8.0 CASE STUDIES: NON DOMESTIC PROJECTS

8.1 Woodland Trust

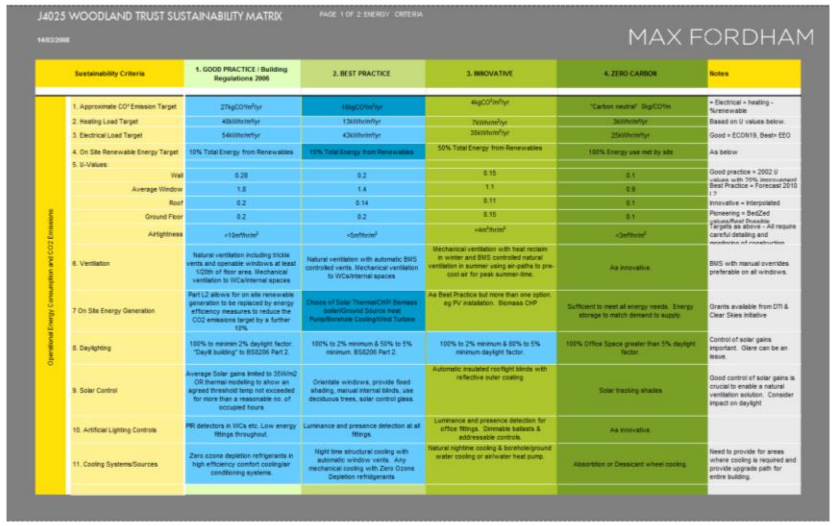
Client: Woodland Trust
Architect: Feilden Clegg Bradley Studios LLP
M&E and Sustainability Consultants: Max Fordham LLP
Engineer: Atelier One

The Woodland Trust provides offices and meeting space for 240 staff. This highly innovative and sustainable building was built within a modest budget. Our services strategy included extensive use of controlled natural ventilation, solar shading, facades with light shelves designed for good daylighting and free cooling for the server room. We carried out thermal modelling to determine the optimum amount of concrete required to absorb heat gains, as part of the innovative concrete and timber composite structure. Office lighting is achieved with floor standing luminaires between desks so that light is provided where it is needed rather than across the whole floorplate. We also provided advice on acoustics and renewable energy feasibility. The building has achieved a BREEAM Excellent rating.

Project data:
£5 million

Awards: Architect's Journal:AJ100 Building of the Year - Shortlist:2011; Green Organisation:Apple Award:2011; Sustain Magazine:Architecture & Design:2011; Building Magazine:Building Services Awards-Project of the year-Shortlist:2011; British Council for Offices:Corporate Workplace-Shortlist:2011; RIBA:East Midlands Award:2011; RIBA:Regional Award-Shortlist:2011; RICS:Regional Sustainability Award:2011

Costs:
Designed for letting at local rental value rates of £12.50/sqft; Construction cost of £5m for 2,800m2 = £1785/m2



J4025 WOODLAND TRUST SUSTAINABILITY MATRIX

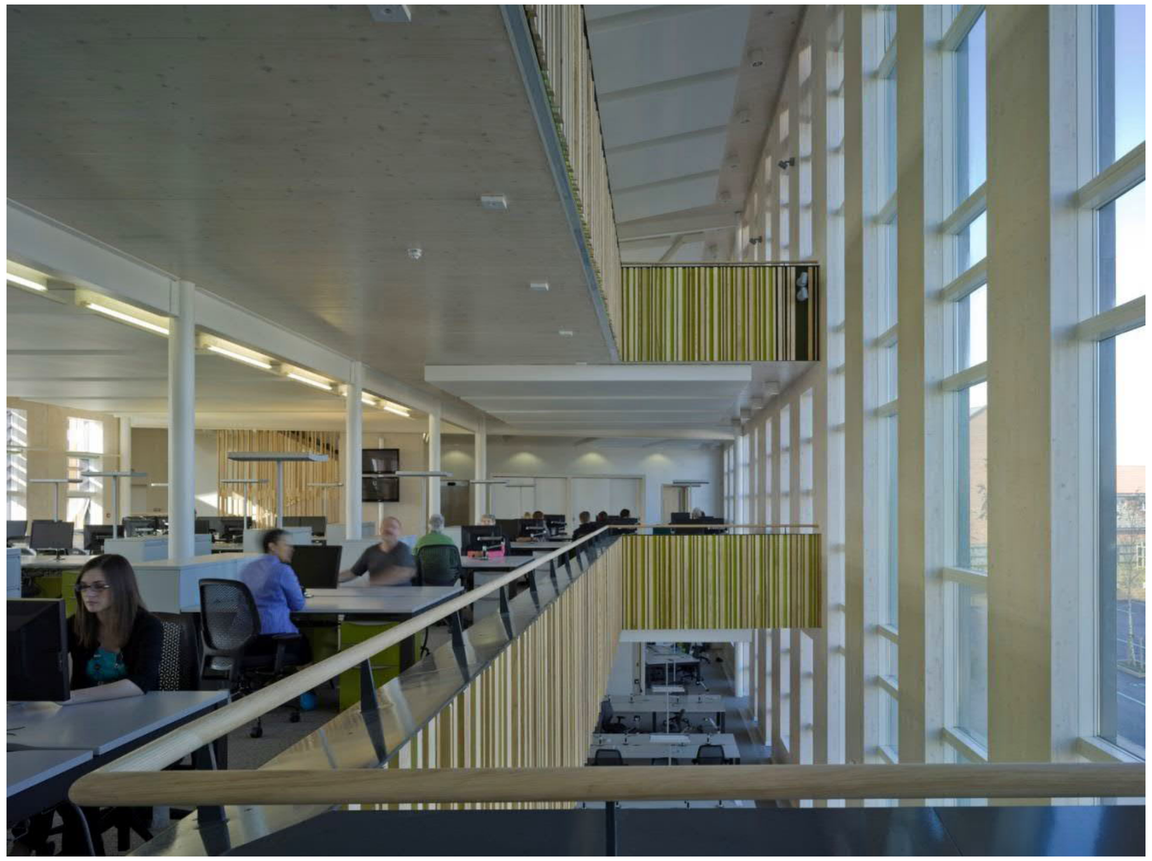
PAGE 1 OF 2: ENERGY CRITERIA

14/03/2008

MAX FORDHAM

Operational Energy Consumption and CO2 Emissions

Sustainability Criteria	1. GOOD PRACTICE / Building Regulations 2006	2. BEST PRACTICE	3. INNOVATIVE	4. ZERO CARBON	Notes
1. Approximate CO^2 Emission Target	27kgCO^2/m^2/yr	16kgCO^2/m^2/yr	4kgCO^2/m^2/yr	"Carbon neutral" 0kgCO^2/m	= Electrical + heating - %renewable
2. Heating Load Target	40kWhr/m^2/yr	13kWhr/m^2/yr	7kWhr/m^2/yr	3kWhr/m^2/yr	Based on U values below
3. Electrical Load Target	54kWhr/m^2/yr	43kWhr/m^2/yr	35kWhr/m^2/yr	25kWhr/m^2/yr	Good = ECON19, Best= EEO
4. On Site Renewable Energy Target	10% Total Energy from Renewables	15% Total Energy from Renewables	50% Total Energy from Renewables	100% Energy use met by site	As below
5. U-Values:					
Wall	0.28	0.2	0.15	0.1	Good practice = 2002 U values with 20% improvement
Average Window	1.8	1.4	1.1	0.9	Best Practice = Forecast 2010 L2
Roof	0.2	0.14	0.11	0.1	Innovative = Interpolated
Ground Floor	0.2	0.2	0.15	0.1	Pioneering = BedZed values/Best Possible
Airtightness	<10m^3/hr/m^2	<5m^3/hr/m^2	<4m^3/hr/m^2	<3m^3/hr/m^2	Targets as above - All require careful detailing and monitoring of construction
6. Ventilation	Natural ventilation including trickle vents and openable windows at least 1/20th of floor area. Mechanical ventilation to WCs/internal spaces	Natural ventilation with automatic BMS controlled vents. Mechanical ventilation to WCs/internal spaces	Mechanical ventilation with heat reclaim in winter and BMS controlled natural ventilation in summer using air-paths to pre-cool air for peak summer-time.	As innovative	BMS with manual overrides preferable on all windows.
7 On Site Energy Generation	Part L2 allows for on site renewable generation to be replaced by energy efficiency measures to reduce the CO2 emissions target by a further 10%	Choice of Solar Thermal/CHP/ Biomass boiler/Ground Source Heat Pump/Borehole Cooling/Wind Turbine	As Best Practice but more than one option eg PV installation. Biomass CHP	Sufficient to meet all energy needs. Energy storage to match demand to supply.	Grants available from DTI & Clear Skies Initiative
8. Daylighting	100% to minimum 2% daylight factor. "Daylit building" to BS8206 Part 2.	100% to 2% minimum & 50% to 5% minimum. BS8206 Part 2.	100% to 2% minimum & 80% to 5% minimum daylight factor.	100% Office Space greater than 5% daylight factor.	Control of solar gains important. Glare can be an issue.
9. Solar Control	Average Solar gains limited to 35W/m2 OR thermal modeling to show an agreed threshold temp not exceeded for more than a reasonable no. of occupied hours	Orientate windows, provide fixed shading, manual internal blinds, use deciduous trees, solar control glass.	Automatic insulated rooflight blinds with reflective outer coating	Solar tracking shades	Good control of solar gains is crucial to enable a natural ventilation solution. Consider impact on daylight
10. Artificial Lighting Controls	PIR detectors in WCs etc. Low energy fittings throughout.	Luminance and presence detection at all fittings.	Luminance and presence detection for office fittings. Dimmable ballasts & addressable controls.	As innovative	
11. Cooling Systems/Sources	Zero ozone depletion refrigerants in high efficiency comfort cooling/air conditioning systems.	Night time structural cooling with automatic window vents. Any mechanical cooling with Zero Ozone Depletion refridgerants	Natural nightime cooling & borehole/ground water cooling or air/water heat pump.	Absorbtion or Dessicant wheel cooling	Need to provide for areas where cooling is required and provide upgrade path for entire building.



