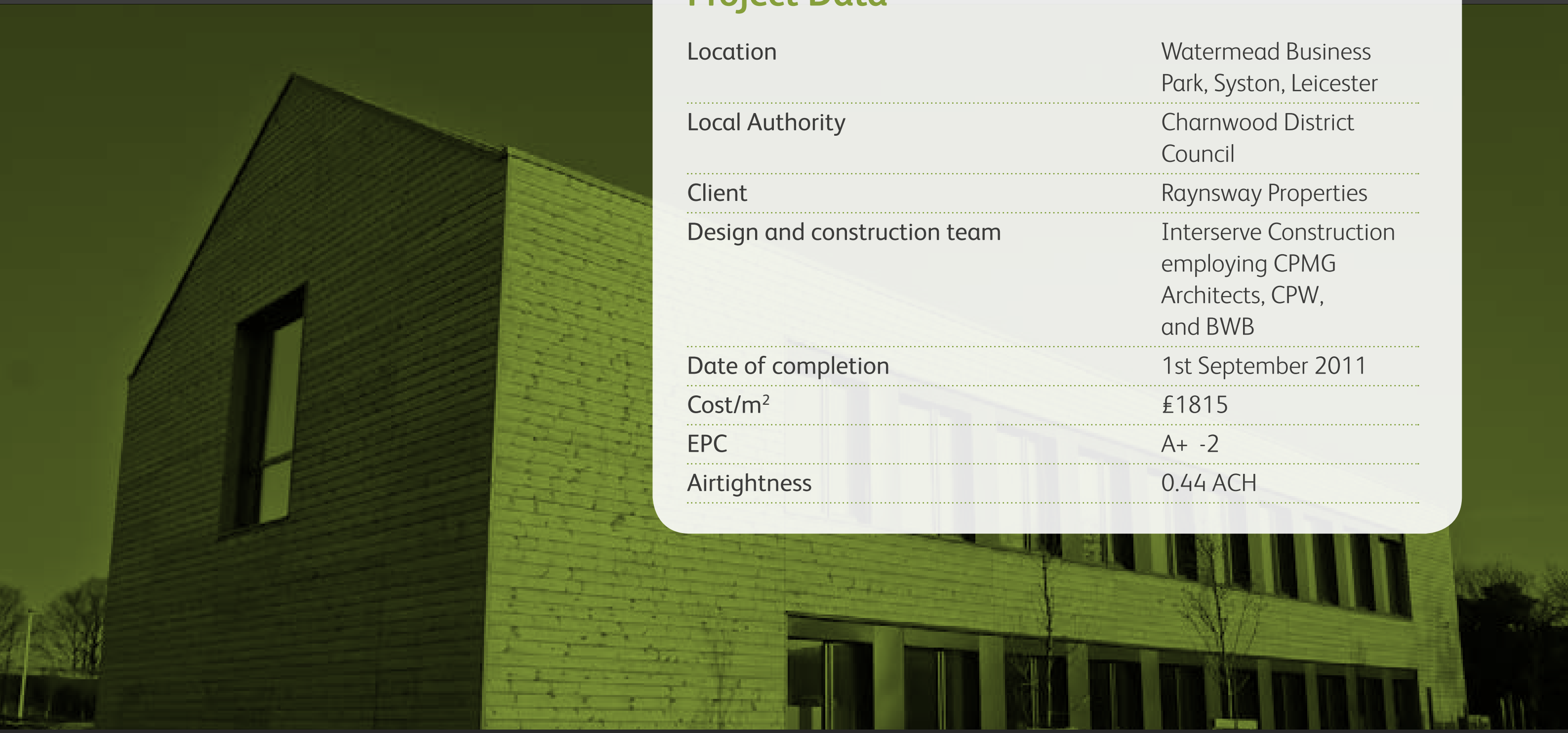

Project Data

Location	Watermead Business Park, Syston, Leicester
Local Authority	Charnwood District Council
Client	Raynsway Properties
Design and construction team	Interserve Construction employing CPMG Architects, CPW, and BWB
Date of completion	1st September 2011
Cost/m^2	£1815
EPC	A+ -2
Airtightness	0.44 ACH

Interserve's PassivHaus, Leicester

Interserve wished to find ways of moving to a more sustainable office, balancing possible additional rental costs against the likely saving in energy costs. Having already embarked on a BREEAM Very Good route, the proposition of the PassivHaus solution, with the associated major energy saving potential to balance the additional capital cost of construction, seemed appealing.

Planning and Design Process

PassivHaus Target:

The BREEAM design was superseded and the same building plan was reoriented to suit the PassivHaus model which drew better performance benefits for this project and allowed greater flexibility of design. The local council's requirement was that business parks within their borders should meet BREEAM Good or better.

Large Scale PassivHaus:

As an innovative Ccommercial PassivHaus project, there were many challenges to be overcome, given the lack of PassivHaus accredited components in the UK for larger scale projects. Items such as mechanical heat recovery plants and large windows were only available in mainland Europe, leading to concern over future failure and ease of rectification. These problems are now being eradicated as more large PassivHaus developments are constructed in the UK.

Passive design measures help to control the thermal performance of the building. The triple-glazed windows and elimination of thermal bridging reduce unwanted heat loss, while the Building Management System (BMS) controlled external blinds limit unwanted solar gains.

Sustainability Outcomes

Heating, Cooling and Ventilation:

The mechanical ventilation heat recovery plant is over 80% efficient at removing heat from expelled air and introducing it to incoming air. In addition, 250 metres of underground air tubes temper the incoming air, increasing the temperature by around 6°C in winter and cooling by up to 6°C in summer.

Thermal Control:

Passive design measures help to control the thermal performance of the building. The triple-glazed windows and elimination of thermal bridging reduce unwanted heat loss, while the Building Management System (BMS) controlled external blinds limit unwanted solar gains.

Affordable Energy:

122m^2 of photovoltaic panels provide 18,240 Watts of electricity. Interserve's old office was the same size as the new building and had an energy cost of £23,480 in 2010. The energy bill for the PassivHaus office was minus £1430 in 2012, a saving of £25K per annum and compares favourably at just 10% of the consumption of the BREEAM performance standard. As future energy costs rise, these saving will become more significant.

Employee Well-Being:

Since moving into the new building, the company has seen a 13% drop in sickness days in 2012. This has been attributed to the 4 air changes per hour through the mechanical ventilation plant, which quickly expels winter germs, whereas the old office had poor ventilation. This is an added benefit which was not previously considered.

References:

> www.PassivHaustrust.org.uk/projects/detail/?cId=21

> www.interserve.com/case-studies/2010/no-3-rayns-way-PassivHaus-office

> www.cpwp.com/news/2011/04/cpw-revolutionise-new-office-complex-using-PassivHaus-eco-design-principals

> http://ukPassivHausconference.org.uk/sites/default/files/MWrate%20-%20Interserve%20Office.pdf

> www.bwbconsulting.com/project/INT006_PassivHaus-watermead-business-park-syston#keyfacts

> http://sustainabilities.interserve.com/2013/05/13/PassivHaus-leicester/

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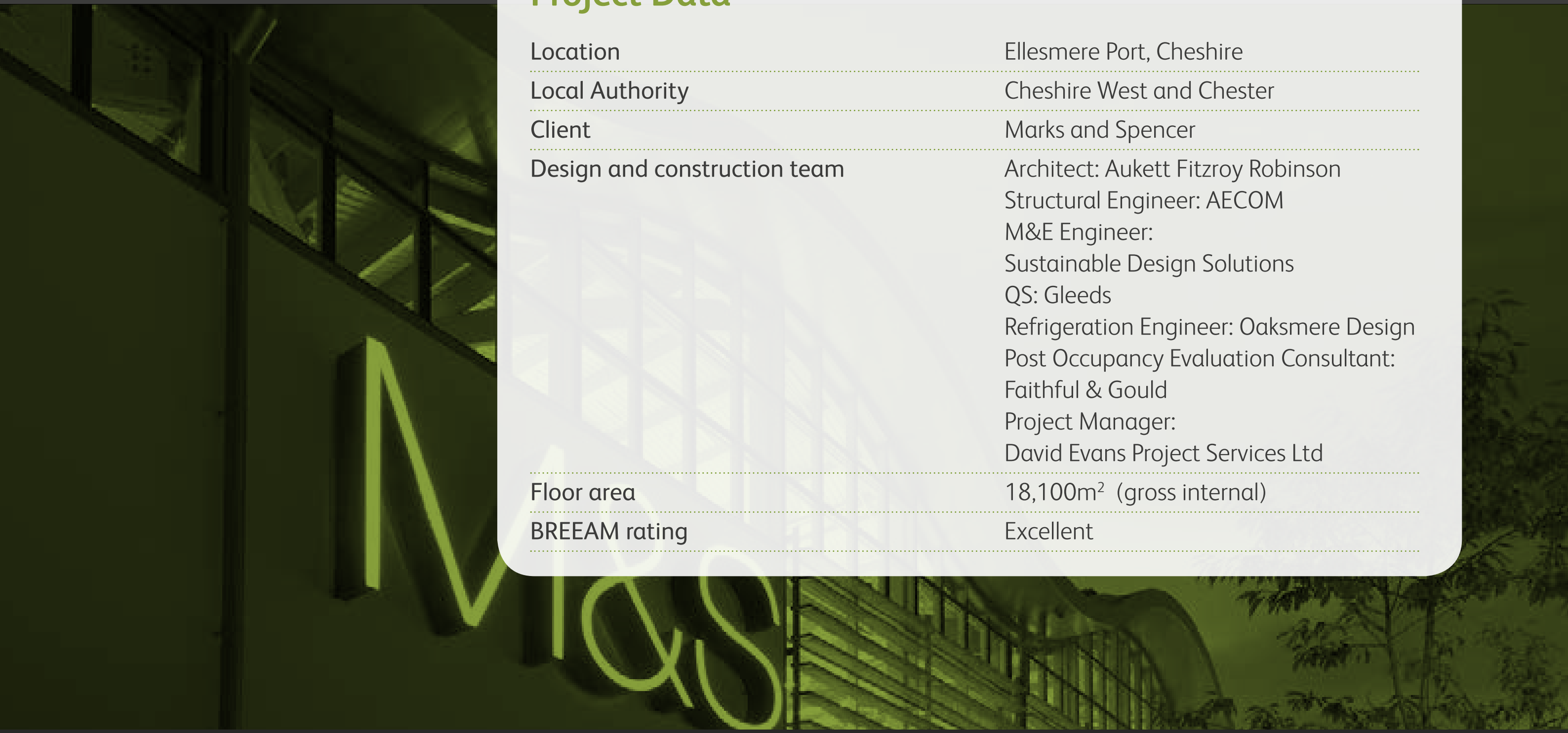
Images

1 Under construction. *Interserve*

2 Building exterior. *Interserve*

3 Plant. *Interserve*



Project Data

Location	Ellesmere Port, Cheshire
Local Authority	Cheshire West and Chester
Client	Marks and Spencer
Design and construction team	Architect: Aukett Fitzroy Robinson Structural Engineer: AECOM M&E Engineer: Sustainable Design Solutions QS: Gleeds Refrigeration Engineer: Oaksmere Design Post Occupancy Evaluation Consultant: Faithful & Gould Project Manager: David Evans Project Services Ltd
Floor area	18,100m^2 (gross internal)
BREEAM rating	Excellent

M&S Cheshire Oaks

The design of the largest M&S store outside London, aimed to set new standards for sustainability in the UK retail sector. The design strategy simultaneously addressed several areas of sustainability. The visible Forest Stewardship Council (FSC) certified timber frame has been designed to allow natural daylight through northlights, whilst the Hemcrete walls provide thermal stability and insulation.

Planning and Design Process

Holistic Approach:

From the outset of the project, the designers and client shared a vision to achieve high standards of sustainability. The resulting building and its surroundings are a testament to their holistic approach to sustainable design, with passive strategies, sustainable materials, travel strategies, improved biodiversity and water management well-integrated.

Innovation:

Rather than adapting a standard form of supermarket construction and adding technologies to make it more sustainable, an innovative approach to materials and construction was taken.

Community Engagement:

The project considered the value it could add to the community which it serves. During the two year construction period 200 volunteered hours were invested in community events and education schemes. These included working with two local schools, a one year construction BTEC with a local college and construction site tours for local community groups. The location for the new store was planned so that it could serve the large local residential population and nearby businesses and create new jobs for local people. Travel services have been implemented to increase accessibility and encourage cycling.

Learning:

The project is one of Marks and Spencer's Sustainable Learning Stores, which aims to build a bank of knowledge and

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experience in sustainable building practices to inform future projects. Part-funded by the Technology Strategy Board, an exemplary post occupation evaluation programme is in place. This will monitor the building's efficiency and performance, as well as gather soft data on the experience of shoppers and staff in a sustainable environment.

Sustainability Outcomes

Transport Strategy:

The new store was integrated with a highways scheme which improved junctions, cycle paths and footpaths prior to the store construction. Funding from the project contributed to improvements to the existing bus service, an electric car charging point, a new shuttle bus throughout the retail park and facilities for cyclists. All these encourage sustainable travel and healthy living.