8.2 Heelis, National Trust HQ

Client: The National Trust
Architect: Feilden Clegg Bradley Studios LLP
M&E and Sustainability Consultants: Max Fordham LLP
Engineer: AKTII

Sustainability is a key issue in the National Trust's philosophy, and it was important for Heelis to meet high-quality benchmarks for sustainable design. We were part of the design team for Heelis, the new central headquarters for the National Trust, providing 6,700 sq metres of office space for 450 staff, a shop and cafe. We worked with the architects Feilden Clegg Bradley Studies on the form and orientation of the building to achieve good natural daylight and ventilation, and to accommodate the PV array, which also acts as solar shading for north-facing roof lights. The result is a two- storey, deep-plan building with generous voids to the first floor plate and roof lights throughout; high daylight levels ensure artificial lighting is only required for around 15% of working hours. The building is naturally ventilated via automated windows and roof lights, and the overall energy use is among the lowest in the country for an office. Heelis takes daylighting and natural ventilation of offices in a new direction and demonstrates how a building can be architecturally enticing, an outstanding place to work and highly sustainable, with very low running costs.

Building Form
The design team settled on a two-storey, deep-plan building with the main public elevation, internal layout and roof all orientated to face due north-south to control solar gain and daylighting. The roof was pitched at a 30° angle to maximise potential output from photovoltaic panels (PVs). Roof lights were placed on the north-facing side of the pitched roof, and the PVs were cantilevered off the south side to provide shading to the roof lights, so limiting high solar gains. First-floor voids bring daylight from the roof lights to the ground floor, and two courtyards allow ventilation into the centre of the deep plan. To provide thermal mass for summer night-time cooling, the roof is formed from 80 mm thick exposed pre-cast concrete panels with high levels of insulation.

Daylighting:
Artificial lighting can be a significant proportion of a building's running costs, and maximising the use of natural daylight was one of the main drivers in the design. There are first-floor mezzanines within the open-plan spaces, and two thirds of the office can be directly roof lit. Artificial lighting is automatically controlled based on daylight levels and detection of occupants, thus keeping electrical energy for lighting to an absolute minimum.

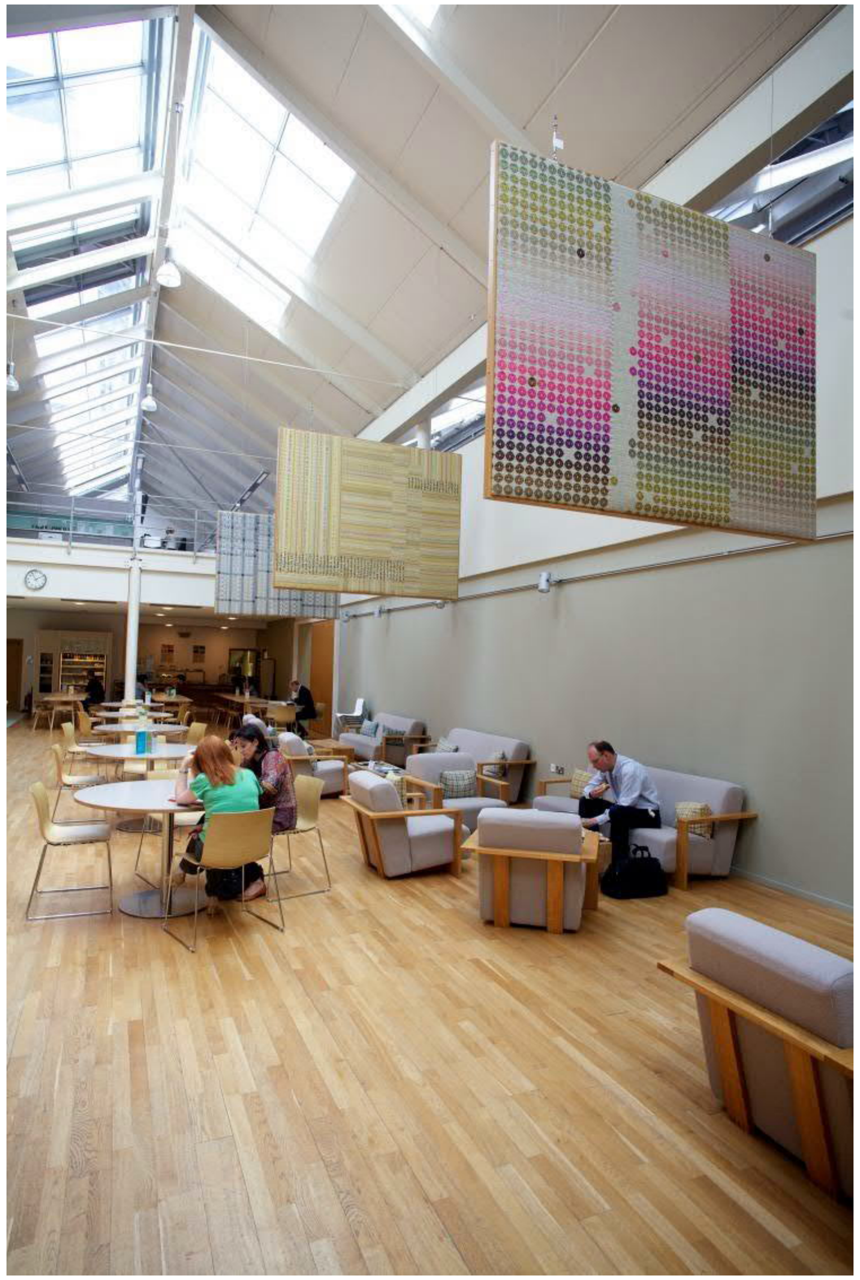
Natural Ventilation:
The building was designed to be naturally ventilated, even on still days by using the stack effect. This uses the buoyancy of hot air to cause it to rise to the roof and exhaust, thus introducing fresh air into the lower occupied level. Air is introduced through automatic opening windows and panels. The windows are at high level and can be left open at night without compromising security. Manual opening windows and an over-ride facility for all of the automatic windows give the occupants a degree of control. Air exhausts via openable roof lights under large roof cowls, known as snouts. Propeller fans in some snouts provide mechanical back-up during still, hot periods. The automatic openings are controlled by the building management system (BMS) to maintain comfortable temperatures within the building. In summer these are achieved by ventilating at night to cool the exposed concrete roof soffit and first-floor slab. This thermal mass absorbs the internal gains during the day and emits them at night, thus smoothing out the effects of fluctuations in external temperature. Unlike air-conditioned buildings, it is not possible to dictate exact internal conditions with natural ventilation; rather the aim is to achieve reasonable conditions for most of the time.

Winter Ventilation
In a well-insulated and well-sealed building, roughly half of the heat loss in winter is due to ventilation for fresh air. A fully naturally ventilated building would provide fresh air during the winter by opening windows and thus lose warm air to outside. In the case of Heelis, however, a mechanical system with heat recovery is used during cold weather. By passing the stale exhausted air through a heat exchanger (using fans to drive the air), heat can be extracted and used to preheat incoming cool fresh air. This reduces the ventilation heat loss by about 70% and is yet another way to reduce the overall running costs of the building.

Cooling
The building is predominantly naturally ventilated, however mechanical cooling is provided in areas with stricter environmental requirements or high internal gains, such as meeting rooms and server rooms. Local fan coil units within the rooms run on chilled water fed from roof-mounted chillers. The chillers operate on Care 45, a hydrocarbon refrigerant that is the HCFC 22 replacement with the lowest global warming potential (GWP) and also has a zero ozone depleting potential (ODP). It is also more efficient than standard HCFC chillers.

Photovoltaics
The photovoltaics, which provide the shading to the roof lights, have a primary purpose of generating electricity. At 1300m2 the array is one of the largest in the country and provides up to 15% of the total electrical load of the building.

Setting targets:
The team defined sustainability targets early on, developing the first Sustainability Matrix in 2005 with in collaboration with Feilden Clegg Bradley Studios, as a communication tool to aid early discussions and to help explain to the National Trust board of directors how their new headquarters building would meet their aspiration for 'best practice and occasional innovation in sustainability'. The matrix presents the range of sustainability options available for a project.



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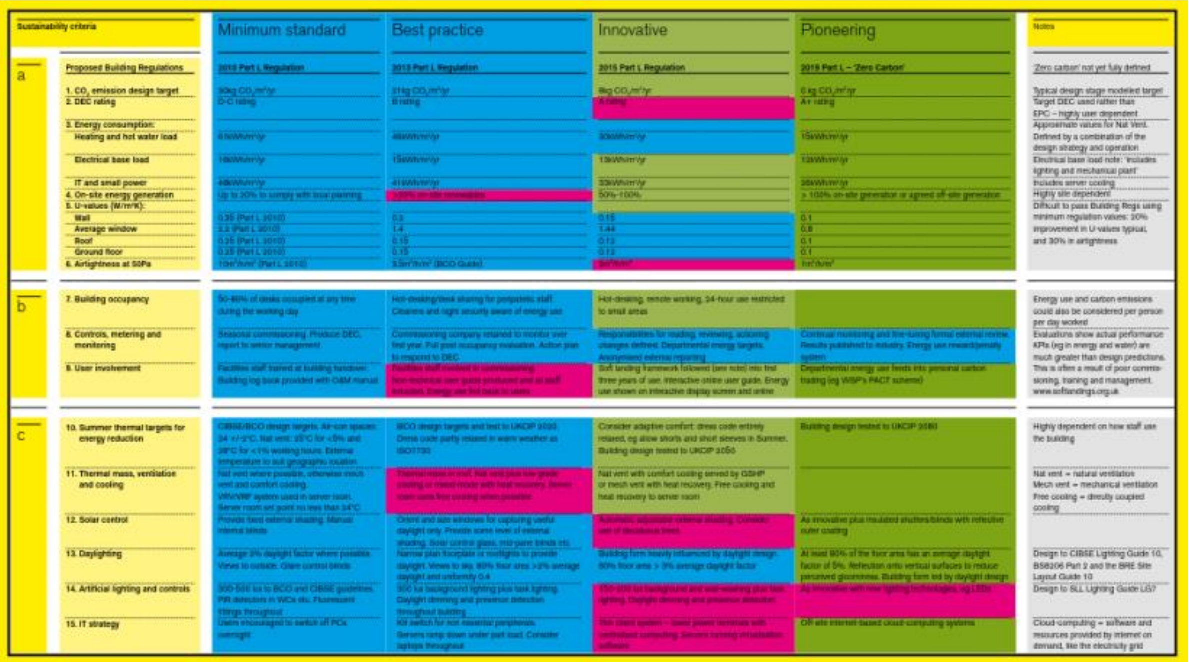
Awards:
Building Performance Awards: Sustainability Award:2008; Building Magazine: Building's Sustainable Building of the Year:2007; Architect's Journal:AJ100 Sustainability Award:2006; BCI:Award:2006; British Council for Offices: BCO Innovations Award:2006; BIFM:BIFM New Build Award:2006; BIFM:BIFM Sustainability Award:2006; Building Magazine: Building Sustainability Awards: Sustainable Project of the Year (over £10m)-Shortlist:2006; Dedalo Minosse: Dedalo Minosse International Prize:2006; Industrial Agents Society/Office Agents Society: IAS/OAS Best Bespoke Development:2006; RIBA: Sustainability Award:2006; Brick Awards: Best Commercial Building:2005; FX Magazine: International FX Interior Design Award:20

Project data:
c.16.7 million

Costs:
£135/sqft = £1375/sqm (CAT A only?)
All in 7,600m2 @ £14m = £1.840/sqm



8.3 The Hive, Worcester Library and History Centre

Client: WLHC Project Co Ltd
Architect: Feilden Clegg Bradley Studios LLP
M&E and Sustainability Consultants: Max Fordham LLP
Engineer: Hyder Consulting Ltd
Contractor: Galliford Try

The Hive is a fully integrated, joint library for Worcester City Council and University, an innovative concept both in the UK and internationally. It has sustainability running through every detail of its design. The 10,000m^2 library also includes the county archives and history centre, the county archaeology service and a centre for council services and was delivered under a PFI contract.

The building achieved a 50% reduction in carbon emissions below Building Regulations and BREEAM Outstanding. This is achieved via a combination of passive design and low carbon technologies. The natural ventilation strategy uses the roof cones as solar chimneys to exhaust stale warm air whilst also providing good levels of daylight to the internal spaces. Heating is from biomass boilers using locally sourced timber. The cooling is generated by water cooled chillers with heat rejection to the River Severn. They serve chilled slabs, chilled beams, fan coil units and air handling units where cooling is required.

The building was modelled using climate projections for 2020 and 2050 to ensure the building is adaptable and comfortable in the future. Rainwater collected from the roof is used to flush WCs and for the washing of finds by the archaeology service. The building is now being monitored to compare operational performance with design predictions.

The naturally-ventilated library faces a busy main road, so the ventilation openings are acoustically treated to prevent disturbance from external traffic noise. The zoned, open-plan design assists air flow using large voids and openings, which required specialist acoustic design to control noise-spill between areas. Particular attention was given to eliminating noise disturbance from plant located at high level in the cross-laminated timber roof cones

Project data:
£35.8 million

Awards:
CIBSE Award:2013; Civic Trust Award:2013; Civic Trust City of Durham Trust AA Winner:2013; SCALA: Civic Building of the Year:2013; RIBA National Award:2013; RIBA Regional Award-Shortlist:2013; BCI: Sustainability Award:2013; Building Mag: Sustainable Project of the Year:2013; Partnership Awards: Best Community Project-Shortlist:2012; Partnership Awards:Best Designed Project-Shortlist:2012; Partnership Awards:Best Local Gov't Project Team-Shortlist:2012; Partnership Awards: Best Pathfinder Project-Shortlist:2012; Partnership Awards:Best Sustainability in a Project:2012; Be Inspired Awards:Innovation in Generative Design:2009
Costs:
Contractor kept amount quiet but about:
£35m for 11,600m2 = £3000/sqm; £35m for 13,000sqm = £2,700; M&E £6m = £461/sqm

8.4 Passivhaus Case Studies

The Enterprise Centre, University of East Anglia

‘The UK’s Greenest Building’

Project Outline

Dubbed by the press as the ‘UK’s greenest building’, The Enterprise Centre is a new university facility at the University of East Anglia, aimed at encouraging entrepreneurship and developing future sustainable businesses. The flagship low carbon building includes an expansive multi-functioning space on the ground floor, which also incorporates an in-house café and hospitality service as well as plenty of seminar rooms, all designed to encourage networking activities. The building also provides spaces for business support workshops, open plan offices, incubation and hatchery space (research and development activities) for new graduate start-up companies and other businesses in the Knowledge Economy. The centre also comprises 300-seat lecture theatre and forms a gateway to the main university.