Thermal Performance:

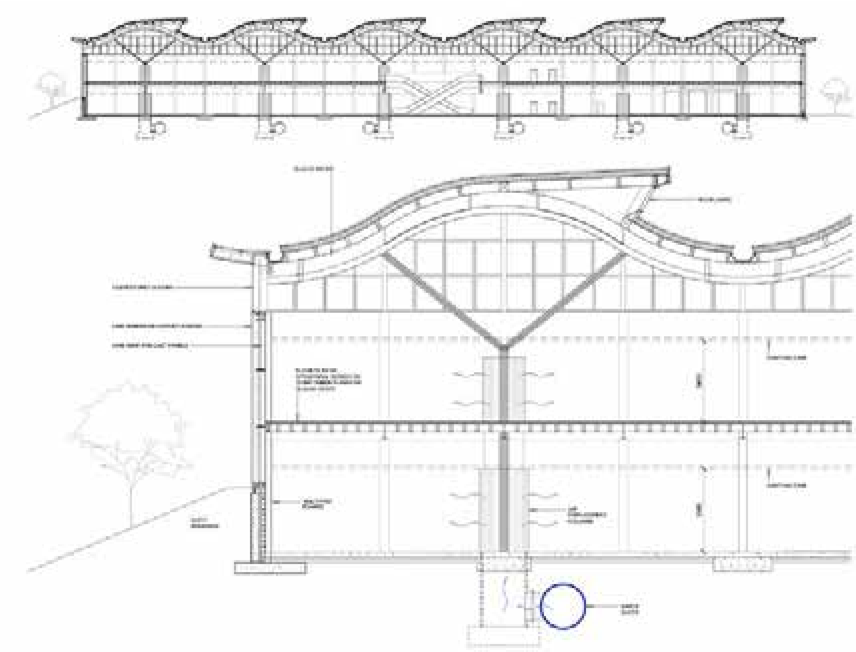
To help maintain a stable temperature within the store, the building is well-insulated and incorporates thermal mass. These are achieved by partially sinking the building into the ground; using 400mm thick Hemcrete (a combination of hemp fibre and lime) in the walls; and insulating the roof with recycled glass wool. The displacement ventilation system uses free air cooling which tempers incoming fresh air by passing it through 6ft diameter tubes in the ground before it enters the building. Passive solar design maximises useful solar gains through glazing on the east, south and west elevations, with cedar brise soleil to give control.

Biodiversity and Drainage:

A large 'living wall', planted with native varieties, on one elevation of the car park acts as a pollution filter and improves biodiversity, whilst perimeter hedgerows, new trees and 12,000m^2 of planting provide habitats for wildlife. Bat and bird boxes were made from recycled timber formwork off-cuts collected on site and installed in the local community. An enhanced SUDS with attenuation pond also attracts wildlife.

Materials:

30%, by value, of the content of construction materials is recycled, including the 100% recycled aluminium roof. Subcontractors and supply chain partners were encouraged to be holders of ISO14001 Environmental Management and were helped through the FSC certification process. Because Hemcrete is made from plant based material, it has absorbed and locked in carbon.



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Images

1	Site plan. *Aukett Fitzroy Robinson*
2	Sections. *Aukett Fitzroy Robinson*
3	Interior. *Aukett Fitzroy Robinson*
4	Exterior. *Aukett Fitzroy Robinson*
5	SUDS and Biodiversity. *Aukett Fitzroy Robinson*

Project Data

Location	Margam Country Park, Neath Port Talbot
Local Authority	Neath Port Talbot County Borough Council
Client	Field Studies Council and Neath Port Talbot County Borough Council
Design and construction team	Architects: Design Research Unit Wales and Loyn & Co.
	Project Manager: EC Harris Engineer: Faber Maunsell Quantity Surveyor: EC Harris CDM Consultant: EC Harris General Contractor: WRW Construction
Date of completion	March 2009
Cost/m^2	£1,594

Margam Discovery Centre

Margam Discovery Centre is a sustainable educational, cultural and leisure facility that caters for residential and day visitors. It is situated within a Grade 1 Registered Historic Garden and Landscape of Special Historic Value at Margam Park in Neath Port Talbot. The building plays a role in demonstrating sustainable design to users, incorporating passive design strategies, biomass plant and water recycling. It also provides a base from which to explore the history, culture and ecology of the surrounding landscape. The building comprises residential accommodation, canteen, visitor interpretation centre, classrooms, staff facilities and sustainable energy centre.

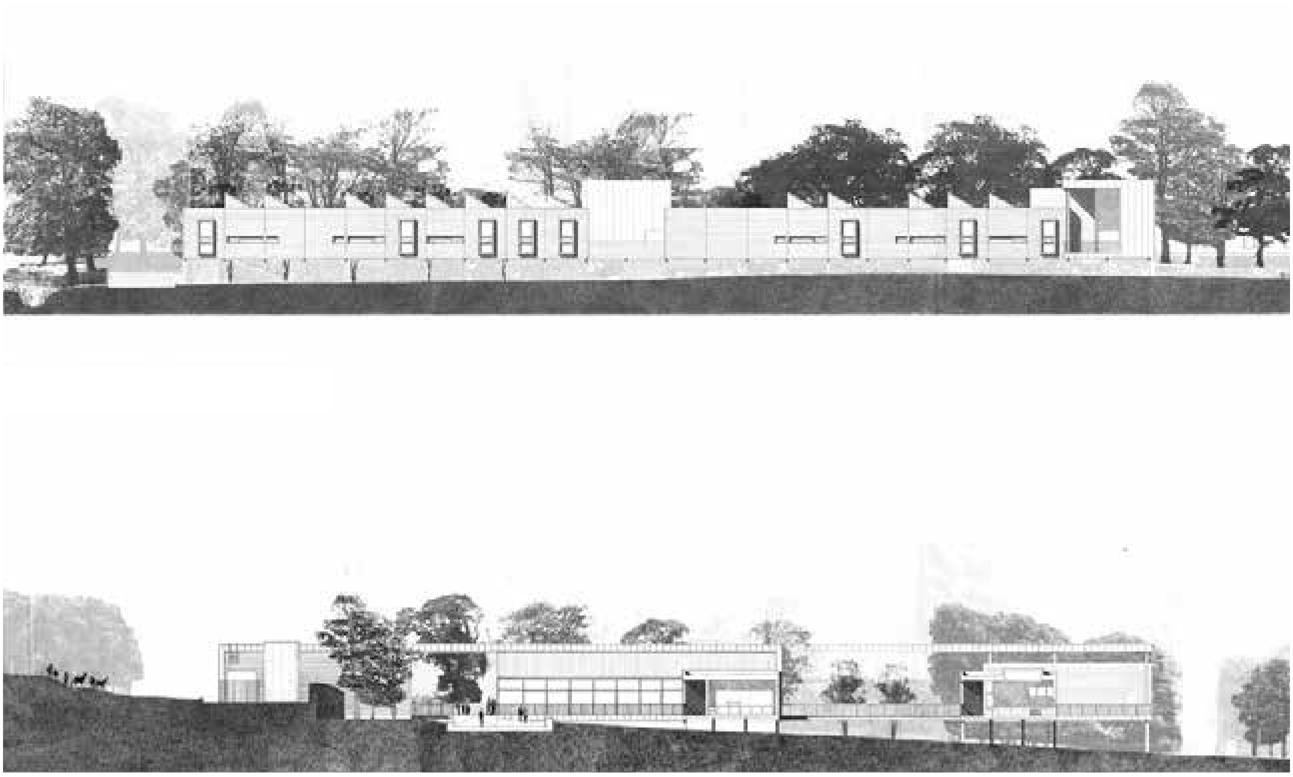
Planning and Design Process

Sustainability in a Sensitive Landscape:

The site has a diverse ecology, archaeological constraints and is within view of Margam Castle. Therefore, a sensitive approach to building was required, to minimise the impact on the site. Extensive analysis of the site was undertaken to inform initial design ideas. The scheme is designed to enhance the visitor experience of the landscape, framing views and employing materials that will weather naturally to complement the surroundings. The building is raised on piloti (piers), so that it touches the ground lightly.

Planning for Modern Methods of Construction (MMC):

80% of the timber-frame building was constructed off-site using timber from sustainable sources. The prefabricated modules were craned into place and assembled on site in just two weeks. MMC was made at an early stage and fabricators were consulted throughout the design process. This ensured maximum efficiency in the design of the repetitive bedroom and classroom modules. Off-site construction can improve building performance and reduces waste as construction takes place in a quality-controlled factory environment. MMC also helped meet the project programme and minimised environmental impacts on the sensitive site.



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Sustainability Outcomes

Passive Design:

A passive, sustainable design strategy was developed using the expertise of the Welsh School of Architecture. To minimise heat loss and the need for mechanical services, the building has been insulated to standards in excess of Building Regulation requirements. The centre is designed to be naturally ventilated via a combination of opening windows and automatic roof lights. The north facing roof-lights also help to maximise penetration of natural light while minimising solar heat gain.

Education:

The client team's vision for the project was to create a high quality educational, cultural and leisure facility that celebrates synergy between heritage, and built and natural environments. They were keen to promote sustainable building, and demonstrate renewable energy use and water management to a wide audience. An exhibition demonstrates and explains the sustainability of the building and has a window onto the biomass energy centre.

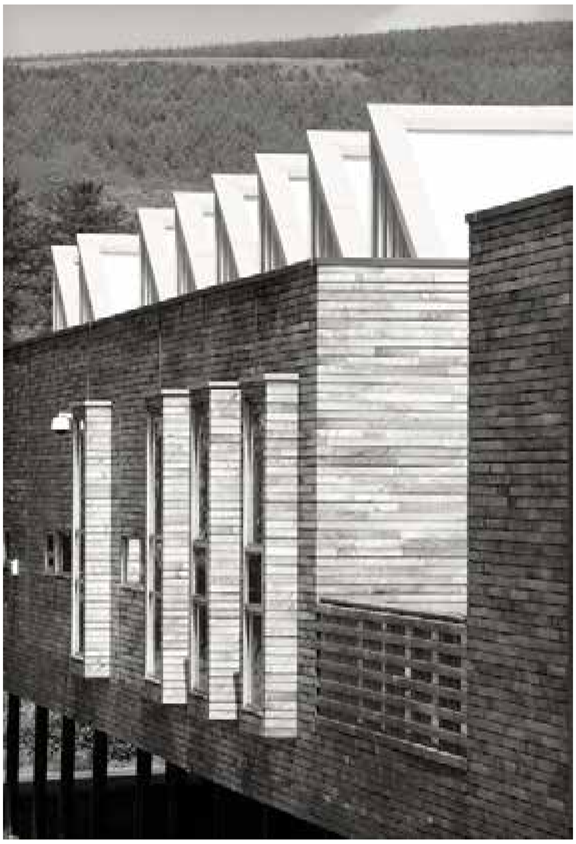
References:

> http://www.margamcountrypark.co.uk/default.aspx?page=5892

> www.dru-w.co.uk/

> www.loyn.co.uk/

> www.field-studies-council.org/margampark/



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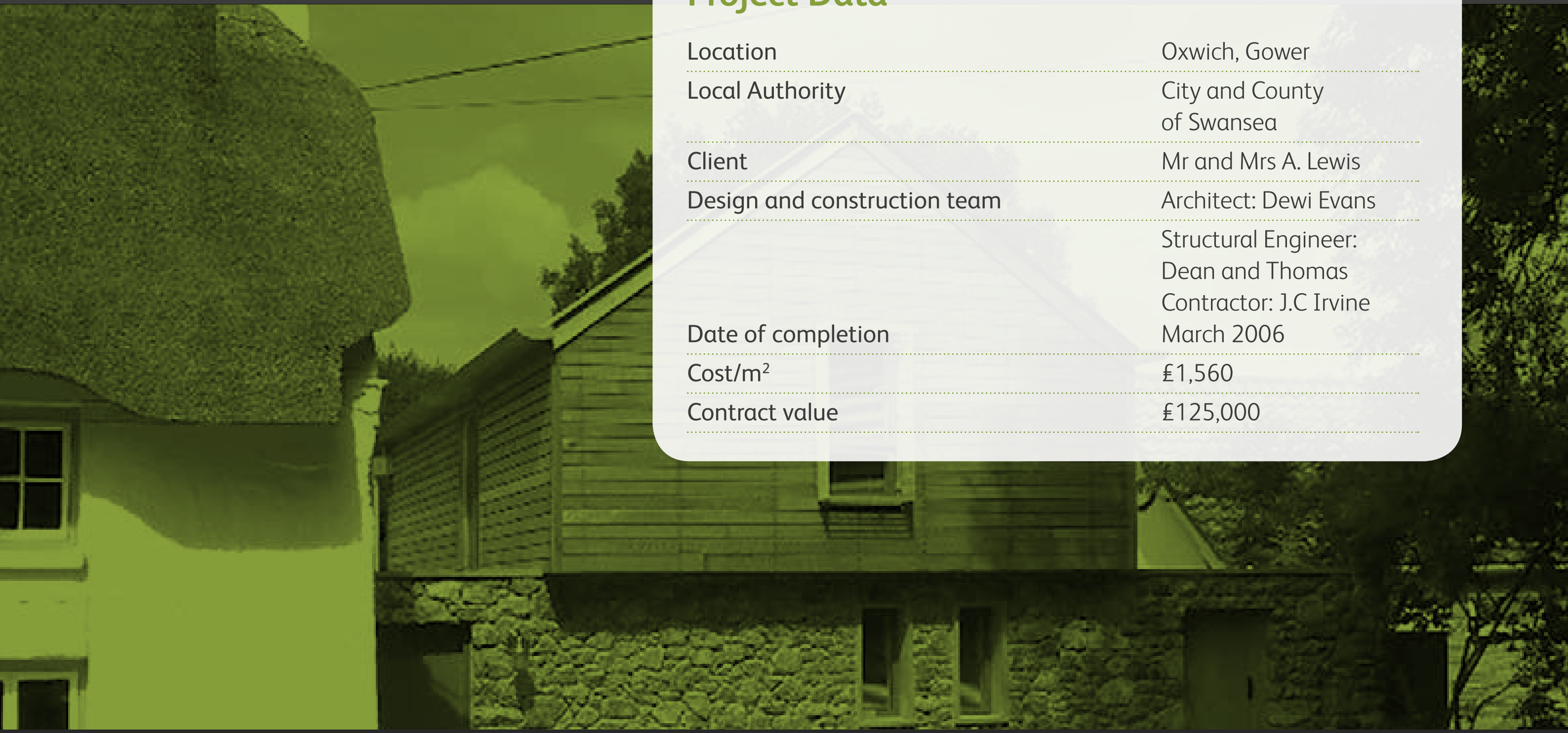
Images