The building is intended to be a world class facility through its design and use of material, physically demonstrating sustainability by design, through the use of prefabricated and vertically hung straw thatch panel cassettes, which have been used to clad the building. The straw was sourced locally, to fill timber cassette modules off-site in barns across Norfolk. To meet the requirements of the brief, we have designed the building to meet a 100-year design life, Passivhaus certification and BREEAM Outstanding. The building also exceeds the local planning requirement for 10% of the building’s energy to be from renewables through the use of roof mounted PVs. Embodied energy has been a major focus at design stage.

Client

University of East Anglia, Adapt Low Carbon Group

Timescale

On Site / Nov. ’13
Completion / Jun. ‘15

Value

£11,600,000

› The UK’s greenest building

› Designed to BREEAM Outstanding

› Designed to Passivhaus standard

The Enterprise Centre, University of East Anglia

'The UK's Greenest Building'

Architype, in a team led by main contractor Morgan Sindall, won the OJEU advertised design competition because their entry not only demonstrated that the many exacting sustainability criteria had been fulfilled, but also because they had designed a striking and beautiful piece of architecture that was well conceived as part of a larger masterplan

John French, CEO, Project Director,
ADAPT Low Carbon Group

Lessons Learnt

The Enterprise Centre project is the largest non-residential Passivhaus project in the country. The design team needed to work closely with the available precedents from Germany and Austria in addition to the Passivhaus Institute in Darmstadt to ensure that the right approach was taken. This included getting Wolfgang Feist, the founder of the Passivhaus standard, to attend a design workshop midway through the design process to audit the design, in particular to assess our assumptions in respect of internal heat gains, occupancy and primary energy. This process has led us to better understand the nuances of the design methodology when handling a variable occupancy building and ensured that the client will get a building more appropriate to their needs.

Outcome

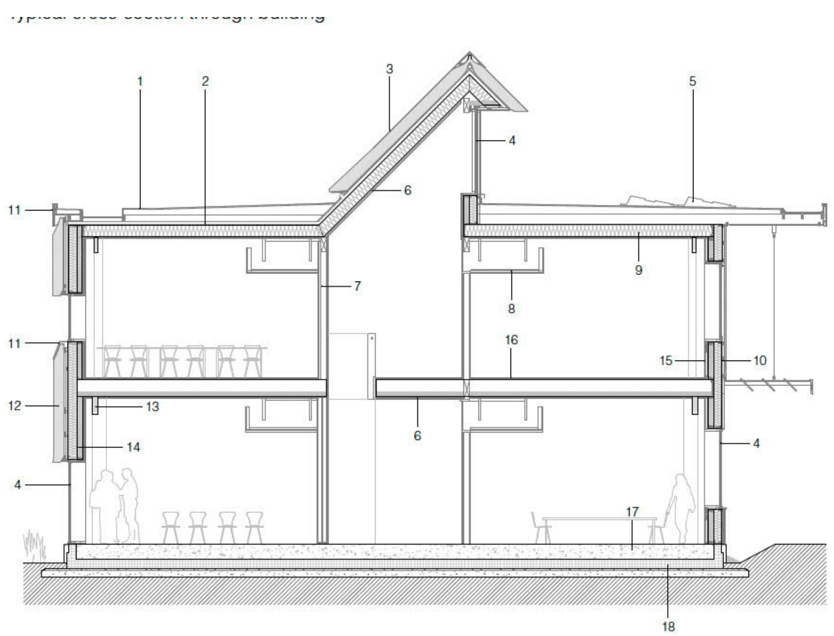
The building is on target to achieve Passivhaus, with overall the embodied carbon of the building calculated to be 440kg/CO2/sqm across the 100-year life cycle. This equates to a quarter of the lifetime emissions of a conventionally constructed university building of equal size and scale. A three-year post occupancy and building performance evaluation programme has been implemented with contributions from all team members to assist the occupiers to operate their building optimally and ensure the building performs as designed.

The project has supported innovation in the construction sector across the East of England, by helping professionals in the sector to understand how to design, build and operate class-leading buildings such as The Enterprise Centre. The scheme is looking to assist over 300 small and medium sized companies with advice, bespoke support, practical tours and demonstrations. Other outcomes from the project include over 200 jobs being created or safeguarded, 35 businesses located to eco-efficient high quality workspaces, which will influence processes or services into at least 200 businesses. The Enterprise Centre has also now become a key element in the University's estate master plan, which Architype are also developing.

The Enterprise Centre, University of East Anglia

'The UK's Greenest Building'

Right
The 300 seat lecture theatre



Key

1 spruce ply ventilated roof deck with bitumen membrane roofing system
2 timber roof sheathing board
3 roof covering of local reeds
4 timber/aluminium triple glazed window
5 photovoltaic panels
6 cellulose recycled paper acoustic ceiling finish
7 timber stud frame
8 wood wool acoustic ceiling tiles
9 blown recycled newspaper insulation
10 external grade MDF cladding panels
11 anodised aluminium flashings and sills
12 straw cassette external cladding panel (see detail section)
13 glulam timber frame
14 insulated timber stud frame (see detail section)
15 birch ply wall lining
16 linoleum on isolation mat on 40mm recycled glass flowing floor screed
17 structural ground floor slab with 70% GGBS
18 insulated shuttering on recycled sub-base

Images Left
We used local thatchers who provided the largest example of a thatch-clad building, with a new innovative prefabricated thatch panel system and and above a typical section through the building

Wilkinson Primary School

Achieving Super Low Energy Schools Through Passivhaus

Project Outline
Wilkinson Primary School is the latest addition to Architype's portfolio of Passivhaus schools. The new building provides pupils and staff with a safe, comfortable and inspiring school building following extensive fire damage to their previous school.

We wanted to design a building that would help bring this community back together after the devastation of the fire, and provide an oustanding centre for education and extra curricular activities for generations to come.

Cutting Energy Use Through Sustainable Design
Designed to Passivhaus standards; the sustainable aspects of the building are exemplary, proven through good internal air quality and reduced energy consumption.

Demanding a minimum airtightness of 0.6 a.c.h@50 p.a., Passivhaus is around 15 times more efficient than standard building regulations. Wilkinson School measured 0.34 a.c.h@50p.a, achieving signficant reductions in energy use and minimising energy bills.To achieve the airtightness level, a continuous 'duvet' layer of insulation externally wraps the outside of the frame and underneath the floor; this allows for a fully connected envelope that is thermally intact and free from any thermal bridges.

Our post occupancy research and experience of designing to Passivhaus standards in other schools meant that we were able to develop a tailored south facing glazing design for Wilkinson that saved money, and improved comfort and building performance too. Similarly, through monitoring previous passivhaus schools through their Building Management Systems, we identified there was less need for heating equipment and Wilkinson Primary School was specified with one radiator per classroom and one domestic radiator to heat the whole two form entry school. This both saves building and in use costs, and frees up valuable wall space in the classrooms.

Client
Wolverhampton City Council

Timescale
On Site / Oct'12
Complete / Feb '14

Value
£5,000,000

Local Authority Building Control (LABC) Building Excellence Built in Quality Award 2014

Green Apple Award for Environmental Best Practice

Herefordshire Archive And Record Centre

The UK’s First Passivhaus Archive Building

Project Outline
Providing state-of the art accommodation for the county’s archive records, the new Herefordshire Archive and Records Centre (HARC) is the first building of its kind in the UK to be designed and built to the rigorous Passivhaus standard, as well as the new guide for the storage and exhibition of archival materials, PD5454, released in March 2012. Taking the requirements of the brief beyond client expectation, Architype designed a dynamic building that offered an innovative, simple solution to the complex nature of archiving. The carefully considered design provided long-term sustainable solutions in accordance with the new PD5454:2012 recommendations.

The original building had unforeseen effects of constantly changing temperature conditions which impacted negatively on the archive materials and resulted in extremely high energy bills, at times in excess of £80,000 a year. Herefordshire Council had to promptly create a new repository that met the standards required or face the entire collection being moved to another county. Architype followed the new archive guideline to not only find an optimum temperature point but to protect the building from sudden changes in conditions. Architype worked closely with the CDM-C to reduce risks on site including areas such as the plant room where conditions were not suitable for public use.

The other prominent issue was project funding. An archive is generally one of the more expensive buildings to construct due to the specific climate that must be maintained and the specialist equipment required for storage. The Arts Council of England recently suggested the UK average build cost of a public archive facility is around £3,600/m2.