1 Elevations. *DRU-W*
2 Classroom exterior. *Loyn & Co.*
3 External walkways. *Loyn & Co.*
4 Delivery of prefabricated modules. *DRU-W*
5 Sensitive response to landscape. *Kiran Ridley*



Project Data

Location	Oxwich, Gower
Local Authority	City and County of Swansea
Client	Mr and Mrs A. Lewis
Design and construction team	Architect: Dewi Evans Structural Engineer: Dean and Thomas Contractor: J.C Irvine
Date of completion	March 2006
Cost/m^2	£1,560
Contract value	£125,000

The Nook, Oxwich

The Nook is a sensitively designed contemporary extension to a listed building in a rural village. The highly insulated timber frame construction makes use of local materials.

Planning and Design Process

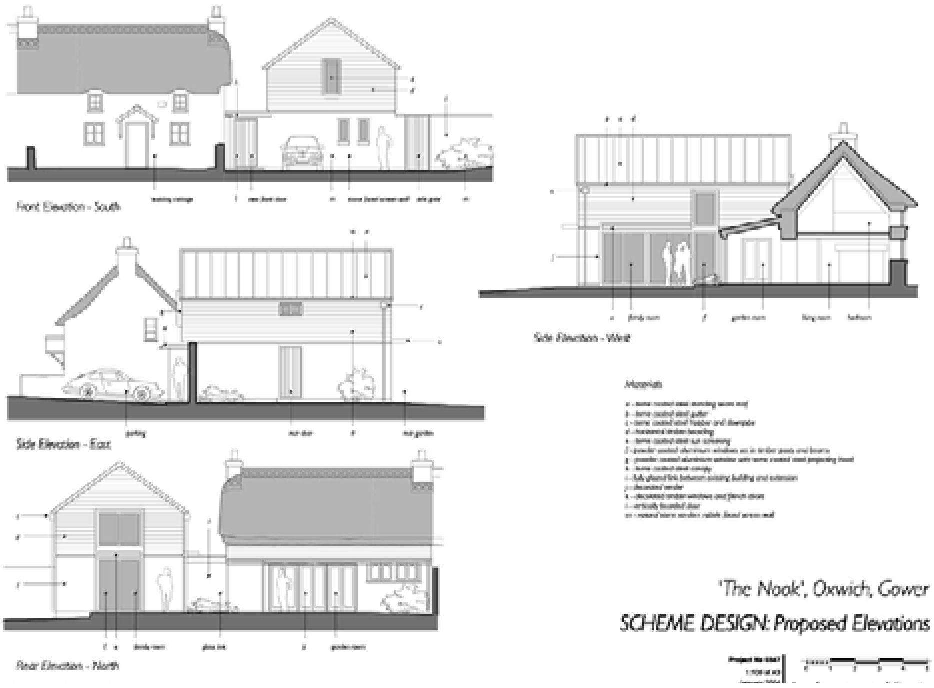
Extending a Listed Building:

Extending a listed building in a sustainable and sympathetic way presented a challenge and an opportunity. The original cottage has very thick walls which could not be significantly altered without having a detrimental effect on the integrity of the listed building. The extension was needed to provide modern family accommodation in a small village and extend the life of the property. The solution was to build a new building at right angles to the form of the existing cottage, and connect the two with a delicate glass link. Creating a separate building rather than an integrated extension allowed sustainable materials and construction methods to be used.

The design, materials and detailing were discussed with the local planning authority and Cadw from the outset of the project.

Materials and Construction:

The natural, local materials and timber frame structure contribute to the sustainability of the extension by having low embodied energy. The envelope of the new building is well-insulated to minimise heat losses. The natural materials are also sympathetic to the listed building and the rural village setting.



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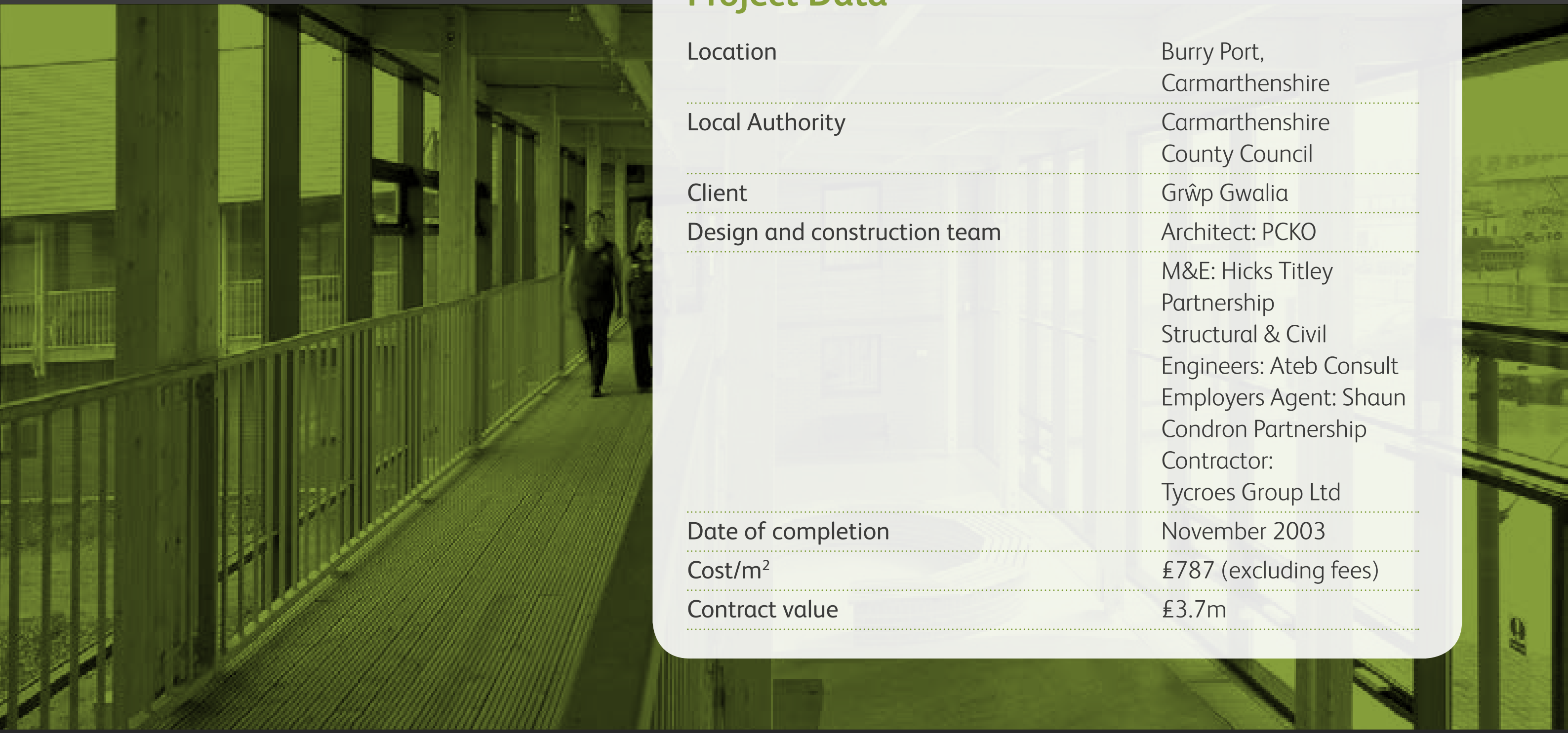
Images

1 Bulding Section. *Dewi Evans*

2 Daylit interior. *Dewi Evans*

3 Exterior view. *Dewi Evans*

4 Building Plan. *Dewi Evans*



Project Data

Location	Burry Port, Carmarthenshire
Local Authority	Carmarthenshire County Council
Client	Grŵp Gwalia
Design and construction team	Architect: PCKO M&E: Hicks Titley Partnership Structural & Civil Engineers: Ateb Consult Employers Agent: Shaun Condron Partnership Contractor: Tycroes Group Ltd
Date of completion	November 2003
Cost/m^2	£787 (excluding fees)
Contract value	£3.7m

Plas y Mor, Assisted Living & Day Care Centre

Plas y Mor has a day centre facility and 38 self-contained one and two bedroom flats arranged around a communal garden. Two blocks of accommodation are linked by the main communal area, which is a light glazed structure, combining entrance hall, focal meeting point and internal garden.

The scheme responds to the growing need to provide quality and choice in housing for older people. It seeks to achieve this by integrating residential accommodation with a mix of essential services, leisure and care facilities. The ethos behind Plas y Mor is intended to form the basis for future developments in this area incorporating extra-care facilities.

Planning and Design Process

Partnership Approach:

The scheme was initiated by Carmarthenshire County Council in 1999. Gwalia Housing Group was invited to enter into strategic partnership with the local authority. The architectural concept reflects the underlying social philosophy of the scheme where a holistic approach to the type of care delivered is adopted to encourage self-reliance among residents and clients from the community. Emphasis is placed on rehabilitation and confidence building in an informal environment, in this progressive model for ‘extra care assisted living’. The ambition is to integrate accommodation and facilities to form the basis of future developments in the area to provide high quality affordable housing and important community resources. The scheme reflects a commitment by Gwalia Housing Group to keep running costs for tenants at affordable levels, through an environmentally sustainable approach to development.

Community Engagement:

A stakeholder panel was established to drive the project development stages including the design stage. This panel included representatives from social services, housing, occupational therapy, day care and local authority architects. The panel was

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also responsible for designing arrangements for long-term management including management agreement, service level agreement and structure of an inter-agency management group. Residents of Gwalia's existing Extra Care scheme at Llys y Werin, Gorseinon, were consulted for their views at the planning stage. Elderly people from the local community are actively involved in the project, either living in the scheme or attending the day centre. User groups have been established to continue to monitor the scheme and inform future plans.

Sustainability Outcomes

Passive Solar Heating:

Preheated air is ducted from the glass garden and distributed throughout communal areas contributing to background heating. This passive solar design allows the glass garden to be enjoyed by users and residents throughout the year.

Building Fabric:

The building fabric comprises high performance 140mm stud timber frame, breathing wall construction with recycled cellulose insulation over-clad with FSC certified timber cladding. The timber is highly durable and provides a zero maintenance finish externally. Openings incorporate high performance windows and doors with Low-E glazed argon-filled double glazing units. Joinery units are aluminium/timber composites, further contributing to the low maintenance characteristic of the building fabric.

For the majority of the building, fabric, materials and labour were supplied locally or from the South Wales area including the timber frame, the majority of cladding, insulation, roof finishes, curtain wall glazing, sun pipes, bio-mass plant and solar installations.

Affordable Renewable Energy:

Heating and hot water is provided via a community heating system powered by twin bio-mass 93KW boilers, fuelled from a locally procured fuel source. Secondary heating is derived from solar heating arrays which assist water heating. The solar panels are designed to contribute between 60%-70% of the schemes average hot water requirement through the year. In combination, these features enable residents to derive all heating and hot water requirements with average fuel bills of just £5.44 per week. Photovoltaic arrays power the passive ventilation systems.

Reference:

> www.pcko.co.uk/word/lang/en/2010/05/burry-port/

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Images

1	Interior view. *PCKO Architects*
2	Site plan. *PCKO Architects*
3	Exterior view. *PCKO Architects*

Project Data

Location	Princedale Road, London
Local Authority	Royal Borough of Kensington and Chelsea
Client	Octavia Housing
Design and construction team	Architect: Paul Davis + Partners
	Contractor: Princedale Ecohomes Site Co-ordinators: Green Tomato Energy QS: Pellings Energy: Eight Associates Windows: Princedale Ecohomes
Date of completion	2011
Cost	£180,683 (incl energy efficiency measures £69,870)
Procurement	Negotiated tender with Princedale Ecohomes
Cost/m^2	£1500/sqm approx

Princedale Road, London

Princedale Road house in London is the first residential retrofit to be certified to the PassivHaus standard. It is the property of social landlord Octavia, was part of the Retrofit for the Future Programme (Technology Strategy Board) and completed in November 2012.