Client
Herefordshire County Council

Timescale
On Site / Oct. ‘13
Est. Completion / Nov. ‘14

Value
£8,000,000

- Winner of RIBA West Midlands Regional Award 2015
- Best Sustainable and Best Value Project in the Constructing Excellence West Midlands Awards 2015

Herefordshire Archive And Record Centre

The UK's First Passivhaus Archive Building

UK's first archival storage building to be built to the rigorous Passivhaus standard as well the first archival facility in the UK to be constructed to the new PD5454:2012 standard; Guidance on the storage and exhibition of archival materials.

A natural material palette was used on the HARC. The external façades are clad in vented cedar shingle, zinc panels and render

Lessons Learnt
The focal repository element of the centre benefits from principle Passivhaus methodology, employing rigorous insulation and airtightness, a robust thermal envelope and breathable wall technology. Passivhaus demands a well resolved fabric that is thermal bridge free with good levels of airtightness, which helps to create a constant internal temperature. Using cheaper but beautiful, high quality materials such as vertical cedar shingles helped reduce the building costs to well below what the council originally estimated.

This passive approach is more effective and cheaper to maintain than an over engineered design with an abundance of mechanical equipment that requires a high maintenance programme. This also reduced the capital investment but also optimised storage conditions, with the archives now subject to less interference and infiltration.

Outcome
HARC is an example of a highly intelligible building, where the form of the building is distinctly expressive of its different uses. Arranged into two blocks, an un-perforated cedar shingle clad box houses a three-floor repository, whilst a two storey timber-framed building accommodates the administration, public research areas and restoration laboratories. A linear atrium separates the two blocks forming a light, airy and welcoming entrance while also providing a thermal buffer for the respository and stack ventilation for the front facing office administration block. The spectacular external facade of the archive is amass with vertical cedar shingle cladding, softening the opposing edges of this dominant form with all natural texture and pattern.

Architype delivered the project on time and considerably below the council's anticipated budget. We compared cost estimates for developing the building to BREEAM versus Passivhaus standards and the outcome proved that Passivhaus offered 4.5% capital cost savings due to the reduction in M&E specification required to maintain a tempered environment.

Architype's approach of elegant simplicity, coupled with the greatly reduced reliance of mechanical system and equipment has helped to achieve these great results. It has been estimated that HARC will save approximately £60,000 per year on energy bills compared to the client's previous accommodation, not to mention the expelled cost of maintenance of systems; an indirect aim of the new guidance.

It is envisaged that due to the new facility providing a multidisciplinary service, visitor numbers will rise significantly, and all will benefit from improved internal conditions, extensive outreach, education and workshops.

Wilkinson Primary School

Achieving Super Low Energy Schools Through Passivhaus

The finished school is an absolute delight for staff and pupils having spent so long in temporary buildings. Staff moved in to a school they were already familiar with given the involvement they all had in the design and construction phases. The school flows perfectly with everything to hand.

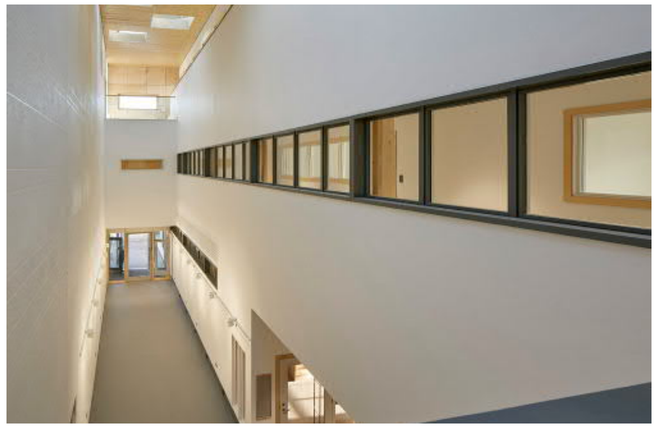
Marc Webb / Wolverhampton City Council

Herefordshire Archive And Record Centre

The UK's First Passivhaus Archive Building

Construction
- The timber framed building uses a Limetech render, fully filled with warm cell insulation,
- The monolithic concrete structure for the repository is clad with cedar shingles and filled with warm cell insulation to achieve extremely high levels of air-tightness

Archive Materials
- The building will house extensive archives on paper, wood and cloth
- The collection includes medieval maps and manuscripts, paintings, sculpture, Saxon construction timbers, and high volumes of newspapers
- Temperatures needed to be between 14 and 19 degrees, and relative humidity close to 50



Passivhaus Solution
- The airtight fabric and high levels of thermal insulation required for Passivhaus standards protect the collections from sudden changes in conditions - and meet the requirements of the new British Standards Institution guidance PD5454 on archive stores
- By designing to Passivhaus standards, building costs were reduced by 4.5% and running costs approx £65,000 less per year

Creating Optimum Storage Conditions
- The building is slightly pressurised with filtered air, virtually eliminating uncontrolled infiltration
- Airtightness was critical - 0.35 ach @ 50pa was achieved over the whole building through close collaboration with the design team and contractor

Devonshire Gate

The Curve. A New Passivhaus Office Development at M5 J27

The client intends to expand his existing B1 business complex on his land next to Junction 27 of the M5 with a new state of the art office building.

The existing business complex 'Swallow Court' consists of 'barn like' 1 to 2 storey buildings with pitched roofs, arranged around a central courtyard. The new office building has been designed for a current tenant at Swallow Court. The new unit is to provide the tenant with the space required for their business growth and to gather their facilities within one unit, to optimise communication and logistic processes thus making their business more efficient.

The project has the following aims:

- To provide a building that suits the client's needs with the potential for future expansion
- To preserve the rural character of the area by scale, design, and siting of the new development
- To be an ecologically sustainable project in all respects
- To be a healthy working environment for staff and clients alike

Landscape Integration

The landscaping has been designed to be an integral part of the architecture. Earth banks shelter the scheme from the motorway and merge to form the new two storey building which is topped by a green roof to form a seamless "hill". The unobtrusive architecture merges with the landscape and allows for a generous communal green space at the centre of the development maximising the amenity potential of the site.

Key Features

Building Form and Massing

The intention is to 'frame' the existing buildings by mirroring the northern development and siting a new symmetric complex to the south. The L-shaped building consists of two wings, a double height area to the east with separate access and a two storey office tract to the west. To provide high levels of natural daylight, the width of the building has been limited to 12m.

Daylight Design

A key aim of the design is to achieve best practice daylight levels with a minimum of glazing. Large amounts of glazing contribute to internal heat gains causing overheating especially in summer. As the building follows passive design principles air conditioning systems will not be used. So the optimum balance of maximising daylight levels and minimizing solar gains had to be found. To do this several different fenestration designs were computer modelled before an optimized elevation was adopted.

Low Energy Design

The building is designed as a two storey timber frame construction. This offers a lightweight low embodied energy construction which is super-insulated with limited thermal bridging. A solid construction of internal walls and floor slabs guarantees sufficient thermal mass to reduce internal temperature fluctuations removing the need for air conditioning systems.

- Passivhaus Certified including super insulation, non thermal bridging design, triple glazing and high levels of air tightness
- Natural daylight design and total low energy lighting
- Thermal mass to provide stable internal temperature fluctuations and reduce summertime overheating
- Solar water heating
- Roofing – extensive green roof (sedum roof)

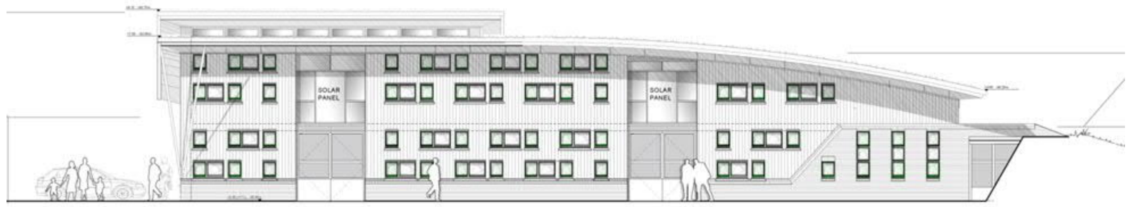
Climate Ready Design. The project has benefited from Technology Strategy Board funding allowing the design team to design the building ready for weather patterns into the future up to 2080.