From the outset, the aim of the owner and the design team was to achieve PassivHaus certification. The owner saw several benefits in the standard such as an outstanding assurance in the quality of the building fabric, a way to tackle fuel poverty for tenants at high risk, a way to reduce the carbon emissions of its property portfolio and an investment in the long run, adding a new life to this Victorian house. The team was also keen to ensure that the finished project resulted in a comfortable and functional home for the new occupants.

Being the first PassivHaus retrofit also meant that this project was very much regarded as a prototype and an opportunity to assess aspects such as costs, procurement, trade skills and to tease out potentials for rolling out methods on Octavia's wider housing stock.

Planning and Design Process

Retrofit Approach:

On inspection, the 1840-built Victorian house was found to be in a very poor state of repair and in need of a significant upgrade. The extent of the necessary repairs to the fabric and the lack of original features inside suggested that an intrusive approach was justifiable.

Window Development:

A critical part of the approach was the rethinking of the window and door design to satisfy planning and PassivHaus requirements. The new windows needed to resemble the old Victorian single-glazed sash windows as closely as possible, to

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maintain homogeneity within the streetscape, whilst also having a minimal heat loss.

Such windows were not readily available on the market at the time of the project so the decision was taken with the client to design and manufacture them as a Research and Development Project (R&D) project. The outcome was a 'look-alike' sash window very close in external appearance to the original Victorian one, but formed of a fixed top light and a bottom casement opening inwards with three perimeter seals.

Sustainability Outcomes

Low-Energy Retrofit:

A PassivHaus philosophy was applied in a retrofit context with excellent post occupancy energy demand results. This project demonstrates how improving the energy efficiency of existing housing stock can go hand-in-hand with preserving the built heritage.

Insulation and Airtightness:

As well as the prototype triple-glazed sash look-alike windows, the project employs an internal insulation strategy to reduce heat loss.

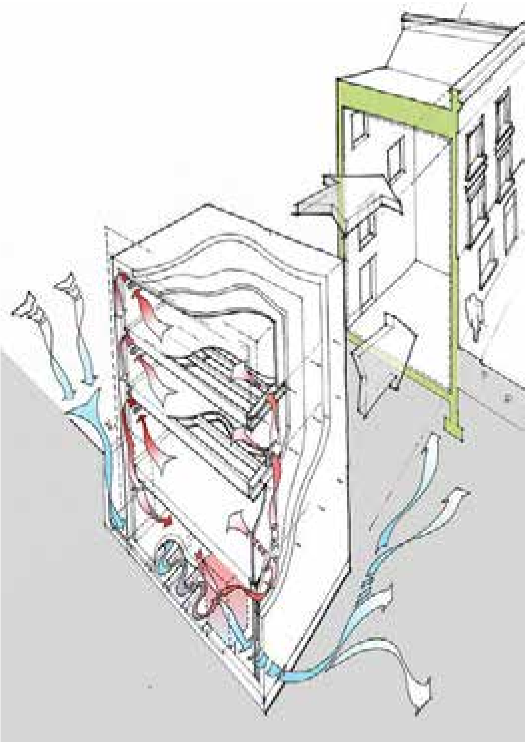
Ventilation and Heat Recovery:

A unit combines MVHR, an exhaust air heat pump and hot water storage, whilst an underground labyrinth that tempers incoming ventilation air beneath the footprint of the house.

References:

> www.pauldavisandpartners.com

> www.princedalehomes.com



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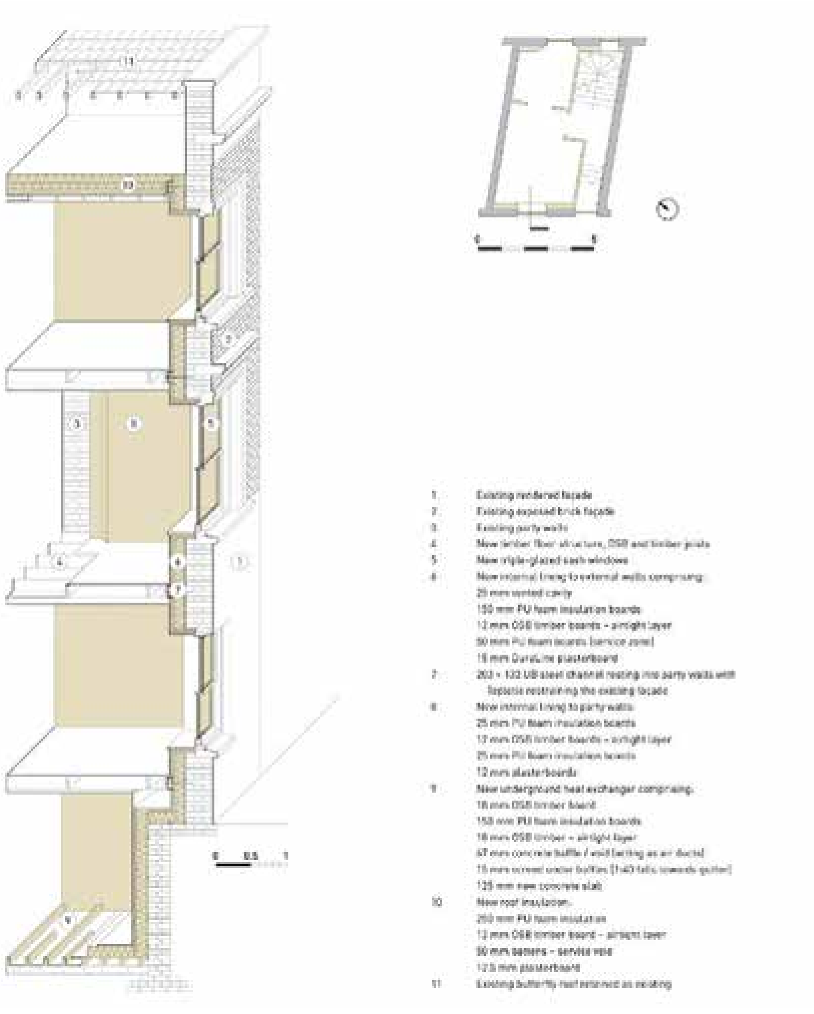

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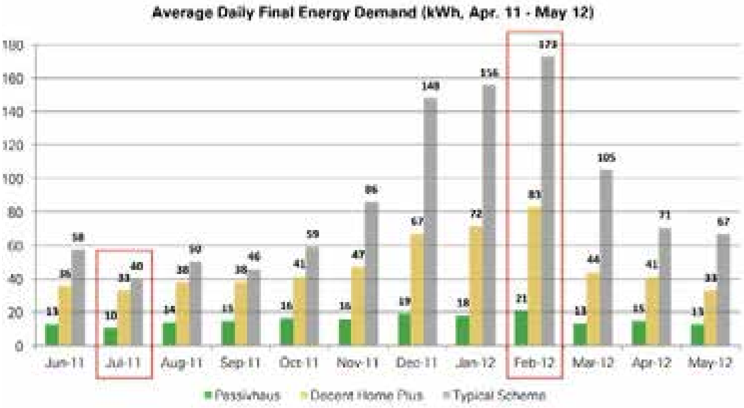

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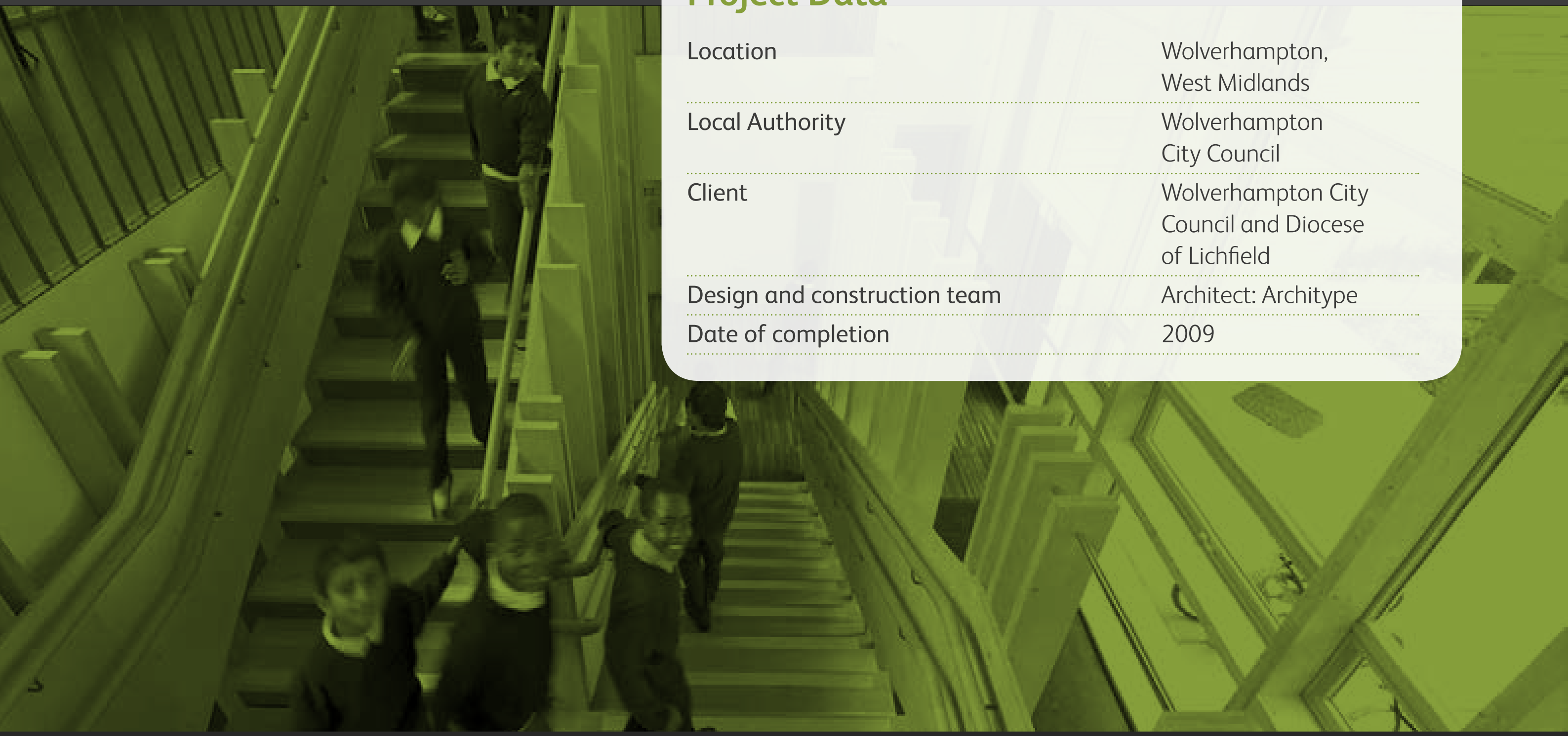
Images

1 Street Photo. *Octavia Housing*
2 Ventilation strategy. *Paul Davis + Partners*
3 Window. *Octavia Housing*
4 Façade section. *Paul Davis + Partners*
5 Graph, energy demand. *Eight Associates*



Project Data

Location	Wolverhampton, West Midlands
Local Authority	Wolverhampton City Council
Client	Wolverhampton City Council and Diocese of Lichfield
Design and construction team	Architect: Architype
Date of completion	2009

St Luke's Primary School, Wolverhampton

St. Luke's Primary School is located at the heart of a close knit, multi-cultural community in the city of Wolverhampton on a constrained, sloping site where a tower block once stood. The quality of the building provides a stimulating learning and teaching environment that also brings the habit of energy and resource efficiency seamlessly into everyday experience. St. Luke's is designed to be a highly efficient, low energy, low water use, naturally ventilated, healthy and comfortable school. It is the first primary school in Britain to achieve an 'Excellent' BREEAM rating.

Planning and Design Process

Integrated Sustainability:

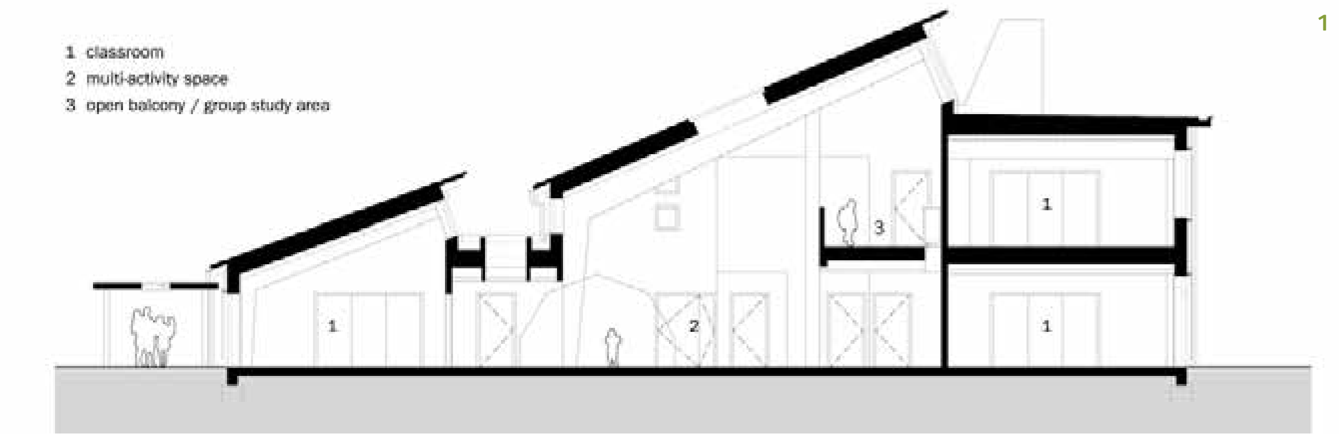
Sustainability was integrated from the first principles.

Collaborative Working:

A collaborative approach was taken to harness the whole school community in the design process. All stakeholders were actively engaged. A range of participatory techniques were used to enable everyone to feel comfortable about being involved, to share ideas and experiences, and to learn from the process of creating a new building.

This enabled the design team to draw out and develop the school's vision, to raise ambition and aspiration as to the possibilities, to explore their concerns and experience and meet their practical needs. It also helped the team to appreciate the complex social context in which the school operated and the need to create a safe, reassuring, homely and loving atmosphere for the children – a home from home. The desire to create a sense of wholeness, clarity and encompassing safety, emerged.

The project sought to go beyond meeting the physical and spatial requirements of Department for Education 'Building Bulletins', to deliver new opportunities for teaching and learning, being inspired and driven by the school's ethos and its vision for education and learning.



Sustainability Outcomes

Passive Design:

The building is highly insulated, with U values significantly improved over those required to comply with Building Regulations for walls, windows and the roof. The majority of windows are triple glazed. Extensive north facing glazing and clerestory windows provide maximum natural daylight but limit glare and solar gains in summer. Heavyweight partition materials are used to provide thermal mass to the internal walls throughout the building.

Ventilation:

The building is predominantly naturally ventilated using windows that open. High level windows are all automatically controlled to provide optimum thermal comfort and indoor air quality. Secure overnight ventilation is provided in each classroom to allow free cooling in summer. Toilet extract ventilation and lighting systems are controlled using 'washroom controllers' which minimise on-time for both lights and fans.

Building Management System (BMS):

The building has a BMS to provide control and monitoring. This allows separate zones within the building to be heated at different times. The majority of lighting installations use fluorescent lamps. Lighting controls automatically dim the lights when there is sufficient daylight in the classrooms, and when the classrooms are unoccupied. There are automatic shut off valves on water pipe work serving the WCs, which close when toilets are unoccupied.

Biomass Neighbourhood Heating:

A biomass boiler provides 76% of the heat requirement. A district heating link is currently being installed to the adjacent neighbourhood centre to make use of the school's biomass boiler during school holidays and at weekends.

Materials:

Sustainably sourced, high quality 'natural' materials were used, including: I-beam timber structure with recycled newspaper insulation, UK grown Douglas fir cladding, cedar shingle roof tiles, triple glazed windows, internal plywood finished with natural oils, linoleum and rubber flooring, matting made from recycled car tires and slatted timber and Heraklith wood wool panel acoustic ceilings.

Post Occupancy and Soft Landings:

Post occupancy assistance is being provided for the first two years of occupation, through a number of initiatives. 'Cartoon' style guides have been produced on how to operate systems for heating, lighting and ventilation for display in each room. A full post occupancy evaluation and 'soft landings' support to the building manager was also provided to St Luke's for a similar time period. The installation of specialist software enables staff and children to access monitoring information from any computer on the school network and directly engage with and learn from the building's performance.

Reference:

> http://www.architype.co.uk

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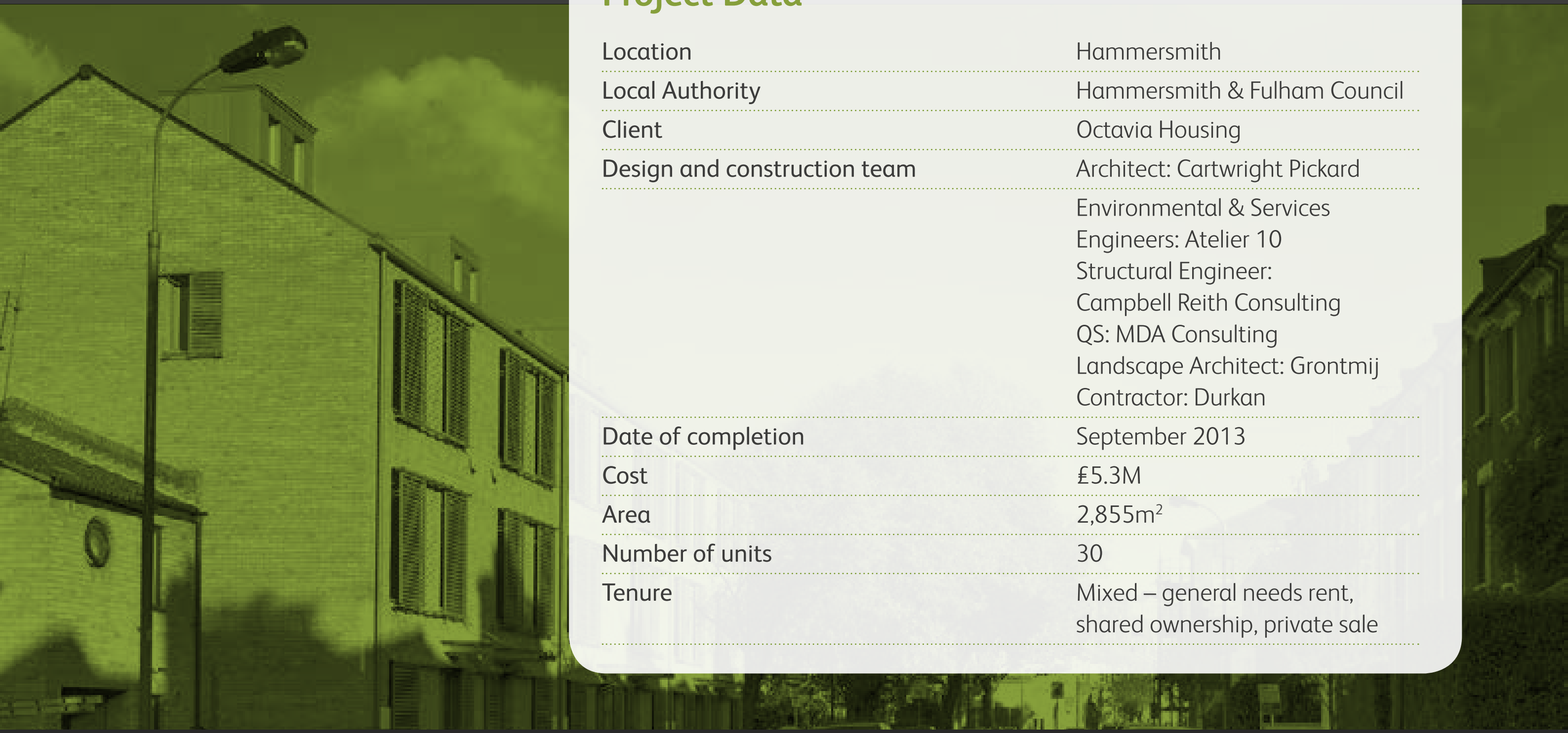
Images

1 Section. *Architype*
2 Daylit classroom. *Architype*
3 Natural materials. *Architype*
4 Architect's sketch. *Architype*
5 Site plan. *Architype*
6 Floor plan. *Architype*



Project Data

Location	Hammersmith
Local Authority	Hammersmith & Fulham Council
Client	Octavia Housing
Design and construction team	Architect: Cartwright Pickard Environmental & Services Engineers: Atelier 10 Structural Engineer: Campbell Reith Consulting QS: MDA Consulting Landscape Architect: Grontmij Contractor: Durkan
Date of completion	September 2013
Cost	£5.3M
Area	2,855m^2
Number of units	30
Tenure	Mixed – general needs rent, shared ownership, private sale

Sulgrave Gardens

This development of 30 family homes in West London demonstrates that PassivHaus standards can be achieved on complex inner-city sites at affordable cost. The site is sandwiched between two conservation areas, has a significant level change across its width and is an awkward shape, with a 1960s 8 storey block of flats, a terrace of 1970s brick houses and a street of Victorian terrace houses surrounding it. Pre-fabricated Structural Insulated Panels (SIPs) were used to help achieve the insulation and airtightness levels required for PassivHaus.

Planning and Design Process

Planning for PassivHaus in an Urban Context:

The scheme borders two conservation areas on an awkwardly-shaped inner city site with overlooking from adjacent buildings. Together with the requirements of PassivHaus, this context informed the design from the outset, influencing the shape and massing of the buildings, including a reinterpretation of the London Mews house. Daylight and sunlight levels were a major consideration in a dense urban environment. Through careful liaison with the local planning authority, the different building types were agreed, producing generously-proportioned units with high levels of natural daylight and, in most cases, dual-aspect views.

The need to balance achieving good light, energy performance and amenity space and therefore, the PassivHaus certification, influenced the design and layout throughout.

Due to the proximity to two neighbouring conservation areas the scheme needed to respond to the immediate context, with brickwork being the predominant material for the development. This became one of the key challenges in developing details to minimise the thermal bridging associated with the support of brickwork. It was decided that the height of the brickwork would be limited to 12 metres to avoid having to install a masonry support angle, which would incur an unacceptable thermal bridge.

Some building elements required for PassivHaus also helped create interest and depth to the facades: the externally mounted sliding timber louvres also provided solar shading to south and south-west facing windows to reduce the thermal gain during the summer months, and control the levels of direct sunlight.

Designing for Off-Site Construction for PassivHaus:

The complexities of designing on a tight urban site led the team to research structural wall systems that would enable the thinnest external wall possible to achieve the high U-values required by PassivHaus.

Different construction systems were researched for their high performance, and evaluated for cost implications, delivery and installation on site and programme. Structural Insulated Panels (SIPs) panels were compared with a more traditional and less expensive building method using blockwork as the structural inner leaf. The use of SIPs panels provided the structural element with integrated high performance insulation. With the SIPs, external wall thickness was kept to 450mm which helped maximise internal room areas and achieve reasonable distance to adjacent blocks within the site.

From an early stage, the design and engineering team had a series of technical meetings with the SIPs suppliers, where they discussed how the Kingspan TEK system would be detailed at key junctions; other components required to meet the U-values; airtightness detailing; and any potential issues with thermal bridging.

One of the key details involved the support of SIPs at ground floor level. With the soleplate of the SIPs panel requiring constant support, the design team looked at various up-stand solutions, comparing the effects on the PassivHaus Planning Package (PHPP). Thermal modelling in 3D was carried out which allowed the team to understand which details could be accommodated without taking the overall heat loss beyond the 15KwH/m2/yr required for PassivHaus Certification. Similarly, methods to tie the brickwork back to the structure were modelled, before selecting a slot cavity wall tie/vertical channel system that was face fixed to the high performance external rigid insulation. The channel was screw fixed back to the SIPs panel and each separate screw was calculated within the PHPP for its thermal point load to ensure the fixing system could be accommodated.

Sustainability Outcomes

Insulation and Airtightness:

The SIPs are used along with additional rigid insulation board. The prefabricated system improves quality and predictability of airtightness and insulation levels, and reduces cold-bridging. The panels are manufactured in a factory to bespoke sizes and assembled on site. Tongue and groove joints are nailed and then taped to prevent air leakage. Triple-glazed windows are installed into pre-formed openings, with phenolic insulation wrapped around the outside to reduce thermal bridging.

Solar Control and Energy:

External timber louver panels can be manually slid in front of windows on the south and south west elevation to prevent overheating and glare on warm, sunny days. When the louvers are open, homes can utilise heat from the sun to warm spaces on colder days. Roofs incorporate solar hot water and photovoltaic panels.

Ventilation:

Each home has a Mechanical Ventilation Heat Recovery (MVHR) unit to provide whole house ventilation whilst recovering up to 93 % of heat from the outgoing air to pre-heat fresh incoming air. Most homes are dual aspect to allow natural cross-ventilation through opening windows on hotter days.

Landscape:

The landscape has been designed to be high-quality but low-maintenance, including a pedestrian-priority shared surface to encourage play and social interaction.