Low environmental impact natural materials and avoidance of PVC

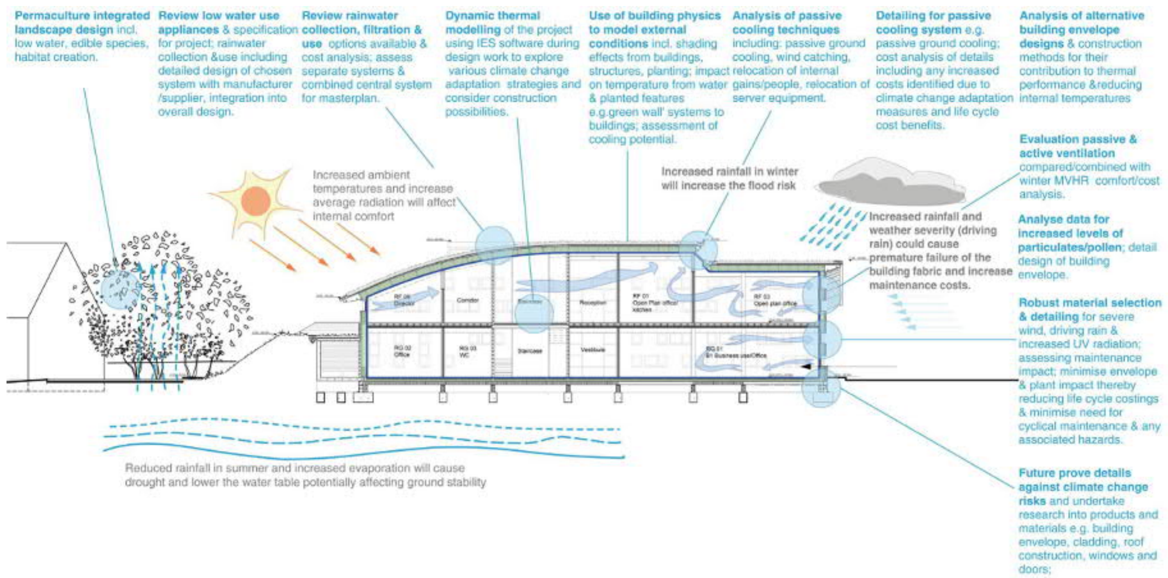
Healthy building design – use of non VOC materials; avoidance of dust mite habitats; radial wiring to avoid low level EMFs; improved thermal comfort; high quality air

Water efficiency – low water use appliances; pressure reduction gauges, rain water collection system to WCs

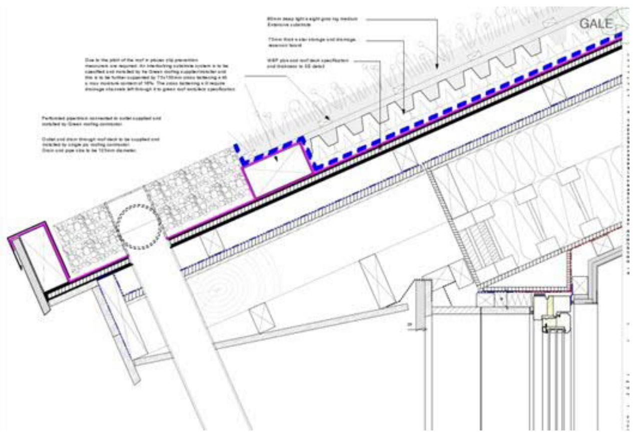
The project is designed to meet Passivhaus Certified Standard and is designed for future weather



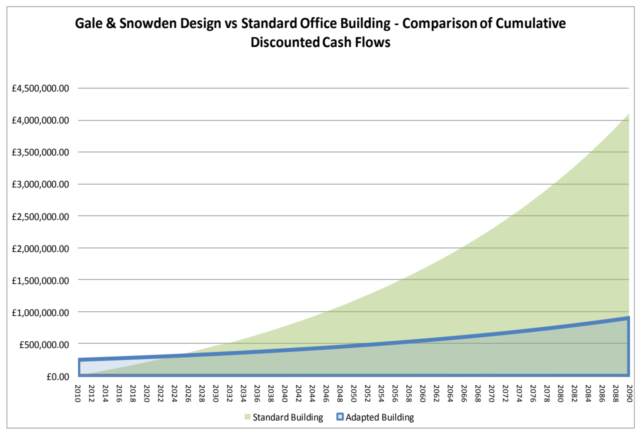
Conceptual View of Phase 1 of the Development



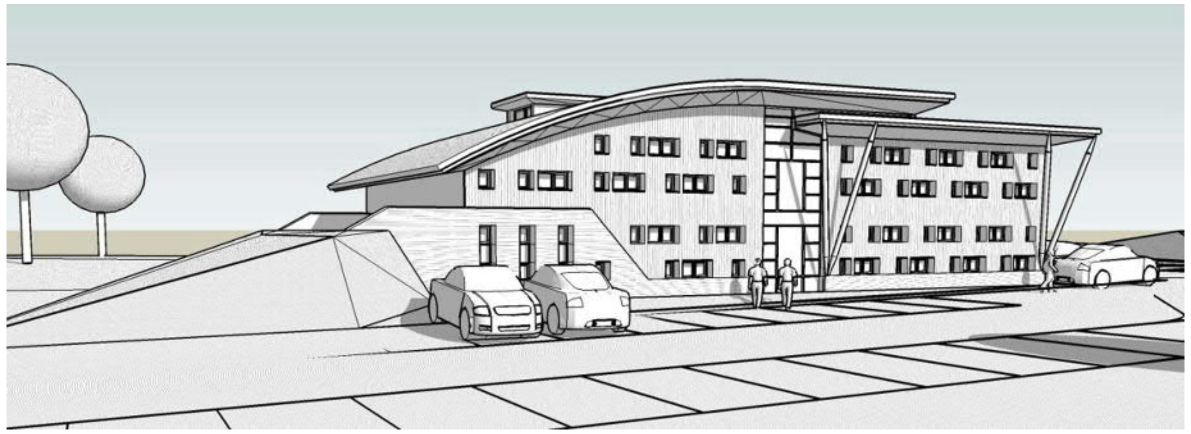
Designed for Future Weather to Enable Thermal Comfort into the Future Without the Need for Energy Intensive Systems



Designed to meet severe future weather events



Payback period 14 years



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Reed Walk

Passivhaus, Healthy Homes for Exeter City Council Tenants

20 units on threes sites – 1800m2 GIA - £1,150/m2 (basic costs) - Completed 2015

The development of 6 terraced houses, including one wheelchair accessible unit, at Reed Walk, off Newport Road in Exeter is one of 3 sites developed by Exeter City Council (ECC) to deliver high-quality, affordable, healthy, Passivhaus homes for Exeter's social tenants.

Completed in August 2015 and occupied shortly thereafter, Reed Walk is part of the second wave of council-own-build developments in Exeter designed to optimise underused sites in the city. Together with sites at Barberry Close and Silverberry Close, Gale & Snowden Architects have helped ECC deliver a further 20 family homes. G&S first introduced ECC to the concept of Passivhaus and Healthy Buildings during the first wave of Council developments in 2008.

The design of the houses utilises dense concrete blockwork walls, wrapped with high levels of external wall insulation and colourful render. The combination of high internal thermal mass, insulation, thermal-bridge-free design, and exceptional airtightness will result in excellent, stable comfort levels and very low energy bills for occupiers.

The houses tackle fuel poverty and provide exemplar living conditions with the specification of healthy building materials based on Building Biology principles featuring:

- non-toxic materials
- organic materials
- designing out the risk of dust mites
- minimising electromagnetic radiation by good wiring design and specification
- high levels of thermal comfort
- high levels of natural daylight

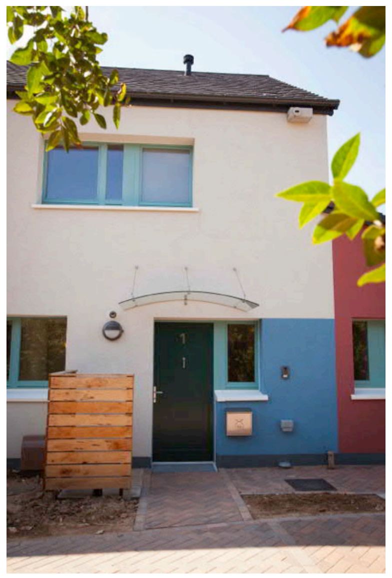
Air tests carried out during construction delivered outstanding results of 0.275 air changes per hour (at 50Pa) that were well below the requisite 0.6 air changes per hour demanded by the Passivhaus Standard and approximately 1/30th of those required by current UK Building Regulations. Air quality in the homes is maintained to a high standard via highly-efficient mechanical ventilation systems with heat recovery (MVHR), and is also achieved by the specification of non toxic materials and finishes such as mineral paints and organic waxes.