References:

- www.cartwrightpickard.com/projects/residential/486_sulgrave-gardens.aspx
- www.octaviahousing.org.uk/building-new-homes/our-projects/view.php?Id=399
- www.atelierten.com/pdfs/Atelier_Ten_Sulgrave_Gardens.pdf

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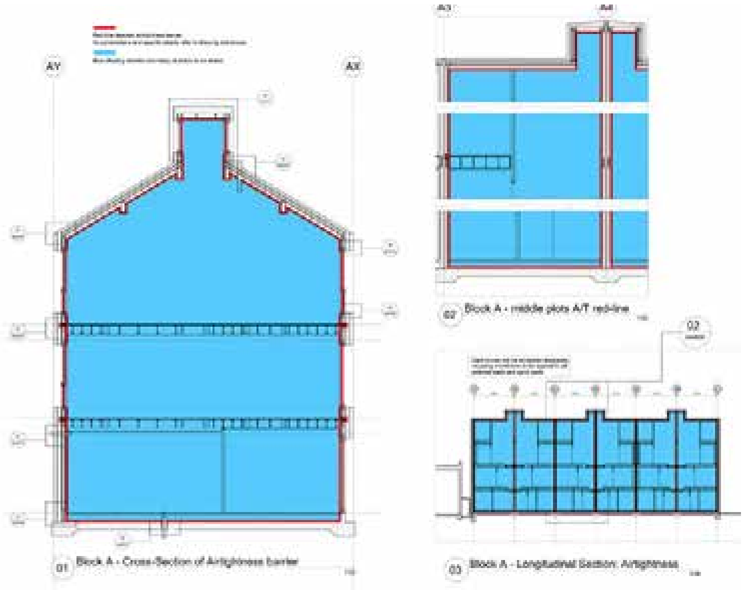

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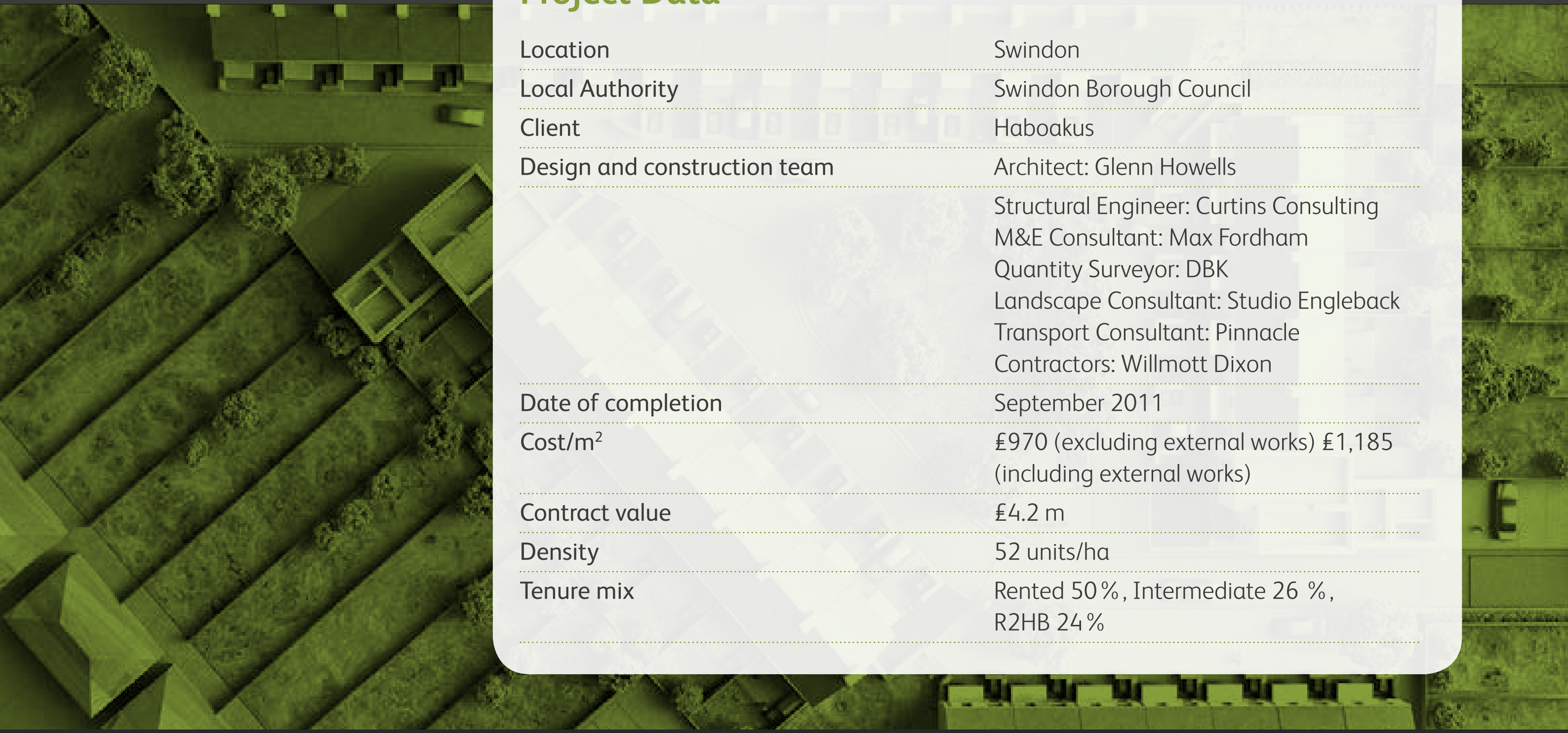
Images

1 Sliding solar shutters. *Morley Von Sternberg*

2 Victorian street view. *Morley Von Sternberg*

3 Airtightness barrier. *Cartwright Pickard*

4 Street view. *Morley Von Sternberg*



Project Data

Location	Swindon
Local Authority	Swindon Borough Council
Client	Haboakus
Design and construction team	Architect: Glenn Howells
	Structural Engineer: Curtins Consulting M&E Consultant: Max Fordham Quantity Surveyor: DBK Landscape Consultant: Studio Engleback Transport Consultant: Pinnacle Contractors: Willmott Dixon
Date of completion	September 2011
Cost/m²	£970 (excluding external works) £1,185 (including external works)
Contract value	£4.2 m
Density	52 units/ha
Tenure mix	Rented 50%, Intermediate 26 %, R2HB 24%

The Triangle, Swindon

The Triangle is a low-energy housing development in Swindon. In this contemporary interpretation of Swindon's mid-Victorian railway cottages, there are 42 homes on the site, which are flexible, affordable and have been designed to be efficient to build and manage, using sustainable materials. The houses are set in a good quality landscape which provides space to grow food and spaces to play.

Planning and Design Process

Collaborative Working:

The client's manifesto, to establish a new housing development using sustainable materials and processes to create well-crafted landscapes and buildings, has been realised through a collaborative and innovative approach. The scheme, stitched around its central village green, is intended to foster community and bring residents together, giving The Triangle a strong sense of place and acting as a focus for interaction and play.

Integrated Sustainability:

The project has benefited from a holistic approach which has led to an integrated solution for the environmental, structural and design proposals, creating a scheme that incorporates advanced passive strategies in comfortable well-proportioned spaces.

Organised Consultation:

A schedule of design workshops and formal presentations helped to develop the design, while also gaining the confidence of local residents by engaging them through sketches and models which explained the scale and style of the scheme, whilst also understanding their concerns about boundary conditions and proximity to existing dwellings. During the construction phase, local residents were kept up to date and informed of progress through one-on-one visits and flyers were also distributed on a regular basis.

Working within a restricted budget, it was important to prioritise important elements, which would improve the overall quality of the scheme and be appreciated by residents, such as better quality kitchen design, materials and lighting, which also provided greater value for money.

1

Sustainability Outcomes

Affordable Living:

The Triangle is one of the most resource efficient new housing developments in the UK. It provides a high quality of life for residents in an affordable and practical way. Each home meets the Lifetime Homes standards including cycle storage and provision for home working.

The durability of internal finishes reduces maintenance requirements and costs. With good accessibility to the town centre, access to regular bus services and the provision of cycle paths, The Triangle challenges the norm of two parking spaces per dwelling to a lower ratio of 1.5 spaces, including visitor parking. The total of 63 car spaces is strategically underpinned by a range of measures designed to reduce the need for car ownership, including provision for a community car club. IT facilities in each home allows access to information sharing which helps people car-share or use public transport, the timing of which is conveyed in real time.

Sustainable Materials:

The external walls are constructed from Hemcrete cast in situ on a timber frame. Hemcrete is a natural fibrous product, which is carbon negative. The Hemcrete acts as an insulator, but also provides thermal mass, thereby helping to reduce temperature peaks. It offers very good air tightness and thermal performance.

Passive Before Mechanical:

The designs minimise use of mechanical systems by seeking passive systems to control the internal environments, therefore reducing energy and maintenance costs over the life of the houses. The proportion of glazing to each façade has been adjusted to give the greatest solar gain in winter without overheating in summer. All habitable rooms maximise use of natural daylight to improve the quality of the spaces and reduce the need for artificial lighting. The layout of the houses were planned to provide an 'air lock' hallway and the stairs have been arranged to provide unimpeded connections with the living space to the rest of the house. In winter, this allows the warmth generated on the ground floor to rise through the house and in summer it allows the stack ventilation to function, drawing warm air to escape through the ventilation cowl. There is provision for retrofitting photovoltaics on the pitched roofs, and grey water recycling to enhance the rainwater harvesting strategy can be added.

References:

- > www.haboakus.co.uk/triangle/
- > www.glennhowells.co.uk/content/housing/83

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Images

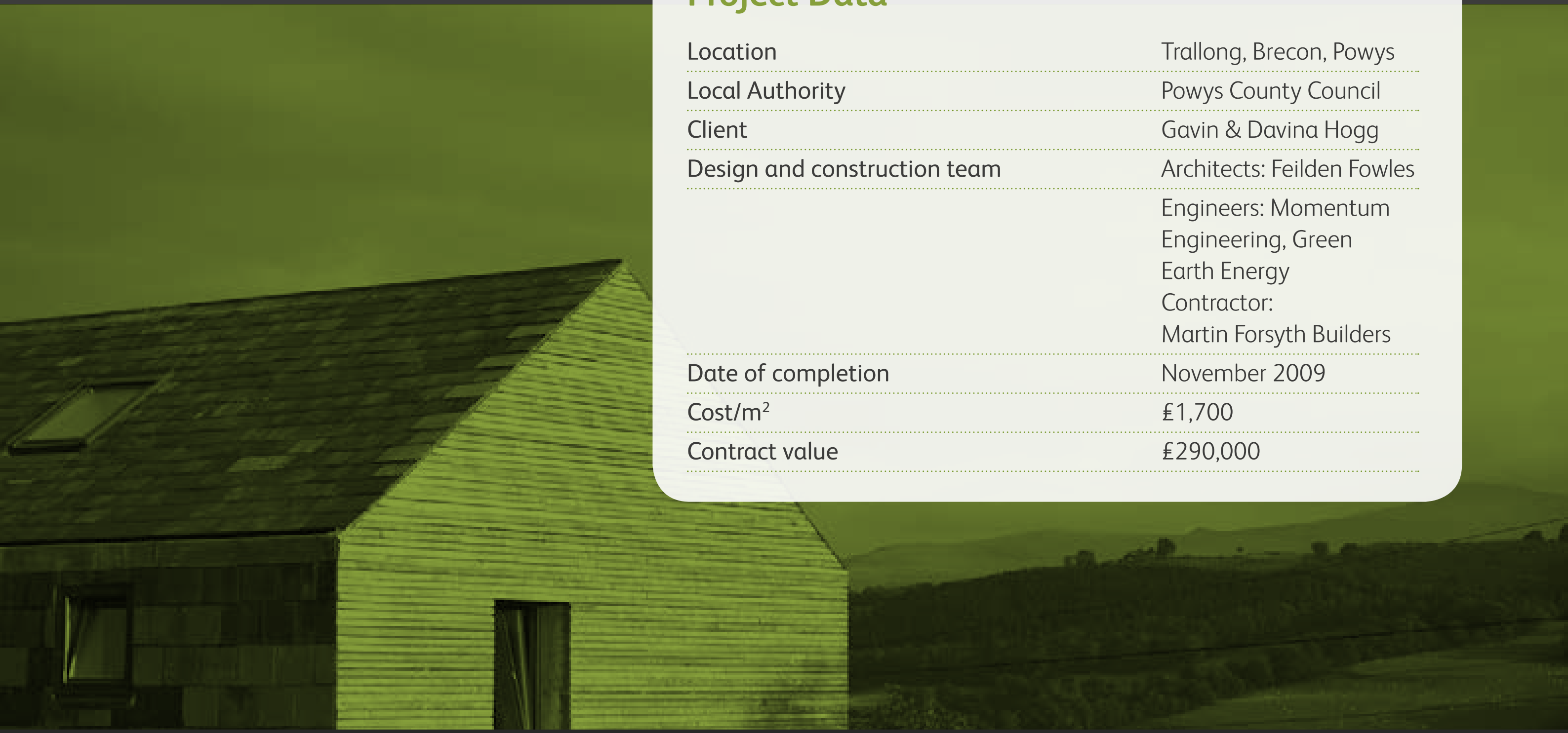
1 Street view, showing commercial space. *Glenn Howells Architects*

2 Floor plans. *Glenn Howells Architects*

3 Site plan. *Glenn Howells Architects*

4 Allotment gardens. *Glenn Howells Architects*

5 Cycle storage. *Glenn Howells Architects*



Project Data

Location	Trallong, Brecon, Powys
Local Authority	Powys County Council
Client	Gavin & Davina Hogg
Design and construction team	Architects: Feilden Fowles
	Engineers: Momentum Engineering, Green Earth Energy Contractor: Martin Forsyth Builders
Date of completion	November 2009
Cost/m^2	£1,700
Contract value	£290,000

Ty Pren

This house is a well considered contemporary response to the Welsh architectural vernacular, designed and built to exceptionally high environmental standards on the edge of a National Park. It combines the use of Structural Insulated Panels (SIPs) together with high quality craftsmanship, which came about through a close collaboration between the client, design team and contractors to deliver a uniquely local and sustainable building. The intention was to push the environmental debate surrounding sustainable homes, and to set a precedent of excellence for future developments in Welsh housing.

Planning and Design Process

Client Brief:

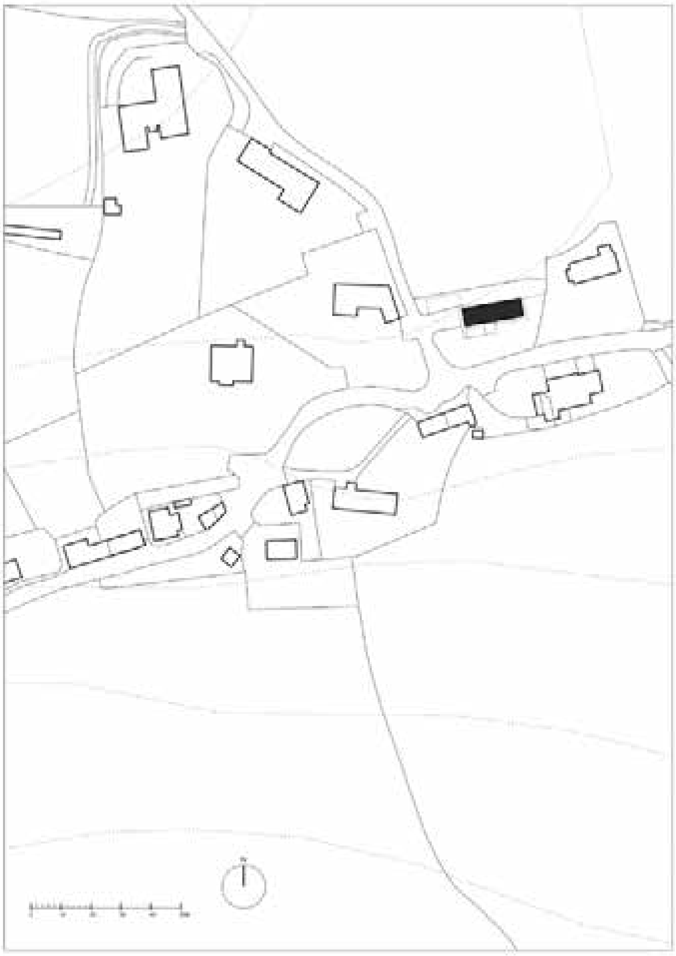
The clients for Ty Pren (House of Wood) set out a brief which required the architects to create a sustainable building which drew strongly from the Welsh architectural vernacular. The site is in the midst of the Brecon Beacons, in the village of Trallong.

Design Response to Topography:

The architects spent two years developing designs for the house through extensive site visits, models and prototypes to test ideas. The modern 'long house' follows the contours of the land, embedding itself in the slope of the hill whilst responding to the prevailing conditions. The building form and plan are designed for passive solar, enhanced by the topography and aspect of the site. An analysis of seasonal sun paths determined the location for the building in order to maximise solar gain, whilst also providing a south-facing garden to grow produce and maximise views over the valley.

Project Management:

The client, acting as a project manager, took a holistic environmental approach that facilitated the efficient delivery of a sustainable building within a tight budget. A shared commitment to sustainability from all involved enabled the delivery of an exceptional sustainable rural house in the Brecon Beacons.



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Sustainability Outcomes

Passive Design:

The simple, compact form of the building provides an efficient, well insulation and airtight envelope. The elevations are designed to make use of natural daylight whilst deep window reveals and sliding shutters prevent overheating in summer. Natural cross and stack ventilation are used during the summer, and a mechanical ventilation heat recovery system operates in the winter to minimise heat loss. The building only requires active heating throughout two months of the year.

Sustainable Technology:

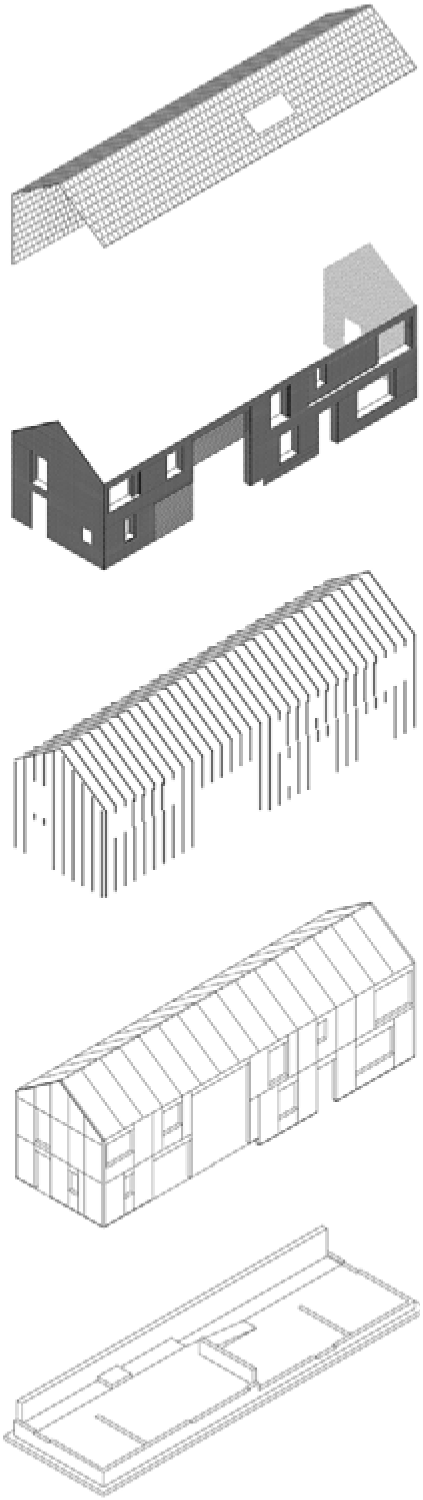
Sustainable technologies were incorporated within the design from the outset. An active heating strategy combines hot water from an 8KW log boiler and the solar collectors to supply all domestic hot water needs and supplement the under floor heating system. A sealed 'water waste processing plant' is located in the garden.

Local Materials:

The building is clad in larch, sourced and felled from the client's estate two miles away. This untreated cladding has a predicted life of 25 years and eight larch trees have been planted on the client's estate to replace the cladding when necessary, whilst the removed cladding will be burnt to heat the house.

Reference:

> www.feildenfowles.co.uk/projects/TyPren/



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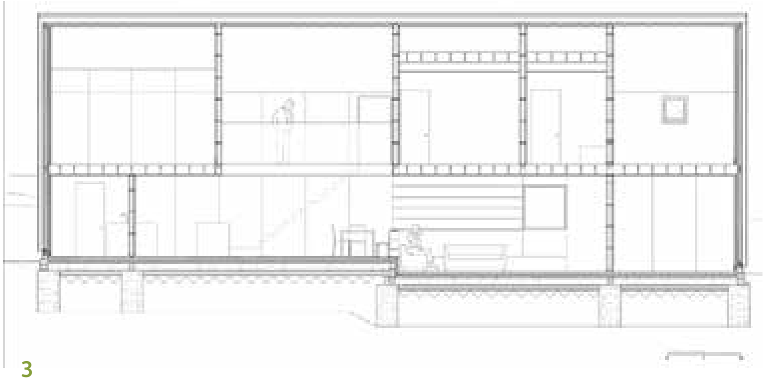

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Images

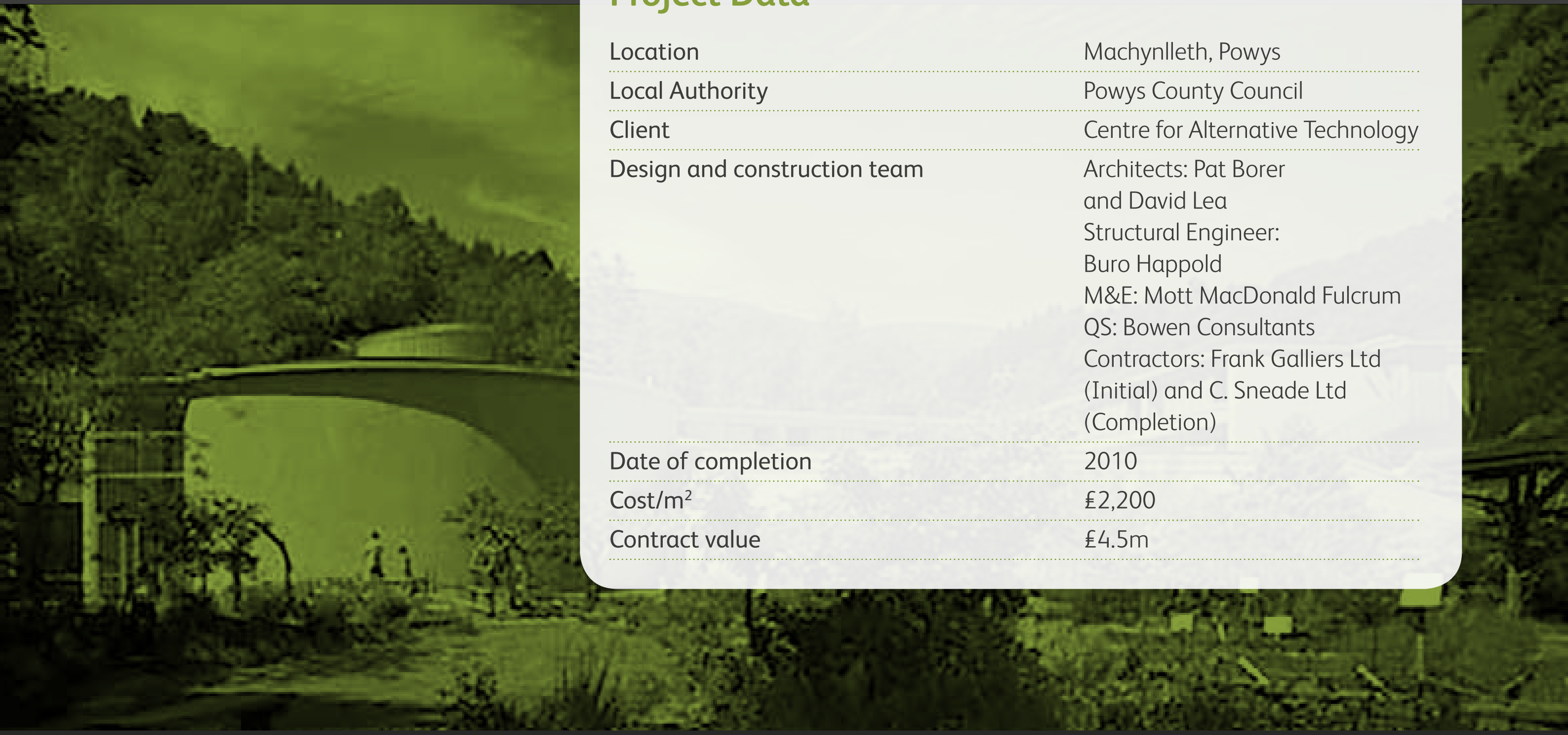
1 Site plan. *Fielden Fowles*

2 Exploded Axometric. *Fielden Fowles*

3 Section. *Fielden Fowles*

4 Under construction. *Fielden Fowles*

5 Sensitive response to topography. *Fielden Fowles*



Project Data

Location	Machynlleth, Powys
Local Authority	Powys County Council
Client	Centre for Alternative Technology
Design and construction team	Architects: Pat Borer and David Lea Structural Engineer: Buro Happold M&E: Mott MacDonald Fulcrum QS: Bowen Consultants Contractors: Frank Galliers Ltd (Initial) and C. Sneade Ltd (Completion)
Date of completion	2010
Cost/m²	£2,200
Contract value	£4.5m

Wales Institute for Sustainable Education

The Wales Institute for Sustainable Education (WISE) provides a state of the art environmental education centre, drawing on the Centre for Alternative Technology's (CAT) vast experience of educating a wide range of participants in the principles of sustainable development.

Planning and Design Process

The brief for WISE was to provide the following accommodation:

- 200 seat lecture theatre
- 3 workshops
- 3 seminar rooms
- Bio-laboratory
- Common room/foyer/bar
- Offices for the WISE education staff
- 24 double study bedrooms
- Service accommodation

As with all CAT buildings, WISE had to be a low-energy building and demonstrate benign and novel 'green' building technologies.

Collaborative Working:

The brief and design were evolved using 'Planning for Real' techniques (developed by the Neighbourhood Initiatives Foundation), involving the whole CAT staff body and encouraging a good working relationship with the design team.

1

Sustainability Outcomes

Natural Materials:

Throughout the accommodation and main teaching areas, WISE employs natural building materials and traditional construction methods such as rammed earth, hemp, lime and timber frame. The sensitive use of materials not only has a low carbon impact, but also helps to achieve a warm, comfortable people-friendly environment. The sensitive architecture approach achieves a light, warm building.

Passive Design:

The building has an extremely well insulated and air-tight envelope, and uses high-performance glazing to optimise natural day-light and passive heat gains, meaning that energy requirements are minimal.

Water Treatment:

Natural waste water treatment systems are designed to use zero energy.

Renewable Energy:

Electrical energy is supplied entirely from CAT's own renewable supply, which includes hydro-electric, wind turbines, PVs and wood-chip CHP.