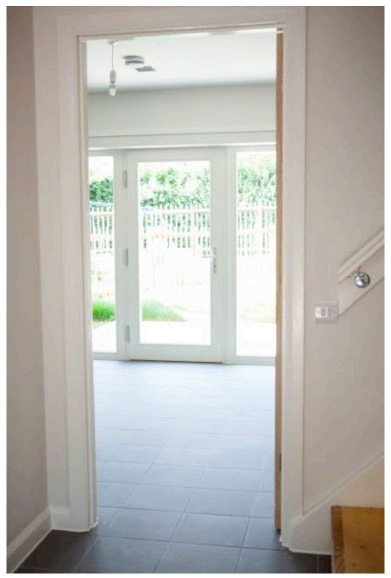
The external colours were carefully developed to reflect natural building materials of the Exeter area such as Devon sandstone, blue lias, green marble, clay brick and Heavitree stone. Internally, a distilled palette of high-quality, robust materials accentuates simple, efficient floor plans.

Ecological landscape design strategies have been employed for the site with all communal and private garden areas designed to follow permaculture principles. Bird boxes are mounted on the building, whilst habitats for bats, swifts and insects have been installed throughout the site establishing wildlife corridors linking the site to existing local ecology.

"These new homes are sustainable, environmentally sound and offer great energy-saving features for the families living in them. But they are also providing a space for a strong community spirit to grow and develop, that will set these families in good stead in the future"

Councillor Sutton, Lead Councillor for City Development, ECC.





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Rowan House

Passivhaus Housing in Exeter

Together with Knights Place, the 3 flats of Rowan House at Sivell Place, Exeter are the first affordable, multi-residential buildings in the UK to be certified Passive Houses by the Passivhaus Institut.

When the client, Exeter City Council, was offered a funding opportunity by the HCA to develop council housing in Exeter, it was decided to use this chance to provide exemplary, affordable housing, built to the highest standard of sustainable construction.

The site is situated within a Conservation Area in Exeter with a Grade II listed building on the adjacent site to the west and a locally listed building to the east that has recently been converted for residential use.

Primary Design Objectives:

- To develop a sustainable and healthy affordable housing scheme to meet Code 4 of the Code for Sustainable Homes and the Passivhaus standard.
- To achieve a contemporary interpretation of vernacular forms that is respectful of its residential context in terms of scale and massing, and that will be attractive to 'down-sizing' tenants.
- To provide down-sizing units throughout, to be fully accessible in accordance with Lifetimes Homes Standards.

To meet the stringent Passivhaus standard, the development was required to achieve exceptional levels of airtightness with an air permeability target as low as 0.3 $m^3/m^2/hr$. This, together with high levels of insulation, high performance windows and doors, thermal bridge free detailing and the use of a more than 90% efficient mechanical ventilation with heat recovery system, reduced the overall heating demand to a minimum so that a traditional heating system was not required.

Achieving the Passivhaus standard was only possible through the combined effort of the design team developing the air tightness strategy and detailing, the site management team and builders for implementing this strategy and finally the client for their commitment and passion to deliver an outstanding, exemplary housing scheme. Purely through passive design elements, Rowan House will use approximately 90% less heating energy when compared to a standard UK building (built to current Building Regulation requirements). In other words, Rowan House could be heated by the equivalent of 1.5 litre of heating oil per m^2 per year, i.e. 15kWh of thermal energy per m^2 per year, or 60p per m^2 per year (based on a price for heating oil of 40p per litre), making it truly affordable for its future tenants without compromising on comfort or indoor air quality.

Key Qualities of the Design:

- The quality of materials and subtle fenestration offer residents a sense of place with an appropriate 'quiet' character within the conservation area which they can take pride in over the long term.
- Code 4 of the CSH
- All occupants gain private gardens, designed using Permaculture principles.
- Building design based on the Passivhaus method ensures minimal space and hot water heating requirements and greatly reduced carbon emissions.
- Solar panels serving each individual unit further reduce the energy demand for domestic hot water.
- Designed to meet CSH best practice daylight levels.
- Independently assessed under the *Building for Life* standard with a final score of 18.5 out of 20.
- Low water use fittings reduce the water consumption to less than 80 litres/person/day.

The flats have a number of features designed to improve the health of their tenants including the use of ceramic floor tiles instead of carpet to reduce dust mite infestation, minimal volatile organic compounds (VOCs), no PVC throughout (including any pipes and wiring) and radial electric circuits to reduce electromagnetic radiation (EMF).

This building shows that we can defeat fuel poverty and combat climate change at the same time. Rowan House is amongst the most energy efficient and healthy homes in the UK. The super-insulated building uses a fraction of the energy of traditionally constructed new buildings and will allow for extremely low running costs. There will soon be a time when we wonder why we ever thought heating our homes with valuable and scarce fossil fuels was a sensible thing to do.

Awards:

LABC South West Building Excellence Awards

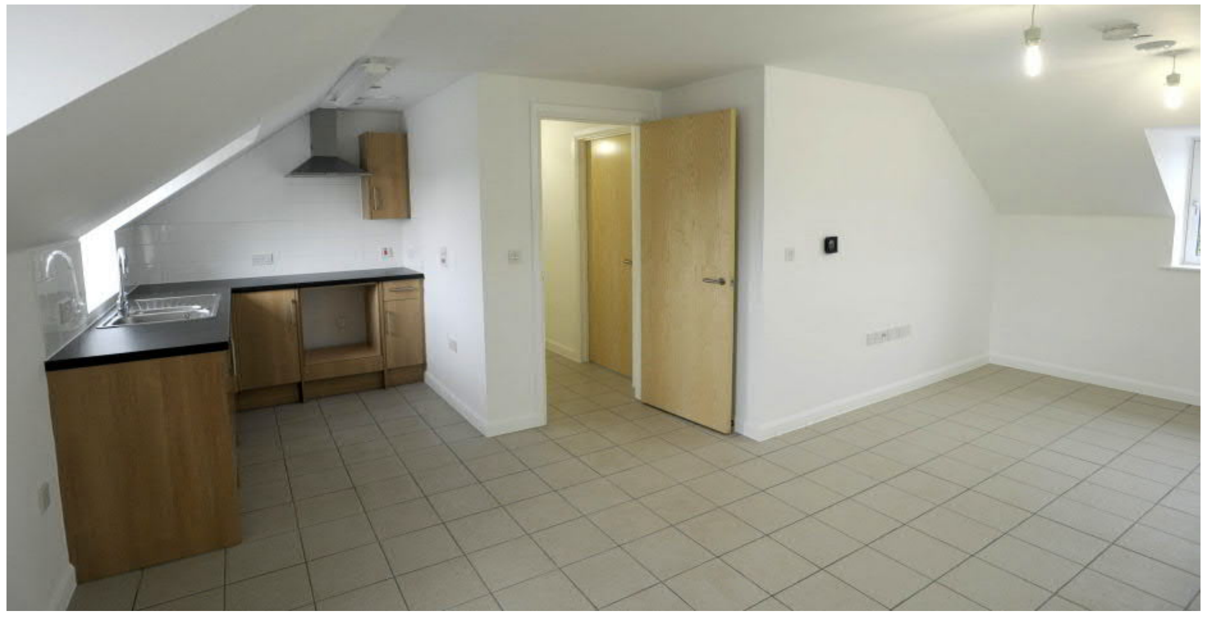
Shortlisted 'Best Social Housing Development'
Shortlisted 'Best Technical Development'
Shortlisted 'Best Sustainable Development'

Association of Retained Council Housing (ARCH)

Winner 'Innovation and Sustainability' with Knights Place

"This development has incorporated sustainable technologies into an innovative design which has assisted Exeter City Council in meeting its housing needs by providing the local residents with high quality affordable housing whilst reducing the impact on the environment for the life of the building."