Reference:

> www.cat.org.uk/index.html

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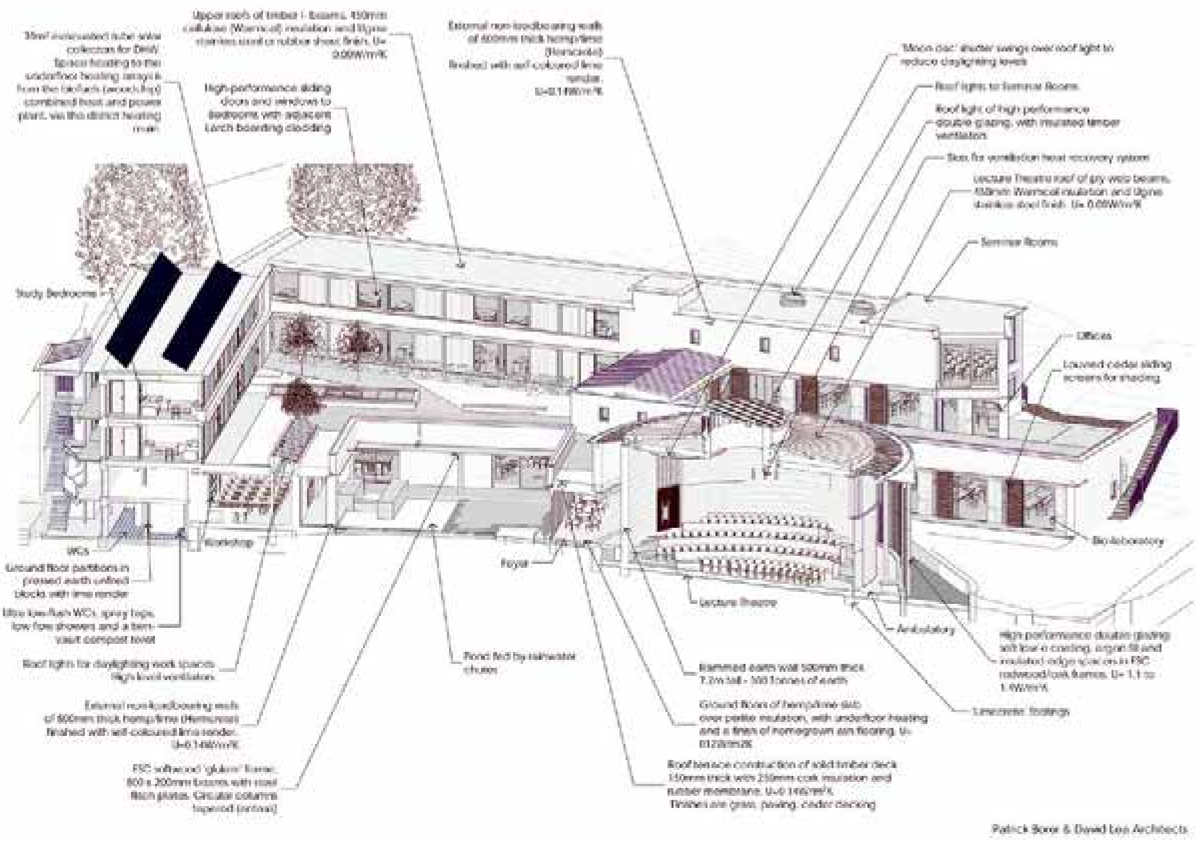

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Images

1 Response to landscape and setting. *Tim Soar*

2 Interior showing daylight and Rammed earth walls. *Tim Soar*

3 Teaching and learning spaces. *Tim Soar*

4 Annotated section. *Pat Borer + David Lea*

Project Data

Location	Woking, Surrey
Local Authority	Woking Borough Council
Client	WWF-UK
Design and construction team	Architect: Hopkins Architects Structural/Civil Engineer: Expedition Engineering Ltd Services Engineer: Atelier Ten Project Manager: King Sturge LLP Carbon Profiling: Sturgis Carbon Profiling Quantity Surveyor: Gardiner & Theobald LLP Landscape Architect: Grant Associates CDM: HCD Management Ltd Ecologist: AECOM Contractor: Wilmott Dixon
Date of completion	November 2013
Size	3,600 m^2

Living Planet Centre, WWF-UK Headquarters, Surrey

Located on a prominent, challenging site at the edge of Woking Town Centre, the building is WWF-UK's administrative building. Created to set a new precedent for similar organisations, it maximises onsite sustainability and targeted the BREEAM Outstanding rating. The building houses 300 staff over two storeys in a collaborative, open-plan environment together with conference and educational facilities.

Planning and Design Process

Collaborative Approach:

In 2007 WWF-UK commissioned the design of their new headquarters prior to the selection of a suitable site. The vision for this building was crafted through close and collaborative dialogue with WWF-UK, and reflects a commitment to the human and natural environment, providing a socially-inclusive and uplifting place to work. They aimed to create an exemplar sustainable building that would enhance the local ecology and express these ideals to the wider public through a public access component and integration with the surrounding landscape of pedestrian and bike paths, parks, canal and the town centre. The entire structure has been raised above a retained public car park (a requirement from the council) with a curving timber grid shell structure that spans the entire 37.5 metre width of the building.

Design for Flexible Working:

The building's open plan interior features office space arranged around a double-height internal 'Street' which adds focus and sociability to the internal environment. Hot-desking is popular, with staff free to work wherever they are most productive within the building. Extensive breakout spaces along the 'Street' and around the building's periphery, together with more private conference and meeting facilities provide a variety of working and meeting areas. These coexist with an exhibition featuring four interactive learning zones to welcome members of the public into the building.

1

Sustainability Outcomes

Ventilation, Heating and Cooling:

A mixed-mode demand-control ventilation system with heat recovery helps to reduce energy demand. At the apex of the roof sits a series of rotating wind cowls that aid internal climate control. These, along with openable windows, assist natural ventilation. Earth ducts provide pre-heated or pre-cooled fresh air and reduce Heat Ventilation and Air Conditioning (HVAC) system energy consumption. Temperature fluctuations are tempered by the high thermal mass from exposed concrete soffits to the mezzanine level.

Daylighting:

Significant natural daylight is provided throughout the building to reduce the need for artificial lighting.

Renewable Energy:

A 100kWp photovoltaic array is mounted on the roof to provide for some of the building's energy demand.

Materials and Education:

Great attention has been paid to the specification and procurement of all materials to ensure minimal environmental impact, including a significantly reduced carbon footprint when compared to the industry standard. Together with WWF-UK's Green Travel Plan and a number of other environmental initiatives, the building looks beyond its own walls to demonstrate how organisations can operate in a sustainable way with the smallest negative environmental impact possible.

References:

- > http://www.wwf.org.uk/about_wwf/the_living_planet_centre2/
- > http://www.hopkins.co.uk
- > http://www.expedition.uk.com
- > http://www.atelierten.com

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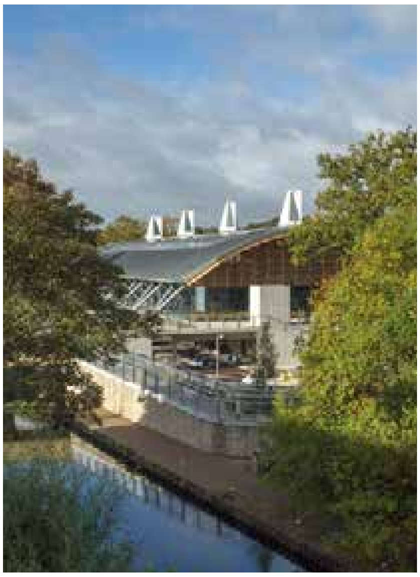

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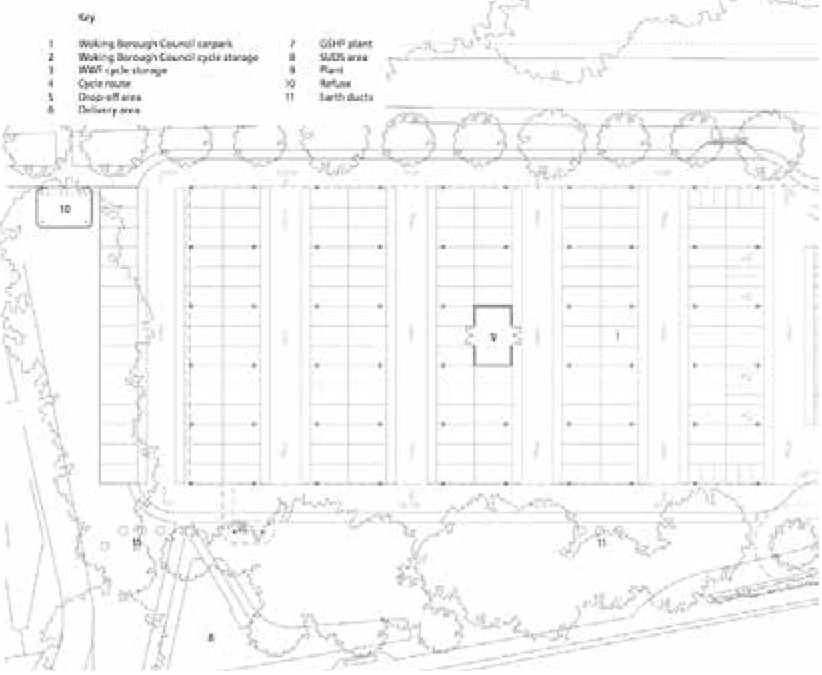

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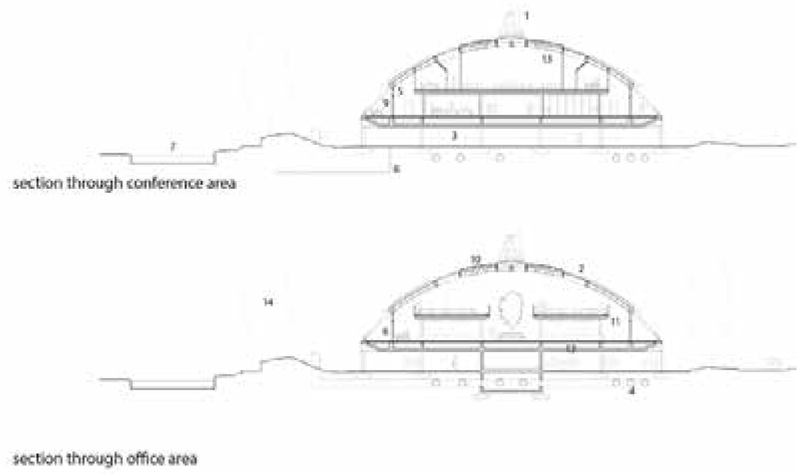
Images

1 Daylit interior. *Morley Von Sternberg*
2 Interior. *Morley Von Sternberg*
3 Exterior. *Morley Von Sternberg*
4 Waterside setting. *Morley Von Sternberg*
5 Exploded diagram. *Hopkins Architects*
6 Groundfloor plan. *Hopkins Architects*
7 Sections. *Hopkins Architects*



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Appendices

7 Appendices

Glossary of Abbreviations and Terms

AEA	Accredited Energy Assessor
BER	Building Emission Rate
BMS	Building Management System
BRE	Building Research Establishment
BREEAM	Building Research Establishment Environmental Assessment Method
CO_2	Carbon Dioxide
CHP	Combined Heat and Power
CCHP	Combined Cooling, Heat and Power
DEC	Display Energy Certificate
DER	Dwelling Emission Rate
DS	Design Stage Assessment
EIA	Environmental Impact Assessment
ES	Environmental Statement
EPC	Energy Performance Certificate
LDP	Local Development Plan
LZC	Low or Zero Carbon Energy
O&M	Operation and Maintenance Manuals
Kelvin	SI derived unit of measurement for temperature
KWh/m^2/yr	Kilowatt hours per metre squared per year
Kilowatt hour	Unit of energy equivalent to one kilowatt (1 kW) of power expended for one hour
Pa	Pascal the SI derived unit of measurement for pressure
PCS	Post Construction Stage Assessment
PPW	Planning Policy Wales
PHPP	PassivHaus Planning Package
MVHR	Mechanical Ventilation with Heat Recovery
SAP	Standard Assessment Procedure
SA	Sustainability Appraisal
SBEM	Simplified Building Energy Model
SEA	Strategic Environmental Assessment
SI	International System of Units (from French: *Le Système international d'unités*)
SIPs	Structural Insulated Panels
SPG	Supplementary Planning Guidance
TAN	Technical Advice Note
TER	Target Emissions Rate
W/m^2K	Watts per metre squared per Kelvin
Watt	SI derived unit of power

Acknowledgements

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Researched, written and compiled by the Design Commission for Wales for the Welsh Government.

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Images, Diagrams and Photographs:
Images are credited where they occur in the text or in the case studies. We are grateful to all contributors who provided case study information and permission to use images for this publication. Diagrams were drawn or recreated by Amanda Spence.

Welsh Translation:
Llinos Jones

Design:
Marc Jennings, Graphic Design: www.theundercard.co.uk

ISBN: 978-1-4734-1399-3 (English)
ISBN: 978-1-4734-1400-6 (Welsh).

WG22631