Steve Chapman, Senior Building Control Officer, Exeter City Council



Energy Performance Certificate (EPC) ***	
Energy use	**102** $kWh/m^2/yr$
CO_2 emissions	**0.7** tonnes/yr
Lighting	**£26** per yr
Heating	**£45** per yr
Hot water	**£123** per yr

Energy Performance			
	Rowan House*	UK Standard**	
Space heating req.	**<15**	100	$(kWh/m^2.a)$
Airtightness	**<0.6**	10	$(m^3/m^2.h)$
Primary energy use	**<120**	240-250	$(kWh/m^2.a)$
Heating load	**<10**	60	(W/m^2)

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* Assessed using Passivhaus Planning Package (PHPP)
** Performance of a typical UK dwelling built to current Building Regulation Requirements
*** EPC assessment for Unit 2

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Knights Place Passivhaus Housing

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Passivhaus Housing in Exeter

These 18 flats are the first affordable, multi-residential buildings in the UK to be certified Passive Houses by the Passivhaus Institut.

The design seeks to achieve a contemporary interpretation of vernacular residential forms. The asymmetric window arrangements on the gable ends contrasts with the symmetrical flank elevations. In combination with the change in façade material, this adds interest and results in a playful design solution. The resulting arrangement is sympathetic to the surrounding residential area, both in scale and detail.

Carefully scaled windows allow for optimum daylight and solar gain levels for enhanced environmental performance. The quality of materials and good quality fenestration offers residents a sense of place with a distinctive modern character which they can take pride in over the long term.

Access galleries provide circulation between units and sit partially behind the façade. This clearly indicates the entrance and circulation routes whilst allowing them to be semi-protected from the elements.

This is exemplar sustainable housing that is fully accessible according to Lifetime Homes Standards, specifically intended to encourage existing tenants to down-size.

Low Energy Design including:

- Thermal mass - reduces internal temperature fluctuations and reduces the risk of overheating in summer.
- Super insulated building envelope - masonry walls are externally insulated and rendered to achieve high insulation levels and a U-value of no greater than 0.15W/m^2K. A clay tiled insulated roof construction achieves a U-value no greater than 0.10Wm^2K and an insulated floor construction also achieves no greater than 0.10W/m^2K. All windows and doors are to be high performance with timber frames achieving a minimum U-value of 0.85Wm^2K.
- Minimal thermal bridging.
- Mechanical ventilation with high efficiency heat recovery - minimising ventilation heat losses through controlled ventilation, ensuring optimum indoor air quality and reduced heating requirements by retaining energy from exhaust air.
- High levels of air tightness - less than 0.6 air changes per hours.
- Daylight design - is maximised in all spaces and habitable rooms where possible to reduce reliance on artificial light and utilise solar gain.
- Low water use strategies - use of low water use appliances significantly reduce mains water consumption below 80 litres/person/day.
- Low carbon technologies and onsite renewables - solar hot water panels for each individual flat provide energy efficient hot water.
- Ecological landscape design strategies - all communal and private gardens have been designed to follow Permaculture principles and wildlife ‘corridors’ link the site to the existing local ecology.

This holistic passive design strategy allows the units to be operated without a conventional heating system. At the same time, it will avoid overheating in the summer and aims to have a minimal environmental impact.

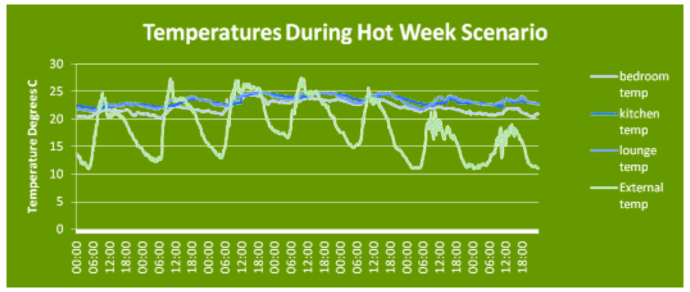
Material Selection and Healthy Buildings:

Building materials and components have been carefully chosen to meet the performance requirements of a low energy building. This includes considering materials according to the following principles:

- Natural/recycled, locally, and sustainably sourced materials (to ISO 14001) where practical.
- Low VOC organic paints, waxes and stains throughout.
- Specification of timber from sustainably managed woodlands (e.g. FSC certified).
- Avoiding the use of PVC by careful product selection
- Reduced use of heavy metals (e.g. lead flashings to be stainless steel or zinc).
- Electrical wiring in the bedrooms is radial to lessen the impact of electromagnetic fields (EMFs).
- The building will be tested to ensure that sound transmission between flats is improved beyond the requirements of Part E of the Building Regulations.
- Use of materials with low embodied energy, where appropriate.
- Prevention of dust-mite infestation by specification of easily cleanable surfaces.

Awards

- Winner ‘Eco Building of the Year’ - Michelmore’s Western Morning News Commercial Property Awards 2012.
- Winner ‘Innovation and Sustainability’ (with Rowan House) - Association of Retained Council Housing (ARCH) Awards 2012.



Passivhaus			
	Knights Place*	UK Standard**	
Space heating req.	**<15**	100	(kWh/m^2.a)
Airtightness	**<0.6**	10	(m^3/m^2.h)
Primary energy use	**<120**	240-250	(kWh/m^2.a)
Heating load	**<10**	60	(W/m^2)

* Assessed using Passivhaus Planning Package (PHPP)
** Performance of a typical UK dwelling built to current Building Regulation Requirements
*** EPC assessment for Unit 5

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Westcott House

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Victorian country house renovated and extended to meet the Passivhaus retrofit standard (EnerPHit)

Westcott House is a large, private residence located within Dartmoor National Park. A holistic passive design strategy allows the existing property to be upgraded to a level of energy efficiency such that a conventional heating system will only be required in times of extreme winter conditions. At the same time, it will avoid overheating in summer and aims to have minimal environmental impact.

Sustainable and Environmental Design Strategy:

- Thermal mass: provided in the load bearing ground floor construction using solid internal walls and floor slabs. Thermal mass reduces internal temperature fluctuations and helps reduce energy use.
- Super Insulated Building Envelope: masonry walls are externally insulated and rendered to achieve high insulation levels and a U-value of no greater than $0.15W/m^2K$. An insulated slated roof construction and insulated floor construction achieve U-values of no greater than $0.10W/m^2K$. All windows and doors are high-performance, triple glazed timber units achieving a minimum U-value of $0.7W/m^2K$. Combined, these high insulation values minimise heat loss through the building fabric and significantly reduce energy use.
- Minimal thermal bridging: ensuring continuity of the insulation around the building through careful detailing reduces heat loss and also prevents mould growth by eliminating cold spots.
- Mechanical ventilation with high efficiency heat recovery: minimising ventilation heat losses through controlled ventilation, ensuring better indoor air quality and reduced heating requirements by retaining energy from exhaust air.
- High levels of airtightness: draught-proofing and sealing all parts of the construction beyond best practice levels to achieve 1.5 air changes per hour (at 50Pa), further reducing heat loss and therefore reducing energy use.
- Daylight design: is optimised where possible to reduce reliance on artificial light and utilise solar gain, which supplements internal heating levels and again reduces energy use.
- Low water use strategies: using rain water harvesting, flow regulators, low flush WCs, aerated taps and low-water-use showers significantly reduces mains water use and costs.
- Low carbon technologies and on-site renewables: solar hot water panels provide energy-efficient hot water. This technology is classified as low-carbon technology and will continue to reduce the building's overall carbon footprint by at least 15%.
- Rainwater collection: these systems recycle rainwater for garden usage and flushing toilets.
- Efficient appliances: energy efficient lighting and controls further reduce energy use.

Material Selection and Healthy Buildings:

- Natural / recycled materials where practical.
- Organic paints, waxes and stains throughout.
- Specification of timber from sustainably managed woodlands (e.g. FSC certified).
- Reduction of the use of composite timber panel products.
- Avoiding the use of PVC by careful product selection (e.g. LSF electrical cabling; clay underground pipe-work; ABS water pipes; timber fascias, soffits and bargeboards; timber windows and doors).
- Reduced use of heavy metals (e.g. Stainless steel or zinc flashing instead of lead).
- Electrical wiring in bedrooms is radial to lessen the impact of electromagnetic fields (EMFs).
- Use of sustainably sourced materials to ISO14001.
- Use of materials with low embodied energy, where appropriate.
- Locally sourced materials, wherever possible.
- Prevention of dust-mite infestation by specification of easily cleanable surfaces.

Westcott House is currently undergoing assessment for EnerPHit Certification as a "Quality-Approved Energy Retrofit with Passive House Components" from the Passive House Institute.

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